

A methodology to estimate an input-output matrix integrated with an account system at state level

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Abstract

Input-output matrixes and account systems at regional level are very hard to produce because of statistical restrictions, mainly of interregional trade flows, and because they are highly demanding of financial resources to generate primary data. This paper presents methodological procedures to use secondary data to estimate a state input-output matrix integrated with a system of regional accounts taking account the recommendations of the System of National Accounts (UN, 1993). The procedures are applied for Rio Grande do Sul, a Brazilian state, and consist in an adaptation of the methodological process used to produce the national input-output model by Brazilian Institute for Statistics and Geography. The model follow a consistent balance rule between supply and demand and the main innovation is to use the database collected by local fiscal authorities to calibrate the interregional trade flows. The RAS procedure is applied in the final stage of the work to promote marginal balance adjusts.

Keywords: methodological procedures, regional input-output matrix and system of regional accounts.

JEL classification: C67, C82, R15.

1 – Introduction

The Brazilian economy tried a hard process of structural change in the last decades. In the beginning of the nineties began a commercial liberalization policy and integration to the global market. After several unsuccessful attempts of monetary stabilization policies implemented starting from middles of the eighties finally in 1994 the *Real Plan* had success to promote stability for the variations of prices and such success continues until the current days. Besides the monetary reform, the federal government also looked for to try “drying” the public machine, in other words, many state companies were privatizing as for instance in the electric sector and in the telecommunications sector. Similarly the state governments also accompanied that privatizing process.

In the context of those changes there was a strong reduction of the federal government in the formulation and implementation of planning and regional development policies. Therefore, along the nineties, also a more intense performance of the state governments is observed in planning and development policies but many times using instruments of tax competition to attract private investments.

The stability reached in the macroeconomic environment allowed to retake the interest for long run planning policies and due to active incursion of the regional governments in such policies also increased the interest for regional input-output

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models to give support to the policy makers and other decision makers. For instance, it is possible to observe estimates of regional and interregional input-output matrixes for several states like São Paulo, Rio de Janeiro and Minas Gerais¹.

This paper aims to present the experience of production a regional (state) input-output matrix (IOM) for Rio Grande do Sul, a representative state of the Brazilian economy². The innovation of this work is the methodology used to estimate the regional IOM, which follows the process accomplished for the production of the national IOM by the Brazilian Institute for Statistics and Geography and it is based on the System of National Accounts (UN, 1993). A by-product of such methodology is the estimate of an Integrated System of State Accounts (ISSA) which is consistent with the regional IOM. All statistics used in this work were available for the 1998 year and this determined the basic-year of the IOM and ISSA for Rio Grande do Sul.

A lot of regional IOM are estimated using location quotients methods and RAS approach³ mainly because is very hard to generate primary data about the regional input-output coefficients and the interregional trade balance. But the methodology proposed in this paper is based on a consistent balance rule applied on a set of secondary data of supply and demand by product and it only uses the RAS approach in the final stage of the estimation work. Such methodology has a high *ad hoc* content but it follows an economic sense than a mechanical process. It's true that still is needful to use national proxies for estimate the regional input-output coefficients (and other coefficients) because of data constraints but the procedures used has the advantage to modeling the regional IOM based on an economic consistent rule.

The following sections present the methodological procedures used to estimate the IOM and ISSA. The last section reports the main outcomes.

2 – Methodological procedures used to estimate the IOM

The regional IOM estimated for Rio Grande do Sul has 28 sectors and 43 commodities⁴ and it is integrated with a system of regional accounts such as the national model. The methodological procedures used in this work follow that same implemented for the national model developed by Brazilian Institute for Statistics and Geography. The System of National Accounts (UN, 1993) is the basic reference to both models.

The main stages implicated by methodology are in Figure 2.1. The upper box focus on IOM and the lower box focus on ISSA. First, the Table of Resources⁵ and Uses⁶ (TRU) for the state economy are building using secondary data from several statistical sources⁷. The second stage is the calibration, that is, the balancing of supply

¹ See Haddad and Domingues (2001), BDMG (2001) and CIDE (2001).

² The Rio Grande do Sul is the fourth regional economy of Brazil with a representation in *national* GDP of approximately 8%. Such economy also has the second position in the manufacture industry and in the exports of Brazil.

³ See Miller and Blair (1985) for more details about location quotients and RAS approach.

⁴ This classification matches with the Brazilian input-output model but the national model has 42 sectors and 80 commodities. All code classifications are based on International Statistics Information Classification. See the table of correspondence to the regional and national IOM in Annex.

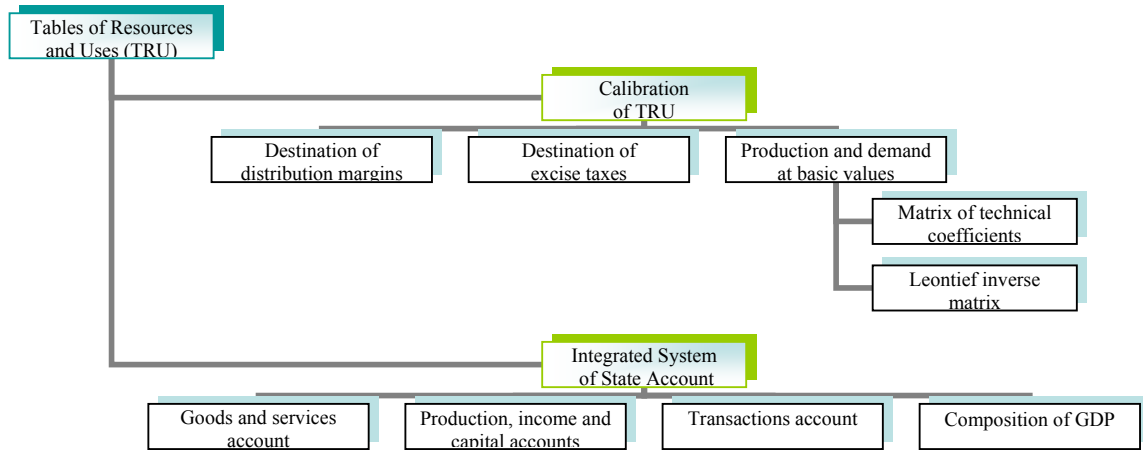
⁵ This term has different forms accordingly other applications such as “supply” (UN form) and “make” (USA form).

⁶ The Table of Uses for regional IOM of Rio Grande do Sul doesn't contemplated the value added components by sector (compensation of employees, gross operating surplus and net taxes of subsidies to production and imports) because some data were not available. Such components are available only at aggregated level and are presented in the composition of GDP account (see sections 4 and 5).

⁷ See section 3 for more details. All statistical sources are listed in Annex.

and demand flows of commodities (see equations 2.1 – 2.4). The third stage is the transformation of the demand (uses) at market prices to the demand at basic prices – exclusion of distribution margins (trade and transportation) and excise taxes. Then, the (symmetric) matrix of technical coefficients and the matrix of Leontief are calculated. But the ISSA is conditional to TRU but should be complemented with more statistics to generate several macroeconomic variables for Rio Grande do Sul⁸.

Figure 2.1
Methodological Structure and Components of the IOM and ISSA



The following equations represent the balance conditions to promote the calibration of data for the TRU⁹:

$$p = mg + t + V \cdot i + m^w + m^r \quad (2.1)$$

$$d = C \cdot i + f \quad (2.2)$$

$$f = e^w + e^r + g + c + k + v \quad (2.3)$$

$$p = d \quad (2.4)$$

where

p = vector of production at market prices;

d = vector of demand at market prices;

f = vector of final demand at market prices;

mg = vector of distribution margins;

t = vector of excise taxes on commodities;

V = matrix of production at basic prices;

m^w = vector of international imports;

m^r = vector of interregional imports;

C = matrix of intermediate consumption at market prices;

e^w = vector of international exports;

e^r = vector of interregional exports;

g = vector of government consumption at market prices;

⁸ See section 5 for more details.

⁹ The lower case letters indicate vectors and the capital letters indicate matrixes. The dimensions are “n” for commodities and “m” for sectors.

c = vector of household consumption at market prices;
 k = vector of gross formation of fixed capital at market prices;
 f = vector of inventories variations at market prices;
 i = unitary vector.

The first obtained statistics to the vectors don't guarantee those identities are satisfied because they come from independent (no integrated) data sources. Such statistics constitute a preliminary database for TRU and the unbalances¹⁰ are the rule for several products (commodities). Then, the construction of IOM requires an exercise of calibration (confrontation) of data in the market of each product in order to promote the balance. At this stage isn't used a mechanical method likes RAS approach because some balances can be high. The balance process is accomplished starting from an economical analysis of supply and demand chain by products through "spreadsheets of balance between resources (supply) and uses (demand)". The structure of the spreadsheets is showed in Figure 2.2 for a product already balanced¹¹.

Figure 2.2
Spreadsheet of balance between resources and uses - 1998
Commodity: 1001 Manufacture of footwear and leather

							R\$ Millions
Price composition Accounts	Basic prices	Distribution margins	Excise taxes				Market prices
			Imports	Other excise taxes (IPI/ISS/Other)	Circulation of Goods and services (ICMS)	Sum	
Resources (Supply)							
Domestic production	4,171	262	0	15	159	174	4,608
Interregional imports	886	56	0	3	34	37	979
International imports	142	9	30	1	5	36	187
Sum of Resources	5,200	327	30	19	198	247	5,774
Uses (Demand)							
Intermediate consumption	983	59	5	0	0	5	1,048
Household consumption	756	49	4	4	57	65	870
Gross formation of fixed capital	0	0	0	0	0	0	0
Inventories variation	86	6	1	0	6	7	99
Interregional exports	1,794	117	11	8	135	154	2,065
International exports	1,581	96	9	7	0	16	1,693
Sum of Uses	5,200	327	30	19	198	247	5,774
Balance	0	0	0	0	0	0	0

Source: Foundation of Economics and Statistics/Nucleus of Social Accounts.

In the *supply block* are fulfilled the cellules of the first column (basic prices) and of the row named sum of resources (total supply at basic prices, margin distribution and excise taxes) whose sum produces the total supply at market prices. In the *demand block* are fulfilled the cellules of the last column where the uses are valued by market prices and whose sum produces the total demand at market prices.

The spreadsheet is fulfilled with preliminary statistics from TRU and it is common to observe a nonzero surplus on the balance row of it. The adjustment of this surplus is the target of the calibration process and to require deciding about allocations in *supply block* and/or *demand block*. The calibration is then done on that borders to promote the balance (equality) among the statistics about supply and demand at market prices. In this stage each statistics and its estimation procedure are revaluated as well as

¹⁰ Unbalance means that production (supply) and demand are not equal at the initial stage.

¹¹ This spreadsheet is an adaptation from the model used for the Brazilian IOM (see Nunes, 1998: 182).

the intermediate consumption flows to decide which accounts should be adjusted to promote the market equilibrium¹². The trust on the statistical sources is also evaluated to identify the necessity to apply other estimation procedures.

It is also important to mention that this process is not mechanical because the spreadsheets are balanced observing the supply chain of each product in order to evaluate the requirements of the sectors and of other agents involved in the chain. For instance, the spreadsheets of the bovine and swine products and of chicken and eggs in the farming sector are balanced simultaneous with the spreadsheets of the products of bovine meat and swine and slaughtered chicken, whose belong to the same supply-demand chain. Thus the mathematical model of equilibrium based on equations 2.1 to 2.4 is applied together to the economic reason, assuring consistency in the calibration process for all markets of products. Interviews with expert people also contribute to the outcome of calibration.

As that process is accomplished in *ad hoc* way it is practically impossible to reduce to zero the surplus between supply and demand. Then the RAS approach is used at the end of this stage to distribute a small parcel of the balance into the intermediate consumption. It is adequate to say that were achieved three phases of calibration in order to review and actualize the statistics and the surplus distributed through RAS did not exceed 2% of total intermediate consume.

Finished the calibration process the other remaining cellules (distribution margins and taxes) are fulfilled using the proportional structure obtained from the balanced columns of each block in spreadsheet. However some aspects must be considered: first, the cellule of ICMS¹³ has always null value in the exports cellule because of Kandir Law that frees the international exports of the ICMS; and second the cellules of ICMS and IPI/ISS/Other on intermediate consumption line also are null for the industrial products because the industrial companies crediting themselves the taxes paid by buying their inputs.

Following, the calibrated spreadsheets are used to engender the tables of destination of production according to origin sources: state (domestic), interstate (interregional) and international. Then the production values by source did need to be allocated to the components of demand. But for that it was admitted two hypotheses: i) all exports are produced in the state economy; ii) the production value by source distributes to the components of demand based on the proportional structure of the demand at market prices from Table of Uses.

The estimated spreadsheets starting from those hypotheses were submitted to an economic evaluation confronting the estimates with the data from the statistical database by source (interstate and international) in order to reevaluate the outcome. Such procedure was done identifying those products subject to associations with the components of demand (intermediate consumption, household consumption and gross formation of capital). This was implemented using the code classification of the interstate and international imports. Thus the destination of the production by source also is consistent with the database and the final outcome presents better degree of coherence with the reality of productive structure of Rio Grande do Sul.

An example of the spreadsheet used in this procedure is presented below.

¹² See section 3 for more details.

¹³ ICMS is the most important tax of the regional governments.

Figure 2.3
Spreadsheet of destination of supply (production) at basic prices - 1998
Commodity: 1001 Manufacture of footwear and leather

R\$ Millions

Uses (Demand)		Resources (Supply)				Balance
		Domestic	Interregional	International	Sum	
Intermediate consumption	983	554	308	120	983	0
Household consumption	756	198	536	22	756	0
Gross formation of fixed capital	0	0	0	0	0	0
Inventories variation	86	44	42	0	86	0
Interregional exports	1,794	1,794	0	0	1,794	0
International exports	1,581	1,581	0	0	1,581	0
Sum of Uses	5,200	4,171	886	142	5,200	0
Balance	0	0	0	0	0	

Source: Foundation of Economics and Statistics/Nucleus of Social Accounts,

The input-output matrix and the Leontief inverse matrix are calculated from table of destination of domestic production at basic prices. This table is organized like the Table of Uses and so is not symmetric. It was used the technology sector hypothesis to convert the commodity by sector table to the sector by sector table to calculate the symmetric IOM¹⁴.

3 – The data estimation procedures for the TRU

This section presents comments about the treatment of secondary statistics and proxies used to fulfill the first version of TRU, before the calibration. The institutional sources for the statistics are presented in Annex. All statistics are to 1998 year.

It's proper to emphasize that the final results are itself a function of the calibration process applied to promote the balancing between the statistics of supply and demand by product (see previous section).

3.1 – Gross production value at basic prices

The gross production value of farming sector was initially got from the Farming Census 1996 and actualized to 1998 with the nominal variation of farming production calculated from the System of Regional Accounts (SRA) published by Brazilian Institute for Geography and Statistics (*Instituto Brasileiro de Geografia e Estatística - IBGE*). But the gross production value for agriculture goods presented a strong down bias because that census didn't show a good covering of small properties. In such a way, it was chosen to use the data from the SRA to calibrate the production value of the agriculture goods. But specific price indexes¹⁵ were used to estimate the gross value production for some goods (wheat, potato and cassava) because the price indexes used by IBGE had overestimated the original values.

The gross production values of the mining and quarrying industry and all manufacturing sectors were obtained from Yearly Industrial Survey (*Pesquisa Industrial Anual - PIA*¹⁶) published by *IBGE*. The statistics of *PIA* are available on a

¹⁴ See System of National Accounts (UN, 1993) and Miller and Blair (1985) for details on transformations methods in input-output models.

¹⁵ The price index was obtained from Getúlio Vargas Foundation.

¹⁶ The statistics from *PIA* bring a better representation of the industrial structure of RS because it's almost an industrial census. That survey collects the data in all industrial enterprises with more than 29

four digits code of the National Classification of Economic Activities (*Classificação Nacional de Atividades Econômicas - CNAE*). The *CNAE* has a direct correspondence to the International Standard Industrial Classification (ISIC).

However even at the level of four digits code may be not possible to identify the production value of some goods that compose a specific industrial sector. When this occurs the production values are estimated in the calibration process taking account the supply-demand chain of those goods. This is possible because the statistics of the *demand block* are known and come from independent sources.

The gross production values of the other sectors are estimated from SRA, except communications. The gross production value of communication had a specific estimation based on the work profiles of the SRA that not taking account the close adjustment applied to calibrate the SRA with the National System of Accounts¹⁷. So, to achieve balance between supply and demand for communications such specific estimation is needful. Nevertheless, the gross production values for some service sectors (transporting sector and household and business services) or products of the service sector (lodging and alimentation products and other services) comes from Yearly Services Survey (*Pesquisa Anual de Serviços – PAS*) published by *IBGE*.

But for the gross production value of all sectors whose data don't come from SRA it was added a part referent to autonomous activities because those surveys not contemplate it. The magnitude of this part was engendered based on the ratio between gross production value and added value calculated for the small companies¹⁸ and after applied to the autonomous income 1998. The autonomous income was obtained from National Search Domicile Survey (*Pesquisa Nacional de Amostra de Domicílios – PNAD*).

Punctual adjust also was done in the production value of nice manufactured in sense to incorporate the clandestine production not captured by *PIA*. The clandestine production was estimated by a similar process such as used to autonomous activities, but applying the calculated ratio in the income of the 14,896 employees not captured by *PIA*.

3.2 – Imports and exports

The values of international imports and exports were obtained from Secretary of Extern Commerce (*Secretaria de Comércio Exterior – Secex*). The database has 7,713 registers of products classified according to Common Nomenclature of MERCOSUL (*Nomenclatura Comum do Mercosul - NCM*)¹⁹. The values are in FOB Dollar and were converted into *Real* using the yearly average exchange rate at 1998 obtained from Brazilian Central Bank²⁰. The *NCM* was first associated with *CNAE* and after with the products code of the Brazilian TRU²¹.

employees and uses a sampling method to estimate the data for enterprises with 5 until 29 employees (see *IBGE*, 2000).

¹⁷ The use of adjustment coefficients is part of the descending methodology applied by *IBGE* to calculate the regional GDP.

¹⁸ The data used were available only for the Economics Census 1985.

¹⁹ The *NCM* is the unique nomenclature used for extern trade operations in Brazil and is structured with 21 sections, subdivided into 99 chapters and uses an eight digits code to identify the products.

²⁰ FOB means that imports were obtained at basic prices and exports at market prices. So, to convert the imports into market prices were needful to add it the insurances and transport costs and taxes.

²¹ The correspondence table between *CNAE* and the products (sectors) code of the Brazilian TRU is published by *IBGE*.

The values of interregional imports and exports were given by the State Treasure Secretary of Rio Grande do Sul. The database has 7,559 registers of products classified to eight digits code of the Brazilian Economic Activities Classification (*Classificação de Atividades Econômicas – CAE*) which is based on *NCM*. Then the *CAE* was associated with *NCM* and after with *CNAE* in order to promote the aggregation into sectors and products code of the national TRU.

3.3 – Distribution margins and excise taxes on products

Due to difficulties to obtain statistics about trade and transport margins of the regional production it was taken as a starting point the national rates²² to obtain the proxies of distribution margins for the products of Rio Grande do Sul economy. After these values were criticized and adjusted during the calibration in a way that the final outcome is a function of the equilibrium in the market of each product.

The evaluation and adjustment were done combining economic analysis of the spreadsheet of balance between resources, through discussion with expert peoples and search from representative organs of the sectors. For example, the statistics for the tobacco sector²³ were obtained from Tobacco Enterprises Union and by a field research done in the main tobacco industry located in the municipal district of Santa Cruz do Sul.

The values concerning excise taxes – taxes on international imports taxes, taxes on manufactured goods and services (IPI and ISS), taxes on flows of goods and services (ICMS) and other goods taxes – were obtained from Regionalization of Public Sector Transitions Survey (*Regionalização das Transações do Setor Público – RTSP*) published by IBGE. As the *RTSP* presents only the total values of excise taxes was need to disaggregate by product. Taking account that tax rates of international imports and IPI are determinate by the Federal Government it was adopted such tax rates to disaggregate the total value associated to regional economy²⁴. The same procedure was used to the taxes on services (ISS) and other commodities taxes.

On the other hand, the statistics of ICMS were obtained from the State Treasure Secretary because they are collected by regional government. The database has 403 registers of effective tax collected by product and it is classified in three digits code according to *CAE*. Again it was made a correspondence between *CAE* and *CNAE* and after with the products code of the Brazilian TRU.

3.4 – Intermediate consumption at market values

The total value of the intermediate consumption by sector it's valued at market prices and the statistical sources for these values are the same listed in the section 3.1, respectively for each sector. By analogy, for that sectors where the data don't come from SRA it also was estimated the portion concerning to the autonomous activities such as related in section 3.1. It was still made an estimate of intermediate consumption of clandestine production of rice manufacture.

At this time are available only the total value of intermediate consumption by sector. But also is needful to estimate the technical structure of input-output by sector in order to identify the input requirements used in the production process. The first step was to apply the national input-output coefficients to the regional model since there

²² The Brazilian TRU was used to calculate the national rates of the distribution margins.

²³ This sector is not explicit at the Brazilian TRU because it is part of the grain mil sector. But it was open in the Rio Grande do Sul TRU because of yours regional significance.

²⁴ Such tax rates were calculated from effective values from Brazilian TRU.

weren't statistical sources on regional input-output matrix. Then, it was used the following estimation equation:²⁵:

$$x_{ij}^{RS} = \left(\frac{X_{ij}^{BR}}{X_j^{BR}} \right) X_j^{RS} = a_{ij}^{BR} X_j^{RS} \quad (3.1)$$

where

x_{ij}^{RS} = product i used as input at sector j in Rio Grande do Sul

X_j^{RS} = gross production value at sector j in Rio Grande do Sul

a_{ij}^{BR} = national input-output coefficient

The sum in all j -sector for each i -product is carried to the intermediate consumption cellule of the spreadsheet of balance between resources and uses. After, this sum and each x_{ij} are adjusted in the calibration process to promote the market equilibrium by product. The adjustment means to revise the distribution of the values on the rows and columns and replace them in away to be adequate to productive structure of the economy in RS and in order to reach the equilibrium in the market of product. At the end, the outcome is an intermediate consumption matrix distinguished from that of Brazil and compatible with productive structure of the regional economy.

These adjustments always combine the mathematical modeling associated to equations 2.1 – 2.4 and an economic analysis of supply-demand chain of the products. At this moment qualitative information obtained from sectorial associations, unions as well as from specialized technicians assures more consistences in the work. But is not easy to engender a perfect adjustment in the balance (surplus) and then a small part of surplus is distributed using the RAS approach. It was used a modified version of the RAS, that is, the values with more confidence were set up a zero variation when running RAS.

3.5 –Government and household consumptions

The value of the government consumption corresponds to the entire value of production of public goods and thus it is obtained directly through *supply data* obtained from the SRA.

The household consumption was estimated from Household Budget Survey 1996²⁶ (*Pesquisa de Orçamento Familiar - POF*) published by IBGE. This survey refers to the metropolitan area of Porto Alegre²⁷ (MAPA). Then, first, it was needful to estimate part of the household consumption of non-metropolitan area of Porto Alegre (NMAPA) that correspond to rest of Rio Grande do Sul and second to estimate such statistics for the 1998 year-basic.

The first step was done taking as a starting point the value of total consumption by the household income classes and multiplying them by the ratio between the number of household of NMAPA and MAPA²⁸. The outcome was an estimate of total household consumption in NMAPA 35% higher to MAPA. But the GDP of NMAPA

²⁵ For the public goods sector was used a specific database of the General Budget of Government of Rio Grande do Sul.

²⁶ The database has 318 products with a proper code and was corresponding with CNAE.

²⁷ Porto Alegre is the central city of Rio Grande do Sul.

²⁸ The source of this information is PNAD-IBGE. This wasn't applied only for the hotels and restaurants and transport margins consumption because it was used the ICMS tax for such products to calculate the ratio.

was 70% higher the GDP of MAPA and so a second step was to maintain this income ratio²⁹. This implies that consumption function by classes is the same in both areas and is conditional to the magnitude of the spatial income.

Following, the household consumption vector estimated for 1996 was carried to 1998 using the nominal variation of the national household consumption by product calculated from the Brazilian TRU 1996 and 1998. This implies that the national and regional quantum and price indexes are the same.

However some goods and services such as the real estate activities with own or leased property are not available in *POF*. The estimates for such products were obtained from SRA. Other products like fuel, hotels and restaurants and transport margins take in a specific work. The fuel consumption was obtained from the National Oil Office. Yet the hotels and restaurants and transport margins consumptions were estimated taking account the ratio between ICMS in NMAPA and MAPA.

3.6 – Gross formation of fixed capital and inventories variation

The estimates of gross formation of fixed capital (GFFC) and the inventories variation (IV) were done in two stages by the parts of the capital formation composition. As conception the gross formation of capital (GFC) is defined as:

$$GFC = GFFC + IV \quad (3.2)$$

where

$$GFFC = C + M + O \quad (3.3)$$

where

C = construction

M = machinery and equipments

O = other capital goods

The estimate of the regional GFFC was initially based on the national GFFC. It was established a coefficient “c” that reflects how much of the national supply is allocated to FBCF, by product. But to calculate each “c_i” (i = product) it was considered the supply at market prices (S_i) less exports (E_i) in order to establishes that proportion allocated to GFFC. Thus³⁰:

$$GFFC_i^{RS} = c_i (S_i^{RS} - E_i^{RS}) \quad (3.4)$$

where

$$c_i = \frac{GFFC_i^{BR}}{S_i^{BR} - E_i^{BR}} \quad (3.5)$$

This coefficient wasn't used to estimate the proportion of other farming products allocated to GFFC because such estimation was based on the value of investment in the forest planting and other permanent cultures. The data source comes from the Farming Census 1996 and the values were carried to 1998 through nominal variation calculated from SRA database.

At last, IV was estimated based on a national coefficient, which is:

$$IV^{RS} = \left(\frac{IV^{BR}}{GDP^{BR}} \right) GDP^{RS} \quad (3.6)$$

Afterwards this value was distributed among the products according the structure of individual participation coming from the national Table of Uses.

²⁹ The data about cities' GDP was obtained from the Foundation of Economics and Statistics.

³⁰ The exports of Rio Grande do Sul refers to international and interregional exports.

4 – The data estimation procedures for the ISSA

The ISSA of Rio Grande do Sul is formed by a set of credit and debt operations accounts that encompass transactions with the national economy and the rest of the world. The ISSA describes the current and accumulations accounts as well as the composition of GDP³¹. The “integrated” term means that the system is integrated with the TRU, that is, the macroeconomic variables of Rio Grande do Sul are equal both in the TRU and ISSA.

Following the national model published by *IBGE*, all accounts are presented in the center of the system and the entries are registered on the borders (right and left) using the resources (credit) and uses (debt) notations³². Each account is interconnected with other one and thus the balance of one account is transferred to the subsequent one. The balances represent aggregated macroeconomic variables. The Table 4.1 presents a summary of all accounts and some subdivisions.

Table 4.1
Summary of an Integrated System of Accounts

Definition of accounts	Definition of balances
<i>Goods and services account</i>	Resources and uses at market prices
<i>Current accounts</i>	
1. Production account	Gross Domestic Product
2. Income account	
2.1. Primary distribution of income account	
2.1.1. Generation of income account	Gross operating surplus
2.1.2. Allocation of income account	Gross state income
2.2. Secondary distribution of income account	Gross disposable income
2.3. Use of income account	Gross saving
3. Capital account	Net lending or net borrowing
<i>Account of the rest of the world with the state economy</i>	
1. Goods and services account	External balance of goods and services
2. Primary distribution of income account and current transfers	Current external balance
3. Accumulation account	
3.1. Capital account	Net lending or net borrowing

Note: Based on IBGE (1997 and 2001) and Feijó (2001).

The goods and services account consist in the consolidation of TRU and then all values are obtained directly from TRU. The same it's applied to the production account. But the other accounts require additional estimates as will be evident in the sequence.

The income account describes the identity bellow:

$$GOS = GDP - [(W + W_{nr}) + (T_m - S_b)] - W_a \quad (4.1)$$

where

GOS = gross operating surplus

GDP = gross domestic product

³¹ Feijó (2001) presents a detailed description of economic integrated accounts (CEI). Also it is interesting to read and to manipulate the national Integrated System of Accounts published by *IBGE* for a better comprehension of the operations and concepts.

³² See section 5.

W = compensation of resident employees
 W_{nr} = compensation of nonresident employees
 T_m = taxes on production and imports
 S_b = subsidies on production
 W_a = mixed income

The compensation of resident employees was estimated based on *PNAD* database and adding up the private and public social security contributions and other social contributions (*Fundo de Garantia por Tempo de Serviços – FGTS*). The private social security contribution was estimated based on the income classes with more than ten minimum wages taking the average contribution to public social security as proxy. The other social contributions (*FGTS*) were engendering applying a tax rate of 8% in the total value of the compensations of resident employees.

The concept of nonresident incorporates the interregional and international nonresidents. The interregional part wasn't estimated in W_{nr} because there wasn't such statistics or a reliable proxy. On the other hand, the compensations of the international nonresidents were available for the national economy. In this case it was resolved to maintain the same ratio between W and W_{nr} of the Brazilian economy to the Rio Grande do Sul. The statistics used for the national economy comes from the Integrated System of National Accounts published by *IBGE*.

The mixed income corresponds to the income of the autonomous activities and was obtained from *PNAD*. Yet the taxes and subsidies on production come from the *RTSP*. The excise taxes and subsidies on production and imports are equal to total value of taxes from Table of Resources.

The allocation of income account presents the gross state income (GSI) as balance. Such balance has the following composition:

$$GSI = GOS + (W + W_r) + (T_m - S_b) + PIW \quad (4.2)$$

where

W_r = compensation of nonresident employees
 PIW = property incomes sent and received from the rest of the world

Again it wasn't possible to estimate the interregional part of W_r . The international part was estimated based on statistics from the Integrated System of National Accounts such as for W_{nr} . The PIW was obtained from the *RTSP* and Foreign Capital Census 1995 of Brazilian Central Bank. The statistics of the Census had a monetary update to 1998 through the nominal variation between 1995 and 1998 calculated from the Integrated System of National Accounts.

The secondary distribution of income account has the gross disposable income (GDI) of Rio Grande do Sul as balance. That is:

$$GDI = GSI + CTW \quad (4.3)$$

where

CTW = current transfers sent and received from the rest of the Brazil and rest of the world

The statistics for CTW were obtained from *RTSP*.

The use of income account has the gross saving as balance and was calculated from the difference between GDI and the final consumption of goods and services by the households and government (FC). That is:

$$S = GDI - FC \quad (4.4)$$

The statistic for FC was obtained from TRU.

The last current accounts are the capital accounts and they have net lending or net borrowing of Rio Grande do Sul as balance. This balance results from the following identity:

$$S_{\text{ext}} = S - (\text{GFFC} + \text{IV}) + \text{CTW}_c \quad (4.5)$$

where

S_{ext} = net lending (if +) or net borrowing (if -)

CTW_c = transfers of capital sent or received from the rest of the world

The GFFC and IS were obtained from the Table of Uses while the CTW_c comes from *RTSP* and also includes the intergovernmental transfers of capital.

Yet the account of goods and services of the rest of the world with the state economy organizes the same accounts defined in the beforehand identities but under the eyesight of rest of the world. Then, the balances of this account are defined as:

$$S_{\text{ebs}} = E - M \quad (4.6)$$

$$\text{CEB} = S_{\text{ebs}} + (W_r - W_{\text{nr}}) + \text{PIW} + \text{CTW} \quad (4.7)$$

$$S_{\text{ext}} = \text{SEC} - \text{CTW}_c \quad (4.8)$$

where

S_{ebs} = external balance of goods and services

CEB = current extern balance

X = interstate and international exports

M = interstate and international imports

The last identities that compose the ISSA are the composition of GDP under three views: production, expenditure and income. Such identities incorporate statistics from TRU and ISSA. Then:

$$\text{GDP (PIB)} = \text{PV} - \text{IC} + \text{T} \quad (4.9)$$

$$\text{GDP (PIB)} = \text{HC} + \text{GC} + \text{GFFC} + \text{IV} + (E - M) \quad (4.10)$$

$$\text{GDP (PIB)} = W + W_{\text{nr}} + W_a + \text{EOB} + (\text{T}_m + \text{S}_b) \quad (4.11)$$

where

PV = production at basic prices

IC = intermediate consumption at market prices

T = excise taxes on production and imports

HC = household consumption

GC = government consumption

5 - Results for the IOM and ISSA of Rio Grande do Sul

The outcomes from the methodological procedures are a set of tables that encompass the Tables of Resources and Uses of Rio Grande do Sul and other auxiliary tables that are needful to generate the IOM at basic prices. The TRU and the other auxiliary tables have a product by sector dimension (43 products by 28 sectors) and the conversion to the sector by sector dimension in order to produce the symmetric IOM was implemented using the technology sector approach³³. The other remaining tables encompass the ISSA.

This section presents a concise version of the symmetric IO table and also the ISSA tables estimated for Rio Grande do Sul³⁴. The symmetric IO table was closed on three sectors (Farming, Industry and Services).

³³ See Miller and Blair (1985) and IBGE (1997a) for details.

³⁴ The whole database is available by request to the author or in website www.fee.rs.gov.br.

Table 5.1
Symmetric Input-Output Table of Rio Grande do Sul

R\$ Millions

	Farming	Industry	Services	International exports	Interregional exports	Household consumption	Government consumption	Gross formation of fixed capital	Inventories variation	Demand
Farming	1,042	3,875	151	349	1,860	1,591	0	17	493	9,378
Industry	555	6,341	1,689	5,314	17,020	5,362	0	6,876	177	43,334
Services	308	2,914	8,699	536	3,809	19,013	10,795	344	204	46,623
Taxes on products	40	439	376	260	1,942	2,474	0	244	102	
Interregional imports	659	6,615	2,805	68	67	10,216	0	2,218	700	
International imports	364	1,465	659	1	13	1,452	0	861	227	
Added value	6,411	21,686	32,244							
Production	9,378	43,334	46,623							

Source: Foundation of Economics and Statistics/Nucleus of Social Accounts.

Table 5.2a
Integrated System of State Account - 1998
Goods and services account

Resources (1,000,000 R\$)	Operations and balances	Uses (1,000,000 R\$)
99,335	Production	
23,347	Interregional imports of goods and services	
5,041	International imports of goods and services	
5,876	Excise tax	
307	Imports duties	
5,569	Other taxes on goods	
	Intermediate consumption	38,995
	Final consumption	50,903
	Gross formation of fixed capital	10,560
	Inventories variation	1,903
	Interregional exports of goods and services	24,710
	International exports of goods and services	6,528
133,599	Total	133,599

Source: Foundation of Economics and Statistics/Nucleus of Social Accounts.

Table 5.2b
Integrated System of State Account - 1998
Production, income and capital accounts

Uses (1,000,000 R\$)	Operations and balances	Resources (1,000,000 R\$)
Account 1 - Production account		
	Production	99,335
38,995	Intermediate consumption	
	Excise tax	5,876
	Imports duties	307
	Other taxes on goods	5,569
66,216	Gross domestic product	
Account 2 - Income account		
2.1 - Primary distribution of income account		
2.1.1 - Generation of income account		
	Gross domestic product	66,216
24,879	Compensation of employees	
8,281	Taxes on production and imports	
-71	Subsidies on production	
33,127	Gross operating surplus including mixed income	
6,450	Mixed income	
26,677	Gross operating surplus	
2.1.2 - Allocation of income account		
	Gross operating surplus including mixed income	33,127
	Mixed income	6,450
	Gross operating surplus	26,677
	Compensation of employees	24,887
	Taxes on production and imports	8,281
	Subsidies to production	-71
831	Property incomes sent and received from the rest of the world	212
65,605	Gross state income	

2.2 - Secondary distribution of income account		
	Gross state income	65,605
4,880	Current transfers sent and received from the rest of the world	4,946
65,671	Gross disposable income	
2.3 - Use of income account		
	Gross disposable income	65,671
50,903	Final consumption	
14,768	Gross saving	
Account 3 - Accumulation account		
3.1 - Capital account		
	Gross saving	14,768
10,560	Gross formation of fixed capital	
1,903	Inventories variation	
194	Transfers of capital sent and received from the rest of the world	93
2,204	Net lending (+) or net borrowing (-)	

Source: Foundation of Economics and Statistics/Nucleus of Social Accounts.

Table 5.2c
Integrated System of State Account - 1998
Table of the rest of the world with the state economy

Uses (1,000,000 R\$)	Operations and balances	Resources (1,000,000 R\$)
Account 1 - Account of goods and services of the rest of the world with the state economy		
31,238	Exports of goods and services	
24,710	Interregional exports of goods and services	
6,528	International exports of goods and services	
	Imports of goods and services	28,388
	Interregional imports of goods and services	23,347
	International imports of goods and services	5,041
-2,850	External balance of goods and services	
Account 2 - Primary distribution of income account and current transfers from the rest of the world with the state economy		
	External balance of goods and services	-2,850
23	Compensation of employees	15
212	Property incomes	831
4,946	Other current transfers sent and received from the rest of the world	4,880
-2,305	Current external balance	
Account 3 - Account of accumulation from the rest of the world with the state economy		
3.1 - Capital account		
	Current external balance	-2,305
93	Capital transfers sent and received from the rest of the world	194
	Changes in the net worth due to saving and capital transfers	-2,204
-2,204	Net lending (+) or net borrowing (-)	

Source: Foundation of Economics and Statistics/Nucleus of Social Accounts.

Table 5.2d
Integrated System of State Account - 1998
Composition of Gross Domestic Product considering production, expenditure and income

Components of Gross Domestic Product	Value (1,000,000 R\$)
A - Production	
Gross Domestic Product	66,216
Production	99,335
Excise tax	5,876
Intermediate consumption (-)	38,995
B - Expenditure	
Gross Domestic Product	66,216
Final consumption	50,903
Families consumption	40,108
Public administration consumption	10,795
Gross capital formation	12,463
Gross formation of fixed capital	10,560
Inventories variation	1,903
Interregional exports of goods and services	24,710
International exports of goods and services	6,528
Interregional imports of goods and services (-)	23,347
International imports of goods and services (-)	5,041
C - Income	
Gross Domestic Product	66,216
Compensation of employees	24,879
Mixed income	6,450
Gross operating surplus	26,677
Net taxes of subsidies to production and imports	8,210

Source: Foundation of Economics and Statistics/Nucleus of Social Accounts.

6 - Final remarks

This work involved the confrontation of difficulties naturally expected when is needful to consolidate a great number of statistics into a consistent model like to decide among different data sources and data estimation methodologies in sense to maintain the coherence with the regional economic structure.

One of the major difficulties in constructing regional input-output models concerns to the interregional trade flow because it is critical to establish the magnitudes of production and consumption and the structural interregional linkages with the rest of the country. Such obstacle was surpassed in full satisfaction by the use of a database collected by State Treasure of Rio Grande do Sul.

Another difficulty is to estimate the regional household consumption because the statistical surveys in general cover only metropolitan areas. In the sense to solve this problem it was used a methodology based on POF 1996 but it still was needful to evaluate the household consumption to the rest of the state economy using the number of household from the metropolitan and non-metropolitan areas and the regional income shares as proxies.

In despite of these and other difficulties to collect or estimate the data of the IOM and ISSA, the general evaluation of this work allow to say that the methodology was successful in order to produce an IOM consistent with the specialists' expectation on Rio Grande do Sul, both in terms of calculated macroeconomic aggregated and in

terms of sectorial linkages identified from the IOM. The unpublished Integrated System of State Account was a by-product of the methodological procedures and it provided a better understand of the macroeconomic variables of Rio Grande do Sul and relationships with the rest of Brazil and rest of the world.

Even though this work not explores the application of the input-output model as a regional planning instrument, the estimates of IOM and ISSA allow to researchers, policy makers and other economic authorities as well as any others people to advance in specific studies about the regional economy of Rio Grande do Sul.

This methodology can be applied in order to estimate an IOM and ISSA for other regions but taking account the need to overcome the constraints to estimate some data.

7 – References

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8 – Annex

Table A1
Data sources used to elaborate the IOM and ISSA

Statistics	Sources
Gross production value at basic prices	System of Regional Accounts by FEE [*] and IBGE; Farming Census 1996-IBGE [*] ; Yearly Farming Survey-IBGE; Yearly Industrial Survey-IBGE; Yearly Services Survey-IBGE; National Search Domicile Survey-IBGE; price index by Getúlio Vargas Foundation.
Intermediate consumption at market prices	System of Regional Accounts by FEE and IBGE; Farming Census 1996-IBGE; Yearly Farming Survey-IBGE; Yearly Industrial Survey-IBGE; Yearly Services Survey-IBGE; National Search Domicile Survey-IBGE; price index by Getúlio Vargas Foundation.
International exports and imports	Secretary of Extern Commerce and Central Bank of Brazil.
Interregional exports and imports	State Treasure Secretary of Rio Grande do Sul.
Excise taxes	Regionalization of Transitions from Public Sector Survey-IBGE and State Treasure Secretary of Rio Grande do Sul.
Other taxes on production	Regionalization of Transitions from Public Sector Survey-IBGE.
Distribution margins	Table of Resources of Brazil-IBGE.
Government consumption	System of Regional Accounts-FEE/IBGE.
Household consumption	Household Budget Survey-IBGE and National Search Domicile Survey-IBGE.
Gross formation of fixed capital	Table of Resources and Uses of Brazil-IBGE; Farming Census 1996-IBGE; System of Regional Accounts-FEE/IBGE.
Inventories variation	Table of Resources and Uses of Brazil-IBGE and System of Regional Accounts-FEE/IBGE.
Compensation of employees	National Search Domicile Survey-IBGE; Regionalization of Transitions from Public Sector Survey-IBGE; Integrated System of National Accounts-IBGE.
Employment by sector	National Search Domicile Survey-IBGE.
Subsidies	Regionalization of Transitions from Public Sector Survey-IBGE.
Properties income from the rest of the world	Regionalization of Transitions from Public Sector Survey-IBGE; Integrated System of National Accounts-IBGE; Foreign Capital Census 1995-Central Bank of Brazil.
Current and capital transfers	Regionalization of Transitions from Public Sector Survey-IBGE.

* FEE = Foundation of Economics and Statistics of Rio Grande do Sul and IBGE = Brazilian Institute for Statistics and Geography.

Table A2
Correspondence between sectors of national and regional IOM

Code	Sectors of national IOM	Code	Sectors of regional IOM
01	Farming (Agriculture, hunting, forestry and fishing)	01	Farming (Agriculture, hunting, forestry and fishing)
02	Mining and quarrying (except fuel)	17	Other manufactures
03	Extraction of crude petroleum and natural gas, coal and other fuels	17	Other manufactures
04	Manufacture of other non-metallic mineral products	17	Other manufactures
05	Manufacture of basic metals	02	Manufacture of metal works
06	Manufacture of non-ferrous metals	02	Manufacture of metal works
07	Manufacture of other metal products	02	Manufacture of metal works
08	Manufacture and maintenance of machinery and equipment	03	Manufacture and maintenance of machinery and equipment
10	Manufacture of electrical equipments	04	Manufacture of electrical and electronic equipments
11	Manufacture of electronic equipments	04	Manufacture of electrical and electronic equipments
12	Manufacture of motor vehicles, trailers and semi-trailers	05	Manufacture of transport equipments
13	Manufacture of other transport equipments, parts and accessories	05	Manufacture of transport equipments
14	Sawmilling and manufacture of wood products and furniture	06	Sawmilling and manufacture of wood products and furniture
15	Manufacture of paper and publish and printing	07	Manufacture of paper and publish and printing
16	Manufacture of rubber products	17	Other manufactures
17	Manufacture of basic chemicals, except nitrogen compounds	08	Manufacture of chemical products
18	Manufacture of refined petroleum, nitrogen compounds, plastics in primary form, synthetic rubber and man-made fibres	09	Manufacture of refined petroleum, nitrogen compounds, plastics in primary form, synthetic rubber and man-made fibres
19	Manufacture of other chemicals products	08	Manufacture of chemical products
20	Manufacture of pharmaceuticals and perfumery products	17	Other manufactures
21	Manufacture of plastics products	17	Other manufactures
22	Manufactures of textiles	17	Other manufactures
23	Manufacture of wearing apparel, except fur apparel	17	Other manufactures
24	Manufacture of footwear and tanning and dressing of leather	10	Manufacture of footwear and tanning and dressing of leather
25	Manufacture of café	16	Other food manufactures
26	Process and preserving of vegetable products, inclusive tobacco products	11	Manufacture of vegetal products, except tobacco products
26	Process and preserving of vegetable products, inclusive tobacco products	12	Manufacture of tobacco products
27	Production, processing and preserving of meat and meat products	13	Production, processing and preserving of meat and meat products
28	Manufacture of dairy products	14	Manufacture of dairy products
29	Manufacture of sugar	16	Other food manufactures
30	Manufacture of vegetable and animal oils and fats	15	Manufacture of vegetable and animal oils and fats
31	Other food manufactures and beverages	16	Other food manufactures
32	Other manufactures	17	Other manufactures
33	Electricity, gas and water supply	18	Electricity, gas and water supply
34	Construction	19	Construction
35	Wholesale and retail trade	20	Wholesale and retail trade
36	Transport and storage	21	Transport and storage
37	Communications	22	Communications
38	Financial intermediation	23	Financial intermediation
39	Household services	24	Household and business services
40	Business services	24	Household and business services
41	Real estate activities with own or leased property and on a fee or contract basis	25	Real estate activities with own or leased property and on a fee or contract basis
42	Public administration	26	Public administration
43	Non mercantile private services	27	Non mercantile private services
46	Financial dummy	28	Financial dummy

Source: Foundation of Economics and Statistics/Nucleus of Social Accounts.