Economic effects of regional tax incentives: a general equilibrium approach

Alexandre Porsse
Fundação de Economia e Estatística – RS e PPGE/UFRGS

Eduardo Haddad
Departamento de Economia – FEA/USP, REAL/UIUC, Bolsista do CNPq

Eduardo Ribeiro
PPGE/UFRGS

Resumo: Governos regionais recorrentemente utilizam políticas de incentivos fiscais para influenciar as decisões privadas de alocação de investimentos visando atraí-los para dentro de suas jurisdições. Esse comportamento não é diferente no Brasil e parece ter sido catalisado nos últimos anos por uma conjugação de fatores. O objetivo deste artigo é demonstrar que a abordagem de equilíbrio geral computável pode ser uma solução metodológica apropriada para analisar os efeitos econômicos de políticas de incentivo fiscal para atração de novos investimentos. A proposta consiste em utilizar um modelo inter-regional de equilíbrio geral computável desenvolvido para duas regiões do Brasil, Rio Grande do Sul e Restante do Brasil, e simular os efeitos econômicos de um aumento no estoque de capital corrente da indústria de transformação do Rio Grande do Sul fomentado por renúncia tributária do governo regional e gastos públicos em investimento.

Abstract: Tax incentives are common instruments in regional policies used to attract new investments and promote increase in employment and income, but the impact on regional public finances is very controversial. This paper uses an interregional computable general equilibrium model for the Brazilian economy to evaluate the net effects of tax incentives on the regional government revenues. The model takes into account the structural relationships between two regions and the specific characteristics of the Brazilian federalism that affects regional public finances. The theoretical specification allows capturing indirect and induced effects of the new investments and the net output of such incentive policies for the regional government revenues.

Área 9: Economia Regional e Urbana

JEL: C68, R13, H73

Economic effects of regional tax incentives: a general equilibrium approach

Introduction

Regional governments often adopt tax incentive programs to attract private investments to their jurisdictions. This behavior is not different in Brazil, where such incentive policies have been growing in the last few years by a combination of factors. The inducement role of the federal government remarkably subsided during the 1990s in the context of the stabilization policies carried out in the country. This federal government's behavior resulted in the lack of a national agenda for industrial policy and regional development for Brazil and opened the way for an active regional development policy by the local and state governments. The improvement in Brazil's competitiveness after a technological upgrade due to the trade liberalization, the stability engendered by the Real Plan and the expansionary cycle of foreign capital investments in the second half of the 1990s, especially in the automobile industry, led Brazilian state governments to engage in a true fiscal war in order to influence the private decisions surrounding the spatial allocation of new investments.

Tax incentive programs are mainly fueled by the expectations of welfare gains by means of an increase in the region's level of employment and income, but the controversy surrounding its efficiency is far from being cleared up due to the difficulty in determining the effects on the economic system as a whole. On the one hand, supporters highlight the positive impacts on the creation of jobs and income whereas, on the other hand, opponents confine attention to the possible costs arising from the loss of tax revenue and, consequently, inefficient allocation of public goods.[1]

A consistent analysis of the effects of tax incentives for attraction of investments should not solely consider the aspects related to the creation of jobs and income, in an isolated fashion, in contrast with the necessary supply of public goods for the population, but also the specific characteristics of the environment in which this competition takes place. An important aspect is concerned with the context in which this "dispute" occurs, that is, the regional dimension and asymmetries can be a relevant factor, since the regional production specialization and the interregional trade patterns can determine a regional interdependence that affects the allocation of investments. The government's vertical relationships are also important, mainly when the federal system uses mechanisms for the transfer of tax revenues to regional governments,[2] as is the case of Brazil.

However, an important issue is the type of investment targeted by the tax incentive program. In the real world, incentive programs can be used to attract new investments when they do not seek to influence, at least not directly, the allocation of investments already made and distributed across regions.[3] This situation involves granting of specific

[1] The available literature on interjurisdictional competition has not yet reached a common agreement on the implications related to the efficiency of allocation of public goods. Some studies suggest that this type of competition results in suboptimal allocation of public goods, whereas others consider allocation to be efficient when the federal government keeps tabs on competition. For a literature review see Kenyon (1997) and Wilson and Wildasin (2004).

[2] In this case, the region that grants tax benefits may have an increase in its revenues due to the transfers of revenues since undertaken investments tend to produce a positive effect on the collection of federal taxes.

[3] In a context of capital and labor mobility, we cannot rule out the possibility of indirect effects of tax incentives on the spatial distribution of investments.

incentive packages negotiated at the firm level (e.g.: large investments intended for the installation of a new production plant), strongly resembling the behavior of regional governments regarding the competition for the allocation of investments by automobile industries. Nevertheless, regional governments can also implement permanent incentive programs that can either be used to encourage new investments or to influence the regional reallocation of investments. The latter case may be perverse because it implies direct competition for the existing capital stock and its application in a context of strategic interactions between regions can lead to a zero-sum game and to inefficient allocation of public goods.

This study focuses on the first type of tax incentives, whose aim is to attract new investments by offering tax relief. The objective is to show that the computable general equilibrium (CGE) approach can be an appropriate method for assessing the economic effects of tax incentives to attract new investments in a given region. Our proposal consists in using an interregional computable general equilibrium (ICGE) model developed for two Brazilian regions (State of Rio Grande do Sul and Rest of Brazil) and simulating the economic effects of an increase in the capital stock of manufacturing industries in Rio Grande do Sul which is fully granted by the regional government, that is, by the tax revenue already collected. We pay attention to the effects on GDP, employment and the change in tax revenue collection induced by the new investments. The theoretical framework of this model is based on the B-MARIA model (Haddad, 1999) and its advantage is the integration between an interregional economic database and a public finance module for regional and federal governments that take into account the structural characteristics of Brazilian fiscal federalism.

The B-MARIA-RS model

B-MARIA-RS (*Brazilian Multisectoral and Regional/Interregional Analysis – Rio Grande do Sul*) is an interregional computable general equilibrium model developed for the analysis of the economy of Rio Grande do Sul and of Brazil. Its theoretical framework is similar to the B-MARIA model (Haddad, 1999) and follows the Australian tradition of general equilibrium models.[4]

The B-MARIA-RS model divides the Brazilian economy into two regions, Rio Grande do Sul and Rest of Brazil, and identifies a single foreign market (Rest of the World). The calibration data are those for 1998, and 25 productive sectors and investment goods are specified for each region. The productive sectors use two local primary factors (capital and labor). The final demand consists of household consumption, investment, exports, and regional and federal government consumption. The regional governments are sources of exclusively local demands and expenditure, comprising the state and municipal levels of public administration in each region. The whole model contains 60,323 equations and 1,475 exogenous variables.[5]

[4] Following this tradition, the models use the Johansen approach, where the mathematical framework is represented by a set of linearized equations and the solutions are obtained as growth rates. In the Brazilian economy, the PAPA (Guilhoto, 1995), EFES (Haddad e Domingues, 2001) and EFES-IT (Haddad *et al.*, 2001; 2002) models, among others, use this approach.

[5] The full description of the model is available in Porsse (2005). A miniature version for tests and evaluation is available from the authors upon request. This miniature model can be implemented in the demo version of the GEMPACK program (*www.monash.edu.au/policy/gpdemo.htm*).

The main innovation in the B-MARIA-RS model is the detailed treatment of public finances. As will be described ahead, this modification consists of the introduction of alternative closures for the governments regarding public finance policies.

The core module of the model comprises blocks of equations that determine the relationship between supply and demand, derived from optimization theories, and market equilibrium conditions. The indirect taxes at the core of the model are decomposed in order to separate the state indirect tax from the other federal and municipal indirect taxes. In addition, several regional and national aggregates are defined, such as level of aggregate employment, balance of trade and price indices. Next, we present the main theoretical aspects of the model.

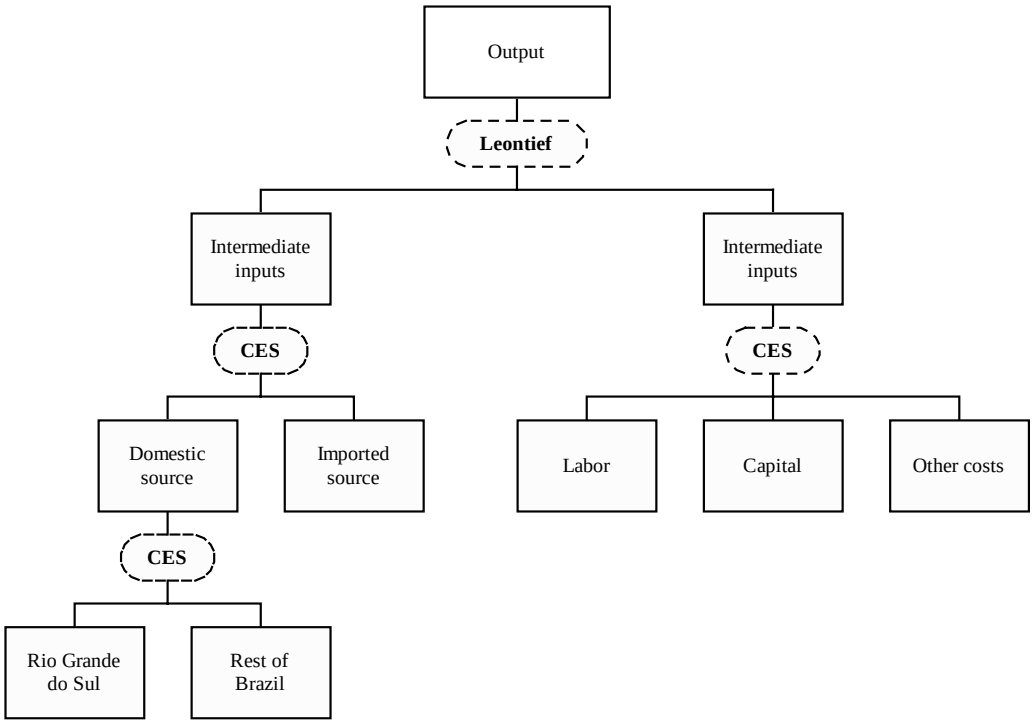
Production technology

Figure 1 illustrates the production technology encountered in the B-MARIA-RS model, a usual specification in regional models. This specification defines three levels of optimization for the productive process of firms. The dashed lines indicate the functional forms specified in each stage. Fixed proportion combinations of intermediate inputs and primary factors are assumed at the first level, through the Leontief specification. The second level involves substitution between domestically produced and imported inputs on one side, and substitution between capital and labor on the other side. A constant elasticity substitution (CES) function is used for the combination of inputs and primary factors. At the third level, bundles of domestically produced and imported intermediate inputs are formed as combinations of inputs from different sources. Again, a CES function is used to combine goods from different sources.

The use of CES functions in the production technology implies the adoption of the so-called Armington assumption (Armington, 1969) for product differentiation. This hypothesis regards goods from different sources as imperfect substitutes. For instance, agricultural and livestock products from Rio Grande do Sul are different from the agricultural and livestock products from the Rest of Brazil with regard to their use in the productive process (third level in Figure 1). This treatment permits the model to exhibit non-specialized intrasectoral market patterns, an important empirical regularity described in the literature.[6]

[6] For product differentiation in the world market and CGE models, see De Melo and Robinson (1989). The behavior of several classes of CES functions is analyzed in Perroni and Rutherford (1995).

Figure 1. Nested Structure of Regional Production Technology



Household demand

Each region has a group of representative households, which buy domestic goods (either locally produced or from other regions) and imported goods. The specification of household demand, in each region, is based on a CES/linear expenditure system (LES) preference function. The demand equations are derived from a utility maximization problem, whose solution follows hierarchical steps, similar to the ones shown in Figure 1. At the bottom level, substitution occurs across different domestic and imported sources of supply. At the subsequent upper level, substitution occurs between domestic composite and imported goods. The utility derived from the consumption of domestic and imported composite goods is maximized according to a Stone-Geary utility function. This specification gives rise to the linear expenditure system (LES), in which the expenditure share above the subsistence level for each good represents a constant proportion of the total subsistence expenditure of each regional household**.**[7]

Demand for Investment Goods

Investors are a category of use of final demand, and are held responsible for capital formation in each regional sector. They choose the inputs used in the capital formation process through cost minimization using a hierarchically structured technology.

[7] For the parameters necessary for the calibration of this specification, see Dixon *et al.* (1982). The LES specification is non-homothetic, such that the increase in the household expenditure (income) causes changes in the share of goods in overall expenditure, *ceteris paribus*.

This technology is similar to the production technology, with some adaptations. As occurs with the production technology, the capital good is produced by domestic and imported inputs. At the third level, an aggregate bundle of intermediate goods (domestic and imported) is formed as the combination of inputs from different sources. A CES function is used in the combination of goods from different sources. Differently from the production technology, primary factors are not used directly as input for capital formation, but used indirectly through inputs in sectoral production, especially in the civil construction sector. The level of regional investment in capital goods per sector is determined by the capital accumulation block.

Export and Government Demand

All export goods have downward sloping demand curves for their own prices in the world market. A vector of elasticity defines the response of foreign demand to changes in the FOB price of regional exports.

The government demand for public goods is based on the isolation of the consumption of public goods by the regional and federal governments, obtained from the input-output matrix. However, productive activities carried out by the public sector cannot be dissociated from those performed by the private sector. Thus, the government's entrepreneurial behavior is dictated by the same cost minimization assumptions adopted by the private sector. This hypothesis may be considered more appropriate, at first, for the Brazilian economy, since the privatization process implemented in the 1990s substantially reduced the participation of the government in the productive sector (Haddad, 1999). Public goods consumption is set to maintain a constant proportion with 1) regional private consumption, in the case of regional governments, and 2) with national private consumption, in the case of the federal government.

Capital Accumulation and Investment

Capital stock and investment relationships are defined in this module. There are two comparative static versions for the model that allow its use in short-run and long-run simulations. The use of the comparative statics model implies no fixed relationship between capital and investment; this relationship is selected on the basis of the requirements of the specific simulation. For example, in typical long-run comparative static simulations, growth of investment and capital is assumed to be identical (see Peter *et al.*, 1996).

Some qualifications are necessary for the specification of capital formation and investment in the model. As discussed in Dixon *et al.* (1982), the modeling of these components is basically concerned with how investment expenditures are allocated both per sector and per region, and not with the aggregate private investment in construction, machinery and equipment. On top of that, the temporal conception of investment used is not endowed with a correlation with a precise timetable; this would be a necessary characteristic if the model had the aim to explain the investment expansion path over time. Therefore, the main

concern regarding the investment modeling is to capture the effects of the shocks on the allocation of current investment expenditure across sectors and regions.

Labor Market and Regional Migration

In this module, the population in each region is defined exogenously through the interaction of demographic variables and interregional migration variables, and there is also a connection between regional population and labor supply. Given the specification of the labor market functioning, labor supply can be determined by interregional wage differentials or by regional unemployment rates, along with demographic variables, often defined exogenously. In summary, both labor supply and wage differentials may determine unemployment rates or, alternatively, labor supply and unemployment rates will determine wage differentials.

Other Specifications

The government finance module incorporates equations determining the gross regional product for each region, through the decomposition and modeling of its components, on both the expenditure and income sides. Budget constraints of the regional and federal governments are also defined[8], as well as the aggregate household consumption functions in each region (disaggregated into the main sources of income and in the respective tax duties). Other definitions in the model include tax rates, basic prices, and purchase prices of commodities, tax revenues, margins, components of the gross domestic product (GDP) and gross regional product (GRP), regional and national price indices, factor prices, aggregate employment and money wage settings.

Closures

The B-MARIA-RS model can be used for short-run and long-run comparative static simulations. The basic distinction between these two types of closure lies in the treatment given to the microeconomic approach to capital stock adjustment. Capital stocks are held fixed in the short run, whereas in the long run, policy changes may affect capital stocks in each region.[9]

In the short-run closure, besides the hypothesis of interindustry and interregional immobility of capital, the regional population and labor supply are fixed, the regional wage differentials are constant and the national real wage is fixed. Regional employment is driven by the assumptions on wage rates, which indirectly determine regional unemployment rates. On the demand side, investment expenditures are exogenous – firms cannot reassess investment decisions in the short run. Household consumption follows household disposable income, and government consumption, at both regional and federal levels, is fixed (alternatively, government deficit can be set exogenously, allowing government expenditures to change). Finally, the technology variables are exogenous, given that the model does not present any endogenous growth theory.

[8] See next section.
[9] For closures in CGE models, see Dixon and Parmenter (1996) e Dixon *et al*. (1982).

In the long-run closure, capital and labor are mobile across sectors and regions. The major differences from the short-run closure lie in the configuration of the labor market and capital accumulation. In the former case, aggregate employment is determined by population growth, labor force participation rates, and the natural rate of unemployment. The distribution of labor force across regions and sectors is totally determined endogenously. Labor is attracted to more competitive sectors in more favored geographical areas. Likewise, capital is directed towards more attractive sectors. This movement keeps the rates of return at their initial levels.

Modeling strategy

The simulation design is based on the observation of several tax incentive packages established by Brazilian state governments in the mid-1990s in order to attract new investments in the automobile sector to their jurisdictions.[10] These incentives consisted of tax exemption, mainly from the value-added tax on sales and services (ICMS[11]), direct infrastructure expenditures, provision of plots of land and direct financing in the form of subsidized credit for fixed capital and shareholder in some cases.

The simulation strategy encompasses two aspects. First, it considers that the values of new investments are totally paid by the regional (state) government's indirect tax revenue, that is, it is assumed that the total value of new investments is deducted from the collection of ICMS, the major state indirect tax. This is equivalent to a tax exemption policy that fully covers the private expenditures with the capital stock expansion of the regional firms[12]. Secondly, it considers that the regional government's public expenditures with investment goods are endogenous and follow the growth of private investments. This allows capturing the effects of public investments in infrastructure needful to support the private investments.

To apply this strategy we use a similar procedure applied in Haddad and Hewings (1999). It is assumed that the effects of new investments can be assessed under the hypothesis of technological upgrade of industries. Specifically, a 1% shock is attributed to the current capital stock of manufacturing industries of Rio Grande do Sul. To include the tax relief in the simulation, the monetary value[13] corresponding to the shock in the current capital stock is deducted from the tax revenue collected through indirect taxes charged by Rio Grande do Sul's governments. The simulation is performed under a long-run closure and, therefore, it admits interregional and intersectoral mobility of capital and labor.

---

[10] Prado and Cavalcanti (2000) conducted an excellent review of state incentive programs implemented during this period.

[11] The ICMS is an excise tax and is collected like a value added tax by Brazilian state governments. Considering the revenues from all indirect taxes collected by Rio Grande do Sul's governments (state and municipalities), ICMS accounts for 91.7% of the total, according to the database calibrated for the B-MARIA-RS model.

[12] The Rio Grande do Sul state government actually have a tax incentive program to attract business investments that covers until 100% of the fixed capital augmenting by the firms through ICMS exemption. This program is denominated FUNDOPEM and applies the following rules: a 4% annual nominal interest rate, until six years to start the loan payments and until eight years to amortize the each monthly debt quote. Taking into account the depreciation rate and the real interest rate, in some cases the tax exemptions fully covers the private investments and thus our hypothesis is not unrealistic.

[13] This value is deflated by the GDP deflator.

The government's closure plays a key role in this simulation. In the B-MARIA-RS model, government's revenues and expenditures are itemized and sorted out according to the level of regional government, including state, municipal and federal government. The federal government has vertical relationships with regional governments through current transfers and capital transfers.[14] Most of the public expenditure components are determined endogenously by aggregate variables of the macroeconomic, demographic and labor market modules. For instance, public investments follow the variation in private investments in order to accommodate the needs of infrastructure investments, personal benefit payments evolve positively with labor supply and population growth and negatively with the employment variation, the subsidies follow the performance of indirect tax revenue, payment of interests are contingent upon the GDP variation. Despite its endogenous determination, this mechanism implies that the government spending policy is exogenous – the governments should meet the demand for public goods – and that the pressures on such expenditures should be accommodated by tax revenue increases.

The tax revenue can grow if there is a positive effect of the new investments on the tax base, or due to changes in tax rates, or both. Then we allow the federal government to respond to public goods pressures by endogenously adjusting the income tax rate if the income tax base effect is not so high. For the regional governments we assume an endogenous adjustment in payroll tax rates. But it is worth noting the effects on federal income and indirect tax revenues that also have effects on regional government revenues due to the fiscal transfer mechanism. Table 1 summarizes the government's closure regarding the degree of freedom to implement public finance policies in the government view.

[14] The federal government collects income tax and indirect taxes on industrialized products and approximately one quarter of this revenue is transferred from the federal government to regional governments.

Table 1 – Government's closure for the public finance policy

Components of public finances	Regional Govt.	Federal Govt.
Government's revenue	Mixed	Mixed
Direct taxes	Exogenous	Mixed
Income taxes	-	Endogenous
Other direct taxes	Exogenous	Exogenous
Indirect taxes	Mixed	Exogenous
Tariff revenue	Exogenous	Exogenous
Commodity taxes	Exogenous	Exogenous
Payroll taxes	Endogenous	Exogenous
Property taxes	Exogenous	-
Land taxes	-	-
Other indirect taxes	Exogenous	Exogenous
Interests received	Exogenous	Exogenous
Federal transfers	Exogenous	Exogenous
Other revenues	Exogenous	Exogenous
Discrepancy	Exogenous	Exogenous
Public deficit	Exogenous	Exogenous
Government's expenditure	Exogenous	Exogenous
Expenditures on goods and services	Exogenous	Exogenous
Government consumption	Exogenous	Exogenous
Government investment	Exogenous	Exogenous
Personal benefit payments	Exogenous	Exogenous
Subsidies	Exogenous	Exogenous
Interest payments	Exogenous	Exogenous
Federal transfers to regions	Exogenous	Exogenous
Other outlays	Exogenous	Exogenous

Simulation results

The simulation was implemented using Euler's method to correct linearization errors and the results are reported in percentage change rates, except for the equivalent variation. Table 2 summarizes the main effects of the increase in current capital stock in the manufacturing industry of Rio Grande do Sul for some regional and national variables. The GDP components were deflated by their respective price indices. By observing the results for Rio Grande do Sul, the increase in demand generated by new investments produces positive effects on employment and on equivalent variation, indicating that it is necessary to increase the number of employed individuals to guarantee the productive growth of manufacturing sectors and that the representative household of the model has a superior level of utility. The welfare effect is strengthened by the decrease in the price of final consumer goods and by the increase in the household disposable income due to the positive impact on primary factors income.

Table 2 – Long-run percentage effects: 1% increase in current capital of manufacturing industry of Rio Grande do Sul

Variables	Rio Grande do Sul	Rest of Brazil	Brazil
GDP components			
Real household consumption	0.630	0.031	0.073
Real aggregate investment	4.355	-0.012	0.273
Real aggregate regional government demand	-	-	-
Real aggregate federal government demand	-	-	-
Interregional export volume	-1.331	1.184	-
International export volume	-2.488	-1.006	-1.151
Interregional import volume	1.184	-1.331	-
International import volume	0.737	0.341	0.362
Prices			
Consumer price index	-0.071	0.457	0.419
Investment price index	1.558	0.445	0.519
Regional government price index	0.485	0.537	0.534
Federal government price index	0.485	0.537	0.535
Interregional export price index	2.070	0.435	-
International export price index	1.709	0.418	0.544
Interregional import price index	0.435	2.070	-
International import price index	-	-	-
GDP deflator (expenditure side)	1.117	0.463	0.513
Primary factors			
Aggregate payments to capital	4.506	0.428	0.727
Aggregate payments to labor	0.543	0.481	0.486
Aggregate capital stock	2.712	-0.018	0.184
Welfare indicators			
Equivalent variation*	1,305	1,281	2,585
Real GDP	-0.219	-0.005	-0.021
Employment	0.118	-0.008	0.001

Source: calculated by the authors.
Note: * values in R$ million.

Nevertheless, the effect on real GDP is negative because of the sharp increase in the general price level (GDP deflator) caused by the demand shock. As Rio Grande do Sul's economy is highly specialized in the production of final consumer goods, especially in the agroindustrial sectors, but poorly specialized in the production of investment goods and of some basic inputs, the shock tends to produce remarkable increase in the prices of these goods. Price increases affect mainly the competitive position of goods traded in the interregional and foreign markets, resulting in a substitution effect that exceeds the gains induced by the real increase in investments and in household consumption. The benefits of the incentive program are absorbed by investors and households, whereas the costs are absorbed by interregional and international export agents.

The effects on GDP and employment in the Rest of Brazil are negative and relatively small. Although this region has a competitive advantage in the interregional market, regional mobility of production factors exerts pressure on the cost of production and on the general price level of goods in the region. Interregional relationships concentrate the absorption of price increases in this region. Thus, the reduction in GDP is contingent on

the real reduction in investments and on the loss of competitiveness in the foreign market, which also produces a substitution effect between domestically produced and imported goods. Quite surprisingly, real household consumption and equivalent variation show a positive variation in the Rest of Brazil. In this case, the effect results from a nominal increase in the primary factors income, especially labor, higher than the increase in the prices of household consumer goods.

The aggregate effects in both regions determine positive results for the Brazilian economy in terms of job creation and higher level of utility for households, but the negative effect on GDP persists. Considering Brazil as a whole, it is clear that the gains from the tax incentive program for attraction of investments to the manufacturing industry of Rio Grande do Sul tend to benefit investors and consumers, whereas the costs related to the increase in the domestic price level determine a substitution between domestically produced and imported goods which have a negative effect on the balance of trade.

Now we can look at the implications for public finances of the governments. Table 3 shows the effects on tax revenue, expenditures and public deficit of the regional and federal governments in real growth rates obtained from the difference between nominal variations and the GDP deflator. It should be highlighted that the change in indirect taxes revenue of Rio Grande do Sul is already adjusted, that is, it represents the net revenue after deduction of the monetary values of the shocks in the current capital stock.

The increase in the level of investment in the manufacturing sectors of Rio Grande do Sul increases the demand for investments by the government of Rio Grande do Sul and by the federal government, placing some pressure on their expenditures. For the federal government, the shock of investment in Rio Grande do Sul has a low impact on the tax base associated with the collection of indirect taxes and there is a real negative effect on tax collection because the nominal variation is lower than changes in the general price level. Considering the effects on the production factors income, the impact on the income tax base is also low. Therefore, the federal government's investments are financed through a relatively high increase in the income tax rate since part of this revenue is transferred to regional governments in compliance with constitutional rules.[15] So, the adjustment of federal government on the revenue side tends to benefit the revenue of regional governments.

[15] In the implemented simulation, the income tax rate had a 4.86% endogenous increase.

Table 3 – Long-run percentage effects on public finances: 1% increase in current capital of the manufacturing industry of Rio Grande do Sul

Variables	Governments		
	Rio Grande do Sul	Rest of Brazil	Federal
Government's revenue	0.002	0.057	0.105
Tax revenue	0.293	0.106	0.820
Direct taxes	-0.222	-0.005	3.692
Income taxes	-	-	5.033
Other direct taxes	-0.222	-0.005	-0.022
Indirect taxes	0.691	-0.096	-0.030
Tariff revenue	-	-	-0.136
Commodity taxes	1.091	-0.042	-0.021
Payroll taxes	-2.618	-1.348	-0.022
Property taxes	-0.222	-0.005	-
Land taxes	-	-	-
Other indirect taxes	-0.222	-0.005	-0.022
Interests received	-0.222	-0.005	-0.022
Federal transfers	2.896	3.550	-
Other revenues	-0.222	-0.005	-0.022
Discrepancy	-0.633	0.074	0.021
Public deficit	-	-	-
Government's expenditure	0.002	0.057	0.105
Expenditures on goods and services	0.006	0.061	0.156
Government consumption	-0.633	0.074	0.021
Government investment	4.864	-0.030	1.825
Personal benefit payments	-0.579	-0.052	-0.089
Subsidies	0.957	-0.044	0.043
Interest payments	-0.222	-0.005	-0.022
Federal transfers to regions	-	-	3.500
Other outlays	0.002	0.057	0.105

The pressures on public investments are more remarkable for the regional government of Rio Grande do Sul and are financed by the increase in the indirect taxes revenue (exclusively due the tax base growth) and by the increase in revenues from federal transfers. Two aspects related to the effects on the tax base of Rio Grande do Sul should be noted: first, as the regional government comprises the state and its municipalities, the tax base growth extends to the indirect tax collection of municipal governments; secondly, even though the international export sector absorbs a significant amount of the price increase, the decrease in the volume of international exports does not substantially affect the collection of indirect taxes at the state government level because the Kandir Law exempted exporters from paying the ICMS.[16]

The reallocation effect on the economy of the Rest of Brazil, especially regarding capital, contributes to a reduction of the region's real tax base, but on the other hand, it originates less demand for public investments. Even so, the government's revenue in this region benefits from the increase in federal transfers, and this allows elevating the provision of public goods or creating new expenses. If, on the one hand, the region loses in terms of job

[16] The Kandir Law came into force in 1997 and the base year for the B-MARIA-RS model is 1998.

creation and GDP, on the other hand, it can have public revenue gains due to vertical governmental relationships.

Two final remarks are also necessary. The combined effect of a tax base growth in Rio Grande do Sul and the increases in regional government revenues established by vertical governmental relationships allow for a reduction in payroll tax rates. The high negative effects on the collection of payroll taxes from regional governments, albeit influenced by a general price increase, also result from an endogenous reduction in tax rates caused by the increase in the indirect tax revenue (only for Rio Grande do Sul) and in the transfer revenues. Finally, on the expenditure side, the real variations in government consumption arise from the relative effect between the price of these goods and the GDP deflator.

Decomposition of results

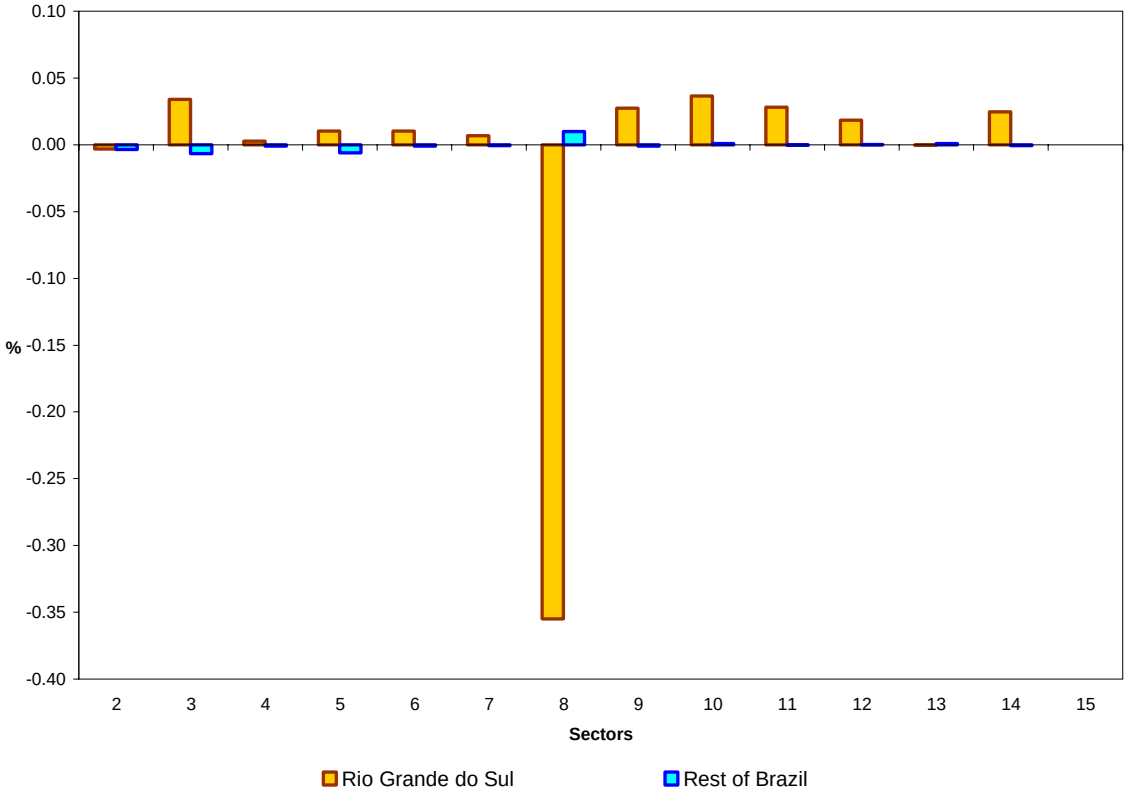
In the previous section, we could observe that the increase in current capital stock in the manufacturing industry of Rio Grande do Sul in a context of a tax incentive program causes demand pressures that result in a general price increase that produces negative effects on real GDP all over the country and, more significantly, in Rio Grande do Sul. This section explores the sources of this effect by the sectoral decomposition of those sectoral shocks. To do that, each sectoral shock was simulated separately assuming that the investments in other sectors of the manufacturing industry of Rio Grande do Sul remain constant.[17] The results for both regions are described in Graphs 1 and 2.

We can clearly see that the increase in the implicit GDP deflator is a general effect, both at the sectoral and interregional levels, resulting from the increase in the capital stock of the manufacturing industry of Rio Grande do Sul, which varies in intensity. However, the effects of the increase in the deflator and of the reduction in real GDP are influenced by the resulting growth of investments in the chemical and petrochemical sector of Rio Grande do Sul. In the absence of shock in this sector, the results would be influenced by the activity effect and there would be a positive impact on real GDP, at least in the Rio Grande do Sul.[18]

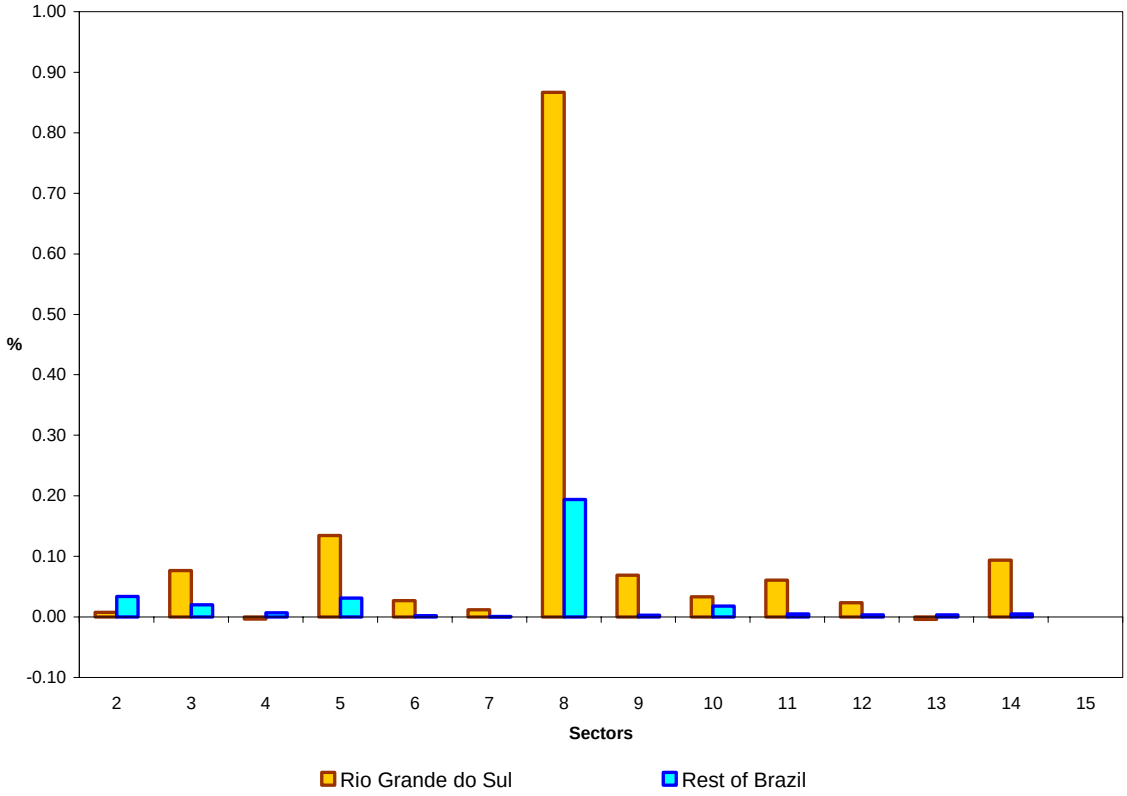
[17] In the B-MARIA-RS model, manufacturing industry is stratified into 14 sectors: metallurgy (2), machinery and tractors (3), electrical and electronic equipment (4), transportation material (5), wood products and furniture (6), paper and printing (7), chemical and petrochemical products (8), leather and footwear (9), processed vegetables (10), meat products (11), dairy products (12), vegetable oils (13), other food industries (14), and other industries (15).

[18] The simulation was implemented in the same context, only leaving out the chemical and petrochemical sector, and the results showed a variation of 0.125% and –0.014%, respectively, for the real GDP of Rio Grande do Sul and of the Rest of Brazil.

Graph 1 - Decomposition of long-run percentage effects on GDP by sectoral shocks



Graph 2 - Decomposition of long-run percentage effects on GDP deflator by sectoral shocks



In Rio Grande do Sul, the chemical and petrochemical sector is the one with the largest demand for investment goods among other sectors (26.1%) and with strong domestic sectoral and interregional relationships. The growth of current capital stock in this sector exerts a strong pressure on the prices of investment goods, increases the cost of capital in the sector and also the cost of production. Since the goods produced by the chemical and petrochemical sector feed the chain of intermediate inputs in several economic sectors of Rio Grande do Sul and also in the Rest of Brazil, price increases are passed along. The final result is a more remarkable price increase in Rio Grande do Sul compared to the Rest of Brazil. In such a way the interregional substitution effects prevail over the activity effect causing a decrease in the real GDP of Rio Grande do Sul and an increase in GDP of the Rest of Brazil (see Graph 2).

Final remarks

This paper used a general equilibrium approach to evaluate the effects of a regional tax incentive program for attraction of investments. The analysis focused mainly on the financing of new private investments through tax revenue relief and public investment expenditures by regional and federal government. The interregional general equilibrium model used to run the simulations captures the effects of regional interdependence and of vertical relationships between the governments.

The results showed that the effects on employment and household welfare of consumers are positive for the region that implements such incentive policy, the Stete of Rio Grande do Sul. However, the effect on real GDP may not follow the same path and this would occur mainly because of the specialized pattern of production in the region. As shown, the specificity of the productive structure of Rio Grande do Sul plays an important role. The absence of a consolidated investment goods sector and the demand for these goods concentrated in sectors that produce basic inputs caused a sharp increase in the production factor prices. The increase in the input prices extended for goods produced by other sectors and in the regional production chains, due to forward linkages. This sector's specific effect dominates the positive impacts on the real GDP of Rio Grande do Sul when the shocks are implemented in the other manufacturing sectors. At the aggregate level, the advantages of this incentive policy tend to benefit investors and consumers, while costs are absorbed by export agents. Surprisingly, although the effects of interregional competition prevail over the Rest of Brazil due to the re-location of production factors, the intensity is relatively smaller and does not seem to affect the consumers' utility level. In this region, the effects wind up absorbed by foreign investors and exporters.

Another interesting result concerns the effects on the public finances of regional and federal governments. The net result on the indirect tax revenue is positive due to the increase in the tax base, even considering the tax revenue relief offered by the regional government to thoroughly finance the increase in private investments. A key role may be ascribed to the federal government's tax policy. If the federal government increases the income tax rates in order to meet the demand for federal public investments, regional governments are benefited through income transfer mechanisms. The transfers received by the Rest of Brazil government exceed the loss that arises from relocation of the tax base. Additionally, the impact of the increase in federal income tax rate on the disposable

income is not negative due to the relatively higher gains produced on the primary factors income and other earnings.

These results show that the general equilibrium approach is a useful framework for investigation of the economic effects produced by tax incentive programs that seek to attract business investments. This methodology permits analyzing the welfare effects of such policies using a consistent model that captures important second order effects. The focus of the present study was on a situation in which only one region uses a tax incentive program to attract new investments and the federal government adjusts its tax policy according to the high demands for public investments. Since regional asymmetries and the pattern of interregional linkages may play a crucial role on the welfare effects, we may think of an alternative environment where both regions adopt tax incentive programs to attract new investments. Investigation of the sensitivity of the results to different closures for the federal government tax policy also appears to be relevant. Finally, this approach can also be used to assess issues related to interregional tax competition.

References

Armington, P. S. (1969) A theory of demand for products distinguished by place of production. *International Monetary Fund Staff Papers*, 16, pp. 159-178.

De Melo, J. and Robinson, S. (1989) Product differentiation and foreign trade in CGE models of small economies. Whashington DC, World Bank, *Policy, Planning and Research Working Papers*, WPS 144.

Dixon, P. D. and Parmenter, B. R. (1996) *Computable general equilibrium modeling for policy analysis and forecasting*, In: H. M. Amman, D. A. Kendrick and J. Rust (Eds.) *Handbook of Computational Economics*, 1: 3-85, Amsterdam, Elsevier.

Dixon, P. D., Parmenter, B. R., Sutton, J. and Vincent, D. P. (1982) *ORANI: A multisectoral model of the Australian economy*, Amsterdam, North-Holland.

Domingues, E. P., Leon, F. L. L. and Haddad, E. A. (2001) Impactos das exportações sobre a estrutura setorial e de qualificação do emprego no Brasil. *Economia*, v.2, n. 1.

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

Haddad, E. A. (1999) *Regional inequality and structural changes: lessons from the Brazilian experience*. Aldershot: Ashgate.

Haddad, E. A. and Domingues, E. P. (2001) EFES – Um modelo de aplicado de equilíbrio geral para a economia brasileira: projeções setoriais para 1999-2004. *Estudos Econômicos*, v. 31, n. 1.

Haddad, E. A., Domingues, E. P. and Perobelli, F. S. (2002) Regional effects of economic integration: the case of Brazil. *Journal of Policy Modeling*, v. 24, n.5, pp. 453-482.

Haddad, E. A. and Hewings, G. J. D. (1999) The short-run regional effects of new investments and technological upgrade in the Brazilian automobile industry: an interregional computable general equilibrium analysis. *Oxford Development Studies*, v. 27, n. 3, 25 p.

Kenyon, D. A. (1997) Theories of interjurisdictional competition. *New England Economic Review*, March/April, 23 p.

Perroni, C. and Rutherford, T. F. (1995) Regular flexibility of nested CES functions. *European Economic Review*, v. 39, n.2, p. 335-343.

Peter, M. W., Horridge, M., Meagher, G. A., Naqvi, F. and Parmenter, B. R. (1996) The theoretical structure of MONASH-MRF. *Preliminary Working Paper no. OP-85*, IMPACT Project, Monash University, Clayton, April.

Porsse, A. A. (2005) *Competição tributária e efeitos econômicos regionais: uma análise de equilíbrio geral computável*. UFRGS, Porto Alegre, Tese de Doutorado.

Prado, S. e Cavalcanti, C. E. G. (2000) *A guerra fiscal no Brasil*. São Paulo: Fundap: Fapesp.

Wilson, J. D. and Wildasin, D. E. (2004) Capital tax competition: bane or boon? *Journal of Public Economics*, v. 88, n. 6, 26 p.