REN

ECONOMIA REGIONAL

THE SHORT-RUN REGIONAL EFFECTS OF NEW INVESTMENTS AND TECHNOLOGICAL UPGRADE IN THE BRAZILIAN AUTOMOBILE INDUSTRY: AN INTERREGIONAL CGE ANALYSIS

Eduardo A. Haddad
Centre for Brazilian Studies, University of Oxford, 33 Beaumont St., Oxford OX1 2NP, England, and Regional Economics Applications Laboratory, University of Illinois, USA (The author would like to thank financial support from CNPq – Brazil).

Geoffrey J. D. Hewings
Regional Economics Applications Laboratory, University of Illinois (USA).

RESUMO:

Apresenta um modelo computável de equilíbrio geral inter-regional (ICGE) desenvolvido para a economia brasileira. O modelo contém mais de 240.000 equações e é atualmente utilizado para avaliação de políticas econômicas e seus impactos no padrão de concentração regional e mudanças estruturais. O comportamento dos agentes econômicos é modelado a nível regional, acomodando variações e especificidades das economias das regiões Norte, Nordeste e Centro-Sul do Brasil. Os resultados são baseados numa abordagem "bottom-up", em que os resultados para o País são obtidos a partir da agregação dos resultados regionais. São identificados 40 setores/produtos em cada região. Modelam-se explicitamente os serviços de transporte e o custo de distribuição dos produtos baseado na origem e destino do fluxo de cada transação, proporcionando diferenciação espacial de preços. Os resultados de um grupo de simulações são apresentados em que se avalia o impacto dos investimentos planejados para o setor automobilístico, levando-se em consideração a distribuição regional dos investimentos e a tecnologia inerente ao novo capital.

PALAVRAS-CHAVE:

Modelo Compatível de Equilíbrio Geral Inter-regional; Análise de Impacto; Indústria Automobilística; Desenvolvimento Regional no Brasil.

1- INTRODUCTION

Recent changes in the world economy are having direct effects on the Latin-American countries. Transformations induced by technological changes are responsible for a new world order, in which global competition plays a major role; the opening of markets is a process that is occurring in many countries in the region, and has brought about significant impacts on their productive structure. As these countries present internal heterogeneity in their resources allocation, these impacts are perceived differently across regions within these national economies.

The liberalization process of the 1990's in Latin-America resulted in the increase and diversification of trade in the region. Brazil, as a major player, strengthened its insertion into the world economy through the adoption of strategies for opening up markets adopting new production technologies, complemented recently by the creation of a broadly-based stabilization plan. The latter plan has been a familiar strategy for Latin-American countries: it involves monetary and fiscal reforms, and privatization processes that stimulate private investment and inflow of capital, spurred by interest rates that are more attractive than those of other international markets AROCENA (1995).

Consequently, one of the most important dimensions of change in the Brazilian development context has been in the external environment. When regional development policies were proposed in the 1960's, the Brazilian economy had a larger number of policy instruments that could be applied to redress problems of spatial inequity. However, by the 1990's, the external environment had changed dramatically; as a member of Mercosul and signatory to the WTO, the degrees of freedom for policy manipulation were significantly reduced. Accordingly, there has been a change in the type of policies that has been enacted with a greater focus on what Hirschman would refer to as indirect (or infrastructure) investment. With a greater commitment to market forces, as manifested in the neoliberal policies of the 1990's, the federal government is left with fewer options to manipulate growth and development of the less developed regions of the country. Thus, private investments play a key role in the process of regional development.[1]

Direct foreign investments rose from US$ 510 million in 1990 to US$ 1.3 billion in 1992, US$ 2.4 billion in 1994, US$ 4.7 billion in 1995, US$ 9.6 billion in 1996; they were expected to reach over US$ 16 billion in 1997. Much of this direct investment represent investments by multinationals in such key industries as transport equipment. Many which were already located in Brazil expand their facilities, while other firms set up production facilities in the country for the first time. Besides wanting to participate in a growing and stable Brazilian market, one additional motive for these investments is the use of Brazil as an export platform to the regional common market, Mercosul, and to the rest of the world.

In this context, the case of the automobile industry and issues related to structural changes in the economy and their impacts on the Brazilian economy deserve special attention. Brazil's economy is not homogeneous internally, presenting strong variations across regions, sectors, and income groups. Consequently, macro policy changes have differential regional impacts, as well as differential impacts on producers and consumers. Thus, as HIGGINS & SAVOIE (1995) argue, the designing of policies to assure good performance of national economies requires thorough understanding of the behavior of the regional economies of which they are composed, and formulating policies for each region on the basis of that understanding.

The discussion of regional and sectoral impacts of alternative strategies of regional development in the present macroeconomic context of the Brazilian economy has often lacked a formal analytical framework. Hence, if policy analysis is to be based on sound, consistent economic data, it is important that an analytical framework be developed to provide this capability. Accordingly, the primary analytical focus of this paper is to use

[1] For an analysis of the regional impact of neoliberal policies in Brazil, see BAER., et al. (1998).

an interregional computable general equilibrium model (ICGE) for the Brazilian economy for purposes of regional impact assessment. The model is to be used to capture the role of interindustrial and interregional relations in the economic development process through the evaluation of the regional impact of the new investments in the automobile industry. The use of this modeling approach is very relevant to the Brazilian case. Its ability to handle detail – both in terms of its disaggregation level and in terms of its theoretical specification – is useful for the analysis of the evolution of Brazil's productive structure. The model used to analyze the regional effects of sectoral policies, represented by the analysis of the new investments in the automobile industry, is described in the next section. The effects of such policies on the regions have not yet been considered in an integrated formal framework. The general equilibrium nature of economic interdependence and the fact that the policy impacts in various regional markets differ are considered in the results of the model presented in section 3. Attention is directed to three issues: a) the regional distribution of the new investments; b) the differential impacts of investments originating in different regions; and c) the differential impacts of alternative technology choices. Final remarks follow in section 4.

2- THE BRAZILIAN MULTISECTORAL AND REGIONAL/ INTERREGIONAL ANALYSIS MODEL (B-MARIA)

Many modeling approaches designed to address economic impact analysis in a regional system have been developed, initially, from international trade models. They evolved from the simple economic-base framework, through input-output and the general social accounting framework, to the more sophisticated econometric input-output and computable general equilibrium (CGE) models. In a sense, these models are all related to each other so that they might either form a chain of theoretical links established in a consistent way, or they might simply play a role as a module of larger, integrated set of models HEWINGS (1985).

The CGE approach treats economy as a system of many interrelated markets in which the equilibrium of all variables must be determined simultaneously. Any perturbation of the economic environment can be evaluated by recomputing the new set of endogenous variables in the economy. Optimizing behavior of consumers and producers is explicitly specified, as well as the institutional environment. Thus, demand and supply functions are derived consistently with prevalent consumer and production theories. Both production and consumption decisions respond to changes in prices. Regional interactions can be introduced through the interregional framework, allowing for regional imbalances and feedback effects from the other regions to be captured.

The **B**razilian **M**ultisectoral **A**nd **R**egional/ **I**nterregional **A**nalysis Model (B-MARIA) is the first fully operational interregional CGE model for Brazil.[2] The model is based on the MONASH-MRF Model, which is the latest development in the ORANI suite of CGE models of the Australian economy. B-MARIA contains over 200,000 equations, and it is designed for forecasting and policy analysis. Agents' behavior is modeled at the regional level, accommodating variations in the structure of regional economies. The model recognizes the economies of three Brazilian regions: North, Northeast, and Center-South (Rest of Brazil). Results are based on a bottom-up approach – national results are obtained from the aggregation of regional results. The model identifies 40 sectors in each region producing 40 commodities, a single household in each region, regional governments and one federal government, and a single foreign consumer who trades with each region. Special groups of equations define government finances, accumulation relations, and regional labor markets. In the Brazilian tradition of modeling, it benefits from the work by GUILHOTO (1986, 1995), which provides a computable national model of the type with the solutions given in growth rates. Besides the MOREIRA & URANI (1994) model for the Northeast Brazil, which is rooted in the requirement analysis framework, and, therefore,

[2] The complete specification of the model is available in HADDAD & HEWINGS (1997), and HADDAD (1997).

does not provide any supply-side constraint, B-MARIA is the first attempt to model the Brazilian economy in an interregional general equilibrium framework, taking into account both demand and supply constraints. [For a survey of CGE models applied for the Brazilian economy, see GUILHOTO & FONSECA (1990), MOREIRA & URANI (1994), and GUILHOTO (1995).]

2.1 THEORETICAL STRUCTURE

B-MARIA is based on the multiregional version of the MONASH Model, the MONASH Multiregional Forecasting Model – MONASH-MRF NAQVI and PETER 1995, (1996); PETER, (1996); PETER et al., (1996a); PETER et al. (1996b) the equations of the CGE core module of the model are defined following the same structure of the ORANI Model DIXON et al. (1982), with a regional subscript added, when appropriate. It may be considered a Johansen-type model, in which the solutions are obtained by solving the *linearized* equations of the model. A typical result shows the percentage change in the set of endogenous variables, after a policy is carried out, compared to their values in the absence of such policy, in a given environment.

The schematic presentation of Johansen solutions for such models is standardized in the literature. What follows is a summary of its contents in order to see how these models work. More details can be found in DIXON et al. (1982, 1992), HARRISON and PEARSON (1994, 1996), and DIXON and PARMENTER (1994).

In Johansen's approach, the system of linearized equations of the model can be written as

$$F(V) = 0 \qquad (1)$$

where V is an equilibrium vector of length n, and F is a vector function of length m, which is assumed to be differentiable. Regarding the dimensions, n and m, it is assumed that the total number of variables is greater than the total number of equations in the system, i.e., $(n > m)$. Thus, $(n - m)$ variables must be set exogenously. Examples of economic variables contained in the vector V include quantities, prices, taxes, and technological coefficients. The economic relations depicted in the system (1) are comprised of equations representing household and other final demand for commodities, equations for intermediate and primary-factor inputs, pricing equations relating commodity prices to cost, and market clearing equations for primary factors and commodities, among others.

For the purpose of calibration of the system, it is fundamental to assume that an initial solution, V^*, is known. In other words, $\exists V = V^* s.t.\ F(V^*) = 0$.

For B-MARIA, the vector V^* is read from the interregional input-output data base especially designed from the regional input-output tables for the North SUDAM (1994) and Northeast BANK OF THE NORTHEAST OF BRAZIL, (1992) regions, and from the national input-output tables for Brazil FIBGE (1995), for the year of 1985.[3] Given the initial solution, V^*, the basic approach used to compute a new set of solutions to the model starts with assigning the variables to the exogenous and endogenous categories.[4] Let V_1 be the vector of m endogenous variables, and V_2 be the vector of $(n - m)$ exogenous variables. Equation (1) can be rewritten as

$$F(V_1, V_2) = 0 \qquad (2)$$

By totally differentiating (2), we get

$$F_1(V^*)dV_1 + F_2(V^*)dV_2 = 0 \qquad (3)$$

[3] See HADDAD (1997).

[4] The following describes the one-step Euler or Johansen solution.

where F_1 and F_2 are matrices of partial derivatives of F evaluated at V^*. Solving (3) for dV_1,

$$dV_1 = \underbrace{\left[-F_1^{-1}(V^*)F_2(V^*)\right]}_{B(V^*)}dV_2 \quad (4)$$

or

$$dV_1 = B(V^*)dV_2 \quad (5)$$

It is assumed that the relevant inverse, $F_1^{-1}(V^*)$, exists.

In the B-MARIA Model, the specification of F, i.e., the specification of the equations of the model, is presented in five different integrated blocks of equations: the CGE core module, the government finance module, the capital accumulation and investment module, the foreign debt accumulation module, and the labor market and regional migration module.

2.1.1 CGE core module

The basic structure of the CGE core module comprises three main blocks of equations determining demand and supply relations, and market clearing conditions. In addition, various regional and national aggregates, such as aggregate employment, aggregate price level, and balance of trade, are defined here.

FIGURE 1 illustrates the basic production technology encountered in B-MARIA. Dotted-line boxes represent functional forms used at each stage. Two broad categories of inputs are recognized: intermediate inputs and primary factors. Producers in each regional industry choose input requirements per unit of output through optimizing behavior (cost minimization). Constraints are given by the nested production technology. Fixed proportion combinations of intermediate inputs and primary factors are assumed in the first level. The second level involves substitution between domestically produced and imported intermediate inputs, on one side, and substitution between capital, labor and land, on the other side. At the third level, bundles of domestically produced inputs are formed as combinations of inputs from different regional sources. The modeling procedure adopted in B-MARIA uses a constant elasticity of substitution (CES) specification in the lower levels to combine goods from different sources.

The treatment of the household demand structure, depicted in FIGURE 2, is based on a nested CES/linear expenditure system (LES) preference function. Demand equations are derived from a utility maximization problem, whose solution follows hierarchical steps. The structure of household demand follows a nesting pattern that enables different elasticities of substitution to be used. At the bottom level, substitution occurs across different domestic sources of supply. Utility derived from the consumption of domestic composite goods is maximized. In the subsequent upper-level, substitution occurs between domestic composite and imported goods.

FIGURE 1
NESTING STRUCTURE OF REGIONAL PRODUCTION TECHNOLOGY

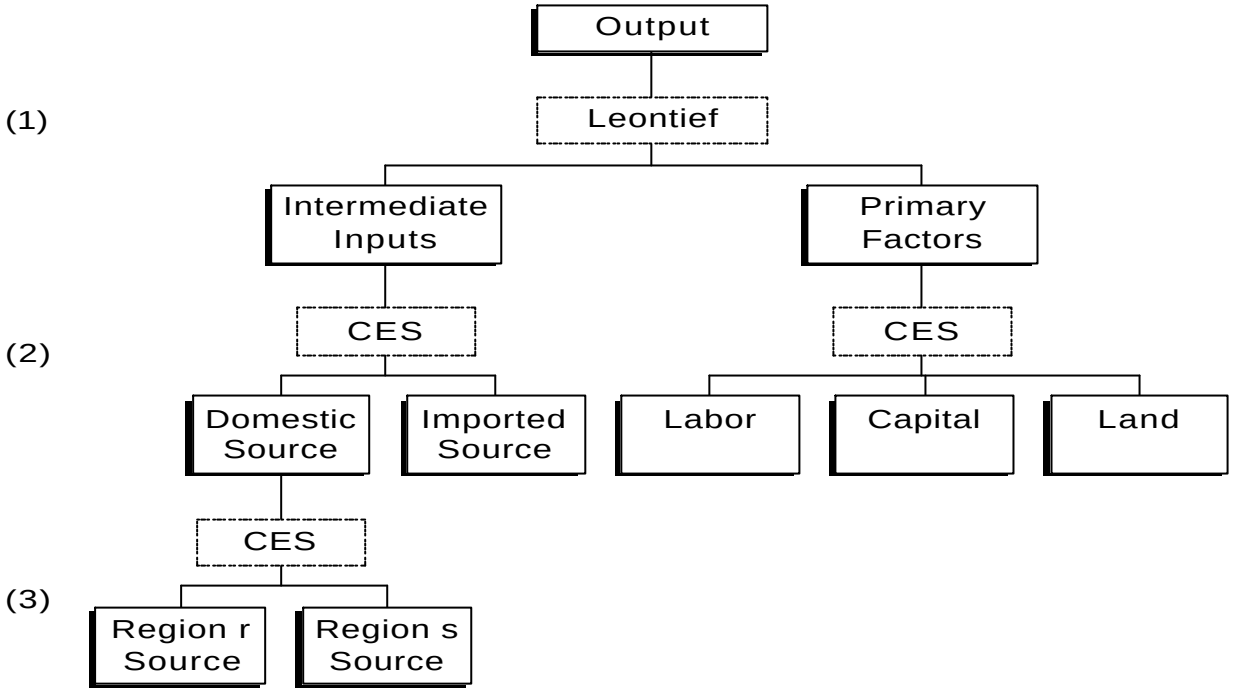
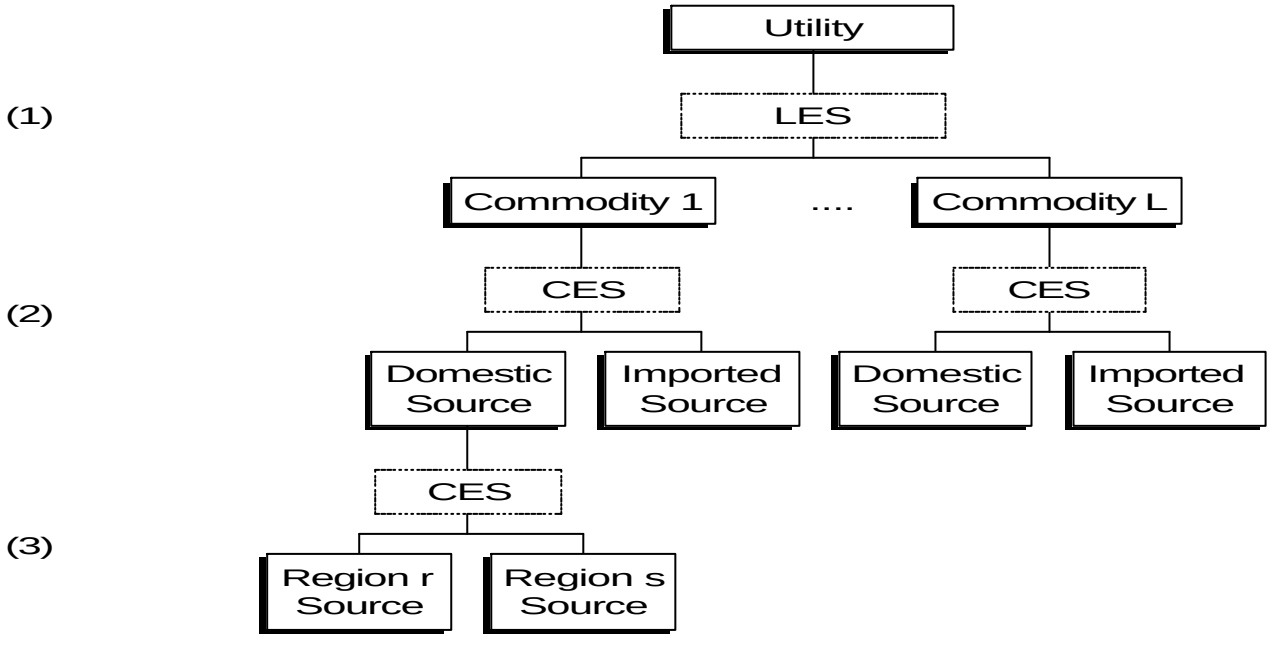


FIGURE 2
NESTING STRUCTURE OF REGIONAL HOUSEHOLD DEMAND



Equations for other final demand for commodities include the specification of export demand and government demand. Exports are divided into two groups: traditional exports (agriculture, mining, coffee, and sugar), and non-traditional exports. The former faces downward sloping demand curves, indicating that traditional exports are a negative function of their prices in the world market. Non-traditional exports form a composite tradable bundle, in which commodity shares are fixed. Demand is related to the average price of this bundle.

One new feature presented in B-MARIA refers to the government demand for public goods. The nature of the input-output data enables the isolation of the consumption of *public goods* by both the federal and regional governments. However, productive activities carried out by the public sector cannot be isolated from those by the private sector. Thus, government entrepreneurial behavior is dictated by the same cost minimization assumptions adopted by the private sector. This may be a very strong assumption for the Brazilian case. It gains greater credibility, though, when the liberalization process of the 1990's is considered, in which the role of government is being constantly reevaluated, and the privatization of previous government-owned activities is proceeding rapidly. Public good consumption is set to maintain a (constant) proportion with regional private consumption, in the case of regional governments, and with national private consumption, in the case of the federal government.

A unique feature of B-MARIA is the explicit modeling of the transportation services and the costs of moving products based on origin-destination pairs. The model is calibrated taking into account the specific transportation structure cost of *each* commodity flow, providing spatial price differentiation, which indirectly addresses the issue related to regional transportation infrastructure efficiency.

Other definitions in the CGE core module include: tax rates, basic and purchase prices of commodities, tax revenues, margins, components of real and nominal GRP/GDP, regional and national price indices, money wage settings, factor prices, and employment aggregates.

2.1.2 Government finance module

The government finance module incorporates equations determining the gross regional product (GRP), for each region, through the decomposition and modeling of its components. A similar approach is adopted for the value added components. GRP is defined from both the expenditure and the income side.

The budget deficits of regional governments and the federal government are also determined here. Regional governments are comprised of the state and municipal levels of direct administration within each region. At both levels of government, productive activities are not considered; they are included in the production sectors. The structure of the government accounts used in the model is heavily based on the State Fiscal Data Base developed by DINSMOOR and HADDAD (1996). some changes were carried out to accommodate the federal and the municipal administrations. Definitions of the main revenue and expenditure components of the government accounts are also available in this module of equations.

Another important definition in this block of equations refers to the specification of the regional aggregate household consumption functions. They are defined as a function of household disposable income, which is disaggregated into its main sources of income, and the respective tax duties.

2.1.3 Capital accumulation and investment module

Capital stock and investment relationships are defined in this module. Comparative-static and forecasting versions of the model contain different equations. The forecasting equations were derived in B-MARIA for purposes of its future developments. As explained below, at this stage, only the comparative-static version of the model

produces reliable results, restricting the use of the model to short-run and long-run policy analysis. When running the model in the comparative-static mode, there is no fixed relationship between capital and investment. The user decides the required relationship on the basis of the requirements of the specific simulation.[5]

2.1.4 Foreign debt accumulation module

This module is based on the specification proposed in ORANI-F HORRIDGE et al. (1993), in which the nation's foreign debt is linearly related to accumulated balance-of-trade deficits. In summary, trade deficits are financed by increases in the external debt.

2.1.5 Labor market and regional migration module

In this module, regional population is defined through the interaction of demographic variables, including interregional migration. Links between regional population and regional labor supply are provided. Demographic variables are usually defined exogenously, and together with the specification of some of the labor market settings, labor supply can be determined together with either interregional wage differentials or regional unemployment rates. In summary, either labor supply and wage differentials determine unemployment rates, or labor supply and unemployment rates determine wage differentials.

2.2 CLOSURES

B-MARIA can be configured to reflect short-run and long-run comparative-static, as well as forecasting simulations. Although a forecasting closure might be theoretically delineated, availability of reliable, consistent time series at the regional level for Brazil precludes this option to be operationalized. At this stage, two basic closures for alternative time frames of analysis in single-period simulations are available. A distinction between the two closures relates to the treatment of capital stocks encountered in the standard microeconomic approach to policy adjustments. In the short-run closure, capital stocks are held fixed, while, in the long-run, policy changes are allowed to affect capital stocks. In the simulations presented below, the short-run closure was adopted. The main assumptions follow.

Short-run. In addition to the assumption of interindustry and interregional immobility of capital, the short-run closure would include fixed regional population and labor supply, fixed regional wage differentials, and fixed national real wage. Regional employment is driven by the assumptions on wage rates, which indirectly determine regional unemployment rates. These assumptions describe the functioning of the regional labor markets as close as possible to the Brazilian reality. First, changes in the demand for labor are met by changes in the unemployment rate, rather than by changes in the real wage. This seems to be the case in Brazil, given the high level of disguised unemployment in most of the areas of the country; excess supply of labor has been a distinct feature of the Brazilian economy. Secondly, interregional immobility of labor in the short-run suggests that migration is not a short-term decision. Finally, nominal wage differentials in Brazil are persistent, reflecting the geographical segmentation of the workforce SAVEDOFF (1990). On the demand side, investment expenditures are fixed exogenously – firms cannot reevaluate their investment decisions in the short-run. Household consumption follows household disposable income, and government consumption, at both regional and federal levels, is fixed (alternatively, the government deficit can be set exogenously, allowing government expenditures to change). Finally, since the model does not present any endogenous-growth-theory-type specification, technology variables are exogenous see PETER (1997).

[5] For example, it is typical in long-run comparative-static simulations to assume that the growth in capital and investment are equal see PETER et al.(1996b).

3- THE AUTOMOBILE INDUSTRY, EMPLOYMENT, AND REGIONAL DEVELOPMENT

The automobile industry is considered to be a critical sector in the development process. Its effects are not only felt by neighboring sectors but also in the build-up of supporting infrastructure – the rise of a motor car industry entails not only the sale of cars, but also investments in road construction and traffic regulation, and in service and repair networks MALECKI (1991). The backward and forward linkages of the sector help to foster development in the region in which production takes place. However, the intensity of the internal multiplier effects will depend on the degree of self-sufficiency of the producing region.

After the slowdown of the 1980's, the automobile industry is in a period of great transition in Brazil. Since 1991, the industry output has almost doubled, even though the level of employment in the sector fell significantly.[6] New investments attracted by policies implemented by the Brazilian government, which has been playing an active role in negotiations for foreign investments in the country, are being sought by the regions. State governments have engaged in strong competition for the incoming capital through fiscal incentives.

TABLE 1
AUTOMOBILE INDUSTRY VEHICLES: PRODUCTION AND EMPLOYMENT (1990-1996)

	Production in Units	Employees
1990	914,466	117,396
1991	960,219	109,428
1992	1,073,861	105,664
1993	1,391,435	106,738
1994	1,581,389	107,134
1995	1,629,008	104,614
1996	1,804,328	101,857

SOURCE: National Association of Automakers (ANFAVEA)

[6] See "A indústria automobilística no Brasil a mil por hora" (1997).

One of the main issues that concern labor unions refers to the production technology embodied in the new investments in the sector. It has been claimed that the new investments in the automobile industry are accompanied by sharp reductions in the employment levels, the reason being the higher capital intensity of the investments.[7] Recent estimates for the automobile industry show that employment has fallen, even though the sectoral output has been increasing TABLE 1. Using alternative measures of productivity for the sector, PEEBLES (1995) shows that productivity has increased dramatically in recent years, due, to a large extent to restructuring of operations, rather than simply scale economies.

In order to address this issue, B-MARIA is applied to evaluate the impacts of the new investments in the automobile sector under the assumption of technological upgrade in the industry, i.e., that labor-saving technology is embodied in the incoming capital. Technically, the modeling trick is to induce capital-labor substitution by imposing changes in the current capital stocks of the industry.

As capital becomes relatively cheaper in the transportation equipment sector, producers will tend to substitute away from labor. The imposed changes in the capital stocks are set proportionally to the regional distribution of the new investments, so that for each dollar increase in the capital stock of the transportation equipment sector in the Northeast, there is a ten dollar increase in the sector in the Center-South.[8] A 5% increase in the capital stock of the transportation equipment sector in the Center-South, and a 55% increase in the Northeast are assumed. These estimates are based on the relation between the figures presented in TABLE 2 and the estimates for the sectoral

[7] The argument in favor of more capital intensive technology refers to the fact that, in an open economy, it is important to use more up-to-date technology to compete in the international markets.

[8] This 10:1 ratio roughly represents the distribution of new investments, simplifying the exposition of the results.

current capital stocks in the benchmark data base.[9] As the main interest here is to evaluate the impacts on the levels of employment which affect union negotiations, the short-run closure is adopted. A key parameter in this simulation is the elasticity of substitution between capital and labor in the transportation equipment sector. It can now be interpreted as the parameter that defines the degree of labor-saving in the technology embodied in the new investments: higher values imply higher degrees of labor saving (an increase in the stock of capital in the industry induces stronger substitution away from labor), and lower values imply smaller switch away from labor.

The automobile industry is part of the transportation equipment sector of the model (hereafter, both denominations will be used interchangeably). The transportation equipment sector is characterized in the benchmark data base, in the Northeast and in Center-South regions, as follows:

Northeast. The sector, whose share in the regional output is less than 0.5%, is characterized by strong linkages with the rest of the country. From its total sales, 48.58% go to other regions of the country (38.92% for intermediate production, 4.43% for capital creation, and 5.23% for household consumption). The share of sales to buyers within the region accounts for 49.30% (38.38% for intermediate production, and 11.32% for household consumption); 1.72% are exported. The transportation equipment sector in the Northeast purchases 53.24% of its inputs for current production from the rest of the country; for capital creation, inputs from other national sources represent 35.32% of the total. Linkages with the rest of the world are weak. The sector faces strong competition from the Center-South, which is responsible for the provision of 91.30% of the total transportation equipment consumed in the Northeast region (the market share in the household market is even higher, reaching over 96%). Compared to the regional averages, the sector is relatively labor intensive and the share of value added in total costs is also relatively lower.

[9] The benchmark data base, which includes the interregional input-output tables, is fully described in HADDAD (1997).

TABLE 2
AUTOMOBILE INDUSTRY PROJECTS TO BE STARTED: BRAZIL, 1997

Region	*Project*	*Product*	*Investment (US$1,000)*
Center-South:			*6,508,000*
Rio Grande do Sul	General Motors	cars	600,000
Santa Catarina	General Motors	engines	500,000
Paraná	Renault, Volkswagen, Chrysler	cars and pick-ups	2,065,000
São Paulo	Volkswagen, Toyota, Honda, General Motors	cars, engines, parts	1,100,000
Rio de Janeiro	Volkswagen	trucks	300,000
Minas Gerais	Fiat, Mercedes-Benz	cars, engines, trucks	1,793,000
Goiás	Mitsubishi	pick-ups	150,000
Northeast:			*1,005,000*
Bahia	Hyundai, Asia	cars	1,005,000

SOURCE: National Association of Automakers (ANFAVEA) - Ministério da Indústria, Comércio e Turismo (MICT)

Center-South. The importance of the transportation equipment sector in the region is much greater than in the Northeast. With a share in regional output of 3.82% (3.18% of the national output), the industry is concentrated in the region (97.71% of the sectoral production take place in the Center-South). Its sales orientation is spread across users: 48.61% go to intermediate production within (46.08%) and outside (2.53%) the region; 12.28% to capital creation (10.81% within and 1.47% outside the region); 19.33% to regional consumers and 3.47% to consumers in the rest of the country; and 16.31% are exported to international markets. Even though most of the sector's suppliers of intermediate inputs for current production and capital creation are regional suppliers (92.71% and 84.01%, respectively), international sources are also important (5.52% for current production, and 11.14% for capital creation); direct interregional linkages are less important. Due to its supremacy in the national production and to strong restrictions on imports (in the benchmark year), the goods produced in the region face small competition from both interregional and international markets; market share of the Center-South is 91.50% in the country (97.56% in the household market). The sector is more capital intensive than in the Northeast and the value added share in total costs, compared to the regional average, is low.

The analysis is carried out in four steps: 1) the short-run results are analyzed focusing on the effects on employment and some regional and national aggregates; 2) the results are decomposed into the effects of investments in the Center-South and investments in the Northeast, determining the multiplier effects of the new technology; 3) the short-run output multiplier is decomposed in its intraregional and interregional components; and 4) sensitivity analysis is carried out using different values for the labor-saving-technology parameter.

3.1 SIMULATION RESULTS[10]

A four-step Euler procedure is adopted in the solution of the model, and the results are reported as percentage deviations from the base case (except otherwise stated). TABLE 3 presents the industry results for employment, activity level, and basic prices of commodities; FIGURES 3-5 show the short-run employment effects of the increase in

[10] The model was solved using GEMPACK HARRISON and PEARSON(1994).

the current capital stocks in the transportation equipment sector. In the figures, the effect of the labor-saving technology becomes clear, as employment is freed from the sector. In the Center-South, because of the higher capital-labor ratio of the sector, relatively more labor is released. The decrease in employment in the transportation sector in the North, which does not receive any new investment, is due to interregional substitution effects, as its products become relatively more expensive than in the other regions of the country.

The increased demand generated by new investments in the transportation equipment sector affects the economy positively. The labor resources released in the sector are absorbed by other industries (recall that in the short-run, the supply responses are via changes in the employment level). The positive impact on the main suppliers of the automobile industry, such as steel, electronic equipment, rubber, and plastics, is also evident. The effects in the Northeast are relatively smaller because of the strong interregional linkages of the automobile industry; spillover effects benefit the other parts of the country. Sectors in the Center-South receive stronger impact; the stronger intraregional linkages generate higher internal multipliers in the region. The results achieved for the rubber sector in the North deserve to be mentioned. The sector sells 59.21% of its output for current production use in the rest of the country (92.62% of its interregional exports are directed to the Center-South), and therefore, interregional feedback effects operate to its benefit. Similar feedback effects operate in favor of the electronic equipment sector in the region, which has a much higher weight in the regional economic structure.

Industries producing goods for consumer use gain from the increased consumption originated by the increase in the employment level in sectors directly benefited from backward linkages of the automobile industry. These industries respond by creating jobs and inducing a second round of expenditures in their goods.

Traditional export sectors (especially mining, coffee and sugar) are the main losers. Initially positively affected by the increase in the domestic demand, their cost of production rises, driven by internal demand pressures and also increases in the input prices. By facing negatively sloped demand curves in the international markets, their exports go down, contributing to their poor performance. Exports from the mining sector decrease by -0.615% in the North, and -1.184% in the Center-South; exports of sugar from the Northeast fall by -0.365%; and exports of coffee from the Center-South decrease by -0.310%. Given the generalized demand-driven price hike, exports in all the sectors in the North and Northeast fall. However, in the Center-South, nontraditional exports growth is led by the performance of the transportation equipment sector, whose products become more competitive in the international markets.

The results calculated for some regional and national variables are presented in Table 4. The introduction of labor-saving technology in the automobile industry produces positive net employment effects in the country (0.105%) and in each region, individually. These results reflect directly in the GDP/GRP levels. Regarding the regional distribution of income, the Center-South is the region that achieves higher growth (0.159%, in the Center-South, as opposed to 0.068% in the North, and 0.050% in the Northeast). In money terms, this corresponds to an increment in the Center-South close to 17.5 times greater than the one in the Northeast. If the initial change is taken into consideration, which reflects a 10:1 ratio of investments in the Center-South and in the Northeast, the results show a striking difference in regional performance. The results also show the North growing faster than the Northeast; even though the region does not receive any new direct investment, the nature of its linkages with the other two regions contributes to this result. From the model's projections shown below, it is clear that interregional exports lead the performance in the region.

Considering the components of domestic absorption, with investments and government expenditures set fixed exogenously, household consumption is the only component allowed to move; it shows increases in real household consumption driven by the employment effect. As

another indicator of the worsening of regional imbalances, the estimates for the regional/national consumption rate indicate a decrease in the regional shares of the North and Northeast in favor of the Center-South.

As noted above, the results for the interregional trade balance of Brazil's North are relevant to understand the regional performance. The weight of interregional trade in the region is very high when compared to the weight of international trade. In the benchmark data base, the ratio of the volume of interregional trade to the volume of international trade equals 6.20 in the North, 4.91 in the Northeast, and 0.52 in the Center-South. Thus, the weak performance in the international markets does not have a strong impact in the regional economy of the North, as it would have been the case if the changes had occurred in the interregional trade components. As was pointed out in the analysis of the sectoral results, international exports are harmed in the North and Northeast by the increase in the cost of production; however, the tranportation equipment sector leads the exports in the Center-South, achieving overall positive results at the regional level. Finally, given the combined effects of demand-driven domestic prices increase and unchanged import prices, there is an increase in the volume of imports.

With the model calibrated with the interregional input-output TABLE for 1985, it is important to emphasize that the import coefficients are underestimated. In the case of the transportation equipment sector, the opening of the market for imports in the 1990's led to their gradual increase in market share. With higher import coefficients for both inputs to foreign production and consumption, B-MARIA overestimates the employment effects by neglecting part of the substitution effects between domestic and foreign commodities and by overestimating the weight of domestic demand.

TABLE 3

B-MARIA PROJECTED PERCENTAGE EFFECTS OF AN INCREASE IN THE PRODUCTION CAPACITY IN THE TRANSPORTATION EQUIPMENT SECTOR: SHORT-RUN

		Employment by Industry			Output by Industry			Basic price of Commodities			
		North	Northeast	Center-South	North	Northeast	Center-South	North	Northeast	Center-South	Imported
S1	Agriculture	0,144	0,015	0,120	0,081	0,011	0,084	0,095	0,056	0,089	0,000
S2	Mining	-0,251	0,065	-0,157	-0,097	0,038	-0,099	0,032	0,061	0,057	0,000
S3	Nonmetallic Minerals	0,238	0,258	0,178	0,155	0,146	0,094	0,132	0,138	0,147	0,000
S4	Steel	0,314	0,489	1,054	0,193	0,228	0,533	0,290	0,205	0,350	0,000
S5	Nonferrous Metals	0,276	0,079	0,702	0,162	0,039	0,491	0,067	0,079	0,138	0,000
S6	Other Metal Products	0,117	0,240	0,317	0,097	0,182	0,273	0,099	0,104	0,180	0,000
S7	Machinery	0,320	0,081	0,409	0,254	0,067	0,355	-0,032	0,118	0,116	0,000
S8	Electrical Equipment	0,216	0,129	0,244	0,187	0,100	0,209	0,065	0,071	0,129	0,000
S9	Electronic Equipment	0,381	0,219	0,458	0,222	0,135	0,329	0,123	0,087	0,153	0,000
S10	Transportation Equipment	-1,076	-6,692	-2,106	-0,573	5,515	0,614	-1,071	-7,986	-1,881	0,000
S11	Wood Products and Furniture	0,050	0,117	0,175	0,045	0,098	0,142	0,055	0,071	0,106	0,000
S12	Paper Products and Printing	-0,007	0,125	0,368	-0,005	0,058	0,205	0,053	0,108	0,177	0,000
S13	Rubber	0,748	0,791	0,662	0,265	0,287	0,335	0,259	0,289	0,297	0,000
S14	Chemicals	0,171	0,132	0,249	0,148	0,089	0,190	0,084	0,066	0,097	0,000
S15	Petroleum Refining	0,208	-0,032	0,508	0,124	-0,016	0,289	0,066	0,057	0,082	0,000
S16	Other Chemicals	0,156	-0,086	0,190	0,124	-0,054	0,157	0,078	0,054	0,083	0,000
S17	Pharmaceuticals and Veterinary	0,149	0,062	0,102	0,128	0,048	0,087	0,090	0,097	0,098	0,000
S18	Plastics	0,361	0,365	0,428	0,185	0,099	0,184	0,201	0,189	0,243	0,000
S19	Textiles	0,217	0,232	0,298	0,143	0,121	0,179	0,111	0,108	0,142	0,000
S20	Clothing	0,200	0,207	0,159	0,147	0,141	0,102	0,120	0,106	0,129	0,000
S21	Footwear	0,483	0,201	0,569	0,329	0,118	0,412	0,144	0,147	0,205	0,000
S22	Coffee	-0,158	0,080	-0,484	-0,060	0,029	-0,169	0,059	0,070	0,009	0,000
S23	Processed Vegetables	0,274	-0,193	0,293	0,178	-0,099	0,177	0,085	0,030	0,128	0,000
S24	Meat Packing Plants	0,137	0,455	0,450	0,078	0,106	0,225	0,098	0,122	0,141	0,000
S25	Dairy Products	0,381	0,226	0,112	0,270	0,130	0,055	0,105	0,085	0,107	0,000
S26	Sugar	0,312	-0,339	0,158	0,194	-0,231	0,077	0,102	0,016	0,117	0,000
S27	Vegetable Oil Mills	0,792	0,599	1,335	0,681	0,232	0,486	0,139	0,197	0,291	0,000
S28	Other Food Products	0,136	0,176	0,095	0,103	0,117	0,063	0,102	0,083	0,127	0,000
S29	Other Manufacturing	0,235	0,181	0,325	0,120	0,049	0,222	0,103	0,063	0,094	0,000
S30	Electric, Gas, and Sanitary Services	0,220	0,105	0,292	0,121	0,052	0,138	0,208	0,120	0,250	0,000
S31	Construction	0,002	0,098	0,031	0,001	0,091	0,026	0,193	0,082	0,104	0,000
S32	Trade	0,053	0,079	0,172	0,046	0,070	0,148	0,060	0,062	0,104	0,000
S33	Transportation	0,097	0,175	0,443	0,063	0,117	0,256	-0,220	-0,095	0,066	0,000
S34	Communication	0,144	0,089	0,266	0,069	0,041	0,147	0,154	0,119	0,220	0,000
S35	Financial Institutions	0,107	0,063	0,226	0,084	0,047	0,184	0,103	0,060	0,094	0,000
S36	Personal services	0,153	0,089	0,291	0,111	0,063	0,185	0,016	0,023	-0,007	0,000
S37	Business Services	0,105	0,107	0,233	0,063	0,068	0,135	0,103	0,104	0,141	0,000
S38	Real Estate	0,235	0,178	0,272	0,006	0,002	0,022	0,512	0,380	0,529	0,000
S39	Public Administration	0,000	0,000	0,000	0,000	0,000	0,000	0,075	0,058	0,065	0,000
S40	Community Services	0,131	0,061	0,180	0,117	0,055	0,160	0,084	0,073	0,109	0,000

FIGURE 3
B-MARIA PROJECTED SHORT-RUN EMPLOYMENT EFFECTS OF INCREASED PRODUCTION CAPACITY IN THE TRANSPORTATION EQUIPMENT SECTOR: NORTH

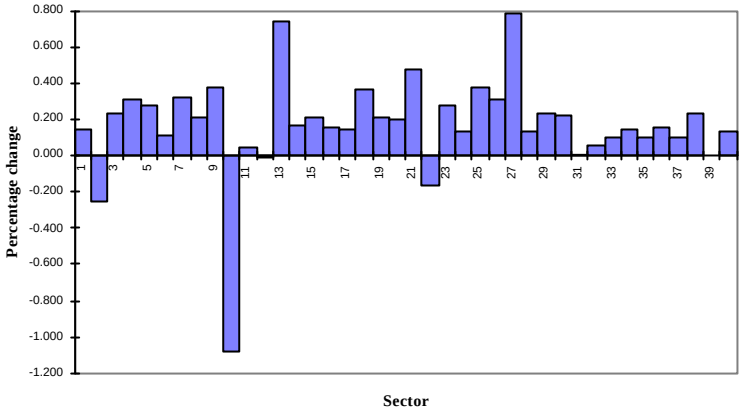


FIGURE 4
B-MARIA PROJECTED SHORT-RUN EMPLOYMENT EFFECTS OF INCREASED PRODUCTION CAPACITY IN THE TRANSPORTATION EQUIPMENT SECTOR: NORTHEAST

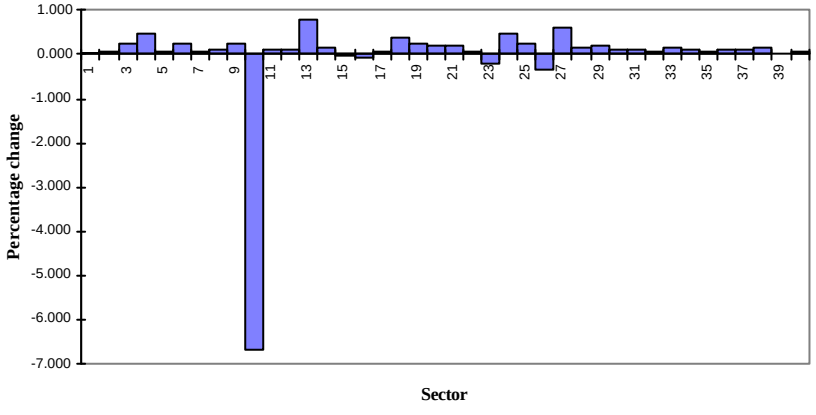


FIGURE 5
B-MARIA PROJECTED SHORT-RUN EMPLOYMENT EFFECTS OF INCREASED PRODUCTION CAPACITY IN THE TRANSPORTATION EQUIPMENT SECTOR: CENTER-SOUTH

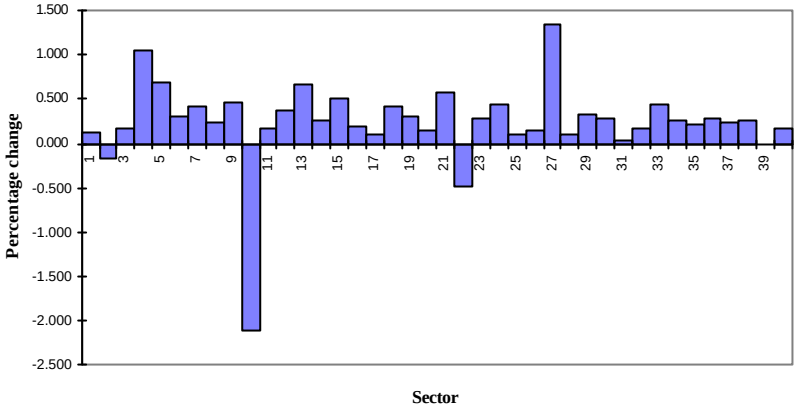


TABLE 4
SHORT-RUN EFFECTS ON SELECTED REGIONAL AND MACRO VARIABLES

	N	*NE*	*C-S*	*Brazil*
Real GDP/GRP	0.068	0.050	0.159	0.140
Real Household Consumption	0.090	0.048	0.121	0.107
Unemployment Rate (% point change)	-0.074	-0.044	-0.126	-0.102
Consumer Price Index	0.070	0.044	0.056	0.055
Regional/National Consumption Rate	-0.018	-0.060	0.014	--
Employment: Persons	0.077	0.045	0.131	0.105
Interregional Export Volume	0.216	0.324	-0.025	--
Interregional Import Volume	0.041	-0.025	0.266	--
Interregional BT (ordinary change)	65.1	132.7	-197.8	--
International Export Volume	-0.678	-0.999	0.758	0.565
International Import Volume	0.111	0.119	0.328	0.316
Balance of Trade (ordinary change)	-35.7	-140.8	781.6	605.1

3.2 DECOMPOSITION OF THE RESULTS

In this sub-section, the results reported above are decomposed into the effects of the investments introducing labor-saving technology in the transportation equipment sector in the Center-South and in the Northeast. B-MARIA is solved twice: once for the shock in the Center-South holding capital stocks in the Northeast constant, and again for the shock in the Northeast, with the capital stock in the Center-South fixed. Two sets of results are produced giving the separate impacts of each regional component of investment. The one-step Johansen procedure is adopted so that the total impact is the sum of the two simulations. However, because of linearization errors, the results are only accurate to the first order. TABLE 5 shows the decomposition of the short-run effects on some selected regional and macro variables using the Johansen procedure. A comparison with the results provided in TABLE 4 shows the extent to the linearization errors.

TABLE 5

DECOMPOSITION OF THE SHORT-RUN EFFECTS USING THE JOHANSEN PROCEDURE: INCREASED PRODUCTION CAPACITY IN THE AUTOMOBILE INDUSTRY (55% INCREASE IN THE NORTHEAST AND 5% IN THE CENTER-SOUTH)

	North			Northeast			Center-South			Brazil		
	CS	NE	CS+NE	CS	NE	CS+NE	CS	NE	CS+NE	CS	NE	CS+NE
Real GDP/GRP	0,048	0,039	0,087	0,010	0,060	0,070	0,170	0,004	0,174	0,141	0,013	0,154
Real Household Consumption	0,059	0,057	0,116	0,028	0,031	0,059	0,128	0,005	0,133	0,108	0,012	0,120
Unemployment Rate (% point change)	-0,047	-0,050	-0,097	-0,019	-0,037	-0,056	-0,135	-0,004	-0,139	-0,099	-0,015	-0,114
Consumer Price Index	0,074	0,000	0,074	0,043	0,001	0,044	0,058	0,002	0,060	0,057	0,001	0,058
Regional/National Consumption Rate	-0,049	0,045	-0,004	-0,080	0,020	-0,060	0,020	-0,007	0,013	--	--	--
Employment: Persons	0,048	0,052	0,100	0,019	0,038	0,057	0,140	0,004	0,144	0,103	0,015	0,118
Interregional Export Volume	0,209	0,029	0,238	0,274	0,123	0,397	-0,060	0,027	-0,033	--	--	--
Interregional Import Volume	0,013	0,045	0,058	-0,091	0,062	-0,029	0,258	0,048	0,306	--	--	--
International Export Volume	-0,771	0,085	-0,686	-1,071	0,036	-1,035	0,825	0,020	0,845	0,615	0,023	0,638
International Import Volume	0,111	0,003	0,114	0,043	0,106	0,149	0,347	0,010	0,357	0,332	0,012	0,344
Balance of Trade (ordinary change)	-40,1	4,0	-36,1	-148,6	2,2	-146,4	860,7	19,9	880,6	672,0	26,1	698,1

TABLE 6
Decomposition of the Short-Run Effects Using the Johansen Procedure: Increased Production Capacity in the Automobile Industry (55% increase in the Northeast and 0.5% in the Center-South)

	North			Northeast			Center-South			Brazil		
	CS	NE	CS+NE	CS	NE	CS+NE	CS	NE	CS+NE	CS	NE	CS+NE
Real GDP/GRP	0,005	0,039	0,044	0,001	0,060	0,061	0,017	0,004	0,021	0,014	0,013	0,027
Real Household Consumption	0,006	0,057	0,063	0,003	0,031	0,034	0,013	0,005	0,018	0,011	0,012	0,023
Unemployment Rate (% point change)	-0,005	-0,050	-0,055	-0,002	-0,037	-0,039	-0,014	-0,004	-0,018	-0,010	-0,015	-0,025
Consumer Price Index	0,007	0,000	0,007	0,004	0,001	0,005	0,006	0,002	0,008	0,006	0,001	0,007
Regional/National Consumption Rate	-0,005	0,045	0,040	-0,008	0,020	0,012	0,002	-0,007	-0,005	--	--	--
Employment: Persons	0,005	0,052	0,057	0,002	0,038	0,040	0,014	0,004	0,018	0,010	0,015	0,025
Interregional Export Volume	0,021	0,029	0,050	0,027	0,123	0,150	-0,006	0,027	0,021	--	--	--
Interregional Import Volume	0,001	0,045	0,046	-0,009	0,062	0,053	0,026	0,048	0,074	--	--	--
International Export Volume	-0,077	0,085	0,008	-0,107	0,036	-0,071	0,083	0,020	0,103	0,062	0,023	0,085
International Import Volume	0,011	0,003	0,014	0,004	0,106	0,110	0,035	0,010	0,045	0,033	0,012	0,045
Balance of Trade (ordinary change)	-4,0	4,0	0,0	-14,9	2,2	-12,7	86,1	19,9	106,0	67,2	26,1	93,3

By looking at the columns referring to the national aggregates, it is clear that the effects derived from the new investments in the Center-South are much stronger. Even though the output effect of increased investments in the Center-South is smaller in the Northeast, than it would be the case of investments increases departing from the Northeast region, because of the labor-saving character of the new investments the employment effect is stronger, generating higher levels of household consumption in the region. Figures 6-8 reveal the extent to which employment effects are decomposed at the industry level.

The results presented in TABLE 6 abstract from the level differences in investments; it is assumed that there is a 1:1 increase in the current capital stocks in the transportation equipment sector in both regions (the shock in the Center-South is ten times smaller). The idea is to compare the differential multiplier effects of investments in the two regions. The effects on the national economy as a whole are still slightly stronger when investments are carried out in the Center-South (led by the performance of the export sector). However, because of the relatively lower interregional backward linkages of the Center-South, a dollar's worth of investment in transportation equipment in the Northeast is more beneficial to the improvement of regional imbalances in the country. While new labor-saving investments in the Northeast improve the GRP of the region by 0.060% and that of the North by 0.039%, with a small increase in the Center-South (0.004%), when these investments are undertaken in the Center-South, the performance of GRP changes to 0.001% in the Northeast, 0.005% in the North, and 0.017% in the Center-South.

FIGURE 6
DECOMPOSITION OF SHORT-RUN EMPLOYMENT EFFECTS OF INCREASED PRODUCTION CAPACITY IN THE TRANSPORTATION EQUIPMENT SECTOR: NORTH

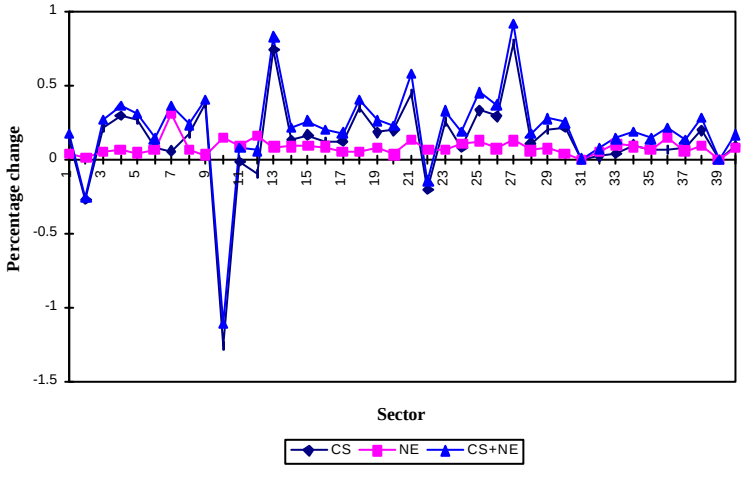


FIGURE 7
DECOMPOSITION OF SHORT-RUN EMPLOYMENT EFFECTS OF INCREASED PRODUCTION CAPACITY IN THE TRANSPORTATION EQUIPMENT SECTOR: NORTHEAST

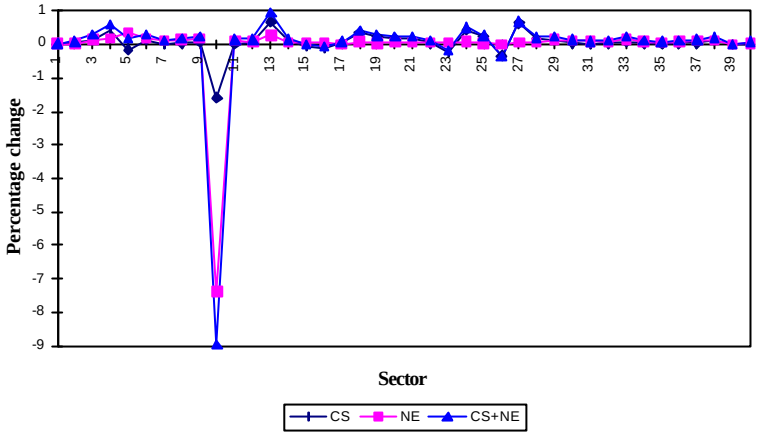
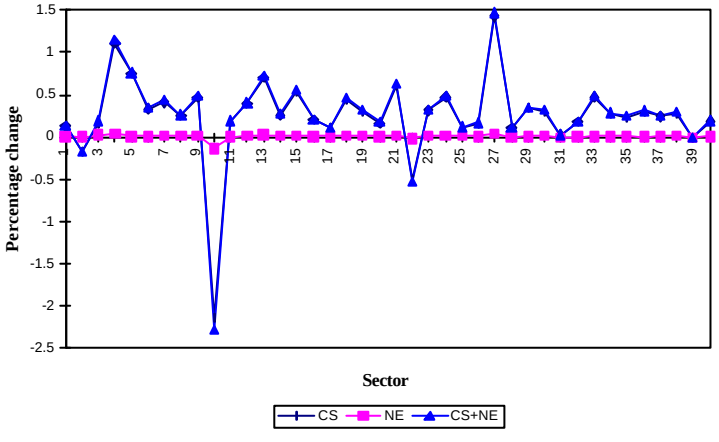


FIGURE 8
DECOMPOSITION OF SHORT-RUN EMPLOYMENT EFFECTS OF INCREASED PRODUCTION CAPACITY IN THE TRANSPORTATION EQUIPMENT SECTOR: CENTER-SOUTH



3.3 INTERREGIONAL MULTIPLIER

As already mentioned, the decomposition of results presented above was based on one-step Johansen simulations which enabled the total impact of increased capacity in the transportation sector to be decomposed into the separate impacts of each regional component of investment. However, as noted, the results are not accurate because of linearization errors. In order to get more accurate results for the output multiplier effects, the impact for the investment originating in each region is calculated individually, adopting a four-step Euler procedure in each simulation to eliminate linearization errors. The analysis focuses on the short-run output multiplier. A 1:1 relationship between the increase in the current capital stock in each region is assumed.

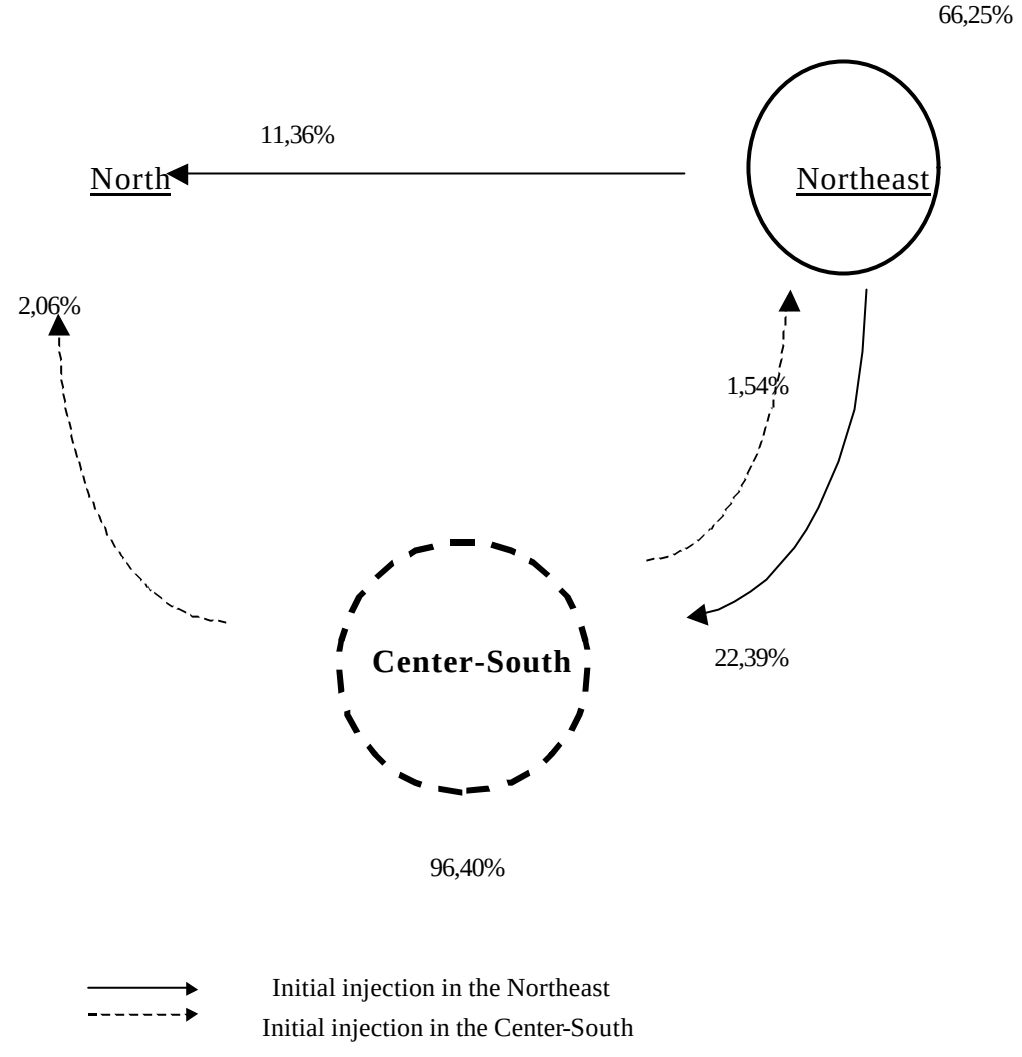
The estimates confirm the efficiency results suggested in the last section: investments carried out in the Center-South produce higher national growth (0.014% against 0.009% when the initial

injection takes place in the Northeast).[11] However, investments originating in the Northeast improve the regional distribution of output; in this case, the results for GRP show the following (the number in parenthesis showing the estimates for investments originating in the Center-South): 0.024% (0.005%) in the North, 0.042% (0.001%) in the Northeast, and 0.002% (0.017%) in the Center-South.

The short-run output multiplier effect can be decomposed into its intraregional (internal multiplier) and interregional (external multiplier) components, the former representing the impacts on the outputs of sectors within the region where the investment change was generated, and the latter showing the impacts on the other regions of the system (interregional *spillover* effects). FIGURE 9 shows the short-run direct and indirect effects of a unit change in the current capital stock in the transportation sector in the Northeast and Center-South net of the initial injection, i.e., the output multiplier effect net of the initial change. The entries are shown in percentage terms, providing insights into the degree of dependence of each region on the other regions. The Center-South is by far the most self-sufficient region; the intraregional flow-on effects from a unit change in the investments in the automobile industry is in excess of 96%; for the Northeast, there is a lower degree of intraregional self-sufficiency, and the dominant interregional flows generated by the region usually end up in the Center-South.

[11] When compared to the figures presented in TABLE 6 (real GDP), these estimates give an idea of the extent of the linearization errors

FIGURE 9
REGIONAL
PERCENTAGE DISTRIBUITION OF SHORT-RUN OUTPUT MULTIPLIER NET OF INITIAL INJECTION: INVESTMENTS IN THE AUTOMOBILE IDUSTRY



3.4 SENSITIVITY ANALYSIS

The simulation described above is based on the assumption that new investments in the transportation equipment sector bring about technological changes producing increases in the capital-labor ratio of the industry. Moreover, it tries to cope with the empirical evidence that the increasing levels of production in the sector have been accompanied by reductions in the employment levels. To adapt the model to carry out impact analysis of such changes, it is assumed that exogenous changes occur in the current capital stocks of the industry, inducing substitution away from labor resources. However, the degree of this substitution, i.e., the labor-saving content of the new technology, depends heavily on the values assumed for the parameters determining the primary-factor elasticity of substitution in the model. The benchmark value, used in the previous exercise, equals 0.50. By varying the value of this parameter for the transportation equipment sector, one can achieve results representing the use of alternative technologies in the automobile industry. The value of the parameter was arbitrarily set at

0.05 and 5.00, defining different degrees of labor-saving content; 0.05 implies very low levels of labor saving, with the technology approaching the Leontief specification; 5.00, on the other hand, implies very high levels of substitution (the model was solved twice).

FIGURES 10-12 depict the differential impacts of the assumed technologies on the levels of employment in the industries. It is clear that employment expands at a greater rate when Leontief-type technology is assumed. The restriction imposed by the model on the movements of employment levels in each region is specified by the regional unemployment rates, defined by the relation between the initial level of employment and the labor supply.

The aggregate results for GRP/GDP employment, shown in FIGURES 13-14, indicate that the choice of technology is very relevant, especially to the regions where investments take place.

FIGURE 10
SHORT-RUN EMPLOYMENT EFFECTS OF DIFFERENT TECHNOLOGIES: NORTH

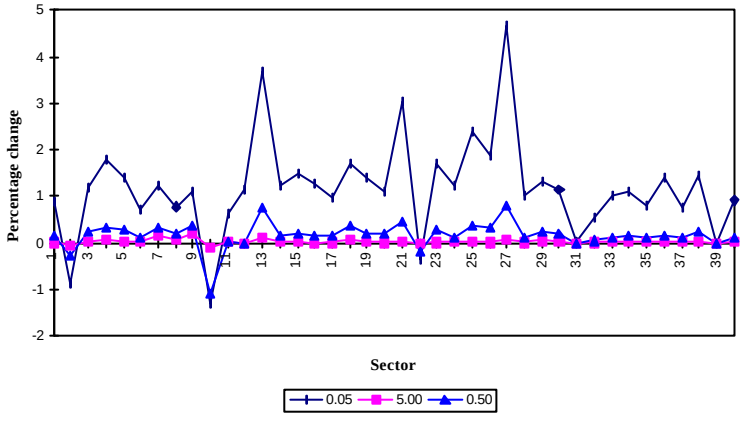


FIGURE 11
SHORT-RUN EMPLOYMENT EFFECTS OF DIFFERENT TECHNOLOGIES: NORTHEAST

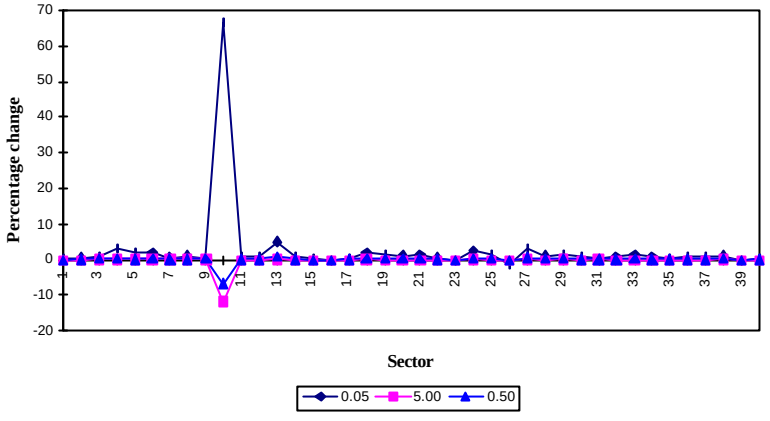
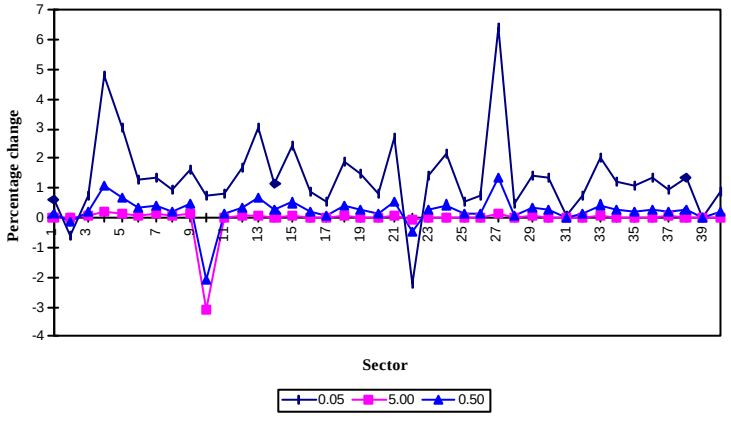


FIGURE 12
SHORT-RUN EMPLOYMENT EFFECTS OF DIFFERENT TECHNOLOGIES: CENTER-SOUTH



Finally, the results show that the concern of trade unions on the level of employment should be considered under two aspects. First, the spillover effects from the transportation sector are very strong, both intraregional and interregionally, and an increase in the investments in the industry are very likely to generate overall positive results, as the model projects. Second, the evaluation of the technology to be adopted should be perceived on the grounds of feasibility: given the available choices, what would be the impact on the variables of interest (e.g. employment). Technically, it reflects the use of appropriate values for the primary-factor substitution elasticity which represent the available technology.

FIGURE 13
REGIONAL AND NATIONAL SHORT-RUN EFFECTS OF DIFFERENT TECHNOLOGIES IN THE TRANSPORTATION EQUIPMENT SECTOR: GDP/GRP

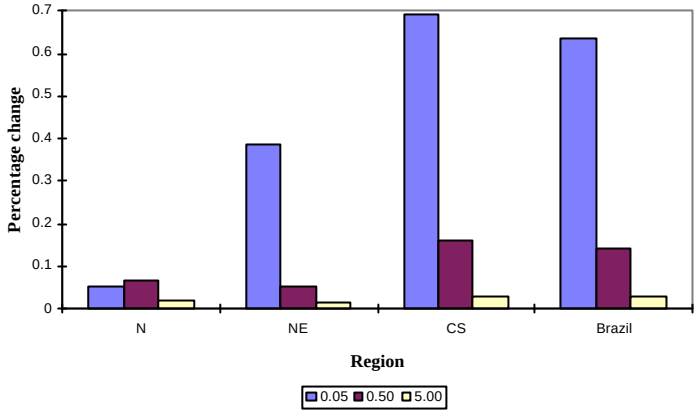
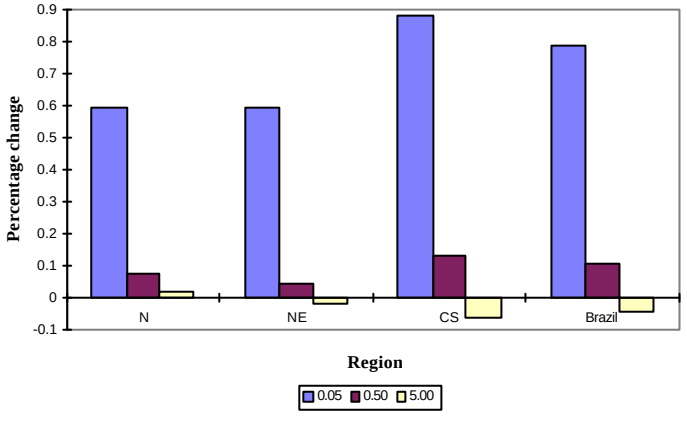


FIGURE 14
REGIONAL AND NATIONAL SHORT-RUN EFFECTS OF DIFFERENT TECHNOLOGIES IN THE TRANSPORTATION EQUIPMENT SECTOR: EMPLOYMENT



4- FINAL REMARKS

In the context of the fiscal adjustment process of the mid-1990's, the role of the central government directly stimulating productive activities and enhancing social overhead capital in lagging regions is being neglected. In the Real stabilization plan, introduced in mid-1994, there was no explicit concern about the formulation of a regional development policy. The plan was conceived as a stabilization plan, which included economic reforms (privatization, deregulation) and institutional reforms (tax system, social security and administrative), without proposing any strategy for medium and long-run development. However, with the benefits from stabilization and other reforms a new cycle of private investments emerged. Most of these were concentrated in the South and Southeastern regions, which provided a full range of non-traditional (e.g., technical skills and urban agglomeration) and traditional (e.g. friction of distance – Mercosul) locational factors to attract incoming capital. The lack of investments by the federal government which would complement the spurt of private investments led regional governments to engage in strong competition for private capital through fiscal

mechanisms. In some cases, the political pressures by the representatives of the lagging regions produced elements of compensatory regional policies, as was the case of the special automotive regime promoted by the federal government for the less developed regions, which resulted in plans for transportation equipment investments in the Northeast. It was shown that these investments are more beneficial to the improvement of regional imbalances in the country, even though, in terms of efficiency, investments in the Center-South generate higher national economic growth. However, with the Asian crisis of the second half of 1997, there were doubts that the planned investments of Korean companies (Hyunday and Asia) in the Northeast would be carried out.

ABSTRACT

With a greater commitment to market forces in the recent years, the Brazilian federal government is left with fewer options to manipulate growth of the less developed regions of the country. Thus, private investments play a key role in the process of regional development. New investments in the Brazilian automobile industry are being sought by the regions in a strong competition for the incoming capital through fiscal incentives. One of the issues that concern labor unions refers to the production technology embodied in the incoming capital, which is claimed to be accompanied by sharp reductions in the employment levels. In this paper, the regional impact of the new investments in the automobile industry is evaluated through the use of an interregional computable general equilibrium model. Attention is directed to employment estimates and the impacts on regional inequality. The simulation results for the short-run show that: a) the employment effects of the labor-saving technology in the automobile industry are positive for the economy as a whole; and b) even though investments in the less developed region (Northeast) are more beneficial to the improvement of regional imbalances in the country, in terms of efficiency, investments in the Center-South generate higher national economic growth.

KEY WORDS:

Interregional CGE Models; Impact Analysis; Automobile Industry; Regional Development in Brazil.

5- BIBLIOGRAPHY CONSULTED

"A INDÚSTRIA Automobilística no Brasil a mil por hora". **Rumo**s, July 1997. p. 24-31.

AROCENA, M. Common market of the southern cone: MERCOSUR. **Working Papers Series 204**, Inter-American Development Bank, Sept. 1995.

BAER, W., HADDAD, E. A. and HEWINGS, G. J. D. The regional impact of neoliberal policies in Brazil. **Economia Aplicada**, forthcoming. 1998.

BANCO DO NORDESE DO BRASIL. **Matriz de insumo-produto do Nordeste 1980 e 1985: metodologia e resultados**. Fortaleza: Banco do Nordeste do Brasil, S.A., 1992.

DINSMOOR, J. and HADDAD, E. A. Brazil: the use of state fiscal data bases for financial projections. **Region I Technical Note.** Inter-American Development Bank, Aug. ,1996.

DIXON, P. B. and PARMENTER, B. R. Computable general equilibrium modelling**. Preliminary Working Paper no. IP-65**, IMPACT Project, Clayton, July.,1994.

_____. PARMENTER, B. R., POWELL, A. A. et al. Notes and problems in applied general equilibrium economics. North-Holland: C. J. Bliss and M. D. Intriligator, 1992. (. Advanced Textbooks in Economics 32).

_____. SUTTON, J. et al. ORANI: A multisectoral model of the australian economy. North-Holland, 1982.

FIBGE. **Matriz de insumo-produto Brasil - 1985**. Rio de Janeiro: Departamento de Contas Nacionais Feb. 1995.

GUILHOTO, J. J M. **A Model for economic planning and analysis for the Brazilian economy**. University of Illinois at Urbana, 1986. (Ph.D. dissertation.).

GUILHOTO, J. J. M. **Um modelo computável de equilíbrio geral para planejamento e análise de políticas agrícolas (papa) na economia brasileira**. Piracicaba: ESALQ, June. 1995. (Tese de Livre Docência).

_____. and FONSECA, M. A. R. As principais correntes de modelagem econômica e o caso brasileiro. In: ENCONTRO BRASILEIRO DE ECONOMETRIA,12, 1990, Brasília, ***Anais***... Brasília. 1990.

HADDAD, E. A. **Regional inequality and structural changes in the brazilian economy**. University of Illinois at Urbana, 1997. (Ph.D.dissertation.).

_____. and HEWINGS, G. J. D. The Theoretical Specification of B-MARIA. **Discussion Paper REAL 97-T-5,** Regional Economics Applications Laboratory, Nov. 1997.

HARRISON, W. J. and PEARSON, K. R. Computing solutions for large general equilibrium models using GEMPACK. **Preliminary Working Paper no. IP-64**, IMPACT Project, Monash University, Clayton, 1994.

_____. An introduction to GEMPACK. **GEMPACK User Documentation GPD-1,** IMPACT Project and KPSOFT, Sept., 1996.

HEWINGS, G. J. D. **Regional input-output analysis**. Beverly Hills: Sage Publications, 1985.

HIGGINS, B. and SAVOIE, D. J. **Regional development theories and their application.** New Brunswick: . Transaction Publishers, 1995.

HORRIDGE, J. M., PARMENTER, B. R. and PEARSON, K. R. ORANI-F: A general equilibrium model of the australian economy. **Economic and financial Computing**, v. 3, n. 2 summer.1993.

MALECKI, E. J. **Technology and economic development:** the dynamics of local, regional and national change. Longman Scientific and Technical, Essex. 1991.

MOREIRA, A. R. B. and URANI, A. Um modelo multissetorial de consistência para a região Nordeste. **Texto para Discussão 352**. Brasília: IPEA, 1994.

NAQVI, F. and PETER, M. W. Notes on the implementation of monash-mrf: a multiregional model of australia Working Paper no. OP-82, IMPACT Project, Clayton: Monash University, 1995.

_____. A multiregional, multisectoral model of the australian economy with an illustrative application. **Australian Economic Papers,** June. 1996.

PEEBLES, G. H. **Lean Production, Sub Contracting, and Industrial Development: The** case of the brazilian automobile industry. University of Illinois at Urbana-,. 1995. (Ph.D. dissertation).

PETER, M. W. An illustrative application: The economic effects of a regional-government infrastructure project. IMPACT Project, Monash University, Clayton, 1996.(mimeo).

_____. Notes on comparative Static closures for MONASH-MRF.1997. (Unpublished manuscript, copy from the author).

_____. HORRIDGE, M., MEAGHER, G. A., NAQVI, F. The Theoretical Structure Of MONASH-MRF. Preliminary Working Paper no. OP-85, IMPACT Project, Monash University, Clayton, April. 1996b

HAN, S. H., MEAGHER, G. A. and NAQVI, F. The datgabase Of MONASH-MRF. IMPACT Project, Monash University, Clayton, July. 1996a.(mimeo)

SAVEDOFF, W. D. Os diferenciais regionais de salários no Brasil: segmentação versus dinamismo da demanda. **Pesquisa e Planejamento Econômico**, v. 20, n. 3, Dec. 1990.

SUDAM **Matriz de insumo-produto do Norte 1980 e 1985:** metodologia e resultados. Belém: Superintendência de Desenvolvimento da Amazônia, 1994.