Building an input-output Model for Buenos Aires City

Chisari, Omar Osvaldo and Mastronardi, Leonardo Javier and Romero, Carlos Adrián

Instituto de Economía UADE, Instituto de Economía UADE and CONICET

28 February 2012

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Mastronardi, Leonardo J.
Instituto de Economía UADE and CONICET

Romero, Carlos A.
Instituto de Economía UADE

Chisari, Omar O.
Instituto de Economía UADE and CONICET

Abstract:

Buenos Aires City (BAC) is the Argentina's biggest city and the second largest metropolitan area in South America after Sao Paulo (Brazil). Assessing regional effects might be useful to take political or/and economic decisions, considering the dimension and the economic importance of Buenos Aires City. Taking into consideration the latter background information, the aim of this paper is to quantify the BAC's interregional flows, evaluating direct and indirect regional effects with other regions of Argentina. At this regard, different levels of integration and dependence between BAC and the other regions country can be estimated applying and Interregional Input Output model. This is the first time a input-output matrix is constructed for Buenos Aires, which does not have a Regional Accounts System available. To tackle this problem, our model uses non-survey and calibration techniques.

The paper focuses on the building process of that Input–Output Model and presents the estimations for intraregional and interregional tables. In particular, Argentina is separated in two regions, BAC and the rest of the country. The estimations to measure the Intraregional coefficients for each region are based on non-survey techniques, using Location Quotients (Simple Location Quotient, Cross Industry, Flegg's Location Quotient and Augmented Flegg's Location Quotient). Two common alternative ways to balance these matrices, the RAS and cross entropy methods are adapted to estimate the interregional coefficients.

JEL: C67 – D57 – R15 – R58

1. INTRODUCTION

This paper focuses on the building process of a regional input-output table for Buenos Aires City (BAC), the capital of Argentina and the second biggest city in South America. Our aim is to estimate transaction matrices for BAC and the Rest of Argentina (ROC), using regional input-output methodology. This paper is part of a broader objective: the construction of a CGE model of Argentina with two regions that trade among them and with the rest of the world. Particularly, our work is a first step to build an Interregional Social Accounting Matrix for BAC.[1]

At this regard, Argentina is separated in two regions to create the input output tables, BAC and the ROC. An estimation of interregional and intraregional flows for ten principal sectors in each region will be provided in this paper. The key of the estimation is the information availability. Unfortunately, there is not a census or other regional stats (survey methods) that can be used to compare with national data. Accordingly, hybrid and non-survey methods were used to build the tables in this study. Therefore to measure an intrarregional coefficient for each region we based our estimations on non-survey techniques such as Location Quotients (Simple Location Quotient, Cross Industry, Flegg's Location Quotient and Augmented Flegg's Location Quotient). Two common alternative ways to balance these matrices, the RAS and the Cross Entropy Method, have been adapted to estimate interregional coefficients.

The paper is organized as follows. In section 2, the paper presents methods based on background literature as Jensen et al. (1978) and Flegg et. al (1995, 1997, 2000). They will be used to estimate the intraregional flows using the national technical coefficients. The idea is "to regionalize" the national input output coefficients using a location quotient (it depends on the relationships between the region and the national data) that assigns a value for the regional technical coefficient. In section 3, we present calibration methods that have been applied in the literature, based on Robinson, Cattaneo and El Said (2001) and Romero (2009). In this section, the Biproportional Adjustment (hereafter RAS) and Regional Cross Entropy will be used to estimate the final tables. Comparative performance indicators are used for these estimates allowing to choose a method in the section 4. Finally, in the section 5 we present conclusions based on the estimated matrix.

Socio-Economic characteristics of Buenos Aires

In 1994, BAC has become an autonomous city of Argentina, changing its institutional status. It has an approximated area of 202 square kilometers and three million inhabitants that represents the 7.5% of the Argentina population. It is the thirtieth urban area with respect to the market size and the best city of Latin America in terms of life quality[2]. The regional Gross Domestic Product (hereafter GDP) of BAC is about 60 billions of dollars and it represented about 28% of Argentina's GDP in 2006. Moreover, Buenos Aires is the

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[1] This is the first approach to estimate regional input output tables for BAC and ROC. Mastronardi (2010) presents an intraregional input-output table for BAC and Mastronardi and Romero (2012) show a methodological approach to build a regional input-output model.

[2] See Ministerio de Desarrollo Económico (2009).

richest region of the country with a GDP per capita of U$20,000, when the average of Argentina is about U$6,500.

In relation to the regional product, Table 1 shows that BAC is specialized in the service sector, especially in financial, real estate and tourism.

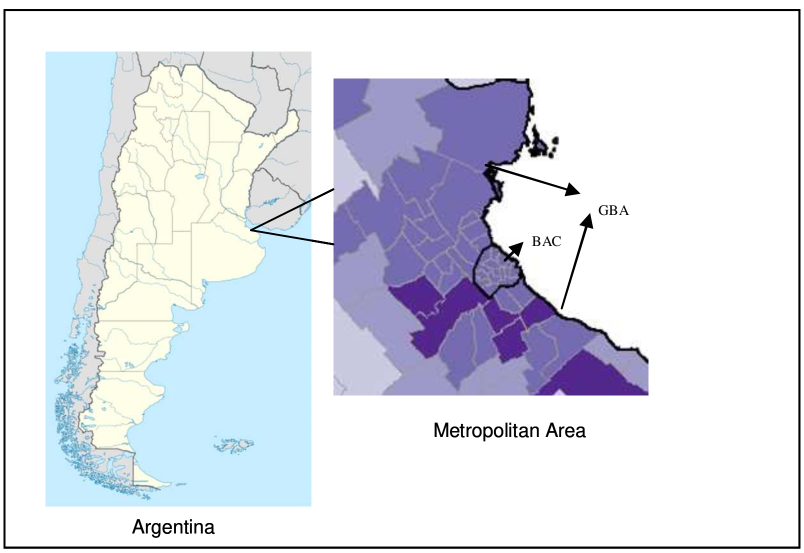
Table 1 – BAC and Argentina's GDP and relative shares (In millions of Argentine Pesos and percentage)

N°	Sectors	BAC's GDP (1)	Argentina's GDP (2)	Relative share ((1)/(2))*100
1	Agriculture, forestry and hunting	807	41962	2%
2	Fishing	45	1707	3%
3	Mining and quarrying	3534	33455	11%
4	Industry	26454	108366	24%
5	Water, Electricity and gas	1939	8883	22%
6	Construction	7480	31822	24%
7	Commerce	16074	65732	24%
8	Hotels and restaurants	7209	15377	47%
9	Transport and communication	18458	47441	39%
10	Financial intermediation	14714	26432	56%
11	Real estate, renting and business	31773	61993	51%
12	Public administration	7834	32407	24%
13	Education, health and social services	10,927	45192	24%
14	Other services	6,695	23592	28%
	Total	153943	544361	28%

Source: Instituto Nacional de Estadísticas y Censos and Dirección General de Estadística y Censos (Ministerio de Hacienda GCBA).

Regarding to the job market, BAC has many *commuters* from Greater Buenos Aires (hereafter GBA). GBA is the name to call the suburbs of BAC (See Figure 1).It has approximately ten (10) million inhabitants (25% of Argentina's population) and is part of the largest province of Argentina (in terms of population and GDP).

Figure 1. BAC and GBA



The migration flow between BAC and the rest of the region is an important problem for the economic modeling because it must be differentiated where the people work, where the people live and which is the proportion of that people that consume and invest in their original regions or in another region. At this regard, Table 2 presents statistics of occupied people in the metropolitan area (BAC and GBA). It differentiates where people work and where people live.

Table 2 – The occupied people in BAC and GBA

		People working at		
		BAC	**GBA**	**Both**
People living at	**BAC**	1,210,089	178,787	65,023
	GBA	908,808	2,939,740	177,411

Source: Encuesta Permanente de Hogares (INDEC)

Table 2 has shown that *commuters* represent a relevant percentage (24.2%) of people. Additionally, about 4.5 million people work in the rest of the country (excluding GBA).

2. INTRAREGIONAL INPUT-OUTPUT: THE USE OF LOCATION QUOTIENTS

The national input-output table has been used to show the flows between sectors within a country. Each industry has produced a single output, using the products produced by other industries as inputs. These tables have not described the specific location of the industry within the country.

However, a national input-output table can be disaggregated in regional tables, taking into account separately intraregional and interregional transactions (Fuentes Flores, 2002).

Two principal methodologies to regionalize a national input output table can be found in the literature. The key to choose between them is the data availability. On one hand, survey techniques are based on particular data or samples, but it presents the disadvantage of a strongly, costly and slowly process. On the other hand, the non-survey techniques do not need samples or particular census, because they use available annual data and economic census.

Statistics techniques have been used to derive regional input-output tables from a National Input-Output table. Generally, these techniques have been employed to adjust a national technical coefficient to reflect the structure of regional production and their relationships with all the sectors of the economy.

In respect to technology, the national input-output table represents the national average requirements of inputs to produce the outputs. Those requirements are obtained from the sum of the companies of the regions. Instead, if a region is specialized in some activities, it could have a different technology compared with other regions. Another difference between the national and regional tables is that the regional tables contain the regional commerce. Additionally, the regional imports are defined by the goods and services that come from another region. They are fundamental to the analysis, because the regional intermediate consumption is considered as a regional import and regional intermediate sales are treated like a regional export, respectively.

The annex I presents the national input-output table for Argentina dated in 2006 and based on Chisari et al. (2010). This table was the starting point to apply the methods listed below and to build the intraregional technical coefficients. Calibration techniques were applied to transform this coefficient into regional input-output tables for 2006.

The primary aim of this study is to separate Argentina in two regions, BAC and the ROC. Therefore, the national input-output table is broken down into four regional tables, which represent intraregional and interregional (exports and imports from/to other region) commerce between regions. Table 3 shows a scheme for N sectors of the economy in each region to describe the tables.

Table 3 – An example of Regional Input-Output Table for N sectors.

		BAC activity sectors			ROC activity sectors		
		S1	...	Sn	S1	...	Sn
BAC activity sectors	**S1** **...** **Sn**		BAC Input-Output			BAC Exports – ROC Imports	
ROC activity sectors	**S1** **...** **Sn**		ROC Exports – BAC Imports			ROC Input-Output	

Source: Own elaboration

Non-survey techniques were used to build the intraregional input-output tables. In particular, the Flegg and Webber's (1995, 1997, and 2000) methodology of location quotients (hereafter LQ) was used to model the regional commerce. There are different LQ's and these techniques have become more complex over time. In this paper each one is mentioned, but the most recent LQ is used to built the regional input-output tables.

This methodology has assumed that the intraregional coefficients (r_{ij}) differ from the national coefficients (a_{ij}) only by a share, which has explained the regional trade (lq_{ij}) (Jensen *et. al*, 1979)):

[1] $$r_{ij} = lq_{ij} \times a_{ij}$$

The subscripts *j* and *i* refer to the purchasing and supplying sectors respectively. The r_{ij} coefficient represents an intraregional quantity of input *i* that is needed by the sector to produce a unity of *j* product. It has been called "regional purchasing coefficient" (Fuentes Flores, 2002).

The possibility to quantify the share of regional requirements for a sector in a specific region has been argued to be the main advantage of the LQ. The rule presented on equation [2] has been considered the fundamental constraint of the LQ's (Jensen, 1979).

The latter referred constraint implies that if the region sector is self-sufficient or a net exporter, the LQ is higher than one ($lq_{ij} \geq 1$) and the regional coefficient (r_{ij}) is exactly the national technical coefficient (a_{ij}). Instead, if the region sector is a net importer, the LQ is smaller than one and the regional coefficient will be a share of national coefficient.

[2] $$r_{ij} = lq_{ij} \times a_{ij} \qquad \text{if } lq_{ij} \leq 1$$

$$r_{ij} = a_{ij} \qquad \text{if } lq_{ij} > 1$$

In the next subsections, several different LQ's to construct the regional input-output tables will be presented. Finally, an augmented Flegg Location Quotient (hereafter AFLQ) and its estimation for intraregional tables will be offered.

Simple location Quotient (SLQ_i)

The Simple Location Quotient (hereafter SLQ) compares a regional sector share in relation to the regional production with the national share with reference to the national production.

[3] $$SLQ_i = \frac{PV_{Si,Ru} / RPV_u}{PV_{Si,TC} / NPV}$$

Where $PV_{Si,Ru}$ is the production value of the sector *i* in the *u*th region, RPV_u is the production value of the *u*th region, $PV_{Si,TC}$ is the production value of the sector *i* in total country and *NPV* is the total production of the country. As it was mentioned, the sector in the region is a net regional exporter if the SLQ is greater than one and a net regional importer if SLQ is less than one.

A major criticism to this type of quotient is that its results overestimate the regional production of many industries, i.e. it usually overestimates the industries self-sufficient (Flegg and Webber, 1997 and Fuentes Flores, 2002). For this reason, it has been suggested that other LQ's have a greater precision like Flegg's Location Quotient (hereafter FLQ) or AFLQ, but calculations have appeared to be more complex.

The annex II shows the production value in each region and the corresponding SLQ, using national data and another calculus based on Chisari et. al (2010). It has been affirmed before in this paper that, if the LQ is higher than one, the regional technical coefficient is exactly the national value.

Cross-industry location quotient ($CILQ_{ij}$)

The Cross-Industry Location Quotient (hereafter CILQ) measures the relative importance of the supplying industry *i* with respect to the purchasing industry *j,* in a specific region:

[4] $$CILQ_{ij} = \frac{PV_{Si,Ru} / PV_{Si,TC}}{PV_{Sj,Ru} / PV_{Sj,TC}} = \frac{SLQ_i}{SLQ_j}$$

Where $PV_{Si,Ru}$ is the production value of the supplying sector *i* in the *u*th region, $PV_{Si,TC}$ is the production value of the supplying sector *i* in the country, and $PV_{Sj,Ru}$ is the production value of the purchasing sector *j* in the *u*th region, $PV_{Sj,TC}$ is the production value of the purchasing sector *j* in total country. The latter formula is similar to the ratio between supplying and purchasing SLQ_i. (Flegg and Webber, 1997).

On one hand, if the regional production of the supplying industry *i* (in terms of its national production) is greater than the regional production of the purchasing industry *j* (in terms of its national production), the $CILQ_j$ is greater than one and the input requirements of *j* sector could be satisfied within the region (Fuentes Flores, 2002). On the other hand, if $CILQ_{ij}$ is lower than one, the inputs needed by the purchasing industry might not be produced by the supplying sector and, consequently, they would need to import the inputs from another region.

The just described method allows to make regional estimations without extensive sectorial data. It only requerires production data from the regions. The main disadvantage of this method is that it reduces the industry technical coefficient and magnify the important sectors of the region (Flegg and Webber, 2000). For this reason, it has been considered that it underestimates the regional import propensity and generates a higher self-sufficient, like the SLQ. Annex III shows the cross-industry location quotient for each region.

The FLQ_{ij} formula

The Flegg Location Quotient (FLQ) attempts to solve the overestimation of the industry sector's self-sufficiency problem, ascribed to CILQ and SLQ. This approach includes a correction to the CILQ method, which is a measure of the size of the region. The aim of the correction is to weight the importance of each region comparing the regional production value with the national production value.

[5] $$FLQ_{ij} = CILQ_{ij} \times \lambda^*$$

[6] $$\lambda^* = \left[\log_2\left(1 + {RPV_u}/{NPV}\right)\right]^{\delta} \text{, with } 0 \le \delta < 1$$

Where λ * is the size factor that weight the regional relative importance for the country. A crucial parameter for this quotient is δ (constant across the sectors), which is a measure of the regional imports.[3] On one hand, if the parameter is close to one, the regional imports will be higher. On the other hand, if the parameter is exactly zero, the FLQ is equivalent to the CILQ (Flegg and Webber, 1997)). Finally, the term that has risen to the power in question, is a logarithm of base two. It measures the size of the region using the resulting share over the total production in the region (RPV_u) and the national production (NPV).

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[3] A recent study of Faye, Romero and Mastronardi (2012) for the Argentinean province of Córdoba have found that it was preferred a sectorial δ because it reduces the sectorial bias in terms of intermediate consumption and represents a better cost structure.

Empirical results in Flegg and Webber (1996a and 1996b) have proved that this method is better than SLQ and CILQ because it reduces the standard error on the non-survey estimation. However, this particular LQ has drawed some criticisms that the formula explained in the following section will try to solve.

The correction by a specialization coefficient: the AFLQ$_{ij}$ formula

McCann and Dewhurst (1998) have criticized the FLQ formula because it has not allowed a regional technical coefficient of some particular industry to be greater than the national technical coefficient of that. Flegg and Webber (2000) have offered a new LQ methodology called the augmented FLQ formula (AFLQ). It new method has included a specialization effect of each industry.

[7] $$AFLQ_{ij} = CILQ_{ij} \times \lambda^{*} \times \left[\log_2\left(1+SLQ_j\right)\right] = FLQ_{ij} \times \left[\log_2\left(1+SLQ_j\right)\right]$$

[8] $$\lambda^{*} = \left[\log_2\left(1+ {RPV_u}/{NPV}\right)\right]^{\delta} \text{, with } 0 \le \delta < 1$$

The correction of the equation [7] (with respect to the equation [5]) will be operative if and only if the industry is self-sufficient, which corresponds with a SLQ greater than one. If that occurs, the specialization term will raise the FLQ formula and, consequently, the regional import will decrease.

It has been affirmed that the parameter δ is important to make the estimation. Flegg and Webber (2000) have said that a reasonable value could be 0.3. In addition, they have also advised a smaller value if the region is smaller and vice versa.

For the current study, it has been decided to work with a parameter δ close to 0.4, because this specific case is about two large regions. It must be remarked that non-survey methods use only production figures. In our case, we also have information on intermediate consumption and value added. Hence, we have a more precise notion about the existent technology at the sectorial level[4]. These are included as additional constraints that our estimation of the regional input output tables has to enforce. The next sections will show calibration techniques to deal with these constraints.

The AFLQ coefficients and the intraregional input-output tables are presented in the annex IV and in the annex V, respectively. These tables change when the interregional commerce is incorporated. It is important to know that every LQ constraint must be enforced when the CILQ has been put in the equation [7], i.e. if CILQ$_{ij}$ is greater than one, the CILQ$_{ij}$ on the equation [7] is one.

Once the AFLQ is computed, the regional technical coefficients are obtained. These coefficients are used to multiply the regional production value and to estimate the intraregional input-output table. With respect to the interregional tables, it has been assumed that a region is a regional net-exporter if and only if the SLQ is greater than one (self-sufficiency). For this reason, it might be considered that BAC is net exporter of services, because it is more specialized in that sector (the SLQ can be checked). In the next

[4] The ratio between regional intermediate consumption and regional production value obtained from a parameter δ of 0.37 for BAC and of 0.4 for the ROC has been close to the observed data in each region.

section, the interregional input-output tables for Argentina with calibration techniques will be estimated.

3. INTERREGIONAL INPUT-OUTPUT TABLES: CALIBRATION TECHNIQUES

Additional constraints must be added to bring consistency to regional input-output tables. First, special attention to the national accounts must be paid, because the sum of transactions carried out by sector must reproduce the national sector in relation to the intermediate consumption and the intermediate sales. Moreover, the sum of regional *ij*'s transactions for a particular sector must reproduce the *ij* national transaction for that sector. This constraint implies to enforce the national technical coefficients and it could be summarizing by the equation [9]:

[9] $$t^{n}_{ij} = \sum_{p=1}^{P} \sum_{s=1}^{S} t_{ij}^{ps}$$

Where r_{ij}^{ps} is the regional *ij* transaction from the purchasing region "*p*" and the supplying region "*s*", and a^{n}_{ij} is the national *ij* transaction.

It can be argued that there are many problems in connection with the consistency of the intraregional tables. It has been mentioned that the LQ theory needs only production data. At the local level, intermediate consumption data are available, so there are additional constraints to enforce. At this regard, since the quotient between the intermediate consumption and the production value is different across the regions, the technology of each sector could be similar but no identical.

Taking into consideration the problems described in the latter paragraph, the interregional tables have been built using calibration techniques to enforce the national table, to reply it after the adjustment.

Biproportional Adjustment (Stone, 1962 and Bacharach, 1970) and Cross-Entropy (Kullback and Leibler, 1951) were the techniques used to solve those problems. It has been affirmed by Mc Dougall (1999) that RAS is an entropy optimization method, concluding that entropy optimization method is preferred when a matrix-filling problem is present. However, it also has been suggested that RAS is preferred for the balancing matrix problem.

An initial table was used by these techniques to build the final tables (see Table 3). For this purpose, the initial table was calibrated taking additional assumptions. First, it was put the intraregional tables which ones were calculated by LQ on the diagonal. Second, the initial commerce between regions was needed. Subsequently, assumptions based on the theory of LQ were used to build tables for the two regions, as follow[5]:

a. A regional sector is an exporter if and only if its SLQ_i is greater than one. Then, the sectors that have broken this rule only supply to the intraregional commerce.

[5] It would be important to point out that if the sector can be disaggregated into smaller specific sectors, these techniques offer a more accurate measurement. Unfortunately, the data collected allowed the disaggregation into only fourteen sectors, given the few information at local level.

b. Subsequently, the equation [9] must be enforced. Using (a), if a sector *j* of BAC exports, the sector *j* of ROC does not export. Thus, it should be understood that or $r_{ij}^{BAC,\,ROC} = 0$ or $r_{ij}^{ROC,BAC} = 0$. The latter sentence is summarized by the equation [10]:

$$\prod_{p \neq s} r_{ij}^{ps} = 0 \qquad [10]$$

Although an initial table that enforces the intermediate sales was obtained, it generally does not enforce the intermediate consumption at regional level. A table where the total sales and consumption (rows and columns) converge, different from initial table, is needed to solve the problem. The available data were: the production value, the intermediate consumption and intermediate sales (for national data) and the regional production value (for intraregional tables), regional intermediate consumption (total columns) and intermediate sales[6] (total rows). Calibration techniques can be applied to solve the latter problem.

It was decided to take additional assumptions to apply the calibration techniques. Taking into account that the work is based on the BAC, it was decided to fix the intraregional tables for this region. The latter assumption has implied that the LQ approach's have a valid theory as source. Moreover, the calibration techniques were applied in the intraregional tables for ROC and the interregional tables.

A crucial aspect for the calibration techniques is the starting point for the interregional tables in the beginning of that procedure. A general approach to build the initial tables was not found in the literature. For this purpose, two starting points were included based on supplying and purchasing assumptions. It has been pointed out before in this study that a BAC's sector exports to a ROC's sector if and only if their SLQ is greater than one.

With respect to the sales theory, it has been assumed that the supplying sectors sell their products in the same proportion in each region, i.e the sector one from ROC has a SLQ greater than one, so initially sell to BAC's sector in the same proportion as it sell to ROC. Certainly, this share changes when the iterations to enforce the restrictions for intermediate sales and consumption are applied.

The other starting point has a purchasing assumption but differs in each region. As the objective of this work is to estimate principally BAC tables to analyze their structure, it has been taken the cost structure from LQ techniques as well. To that end, it has been modeled the starting BAC's imports using the intermediate consumption proportion of BAC intraregional tables. For the BAC's exports, it has been taken a transactional approach[7]. The ROC's imports have been distributed in transactional proportions of ROC's

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[6] In fact, intermediate sales were not considered local data. The totals come from the assumption that if a region is self-sufficient, it can export. If it is not an exporter region, the total intermediate sales was given by the method of regionalization of I-O tables. If it is an exporter region, the total intermediate sales was originated from the difference between national intermediate sales and the sales in the other region.

[7] The same approach could not be used because the LQ method overestimates the ROC intraregional tables for many sectors. The method has estimated an intermediate consumption greater than the regional accounts only for the intraregional transactions. It has led to the result that the LQ theory does not need intermediate consumption data to make the intraregional tables.

intraregional tables. Accordingly, it has been separated the BAC's sectors that sell to ROC's sectors and a share of ROC's intraregional tables have been computed as well. It is a purchasing/supplying approach because it has enforced the cost structure and the importance of the sector at the intermediate level.

The RAS method

Biproportional Adjustment, usually called RAS method (Stone, 1962 and Bacharach, 1970) is the first calibration technique that to be explained in this paper. Basically, the technique takes an initial matrix (in the present case the interregional input output tables) and a set of row and column vectors as benchmark to enforce. After several iterations, the method offers a new table with transactions that has similar structure to the initial matrix but it enforces the constraints (at rows and columns level)[8].

The logic of the iterative procedure is to find r_j and s_j vectors such that:

[11] $$a^*_{ij} = r_i a_{ij} s_j$$

Where r_i is the total of i column (intermediate consumption), a_{ij} is the initial matrix coefficient of consumption (not the transaction), s_j is the total of the j column (intermediate sales) and $a_{ij}*$ is the final matrix of coefficients. The procedure is an iterative algorithm that is enforced in each iteration with the row or column total through the change of the initial a_{ij}.

RAS has been frequently used to calibrate tables in the social accounting matrices (see Chisari et al, 2009 and 2010), like national input-output table and private consumption tables. It has been suggested that the disadvantage of this method is that requires row and column totals and an initial matrix to begin the procedure. Moreover, it has been considered not flexible for the matrix additional constraints (lineal or not lineal). The regional input output tables are shown as an example because under that method the national tables cannot be replicated in the process to calibrate the regional tables (they can be similar but not equivalent).

Once the final regional tables are obtained, the national table could be remade. As was mentioned before, it might be difficult to reach the original national table. In addition, many transactions should be fixed for the BAC, so if one transaction for this region is greater than for the nation (it could happens applying LQ methods), it may be impossible to arrive to the original table.

Regional Cross-Entropy: additional constraints for the regional problem

It has been argued that the traditional cross-entropy approach is an inference statistic application based on information theory.[9]

To illustrate the problem in an intuitively way, the Figure 1 shows the method. Firstly, a set of events ($E_1, .., E_n$) were assumed that initially have q_i probability to occur.

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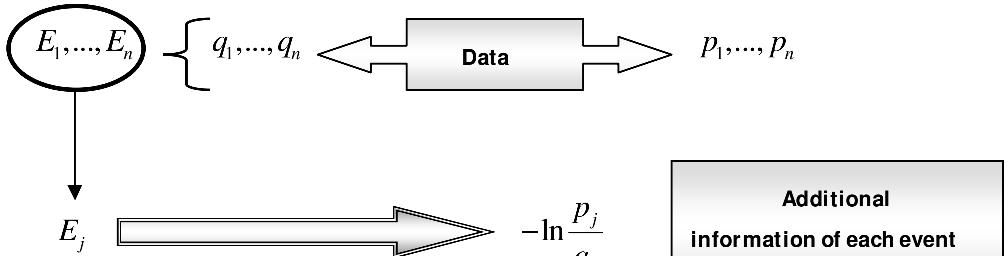
[8] It has been shown by Bacharach (1971) that RAS converges under some necessary and sufficient conditions.

[9] Technical bearings and different applications could be seen in Jaynes (1982) and Golan, Judge y Miller (1996).

Secondly, it has been supposed that a message implies a change of those probabilities and they are transformed in p_i. The procedure implies to minimize a cross-entropy measure of distance (Kullback-Leibler,1951) between the initial and the new probabilities.

Figure 1: The Cross-Entropy method



Source: Own elaboration

Thirdly, it has been assumed that it is focused on some particular event E_j. The received information from the message has been $-\ln p_j$[10], but the additional information has been defined as follow: $(-\ln p_j - \ln q_j) = -\ln (p_j / q_j)$. Subsequently, expect factor has been applied separately over the informative values of each event, the expected informative value has been found from the message (Robinson, Cattaneo and El-Said, 2001):

[12] $$-I\left(p:q\right) = -\sum_i^n p_i \ln \frac{p_i}{q_i}$$

Once the procedure to estimate interregional input-output tables had been applied, the problem has become to find a new matrix close to the already existing matrix[11], minimizing the cross-entropy distance but enforcing the constraints. It could be considered that this method as more flexible than RAS because it allows updating the tables starting from inconsistent data. Moreover, it allows including additional constraints like non-linear constraints of information on each transaction or a set of them (not necessary total row or column).

It has been suggested by Golan, Judge and Robinson (1994) that different techniques to solve the estimation -previously mentioned- have focused on the national input-output table.

The problem to minimize the cross-entropy measure consists in finding a new set of coefficients (A) that minimize the measure between the initial coefficient and the estimated one.

[13] $$\min \quad \sum_i \sum_j a_{i,j} \ln a_{i,j} \big/ a_{i,j}^{*}$$

Such as:

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[10] An experiment with n possible results is considered. A measure of uncertainty S(n) that has three properties has been searched: (i) S ≥ 0, (ii) S(1) = 0 y (iii) S(mn) = S(m) + S(n). It could be demonstrated that the logarithm enforces these properties. So S(n) = k ln n, where k is a scale factor that normalizes to one the measure

[11] It should be remembered the importance of initial tables on the previous sections.

[14] $\sum_i a_{i,j} = 1$, $\sum_i a_{i,j} y_j = y_j$ with $0 \le a_{i,j} \le 1$

The solution can be obtained solving a Lagrangian that includes equations [13] and [14]. The results combine information of the new matrix and the initial one:

[15] $$a_{i,j} = \frac{a_{i,j} \exp(\varphi_i y_j^*)}{\sum_{i,j} a_{i,j}^* \exp(\varphi_i y_j^*)}$$

Where φ_i are the Lagrange multipliers associated by the row-columns sum and the denominator is the normalization factor. This methodology is used to update social accounting matrices.[12]

It might be argued that Cross-Entropy is a more general technique than RAS because:

i. It does not need all the new totals of rows or columns (although the prediction will be less accurate).

ii. It does not need a balanced initial matrix (the sum of rows could be more/less than the sum of columns).

iii. New rims could contain an error term.

iv. New rims can be non-fixed parameters.

v. Many values on the final matrix could be fixed (not necessarily a parameter, which will be explained further on this work).

vi. It allows non-linear constraints.

It has been observed that the initial constraints are the same as the national input-output problem when the latter techniques on the regional approach have been applied. This paper introduces additional constraint that allows a better adjustment to remake the national table.

The same starting point than RAS has been used under purchasing assumption because it has better results for the measure of the error. It allows to compare the performance of the methods. In the case of cross-entropy, it has been established that additional constraints usually take into account the objective to have a lower error more than RAS. The constraints have specified by the transactional equation [16]:

[16] $$t_{ij} = \sum_p \sum_s t_{ij}^{p,s}$$

Where *p* and *s* are the purchasing and supplying region and *ij* are the specific sectors.

The latter constraint (equation [16]) cannot be applied for the entire matrix because the BAC intraregional tables have been fixed, being the loss of degrees of freedom the main problem. Instead, the equation [10] was enforced for each interregional transaction.

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[12] A methodological approach has been shown by Chisari *et. al* (2010) and Romero (2009). In addition, it could also be seen in Arndt, Robinson and Tarp (2002) to view application focuses on computable general equilibrium models.

To that end, it has been decided to run the cross-entropy program with different quantities of restrictions at the sectorial level, having in mind the objective to analyze the results in terms of the estimated national table and the original input-output table.

Firstly, the program without these constraints was run. Secondly, the first principal purchasing transaction for each sector at national level was fixed, applying the equation [16]. Finally, the second purchasing transaction was computed. This procedure was followed until the eighth purchasing transaction.

In the next section, statistics will be presented to decide what assumption could be better in terms of measure the error between the estimated table and the original one.

4. PERFORMANCE INDICATORS AND RESULT ANALYSIS

The objective of this section is to select the interregional tables that are more "accurate". For this purpose, it was decided to contrast the estimated national input output table with the original ones.

Stats for eleven estimations mentioned in previous subsections are offered: two for RAS estimation (differentiating the assumption around the initial matrix) and nine for cross-entropy technique (differentiating the quantity of fix sectorial transactions in the problem).

First, it could be observed the absolute aggregate bias, measured as equation [17].

[17] $$AB = \frac{\sum_{ij} \left| \hat{t}_{ij} - t_{ij} \right|}{\sum_{ij} t_{ij}}$$

This indicator is the result of comparing the transactions in the final aggregated matrix ($\hat{t}_{ij}$) and the starting one (t_{ij}). The indicator is presented on Table 4.

Table 4 – Aggregate bias by calibration method

Method	AB
Supplying RAS	8.9%
Purchasing RAS	7.0%
Entropy 0 transaction	12.2%
Entropy 1 transaction	7.7%
Entropy 2 transactions	5.6%
Entropy 3 transactions	4.0%
Entropy 4 transactions	3.3%
Entropy 5 transactions	1.8%
Entropy 6 transactions	1.4%
Entropy 7 transactions	1.2%
Entropy 8 transactions	0.8%

Source: Own elaboration

It can be observed that RAS method is preferred than Entropy method if and only if any constraint or one constraint are enforced. Comparing the starting point on RAS method, purchasing method is preferred than supplying matrix because the aggregate bias are lower.

Using the equation [18], sectorial bias in terms of sales are computed. Unfortunately, a trade-off between add constraints and the absolute sectorial error was found.

[18] $$ASSB_i = \frac{\sum_i \left| \hat{t}_{ij} - t_{ij} \right|}{\sum_i t_{ij}}$$

Table 5 shows the sectorial bias in terms of intermediate sales. It can be observed that it is possible to add constraints but these are worse in terms of relative prices. It happened because when other transactions are enforced, the error is put in some sectors that are less important in terms of sales. It is worse because the structure of sales of this sector at national level changes. When additional constraints were introduced, the sector most affected was the public administration (S12).

Table 5 – Sectorial intermediate sales bias

	S1	*S2*	*S3*	*S4*	*S5*	*S6*	*S7*	*S8*	*S9*	*S10*	*S11*	*S12*	*S13*	*S14*
Supplying RAS	3.5%	9.3%	4.1%	7.0%	33.3%	38.7%	5.6%	8.9%	6.9%	13.7%	5.7%	52.8%	13.4%	16.7%
Purchasing RAS	2.9%	2.7%	4.2%	5.1%	13.3%	45.8%	5.3%	9.0%	6.3%	8.1%	6.8%	11.4%	15.8%	12.5%
Entropy 0 trans.	3.1%	3.3%	2.6%	8.7%	24.7%	59.6%	4.2%	12.3%	6.5%	22.5%	31.6%	19.9%	21.9%	14.2%
Entropy 1 trans.	2.8%	4.1%	7.2%	2.2%	24.1%	8.1%	5.3%	10.9%	5.9%	12.4%	26.8%	33.6%	19.5%	12.8%
Entropy 2 trans.	0.1%	5.0%	0.0%	0.5%	26.9%	5.3%	6.9%	9.9%	6.1%	9.7%	17.5%	30.6%	24.3%	13.1%
Entropy 3 trans.	0.1%	2.9%	0.0%	0.2%	23.3%	4.1%	11.0%	12.3%	0.4%	8.0%	11.5%	29.6%	21.3%	13.9%
Entropy 4 trans.	0.1%	0.0%	0.0%	0.0%	21.1%	5.8%	8.8%	12.8%	0.0%	2.5%	10.2%	23.2%	19.0%	16.7%
Entropy 5 trans.	0.1%	0.0%	0.1%	0.0%	10.1%	7.5%	2.2%	14.9%	0.0%	1.8%	0.0%	15.2%	14.8%	18.7%
Entropy 6 trans.	0.1%	0.0%	0.0%	0.0%	2.4%	4.4%	2.0%	13.5%	0.0%	1.2%	0.0%	27.6%	13.0%	14.8%
Entropy 7 trans.	0.1%	0.0%	0.0%	0.0%	11.2%	2.2%	2.0%	10.3%	0.0%	0.3%	0.0%	47.1%	1.7%	14.8%
Entropy 8 trans.	0.2%	0.1%	0.1%	0.0%	0.0%	1.1%	2.0%	3.9%	0.0%	0.0%	0.0%	57.6%	1.4%	15.7%

Source: Own estimations.

Using the equation [19], the sectorial bias in terms of purchases is computed. A trade-off between add constraints and the absolute sectorial purchasing bias was found as well.

[19] $$ASPB_j = \frac{\sum_j \left| \hat{t}_{ij} - t_{ij} \right|}{\sum_j t_{ij}}$$

Table 6 shows the sectorial bias in terms of intermediate purchases. This bias is the important one because the inputs requirements affect directly on the production function. It can be observed that it is possible to add constraints but these are worse in terms of relative prices. When additional constraints are introduced, the sector most affected is the real estate, renting and business (S11).

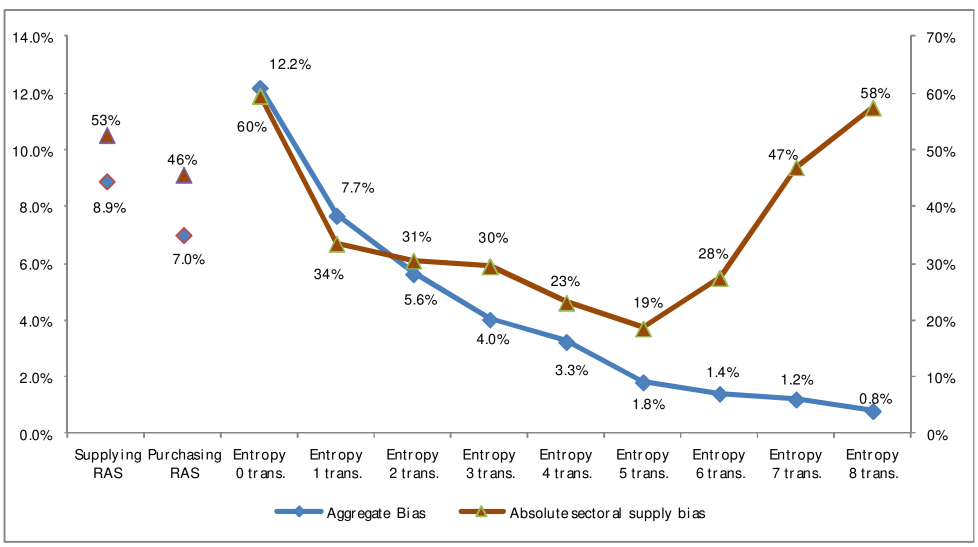
Table 6 – Sectorial intermediate purchases bias

	S1	*S2*	*S3*	*S4*	*S5*	*S6*	*S7*	*S8*	*S9*	*S10*	*S11*	*S12*	*S13*	*S14*
Supplying RAS	11.3%	15.2%	24.5%	4.0%	16.4%	5.3%	15.7%	13.7%	15.6%	23.7%	39.5%	5.4%	3.9%	9.9%
Purchasing RAS	12.0%	4.6%	17.0%	2.8%	5.0%	3.6%	16.3%	6.9%	7.8%	20.0%	62.2%	5.2%	3.5%	6.6%
Entropy 0 trans.	9.7%	10.1%	12.3%	11.8%	6.2%	6.1%	21.8%	4.9%	8.2%	11.9%	67.8%	13.2%	4.6%	14.8%
Entropy 1 trans.	6.7%	8.8%	9.1%	6.1%	4.1%	6.3%	14.5%	4.3%	7.4%	6.1%	33.2%	7.0%	5.2%	12.3%
Entropy 2 trans.	3.0%	7.6%	8.2%	5.2%	3.7%	5.7%	9.0%	1.1%	2.5%	5.4%	31.3%	8.4%	2.6%	8.6%
Entropy 3 trans.	2.2%	3.8%	5.5%	4.3%	3.3%	2.7%	5.2%	0.7%	2.6%	2.6%	25.2%	5.9%	2.1%	4.8%
Entropy 4 trans.	2.6%	2.8%	3.9%	3.7%	3.0%	2.3%	4.8%	0.5%	0.9%	1.0%	19.9%	5.9%	2.1%	2.9%
Entropy 5 trans.	0.7%	1.4%	2.3%	2.5%	1.7%	0.2%	2.2%	0.3%	0.7%	0.2%	16.5%	2.5%	0.9%	2.1%
Entropy 6 trans.	0.4%	0.3%	0.9%	2.0%	1.4%	0.1%	1.3%	0.3%	1.1%	0.2%	16.5%	0.8%	0.9%	1.0%
Entropy 7 trans.	0.1%	0.2%	2.6%	1.5%	0.1%	0.0%	0.8%	0.2%	2.0%	0.1%	15.5%	3.2%	0.6%	0.7%
Entropy 8 trans.	0.1%	0.3%	0.0%	1.4%	2.2%	0.1%	0.0%	1.7%	0.3%	1.5%	11.7%	0.0%	0.0%	0.0%

Source: Own estimations.

It could be appreciated on Figure 2 the absolute aggregate bias and the maximum absolute sales bias. As it was said before on the Table 4, purchasing RAS has a lower error in aggregate terms than supplying RAS. In terms of Cross-Entropy method, it could be appreciated that if it is not possible to enforce transactional constraints, RAS is better. However, when the transactional constraints are increased, the bias falls to 0.8%. The criteria to choose the final matrix was based on the last tables and the next figure.

Figure 2: Aggregate bias and sectorial supply bias



Source: Own estimations.

The criteria could change in terms of the objective. For example, the regional tables are needed to construct a general equilibrium model. Then, if the technique is taken with the eighth biggest purchasing transactions, it is not well when the sectorial relative prices must be computed. However, these conclusions can contribute to the final sectorial aggregation.

For this paper's aims, it was preferred to take for the final matrix the cross-entropy technique, which fixes the fifth principal purchasing transactions[13]. The estimated national input-output table could be seen on annex VI and the final regional matrix could be seen on annex VII, respectively. It can be observed that the supplying bias are concentrated principally in sectors 12 and 14. This indicates that these sectors could be aggregated with the purpose to enhance in terms of bias and not compound a distorted sector for the model.

Other criteria could observe only purchasing transactions with the objective to analyze the Leontief multipliers and technical coefficients. If this were this paper's aim, purchasing indicators must be analyzed. These indicators suggest that more constraints can be put to have better results.

Some implications can be obtained from the final matrix. The interregional propensities to import, interregional propensities to export and final demand share are important to be shown after the final interregional input-output tables are built. Table 7 shows these regional shares in terms of production value. In addition, the requirement of industry imports for BAC are presented, because it explains the 55% of the BAC imports. It could be an under/over estimation measure of the accuracy that have the location quotients methods.

Table 7 – Exports (X_reg) and imports (M_reg) requirements and Final Demand(FD). Industry imports for BAC (In terms of production value)

	1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*	*13*	*14*
M_reg BAC	0.15	0.15	0.06	0.11	0.20	0.07	0.15	0.24	0.08	0.02	0.20	0.11	0.22	0.22
Industry BAC	0.10	0.13	0.03	0.08	0.02	0.05	0.11	0.22	0.06	0.01	0.05	0.06	0.06	0.16
X_reg BAC	-	-	-	-	-	-	0.02	0.22	0.37	0.56	0.04	-	-	0.02
FD BAC	0.03	0.03	0.03	0.68	0.59	0.99	0.90	0.62	0.26	0.00	0.78	0.96	0.86	0.89
M_reg ROC	0.01	0.04	0.01	0.03	0.02	0.05	0.06	0.01	0.05	0.07	0.01	0.06	0.01	0.06
X_reg ROC	0.02	0.01	0.04	0.06	0.17	0.05	-	-	-	-	-	0.02	0.09	-
FD ROC	0.24	0.72	0.20	0.47	0.29	0.86	0.78	0.70	0.23	0.00	0.09	0.93	0.75	0.83

Source: Own Estimations

It was observed that BAC has important regional requirements when it is compared with ROC As it was presented in the second row, the industry regional imports explain the most important purchase in every sector in terms of production value. An example is the sector 8, which imports twenty four percent (24%) of their production value from ROC, but twenty two percent (22%) of these come from ROC industry. Those purchases are important in terms of BAC sectors, because if the industry regional export share is seen, it is 6%, i.e. the industry sales to BAC only six percent (6%) of their production.

When the regions were compared, it was observed the self-sufficiency of ROC that has regional imports shares and regional export shares behind ten percent (10%) of their production value, except for sector 5 that exports the seventeen percent (17%) of their production to BAC

[13] An additional performance indicator could be the value function of the entropy function. However, it was not presented because if constraints are added in the problem, the value to minimize will be greater. It happened because the degrees of freedom are lost when the constraints are added.

5. CONCLUSIONS

This paper is the first approach in Argentina to build a regional input output model for Buenos Aires City. Regional input output tables were built with the final objective to estimate a regional social accounting matrix, which will include Buenos Aires city and the rest of Argentina.

The regional tables were separated in intraregional and interregional tables. The construction methodology of the intraregional tables was based on Flegg and Webber (1995, 1997, 2000). Then, the RAS and the Cross-Entropy methodologies were introduced for the calibration of interregional tables.

It was concluded that the entropy methods performs better than RAS method because it replicates more accurately the national input output table and it has a lower sectoral biases, so it can be expected that the final distortion on relative prices will be lower in a CGE calibration. The final result is a regional input-output matrix that has a 2.2 percent of bias in terms of national input output table, and this bias is concentrated on specific sectors, particularly in financial intermediation and public administration. This sector will be aggregated in the CGE model following this estimate.

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Annex I: Technical coefficients of national input-output tables for Argentina in 2006.

		1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	Agriculture, forestry and hunting	0.09	0.00	0.00	0.11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	Fishing	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3	Mining and quarrying	0.00	0.00	0.04	0.04	0.14	0.16	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4	Industry	0.18	0.18	0.07	0.29	0.05	0.26	0.03	0.37	0.11	0.03	0.04	0.06	0.07	0.12
5	Water, Electricity and gas	0.00	0.00	0.01	0.01	0.23	0.00	0.01	0.02	0.01	0.01	0.00	0.02	0.01	0.02
6	Construction	0.01	0.00	0.04	0.00	0.00	0.00	0.00	0.05	0.00	0.00	0.06	0.02	0.01	0.01
7	Commerce	0.02	0.03	0.00	0.02	0.00	0.04	0.01	0.02	0.01	0.00	0.00	0.00	0.00	0.01
8	Hotels and restaurants	0.00	0.02	0.00	0.01	0.00	0.00	0.00	0.00	0.01	0.02	0.01	0.06	0.03	0.01
9	Transport and communication	0.02	0.07	0.01	0.08	0.04	0.10	0.06	0.01	0.13	0.08	0.02	0.04	0.01	0.12
10	Financial intermediation	0.02	0.02	0.02	0.01	0.02	0.06	0.10	0.01	0.05	0.13	0.02	0.09	0.00	0.04
11	Real estate, renting and business	0.00	0.04	0.02	0.02	0.03	0.06	0.08	0.02	0.05	0.07	0.01	0.04	0.01	0.09
12	Public administration	0.00	0.01	0.00	0.00	0.01	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00
13	Education, health and social services	0.00	0.00	0.03	0.01	0.02	0.00	0.00	0.00	0.00	0.00	0.01	0.02	0.13	0.01
14	Other services	0.00	0.00	0.03	0.00	0.01	0.00	0.00	0.00	0.02	0.01	0.01	0.01	0.01	0.01

Source: Instituto Nacional de Estadísticas y Censos (INDEC).

Annex II – Production values and Simple Location Quotient for BAC and ROC

N°	Sectors	PV of Argentina	PV of BAC	Share of total	SLQ i	PV of ROC	Share of total	SLQ i
1	Agriculture, forestry and hunting	64594	1282	0%	0.09	63312	7%	1.27
2	Fishing	2792	75	0%	0.12	2716	0%	1.27
3	Mining and quarrying	47229	4586	2%	0.42	42643	5%	1.17
4	Industry	403266	62122	23%	0.67	341145	38%	1.10
5	Water, Electricity and gas	23048	4412	2%	0.83	18636	2%	1.05
6	Construction	96792	13990	5%	0.63	82802	9%	1.11
7	Commerce	93114	24346	9%	1.13	68768	8%	0.96
8	Hotels and restaurants	31432	12821	5%	1.77	18611	2%	0.77
9	Transport and communication	102246	34321	13%	1.45	67925	8%	0.86
10	Financial intermediation	40411	21863	8%	2.34	18548	2%	0.60
11	Real estate, renting and business	77833	45272	17%	2.52	32561	4%	0.54
12	Public administration	50727	11554	4%	0.99	39172	4%	1.004
13	Education, health and social services	78117	17635	7%	0.98	60482	7%	1.01
14	Other services	50489	14051	5%	1.21	36438	4%	0.94
	Total	1162089	268329	100%		893759	100%	

Source: INDEC, Ministerio de hacienda GCBA and Chisari et. al (2010).

Annex III – Cross Industry Location Quotients for BAC and ROC

BAC CILQ coefficients

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	1.00	0.73	0.20	0.13	0.10	0.14	0.08	0.05	0.06	0.04	0.03	0.09	0.09	0.07
2	1.36	1.00	0.28	0.18	0.14	0.19	0.10	0.07	0.08	0.05	0.05	0.12	0.12	0.10
3	4.89	3.59	1.00	0.63	0.51	0.67	0.37	0.24	0.29	0.18	0.17	0.43	0.43	0.35
4	7.76	5.70	1.59	1.00	0.80	1.07	0.59	0.38	0.46	0.28	0.26	0.68	0.68	0.55
5	9.64	7.08	1.97	1.24	1.00	1.32	0.73	0.47	0.57	0.35	0.33	0.84	0.85	0.69
6	7.28	5.34	1.49	0.94	0.76	1.00	0.55	0.35	0.43	0.27	0.25	0.63	0.64	0.52
7	13.17	9.67	2.69	1.70	1.37	1.81	1.00	0.64	0.78	0.48	0.45	1.15	1.16	0.94
8	20.54	15.08	4.20	2.65	2.13	2.82	1.56	1.00	1.22	0.75	0.70	1.79	1.81	1.47
9	16.91	12.41	3.46	2.18	1.75	2.32	1.28	0.82	1.00	0.62	0.58	1.47	1.49	1.21
10	27.25	20.01	5.57	3.51	2.83	3.74	2.07	1.33	1.61	1.00	0.93	2.38	2.40	1.94
11	29.30	21.51	5.99	3.78	3.04	4.02	2.22	1.43	1.73	1.08	1.00	2.55	2.58	2.09
12	11.47	8.42	2.35	1.48	1.19	1.58	0.87	0.56	0.68	0.42	0.39	1.00	1.01	0.82
13	11.37	8.35	2.33	1.47	1.18	1.56	0.86	0.55	0.67	0.42	0.39	0.99	1.00	0.81
14	14.02	10.29	2.87	1.81	1.45	1.93	1.06	0.68	0.83	0.51	0.48	1.22	1.23	1.00

ROC CILQ coefficients

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	1.00	1.01	1.09	1.16	1.21	1.15	1.33	1.66	1.48	2.14	2.34	1.27	1.27	1.36
2	0.99	1.00	1.08	1.15	1.20	1.14	1.32	1.64	1.46	2.12	2.33	1.26	1.26	1.35
3	0.92	0.93	1.00	1.07	1.12	1.06	1.22	1.52	1.36	1.97	2.16	1.17	1.17	1.25
4	0.86	0.87	0.94	1.00	1.05	0.99	1.15	1.43	1.27	1.84	2.02	1.10	1.09	1.17
5	0.82	0.83	0.90	0.96	1.00	0.95	1.09	1.37	1.22	1.76	1.93	1.05	1.04	1.12
6	0.87	0.88	0.95	1.01	1.06	1.00	1.16	1.44	1.29	1.86	2.04	1.11	1.10	1.19
7	0.75	0.76	0.82	0.87	0.91	0.86	1.00	1.25	1.11	1.61	1.77	0.96	0.95	1.02
8	0.60	0.61	0.66	0.70	0.73	0.69	0.80	1.00	0.89	1.29	1.42	0.77	0.76	0.82
9	0.68	0.68	0.74	0.79	0.82	0.78	0.90	1.12	1.00	1.45	1.59	0.86	0.86	0.92
10	0.47	0.47	0.51	0.54	0.57	0.54	0.62	0.78	0.69	1.00	1.10	0.59	0.59	0.64
11	0.43	0.43	0.46	0.49	0.52	0.49	0.57	0.71	0.63	0.91	1.00	0.54	0.54	0.58
12	0.79	0.79	0.86	0.91	0.96	0.90	1.05	1.30	1.16	1.68	1.85	1.00	1.00	1.07
13	0.79	0.80	0.86	0.92	0.96	0.91	1.05	1.31	1.17	1.69	1.85	1.00	1.00	1.07
14	0.74	0.74	0.80	0.85	0.89	0.84	0.98	1.22	1.09	1.57	1.73	0.93	0.93	1.00

Source: Own estimations based on Flegg and Webber (1997, 2000)

Annex IV – AFLQ for BAC and ROC

BAC AFLQ coefficients

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	0.64	0.47	0.13	0.08	0.07	0.09	0.05	0.05	0.05	0.04	0.04	0.06	0.06	0.05
2	0.64	0.64	0.18	0.11	0.09	0.12	0.07	0.06	0.07	0.06	0.05	0.08	0.08	0.07
3	0.64	0.64	0.64	0.40	0.32	0.43	0.26	0.22	0.24	0.20	0.19	0.27	0.28	0.25
4	0.64	0.64	0.64	0.64	0.52	0.64	0.41	0.36	0.38	0.32	0.31	0.43	0.44	0.40
5	0.64	0.64	0.64	0.64	0.64	0.64	0.51	0.44	0.47	0.39	0.38	0.54	0.54	0.50
6	0.64	0.64	0.64	0.60	0.48	0.64	0.39	0.33	0.36	0.30	0.29	0.41	0.41	0.38
7	0.64	0.64	0.64	0.64	0.64	0.64	0.70	0.60	0.65	0.54	0.52	0.64	0.64	0.69
8	0.64	0.64	0.64	0.64	0.64	0.64	0.70	0.94	0.83	0.84	0.82	0.64	0.64	0.73
9	0.64	0.64	0.64	0.64	0.64	0.64	0.70	0.77	0.83	0.69	0.67	0.64	0.64	0.73
10	0.64	0.64	0.64	0.64	0.64	0.64	0.70	0.94	0.83	1.11	1.08	0.64	0.64	0.73
11	0.64	0.64	0.64	0.64	0.64	0.64	0.70	0.94	0.83	1.11	1.16	0.64	0.64	0.73
12	0.64	0.64	0.64	0.64	0.64	0.64	0.61	0.52	0.56	0.47	0.46	0.64	0.64	0.60
13	0.64	0.64	0.64	0.64	0.64	0.64	0.60	0.52	0.56	0.47	0.45	0.63	0.64	0.59
14	0.64	0.64	0.64	0.64	0.64	0.64	0.70	0.64	0.69	0.57	0.56	0.64	0.64	0.73

ROC AFLQ coefficients

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	1.10	1.09	1.04	0.99	0.96	1.00	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93
2	1.09	1.09	1.04	0.99	0.96	1.00	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93
3	1.01	1.01	1.04	0.99	0.96	1.00	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93
4	0.95	0.95	0.97	0.99	0.96	0.99	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93
5	0.90	0.91	0.93	0.95	0.96	0.94	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93
6	0.96	0.96	0.98	0.99	0.96	1.00	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93
7	0.83	0.83	0.85	0.86	0.88	0.86	0.93	0.93	0.93	0.93	0.93	0.89	0.89	0.93
8	0.66	0.66	0.68	0.69	0.70	0.69	0.74	0.93	0.82	0.93	0.93	0.71	0.71	0.76
9	0.74	0.75	0.76	0.78	0.79	0.77	0.83	0.93	0.93	0.93	0.93	0.80	0.80	0.85
10	0.51	0.51	0.53	0.54	0.54	0.54	0.57	0.72	0.64	0.93	0.93	0.55	0.55	0.59
11	0.47	0.47	0.48	0.49	0.50	0.49	0.52	0.65	0.58	0.84	0.93	0.50	0.50	0.54
12	0.86	0.87	0.89	0.90	0.92	0.90	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93
13	0.87	0.87	0.89	0.91	0.92	0.90	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93
14	0.81	0.81	0.83	0.84	0.86	0.84	0.90	0.93	0.93	0.93	0.93	0.87	0.87	0.93

Source: Own estimations based on Flegg and Webber (1997, 2000)

Annex V – Initial intraregional input-output tables

Intraregional BAC transactions

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	72	0	0	563	-	0	-	1	0	-	0	0	0	1
2	0	1	-	13	-	-	-	0	-	-	-	-	0	-
3	0	0	128	1,074	200	951	-	-	6	-	0	1	0	0
4	145	9	204	11,367	121	2,292	348	1,704	1,455	185	518	292	534	699
5	3	0	40	378	645	26	100	107	96	49	85	115	50	117
6	8	0	107	24	1	-	0	198	51	-	793	92	65	56
7	14	1	5	828	3	346	209	129	288	23	78	29	31	111
8	2	1	-	202	0	-	46	6	146	323	545	430	308	105
9	17	3	42	3,153	109	867	981	133	3,753	1,235	576	291	142	1,240
10	18	1	45	390	62	541	1,622	111	1,367	3,160	1,053	632	50	448
11	1	2	59	759	73	507	1,356	281	1,507	1,624	686	266	101	947
12	1	0	5	116	23	2	11	-	224	33	8	8	10	22
13	1	0	87	237	67	-	6	29	42	39	236	165	1,445	119
14	1	0	93	126	35	1	32	13	400	97	245	74	88	141

Intraregional ROC transactions

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	6,110	7	1	37,081	-	14	-	26	2	-	0	7	3	68
2	0	69	-	610	-	-	-	0	-	-	-	-	0	-
3	8	0	1,921	14,468	2,494	13,061	-	-	43	-	0	7	3	2
4	10,600	467	2,871	96,527	954	20,904	2,207	6,445	6,998	456	1,121	2,118	3,896	4,147
5	175	3	535	3,067	4,079	228	510	326	371	98	147	670	295	560
6	588	0	1,521	218	11	-	2	798	263	-	1,827	714	509	356
7	909	60	58	6,139	16	2,752	780	287	817	33	100	134	147	386
8	96	33	-	1,202	1	-	139	8	287	302	445	1,621	1,172	282
9	984	138	471	21,026	569	6,212	3,295	230	8,287	1,401	571	1,231	607	3,749
10	706	24	347	1,796	221	2,680	3,765	123	2,085	2,225	648	1,844	148	935
11	43	48	412	3,186	240	2,286	2,870	284	2,096	1,042	393	709	272	1,803
12	84	13	65	898	141	21	49	-	728	56	12	40	51	90
13	39	2	1,128	1,845	403	-	27	75	138	66	348	820	7,192	480
14	48	0	1,120	913	196	8	116	27	1,066	133	293	341	408	462

Source: Own estimations based on Flegg and Webber (1997, 2000)

Annex VI - Technical coefficients of estimated national input-output tables for Argentina.

		1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*	*13*	*14*
1	Agriculture, forestry and hunting	0.09	0.00	0.00	0.11	-	0.00	-	0.00	0.00	-	0.00	0.00	0.00	0.00
2	Fishing	0.00	0.02	-	0.00	-	-	-	0.00	-	-	-	-	0.00	-
3	Mining and quarrying	0.00	0.00	0.04	0.04	0.14	0.16	-	-	0.00	-	0.00	0.00	0.00	0.00
4	Industry	0.18	0.18	0.07	0.29	0.05	0.26	0.03	0.37	0.11	0.03	0.04	0.06	0.07	0.12
5	Water, Electricity and gas	0.00	0.00	0.01	0.01	0.23	0.00	0.01	0.02	0.01	0.01	0.00	0.02	0.01	0.02
6	Construction	0.01	0.00	0.04	0.00	0.00	-	0.00	0.05	0.00	-	0.06	0.02	0.01	0.01
7	Commerce	0.02	0.03	0.00	0.02	0.00	0.04	0.01	0.02	0.01	0.00	0.00	0.00	0.00	0.01
8	Hotels and restaurants	0.00	0.02	-	0.01	0.00	-	0.00	0.00	0.01	0.02	0.01	0.06	0.03	0.01
9	Transport and communication	0.02	0.07	0.01	0.08	0.04	0.10	0.06	0.01	0.13	0.08	0.02	0.04	0.01	0.12
10	Financial intermediation	0.02	0.02	0.02	0.01	0.02	0.06	0.10	0.01	0.05	0.13	0.02	0.09	0.00	0.04
11	Real estate, renting and business	0.00	0.04	0.02	0.02	0.03	0.06	0.08	0.02	0.05	0.07	0.01	0.04	0.01	0.09
12	Public administration	0.00	0.01	0.00	0.00	0.01	0.00	0.00	-	0.01	0.00	0.00	0.00	0.00	0.00
13	Education, health and social services	0.00	0.00	0.03	0.01	0.02	-	0.00	0.00	0.00	0.00	0.01	0.02	0.13	0.01
14	Other services	0.00	0.00	0.03	0.00	0.01	0.00	0.00	0.00	0.02	0.01	0.01	0.01	0.01	0.01

Source: Own estimation

Annex VII - Technical coefficient of estimated regional input-output tables for Buenos Aires City

		1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	Agriculture, forestry and hunting	0.06	0.00	0.00	0.02	-	0.00	-	0.00	0.00	-	0.00	0.00	0.00	0.00
2	Fishing	0.00	0.01	-	0.00	-	-	-	0.00	-	-	-	-	0.00	-
3	Mining and quarrying	0.00	0.00	0.03	0.05	0.05	0.07	-	-	0.00	-	0.00	0.00	0.00	0.00
4	Industry	0.11	0.12	0.04	0.18	0.03	0.16	0.01	0.13	0.04	0.01	0.01	0.03	0.03	0.05
5	Water, Electricity and gas	0.00	0.00	0.01	0.01	0.15	0.00	0.00	0.01	0.00	0.00	0.00	0.01	0.00	0.01
6	Construction	0.00	0.00	0.00	0.00	0.00	-	0.00	0.00	0.00	-	0.00	0.00	0.00	0.00
7	Commerce	0.01	0.02	0.00	0.01	0.00	0.02	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.01
8	Hotels and restaurants	0.00	0.01	-	0.00	0.00	-	0.00	0.00	0.00	0.01	0.01	0.04	0.02	0.01
9	Transport and communication	0.01	0.04	0.01	0.05	0.02	0.06	0.04	0.01	0.11	0.06	0.01	0.03	0.01	0.09
10	Financial intermediation	0.01	0.01	0.01	0.01	0.01	0.04	0.07	0.01	0.04	0.14	0.02	0.05	0.00	0.03
11	Real estate, renting and business	0.00	0.02	0.01	0.01	0.02	0.04	0.06	0.02	0.04	0.07	0.02	0.02	0.01	0.07
12	Public administration	0.00	0.00	0.00	0.00	0.01	0.00	0.00	-	0.01	0.00	0.00	0.00	0.00	0.00
13	Education, health and social services	0.00	0.00	0.02	0.00	0.02	-	0.00	0.00	0.00	0.00	0.01	0.01	0.08	0.01
14	Other services	0.00	0.00	0.02	0.00	0.01	0.00	0.00	0.00	0.01	0.00	0.01	0.01	0.00	0.01
BAC Intraregional Consumption		0.21	0.24	0.16	0.35	0.30	0.40	0.19	0.20	0.27	0.31	0.09	0.20	0.16	0.28
BAC Interregional imports		0.15	0.15	0.06	0.11	0.20	0.07	0.15	0.24	0.08	0.02	0.20	0.11	0.22	0.22
BAC Intermediate Consumption		0.36	0.40	0.22	0.47	0.50	0.46	0.34	0.44	0.35	0.33	0.29	0.31	0.38	0.51
BAC Added Value		0.64	0.60	0.78	0.53	0.50	0.54	0.66	0.56	0.65	0.67	0.71	0.69	0.62	0.49

Source: Own estimation

Technical coefficient of estimated regional input-output tables for the Rest of Country

		1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	Agriculture, forestry and hunting	0.09	0.00	0.00	0.12	-	0.00	-	0.00	0.00	-	0.00	0.00	0.00	0.00
2	Fishing	0.00	0.02	-	0.00	-	-	-	0.00	-	-	-	-	0.00	-
3	Mining and quarrying	0.00	0.00	0.04	0.04	0.15	0.17	-	-	0.00	-	0.00	0.00	0.00	0.00
4	Industry	0.18	0.18	0.07	0.29	0.05	0.26	0.00	0.39	0.11	0.04	0.00	0.05	0.06	0.09
5	Water, Electricity and gas	0.00	0.00	0.02	0.01	0.22	0.00	0.00	0.02	0.01	0.01	0.00	0.02	0.00	0.01
6	Construction	0.01	0.00	0.04	0.00	0.00	-	0.00	0.08	0.00	-	0.01	0.02	0.01	0.01
7	Commerce	0.02	0.02	0.00	0.02	0.00	0.04	0.01	0.02	0.02	0.00	0.00	0.00	0.00	0.01
8	Hotels and restaurants	0.00	0.01	-	0.00	0.00	-	0.00	0.00	0.00	0.02	0.00	0.05	0.02	0.01
9	Transport and communication	0.02	0.05	0.01	0.07	0.03	0.08	0.05	0.01	0.11	0.09	0.02	0.03	0.01	0.10
10	Financial intermediation	0.01	0.01	0.01	0.00	0.01	0.04	0.07	0.01	0.03	0.08	0.01	0.07	0.00	0.03
11	Real estate, renting and business	0.00	0.03	0.02	0.02	0.02	0.06	0.08	0.02	0.05	0.05	0.01	0.04	0.01	0.09
12	Public administration	0.00	0.00	0.00	0.00	0.01	0.00	0.00	-	0.01	0.00	0.00	0.00	0.00	0.00
13	Education, health and social services	0.00	0.00	0.03	0.00	0.03	-	0.00	0.00	0.00	0.00	0.00	0.02	0.10	0.01
14	Other services	0.00	0.00	0.03	0.01	0.01	0.00	0.00	0.00	0.02	0.01	0.00	0.01	0.01	0.01
ROC Intraregional Consumption		0.33	0.35	0.27	0.59	0.55	0.66	0.22	0.55	0.38	0.30	0.06	0.31	0.23	0.39
ROC Interregional Imports		0.01	0.04	0.01	0.03	0.02	0.05	0.06	0.01	0.05	0.07	0.01	0.06	0.01	0.06
ROC Intermediate Consumption		0.34	0.38	0.28	0.62	0.57	0.70	0.28	0.56	0.43	0.37	0.07	0.36	0.25	0.44
ROC Added Value		0.66	0.62	0.72	0.38	0.43	0.30	0.72	0.44	0.57	0.63	0.93	0.64	0.75	0.56

Source: Own estimation