Local taxes in Buenos Aires City: A CGE approach

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LOCAL TAXES IN BUENOS AIRES CITY: A COMPUTABLE GENERAL EQUILIBRIUM APPROACH

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Abstract:

The aim of this paper is to analyze the spillover effects of national and local tax policies using a static bi-regional general equilibrium model for the Buenos Aires City (BAC) and the rest of Argentina. The BAC represents 7% of the population of the country, but 29% of its GDP.

We analyze the reciprocal impact of fiscal policies on welfare of private agents and the spillover effects on the performance of the public sector of both regions. As expected, the model shows that national fiscal policies do have relevant effects on the activity level of the city and on the welfare of its inhabitants. However, more unexpectedly, it also shows that fiscal decisions at the level of the city have a significant impact on the rest of the country.

The results show that: (i) an increase in BAC local taxes produce a decline in the welfare of households and in the activity levels, in both regions; (ii) an increase in national value added tax decreases the regional GDP in both regions, but in different proportions, and increases the regional unemployment rate. The results differ depending on the type of tax (sales or property). Production elasticities and the rule of indexation of wages are key factors that affect the quantitative and qualitative results.

JEL: C68, D58, H77

Key words: Fiscal Federalism, Computable general equilibrium, Regional spillover effects.

1. INTRODUCTION

In recent years, the computable general equilibrium (hereafter CGE) models for different regions have become an important area of research in economics. There are several examples of applied CGE models in the literature. To analyze fiscal federalism impacts in Andalusia (Spain), Cardenete (2009) built a bi-regional static CGE model for that region; also Cardenete and Sancho, developed static regional CGE model to study a fiscal reform of an income tax (2001) and the impact of national tax changes (2002). Horridge (1999) uses a dynamic multi-regional general equilibrium model to explore the effects of an increase in population and the rise in transport costs in urban areas of Australia. Nakayama and Kaneko (2003) constructed a dynamic CGE to explain market trading of goods, services, capital and labor in urban and rural areas in Shanghai and Beijing (China).

This paper presents the results of a static bi-regional general equilibrium model for Argentina, prepared to simulate regional fiscal policies. We separate Argentina in two regions, Buenos Aires City (hereafter BAC) and the rest of the country (hereafter ROC). This is the first regional CGE model for the country that takes into account the city of Buenos Aires. We analyze the reciprocal impact of fiscal policies on welfare of private agents and the spillover effects on the performance of the public sector of both regions. As expected, the model shows that national fiscal policies do have relevant effects on the activity level of the city and on the welfare of its inhabitants. However, more unexpectedly, it also shows that fiscal decisions at the level of the city have a significant impact on the rest of the country. This is the first regional CGE model for Buenos Aires City.

Since an Input-Output Tables for Buenos Aires City was not available, substantial work was necessary to separate the national accounts into two specific regional account systems. That was a necessary stage, which was followed by the construction of the model itself (see also Mastronardi, Romero and Chisari, 2012).

The regional representation must take into account not only the location of production activities, but also that of the households who are entitled to receive the remuneration of factors of production as well as where they make their expenses. This is relevant to determine the general equilibrium effects of tax policies since the place where income is generated can be different from the place where consumption is realized. Moreover, additional effort was necessary to estimate the distribution of ownership of factors of production between households of BAC and ROC.

The model has ten sectors of activity and two types of household (rich and poor) in each region. Moreover, it includes an external sector (that trades separately with each region), a local government for BAC that makes decisions of local fiscal policy in BAC region and a national government that determines the national fiscal policy and local fiscal policy in the rest of the country.

We intend to study regional differences in terms of welfare and profit margin in changes on fiscal policy. The idea is to measure the winners and losers when the central government changes its policies (mainly taxes for Buenos Aires and the rest of the country), or when local government changes their tax policies. Therefore, we use the regional CGE model to evaluate the impacts looking for potential spillovers generated in the other region. We analyze specially the effects of changes in important taxes of the country like regional turnover tax (called "Ingresos Brutos") or other regional taxes (decided by local governments) and national value added tax, national import tariffs or national factors taxes (decided by national government).

The model is constructed on a MPSGE platform and it is based on a previous work of the authors (e.g. Chisari *et. al.* (2010)).

The paper is organized as follows. First, in section 2, the paper shows calibration methods to compute the RSAM. Secondly, in section 3, we present the multiregional computable general equilibrium model and thirdly, fiscal policy scenarios are presented in section 4. Finally, in the section 5 we present conclusions based on the results of the preliminary model.

Socio-Economic characteristics of Buenos Aires

In 1994, BAC became me 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 7.2% 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[1]. The regional Gross Domestic Product (hereafter GDP) of BAC is about 60 billions of dollars and it represented about 29% of Argentina's GDP at market prices of 2006, the 39% of Argentina's consumption and only 1% of Argentinean exports[2]. Moreover, Buenos Aires is the richest region of the country with a GDP per capita of U$20,000, when the average of Argentina is about U$6,500.

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

[2] We considered only exports of goods for BAC, as a consequence of data constraint.

Table 1 – BAC and ROC relative shares in terms of Argentinean indicator (In millions of Argentinean Pesos)

Indicator	BAC	ROC	Argentina
Population	0.07	0.93	40,117,096
GDP *	0.29	0.71	654,439
Consumption	0.39	0.61	465,429
Investment	0.20	0.80	152,838
Exports**	0.01	0.99	162,035

Source: Instituto Nacional de Estadísticas y Censos and Dirección General de Estadística y Censos (Ministerio de Hacienda GCBA). *At market prices of 2006. ** Only exports of goods have been computed for BAC.

As regards governments, Table 2 examines the source of revenues of BAC government using local taxes and the source of revenues of national government, which collect national taxes in every region and local taxes in the ROC. The taxes on sales are the 89% of BAC government revenues (turnover local taxes –Ingresos Brutos- are the 72% of total). Value added tax (VAT) has an important share in BAC (45%) when we see the final consumption (objective of the tax). When we examine the other taxes on sales, ROC pays 75% of it. This happened because of exports properties, because ROC exports the 99% of total exports. If we compare the taxes collected in households, we observe that the 7.2% of the population pay the 43% of national taxes on households.

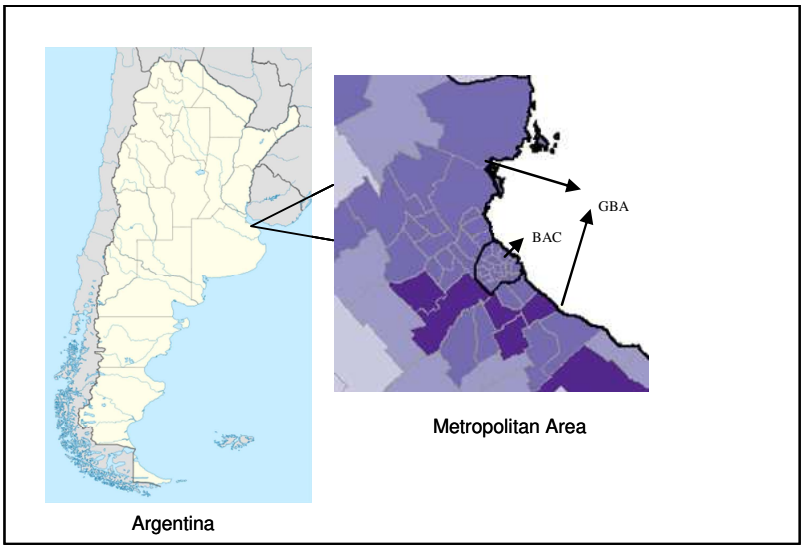
Table 2 – Sources of revenues for both governments. In shares of total and in millions of Argentinean pesos.

Indicator	Region share		Structure	
	BAC	ROC	BAC	ROC
Revenues of National Taxes (Millions AR$)	**53,271**	**104,404**	**1.00**	**1.00**
VAT	0.452	0.548	0.33	0.20
Other Sales taxes	0.254	0.746	0.42	0.63
Households	0.434	0.566	0.26	0.17
Revenues of Local Taxes (Millions AR$)	**6,169**	**19,759**	**1.00**	**1.00**
Turnover taxes (Ingresos Brutos)	0.238	0.762	0.72	0.71
Other Sales taxes	0.241	0.759	0.17	0.16
Taxes on Households	0.243	0.757	0.11	0.13

Source: INDEC and Ministerio de Hacienda (GCBA).

In relation to the job market, BAC has many *commuters* from Great 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 due to the fact that where the people work, where the people live and in which proportion that people consume and invest in each region must be separated. At this point, Table 3 presents statistics of occupied people in the metropolitan area (BAC and GBA). It differentiates where people work and where people live.

Table 3 – 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 3 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. DATABASE AND CALIBRATION: THE REGIONAL SOCIAL ACCOUNTING MATRIX (RSAM) FOR BAC

The basic data for the model are obtained from a regional social accounting matrix (RSAM) that in this case also isolates sectors differentiating the area of doing business.

Here we summarize the most critical aspects of data collection and treatment. The Argentinean initial matrix of national intermediate purchases is based on the 1997 data (INDEC, 2001) and it was updated in Chisari *et al.* (2010) for 2006.

Regional input-output tables can be separated in intraregional flows and interregional ones. 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. Then we used two methodological complementary procedures to obtain the intermediate purchases at regional level. Accordingly, hybrid and non-survey methods were used to build these tables. An estimation of interregional and intraregional flows for ten principal sectors is used in each region following the available results on Mastronardi and Romero (2012) and Mastronardi, Romero and Chisari (2012).

Therefore to measure an intrarregional coefficients for each region we based our estimations on non-survey techniques such as Location Quotients (especially the Augmented Flegg's Location Quotient –AFLQ-) following Jensen et al. (1978) and Flegg and Webber (1996a, 1996b, 1997 and 2000). Two common alternative ways to balance regional input-output tables, the RAS and the Cross Entropy Method, have been adapted to estimate interregional coefficients.

The distribution of the factor income across income groups is based on the distribution observed in Argentina in 2006 according to household income surveys[3]. Households offer their endowments to the regions in the factor market, i.e. BAC household offer labor and capital to BAC sectors and ROC sectors.

The distribution of the consumption basket per type of goods and services is based on aggregates from a new household consumption survey for 2005. To model the regional imports/ exports of consumption, a representative tourism bundle was constructed on the basis of available data of National Secretary of Tourism and local data of Buenos Aires City Government. This bundle includes consumption of commerce, tourism, transportation and other private services.

In both cases, the factor income distribution and the household consumption (across the sectors), consistent data on consumption and factorial incomes were obtained through cross-entropy method (Robinson, Cattaneo y El-Said, 2001). As for the government expenses distribution between goods and services, data are available for 2006 for the national and provincial governments. Aggregate demand and supply in the SAM are consistent with national and regional accounts.

Information on the government accounts was obtained from the Ministry of the Economy (Oficina Nacional de Presupuesto). Income and expenditures of the public sector

[3] To be more precisely we use the household survey (EPH provided by INDEC) to separate regional incomes accordingly to the microdata.

are consolidated results for the federal administration, the provinces and the municipalities for the rest of country (ROC). For BAC we calculate the government size in the public consolidated results based on the BAC government expenditures. Considering expenditures, government consumption represents around 14% of GDP followed by household transfers (10% of GDP). The "Administración Federal de Ingresos Públicos", "Dirección General de Estadística y Censos" (BAC government) and Provincial ministries, respectively provided the information on national and local taxes.

The model includes 10 production sectors, one for agriculture and primary activities, one for goods and eight for services.

Two factors of productions are accounted for labor and physical capital. Both factors are divided in regional terms (BAC labor, BAC capital, ROC labor and ROC capital). In this paper, the labor is mobile across regional sectors while physical capital is regional sector specific.

Table 4 presents participation of each sector in terms of value added, expenses in inputs and gross output. These sectors are disaggregated in our complete RSAM.

Table 4: Value added in Argentina (2006). Distribution and structure among regions.

Sectors	Region distribution		Region structure	
	BAC	ROC	BAC	ROC
Primary sector	0.06	0.94	0.03	0.19
Manufactures	0.24	0.76	0.17	0.21
Electricity, water and gas	0.22	0.78	0.01	0.02
Construction	0.24	0.76	0.05	0.06
Commerce	0.24	0.76	0.10	0.13
Restaurants and Hotels	0.47	0.53	0.05	0.02
Transport and communication	0.39	0.61	0.12	0.07
Financial intermediation	0.56	0.44	0.10	0.03
Real estate and business	0.51	0.49	0.21	0.08
Public sector and other private services	0.25	0.75	0.17	0.19
Total	**0.28**	**0.72**	**1.00**	**1.00**

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

Table 4 has shown that BAC is more specialized on services sectors, especially in "Financial intermediation and Real estate and business". Other important sectors in their structure are "Transport and communication", and "Public sector and other private services". On the other hand, ROC is more specialized on "Primary sector", "Manufactures" and "Construction".

The RSAM also accounts for the positive result of the trade balance and the current account observed in 2006. The information on the balance of payments was obtained from the "Banco Central de la República Argentina".

A summary of the RSAM of the Argentine regional economy of 2006 is shown in Table 5. This simplified RSAM has activity sectors of each region, two factors, national taxes, local taxes, public and private investment and the rest of the world (ROW). Columns show the decomposition of sales of the budget of every agent, while rows represent markets.

The regional input-output matrix is the sub-matrix of the RSAM that represents transactions between activity sectors (activities, activities). Below this, the matrix of factor demands is presented (factors, activities), followed by the matrix of taxes (national and local ones) paid by activity (taxes, activities). The RSAM separates taxes paid by exports, intermediate uses, final consumption and investments. Finally, the vector of imported purchases is included (ROW, activities)[4]. Totals of rows and columns of each sector are the respective gross output value.

Table 5: Aggregated RSAM for Argentina (2006)

	BAC sectors	ROC Sectors	Factors	Taxes	BAC HH	ROC HH	BAC Gov	ROC Gov	Private Investment	Public Investment	ROW	Total
BAC Sectors	63,572	45,061			161,702	2,844	3,309		19,248	2,787	964	299,487
ROC Sectors	39,104	383,427			4,114	185,095		77,938	82,226	11,904	161,072	944,881
Factors	140,341	354,100										494,441
Local taxes	5,491	17,263			677	2,496						25,928
National Taxes	39,267	84,228			9,540	10,892						143,927
Customs taxes	357	2,352			2,944	3,330			4,765			13,748
BAC HH			99,084				703					99,787
ROC HH			387,367					61,271				448,638
BAC Gov.				6,169				803				6,971
ROC Gov.				177,434								177,434
Investment					27,927	108,892	2,787	11,904			1,328	152,838
ROW-BAC	11,354		2,583		11,332				7,786			33,055
ROW-ROC		58,450	5,407			12,820			24,121			100,798
Surplus	0	0	0	0	118,448	-122,268	-173	-25,518	0	0	29,511	0
Total	299,487	944,881	494,441	183,603	218,235	326,370	6,799	151,916	138,147	14,691	163,363	

Note: BAC: Buenos Aires City; ROC: Rest of the Country; HH: Household; Gov: Government; ROW: Rest of the World

Source: Our estimations based on INDEC, BCRA, AFIP, BAC government data and others.

The factors account shows the income distribution matrix (households, factors), that distributes the remuneration of factors to households. Part of the capital is owned by the rest of the world (ROW, factors).

[4] An important issue is that imports are considered in our model as a composite good. It implies that the imports conform a bundle of tradable goods that each agent (consumer or producer) purchase in the same proportion as a Leontief goods.

For the demand side, we summarize the matrix of regional household expenditures (activities, households), regional government consumption (activities, government), private and public regional investments (activities, investments) and the vector of exports (activities, ROW). The matrices (households, households) and (households, government) correspond to transfers between agents.

Private savings, public savings and foreign savings are added up to finance investments. The row surplus closes the model and it represents the superavit/deficit of every agents; it corresponds to financial transactions as of 2006. For households this surplus is a "bond" that closes the income constraint. For the final model, we will model better the transfers because the amount of superavit/deficit of households is very big. ROC government (national and provinces excluding BAC) has a superavit of 25.518 millions of Argentinean pesos and BAC government has a deficit (after coparticipation bond of 803 millions of Argentinean pesos) of 173 millions of Argentinean pesos. The ROW has a deficit of 29.511 millions of Argentinean pesos which indicates the superavit of Argentinean trade balance in 2006.

3. CHARACTERISTICS OF COMPUTABLE GENERAL EQUILIBRIUM MODEL

The agents of the model are two representative households (rich and poor) and ten production sectors in each region, two consolidated public sectors (BAC government and ROC government –national and the rest of provinces-) and the rest of the world. Each production sector produces one good, using intermediate inputs (of the region or imported from the other region or from abroad) and factors of production of the region (assumed not mobile for this version). Goods (both for final and intermediate use) are differentiated by region (though we consider different degrees of substitutability using nested utility and production functions). The model is flexible to address different elasticities and parameters, as well as different degrees of factor mobility. In addition, different mobility of factors can be taken into account in the model; this is relevant for capital which is taken as fix among the sectors[5]. A description of the model is presented in Appendix A.

There is a detailed decomposition of fiscal sources of revenue, since they are key for the subject of the paper. Therefore, there is a thorough representation of the credit and debits compensations in the VAT.

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[5] This is the consequence of preliminary results. Future research lines will include a fraction of mobile capital among sectors.

Our CGE model has all basic properties of the Walrasian perspective, and it is numerically solved using GAMS/MPSGE[6]. It allows simulating the economy-wide impacts of fiscal federalism in both regions.

It is possible to estimate regional differences in terms of welfare and levels of activity in changes on fiscal policy. The idea is identify winners and losers of tax reforms and spillover between regions. Subsequent modifications in relative prices and the response of activity levels due to elasticities of substitution and mobility of resources can explain why certain industries and technologies expand or contract

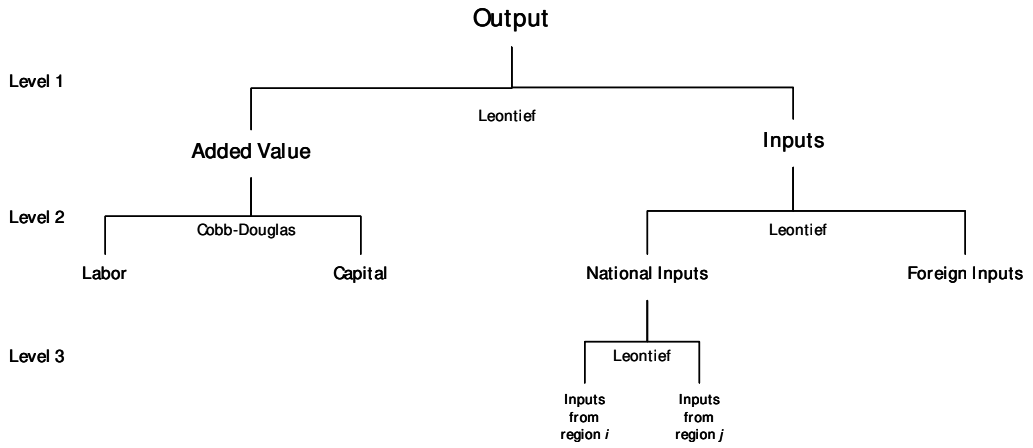
Except for wages (since there is a disequilibrium in the labor market for the benchmark year 2006), prices are computed to simultaneously clear all markets. The model used is a static version of the Computable General Equilibrium for Argentina presented in Chisari *et al*. (2010).

On the supply side, the production function in each sector is a Leontief function between value added and intermediate inputs. The intermediate inputs function is also a Leontief function of all goods, which are strict complements in production. Instead, value added is a Cobb-Douglas function of factors of production (labor and capital specific of the region).

Thus, the output *x* from a region *i* is produced with intermediate consumption added value. Intermediate consumption is represented as a nested Leontief production function. The goods and services are complementary and the elasticity of substitution between them is zero. Value added is represented as a Cobb-Douglas function. The coefficients associated for each factor are their share of participation in the output. Figure 2 shows the structure of production.

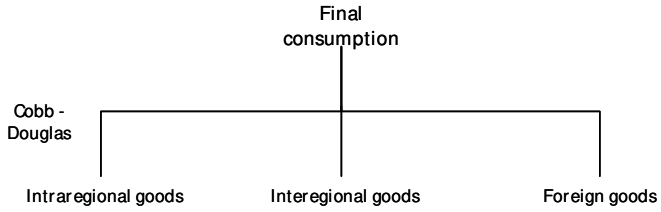
[6] The solution of the model is obtained using the representation of General Equilibrium and using the Mixed Complementarity Approach –see Ferris and Pang (1997) for a survey of the mathematical method and Böhringer and Rutherford (2008) for a recent description on the usefulness to model energy sectors in CGE. The model is developed in the environment of GAMS/MPSGE (see Rutherford (1999)). At present it can be used in interface with GAMS (see Brook *et al*,1992).

Figure 2: Structure of production



The demand side is modelled with four representative households (two in each region divided by income), a national consolidated government, a local government of BAC and an external sector. Households have Cobb-Douglas utility functions and they buy or sell goods and investment goods. The choice of the optimal proportion of the consumption good is obtained from a nested production function into the utility function, through a process of cost minimization.

Figure 3: Structure of final consumption



Each government is represented as an agent that participates in markets for investments, consumes and makes transfers to households and has a Cobb-Douglas utility function; its main source of income is tax collection (though it also makes financial transactions through the bonds account).

The external sector buys domestic exports and sells imports in each region, and collects dividends from investments, and also makes transactions of bonds. This implies that as of the closure rule, there is not trade balance and there are financial compensatory movements of capitals. Though it could be interesting to analyze the results under trade balance, the National Accounts of Argentina showed that the country was still repaying debt at the benchmark year; so the model was calibrated to that case (i.e. for the simulations, the government cannot issue new debt and the trade balance must be positive though it can be variable).

Households decision on the composition of their basket of goods is represented similarly to output structure (see Figure 3). We adopted a nested utility function with an elasticity of substitution equal to 1 (Cobb-Douglas function) between goods though the regions and imported goods.

Regarding factor endowments, capital is fully employed, while there exist eight labor endowments (endowment of labor for region I of household H). That is, at the benchmark it was observed that households of BAC and ROC were supplying labor in the other region, so an endowment of labor used in BAC was attributed to ROC households and reciprocally.

Firms of BAC region use labor of BAC, which is supplied both by households of BAC and from ROC. For this version, it was assumed that households cannot transform the endowment of labor specific of a region into labor used in the other (though this can be accommodated via the construction of an aggregate of labor with different elasticities of transformation).

The modeling of unemployment is quite important for the case of Argentina. The assumption of full-employment could modify the evaluation of benefits of trade liberalization (see Diao *et al.* 2005) for in full-employment models, increased demand for labor (from increased activity and exports) leads to higher real wages, such that the origin of comparative advantage is progressively eroded; but in models with unemployment, real wages are constant and exports increase is higher. An important issue of the model is that includes different unemployment rates among the regions.

4. RESULTS OF SIMULATIONS

In this section, main results from four tax policy simulations are presented in terms of impacts on real GDP, real investment, real private and public consumption (at regional and national level) and impacts on employment, activity level, welfare of the government and of different household categories at regional level. The results of simulations are measured as deviations from the base calibration data[7].

The tax policy simulations are the following:

1. Increase in BAC local sales taxes (10%).
2. Increase all taxes (national and local ones) in both regions (10%).
3. Increase local taxes on Households of BAC (10%).

[7] The unemployment rate for BAC calibration was 9.10% and for ROC calibration was 11.40%. Data was obtained from INDEC stats.

4. Increase of national VAT (both regions) (10%).

As we mentioned before, we want to analyze the spillover effects of national and local tax policies. Since the result can be sensitive to the rule of indexation of wages under unemployment, in the subsection 4.1 we will focus on the case of nominal wages (herafter scenario i.) and explore what happens when wages follow some rule of indexation in the subsection 4.2.

4.1. Spillover effects under nominal wages.

Table 6 shows the results of the simulation for the case of minimum nominal wages. We observe that when BAC changes her tax policy it has a negative effect on the rest of Argentina (see results from simulation 1). In addition, when the national government changes the taxes structure (as we see on simulations 2 and 4), BAC region suffers negative spillovers and it is more affected than ROC region.

When we focus in the results from the first simulation, we can see that the BAC's GDP rises less than ROC's GDP so it can be said that this policy of BAC taxes is detrimental in ROC region. The tax increase augments investments, local employment and government welfare in the region but it decreases the activity level of primary sector and manufactures and the households welfare in the region and worsens all the indicators of ROC. At national level, we observe that the policy decreases real GDP, investment and consumption.

Table 6: Results from tax policy simulations using nominal wages indexation.

Nominal wages								
Simulation	**1**		**2**		**3**		**4**	
National Indicator	**Argentina**							
GDP	-0.10%		-3.48%		0.01%		-0.85%	
Real investment	0.03%		-1.41%		0.02%		-0.59%	
Public and Private Consumption	-0.04%		-1.27%		0.00%		-0.30%	
Regional indicator	**BAC**	**ROC**	**BAC**	**ROC**	**BAC**	**ROC**	**BAC**	**ROC**
GDP	-0.01%	-0.14%	-4.96%	-2.89%	0.02%	0.00%	-1.15%	-0.73%
Real investment	0.67%	-0.10%	-2.18%	-1.22%	0.10%	0.00%	-0.80%	-0.53%
Public and Private Consumption	0.13%	-0.15%	-3.20%	-0.01%	0.00%	0.00%	-0.70%	-0.04%
Unemployment rate	8.83%	11.43%	13.24%	11.64%	9.06%	11.40%	9.47%	11.08%
Activity level Primary Sector	-0.11%	0.00%	-2.02%	-0.50%	0.00%	0.00%	-0.29%	0.00%
Activity level Manufactures	-0.11%	-0.02%	-1.43%	-3.09%	0.00%	0.00%	0.07%	0.00%
Activity level Services	0.12%	-0.03%	-1.37%	0.49%	0.02%	0.00%	0.03%	0.47%
Welfare of HH poor	-0.01%	-0.09%	-2.39%	-1.66%	0.02%	0.00%	-0.44%	-0.07%
Welfare of HH rich	-0.14%	-0.04%	-3.44%	-3.00%	-0.03%	0.00%	-0.62%	-0.49%
Welfare of Government	6.65%	-0.04%	6.62%	3.80%	0.82%	0.00%	0.27%	1.11%

Source: Our estimations.

An increase of taxes on sales in BAC region generates a rise in relative terms of the activity level of the construction sector (principal component of investment) and public service and other services.

This explains the positive effect on the real investment in BAC, this helps also to decrease the rate of unemployment in BAC.

In addition, the increase in the BAC taxes (and the impossibility of substitutability on the inputs) increases input producer prices in both regions. Hence, for the Argentinean economy there is an increase of export costs and consequently there is a deterioration of trade surplus (also explained by the reduction of the relative cost of imports).

This explains the negative spillover effect on the GDP, investment and consumption in ROC.

On the fiscal side, the BAC government is better because of the additional revenue that compensates scale effects. ROC government instead is worse because its revenue falls due to the decrease on the activity level of the sectors and principally on the exports.

From the second simulation, we conclude that an increase in all taxes in the economy produces negative spillovers for BAC region. This is because BAC agents pay higher costs in the form of additional taxes that are collected by ROC national government.

Consistently, the decline of welfare of ROC household is less than BAC household. It is a consequence of the greater increase (4%) on the BAC's unemployment rate that hurts the welfare of the BAC's household. Both governments are better because the increase on the revenue allows an increase on the public consumption and investment.

When we analyze the third simulation, general equilibrium effects are not significant because an increase on BAC's household taxes only generates very low income effects and small or negligible crowding out effects on the real investment. The BAC government improves it welfare and the activity level of services is increased by public sector and other services. Rich households of BAC see their welfare reduced because they pay principally the taxes on real estate property and cars. On the contrary, poor households are better because they receive additional transfers from BAC government (this is a result of the assumption that the governments have a Cobb-Douglas utility function).

Finally, when we examine the increase on VAT taxes from ROC government, the conclusions are similar to those of the second simulation.

4.2. Sensibility of the spillover effects: a comparison among scenarios

Under unemployment, the inclusion in the model of a rule of indexation is necessary for the walrasian mechanism in the labor market is suspended, and therefore the model has to be completed with the addition of an equation to determine wages. We have observed that the results of the model are sensitive to the rule of indexation of wages, especially regarding the rate of unemployment and the welfare of households. The sensitiveness is less significant for the activity levels and for the fiscal spillover effects, which are quite robust.

We consider two benchmark cases of indexation: fixed nominal wages and fixed real wages. The first case is simpler to represent, and entails only the specification of a minimum nominal wage level[8]. The second one requires a more thorough examination because it is necessary to specify the index of prices (local or national) that is going to be used.

And that is not neutral for the results since the industrial structure of a region can be different from the relative composition of the basket of goods considered in the index of prices; for example, a region could be specialized in services while wages could be indexed to a basket with a high proportion of agricultural goods, and depending on the change in taxes the reaction of relative prices of those groups of goods could be different. In turn, those structural differences will explain then the relative differences in rates of unemployment and in welfare of households belonging in the regions. For our work, we take the assumption that real wages will be fixed using the index of prices from the bundle of consumption from poor BAC household.

In addition, the impossibility of substitution between BAC goods and ROC goods at output level maybe strengthen the spillover effects. To analyze this case we evaluate a "long run" scenario which allows substitution of inputs between regions for five sectors of production (Primary sector, Manufactures, Transport, Real estate and Financial intermediation) at the intermediate consumption level[9]. The substitution is represented with an elasticity of substitution 1 between regional inputs (Cobb-Douglas production function).

To compare with the basic case presented in the previous section, we considered two scenarios:

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[8] The results of this benchmark were in the previous subsection.

[9] It represents the 63% from BAC structure of GDP and 58% from ROC structure of GDP.

a. Scenario i: fixed real wage. Short-run effects: Leontief elasticity at the third level of output (see Figure 2)
b. Scenario ii: fixed real wage. Long-run effects: Cobb-Douglas elasticity at the third level of output (see Figure 2).

The results from scenario i. are shown in Table 7. If we compare the results from the first simulation, we see that activity levels and GDP in both regions are lower than the benchmark case.

Table 7: Scenario i. results from tax policy simulations.

Scenario i.: real wages short run								
Simulation	**1**		**2**		**3**		**4**	
National Indicator	**Argentina**							
GDP	-0.18%		-3.94%		0.00%		-1.33%	
Real investment	-0.02%		-1.68%		0.02%		-0.87%	
Public and Private Consumption	-0.13%		-1.82%		-0.01%		-0.87%	
Regional indicator	**BAC**	**ROC**	**BAC**	**ROC**	**BAC**	**ROC**	**BAC**	**ROC**
GDP	-0.15%	-0.20%	-5.78%	-3.21%	0.01%	0.00%	-2.01%	-1.06%
Real investment	0.57%	-0.17%	-2.80%	-1.40%	0.09%	0.09%	-1.44%	-0.72%
Public and Private Consumption	0.01%	-0.23%	-3.88%	-0.48%	-0.01%	-0.01%	-1.41%	-0.51%
Unemployment rate	9.00%	11.52%	14.20%	12.19%	9.07%	11.41%	10.51%	11.65%
Activity level Primary Sector	-0.19%	-0.02%	-2.45%	-0.67%	0.00%	0.00%	-0.74%	-0.17%
Activity level Manufactures	-0.18%	-0.12%	-1.84%	-3.69%	0.00%	-0.01%	-0.36%	-0.62%
Activity level Services	0.01%	-0.14%	-2.05%	-0.20%	0.01%	-0.01%	-0.60%	-0.22%
Welfare of HH poor	-0.14%	-0.28%	-3.16%	-2.84%	0.01%	-0.01%	-1.24%	-1.29%
Welfare of HH rich	-0.23%	-0.07%	-3.97%	-3.21%	-0.04%	0.00%	-1.18%	-0.72%
Welfare of Government	6.52%	-0.12%	5.80%	3.26%	0.81%	-0.01%	-0.51%	0.58%

Source: Our estimations.

This pulls up the rate of unemployment rate in both regions, deteriorates the terms of trade in Argentina and consequently households lose welfare more than in the nominal wages case. The tax policy has a lower effectiveness than nominal scenario because the increase in the BAC government welfare is lower.

If we look now to the second and the fourth simulations, we see that the effects of a tax increase are stronger: the activity levels are lower and households lose more welfare than in the nominal wages case. There is also a reduction in the gains of the governments because real wages increase their payroll costs.

There are no significant implications for the third simulation when wages are adjusted in real terms.

In general, we observe that spillovers effects (for ROC on first simulation and for BAC on third and fourth simulation) are more intensive and they have the same qualitative impact than in the nominal wages case.

The results from scenario ii. are shown on Table 8. The effects on the activity levels have smoothed with the possibility of substitution on the regional output. This implies that the spillover effects (for ROC in the first simulation and for BAC in the second and fourth simulation) are lower than scenario i. but they are greater than nominal wages case because it is important the effect of indexation of wages. Moreover, the effectiveness of the tax policy is lower because the demand of goods on the region which has change the policy are lower in relative terms as a consequence of input substitution.

Table 8: Scenario ii. results from tax policy simulations.

Scenario ii. : real wages long run								
Simulation	**1**		**2**		**3**		**4**	
National Indicator	**Argentina**							
GDP	-0.18%		-4.11%		0.00%		-1.39%	
Real investment	-0.01%		-1.86%		0.02%		-0.93%	
Public and Private Consumption	-0.13%		-2.02%		-0.01%		-0.93%	
Regional indicator	**BAC**	**ROC**	**BAC**	**ROC**	**BAC**	**ROC**	**BAC**	**ROC**
GDP	-0.17%	-0.18%	-5.54%	-3.55%	0.01%	0.00%	-1.91%	-1.19%
Real investment	0.56%	-0.16%	-2.75%	-1.63%	0.09%	0.09%	-1.41%	-0.80%
Public and Private Consumption	0.00%	-0.22%	-3.88%	-0.80%	-0.01%	-0.01%	-1.40%	-0.62%
Unemployment rate	9.04%	11.52%	13.85%	12.40%	9.07%	11.41%	10.37%	11.73%
Activity level Primary Sector	-0.17%	-0.02%	-2.13%	-0.69%	0.00%	0.00%	-0.64%	-0.18%
Activity level Manufactures	-0.17%	-0.11%	-2.01%	-3.81%	0.00%	-0.01%	-0.42%	-0.67%
Activity level Services	0.00%	-0.14%	-2.00%	-0.48%	0.01%	-0.01%	-0.58%	-0.33%
Welfare of HH poor	-0.15%	-0.28%	-3.34%	-3.32%	0.01%	-0.02%	-1.29%	-1.46%
Welfare of HH rich	-0.23%	-0.07%	-4.01%	-3.36%	-0.04%	0.00%	-1.19%	-0.77%
Welfare of Government	6.49%	-0.12%	5.84%	3.14%	0.81%	-0.01%	-0.50%	0.55%

Source: Our estimations.

5. CONCLUSIONS

This paper presents a computational evaluation of the impact of national and regional tax policy for two regions in Argentina (BAC and ROC).

The main findings of the paper are:

- As expected, increases in national taxes (as VAT) or local taxes in ROC produce a negative spillover effect on the welfares of households and local public sector of BAC.
- More surprisingly, increases of local taxes in Buenos Aires (e.g. the turnover tax) reduce welfare of households and public sector of the rest of the country in a significant magnitude.

- A generalized increase in taxes in both regions also causes a negative spill over effect on BAC.
- There are no relevant general equilibrium effects when local taxes on households property of real estate and cars are increased.

Those results were obtained assuming that nominal wages are constant (since there is unemployment it is necessary to specify an non-market rule for the determination of wages) and that the elasticity of substitution is zero between intermediate inputs from different regions.

When we relaxed those assumptions we found that:

- If wages are constant in real terms the spillover effects (for ROC on first simulation and for BAC on third and fourth simulation) will be more intensive though they will have the same qualitative impact than in the case of minimum nominal wages.
- Positive elasticities of substitution between the same kind of input produced in BAC and in ROC compensate the negative effects of regional tax hikes, and reduce the magnitude of the spillover effects.

There are still many cases to explore, and several sensitivities to be studied in our future work. One of the main scenarios to study is the inclusion of mobility of factors between both regions. That is very relevant to understand the long run effect for comparative fiscal policies and tax competition between the regions. However, this paper is a first step since up to now there was not a RSAM available for BAC, a consistent separation of BAC of the ROC in the National Accounts of Argentina, and consequently it was not possible to conduct an evaluation of fiscal spillovers in a CGE framework.

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Appendix A: Model Structure

This section presents a simplified version of the model. Let us consider an economy with *H* domestic agents (in our case two for each region divided by income groups). His utility function depends on consumption of domestic goods and services of the *j* regions (c_j)[10], imported goods (m), bonds held by households (b), and labor supply (L_j^s).

Each household maximizes her utility function [$u_H (c_1, c_2, m, b, L_j^s)$] subject to the budget constraint. Assuming optimal conditions, the agents equalize the marginal rate of substitution to relative prices. The budget constraint of the domestic agent can be written as:

$$[1] \qquad \sum_{j=1}^{2}(1+t_n+t_j)\,p_j c_j + p_m m + p_b b = \sum_{j=1}^{2} w_j L_j^s + \sum_{j=1}^{2}\pi_j \eta_j + \sum_{j=1}^{2} r_j K_j \varphi_j + p_b b_0$$

While w_j represents wages in the *j*th region, L_j^s is the supply of labor in the *j*th region, and π_j stands for profits in the industries producing goods and services in region j, respectively. η_j and θ_j represent shares of domestic agents in profits and in capital in each one of them ($0 < \eta, \varphi < 1$). Equation [2] assumes that the consumers only pay national and local taxes in the purchase of domestic tradable goods. This is a simplification given that the model includes several other taxes observed in the economy. The last term reflects the initial bonds held by the household. The general model includes also investment decisions of households.

PRODUCERS

The equilibrium condition for the market of good *j* is given by:

$$[2] \qquad x_j + \sum_{i=1}^{2} c_{j,i} = F\left(L_j, K_j\right),$$

where F is the production function of domestic goods produced in the *j*th region c_j and exports to the rest of the world x_j, in terms of capital and employment demanded

Profits of the industry are:

$$[3] \qquad \pi_j = p_j\left(x_j + \sum_{i=1}^{2} c_{j,i}\right) - w_j L_j^d - r_j K_j^d$$

where r_j indicates capital remuneration in the *j*th region and w_j represents wages in the *j*th region. The maximization conditions of benefits are:[11]

$$[4] \qquad p_j F_{K_j} - r_j = 0,$$

$$[5] \qquad p_j F_{L_j} - w_j = 0,$$

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[10] In this paper we differentiate the region BAC (c_1) and the region ROC (c_2).

[11] We assume that the degree of homogeneity of F is less than one.

when the levels of capital use and labor are determined optimally. In equilibrium the demand of factors are equal to the supply of them, i.e the demand of labor in the *j*th region must be equal to the supply of labor from *I* regions.

[6] $$L^{d}{}_{j} = \sum_{i=1}^{2} L^{s}{}_{i} ,$$

[7] $$K^{d}{}_{j} = \sum_{i=1}^{2} K^{s}{}_{i}$$

Under unemployment , equation [6] is replaced with a rule of wage determination, e.g. $w \geq 1$, when nominal wages have a minimum level.

BAC PUBLIC SECTOR

The Public Sector of BAC has a budget constraint given by:

[8] $$t_j p_j \mathrm{c}_j + p_b b_0^{G_j} + T = \mathrm{w}_j \mathrm{L}_j^{\mathrm{G}_j} + p_b b^{G_j} \quad for\ j = 1 .$$

The left side represents local tax revenue in BAC, as well as bonds sales and transfers received from the national government. The right side represents the purchases of labor and bonds (so that there is a net position in bonds given by $b^G - b^G{}_0$). Notice that here we assume that the government is not participating actively in the markets for goods or services, although that does not occur in the general model. In this simplified case, the government collects taxes and uses the proceedings to hire workers and repay debt (the general model includes investments and government consumption).

NATIONAL PUBLIC SECTOR

The Public Sector in the rest of country includes provinces and national public sector. It has a budget constraint given by:

[9] $$\sum_{j=1}^{2} t_j p_j \mathrm{c}_j + \sum_{j=1}^{2} t_n p_j \mathrm{c}_j + \sum_{j=1}^{2} \mathrm{t}_{\mathrm{x}} x_j + p_b b_0^G - T = \sum_{j=1}^{2} \mathrm{w}_j \mathrm{L}_j^{\mathrm{G}} + p_b b^G \qquad for\ j = 1,2 .$$

The left side represents local (ROC) and national tax revenue, including export taxes, as well as bonds sales minus the transfers paid to BAC government. The right side represents the purchases of bonds (so that there is a net position in bonds) and labor which are demanded in the two regions at different prices. Notice that here we assume that the government is not participating actively in the markets for goods or services, although that does not occur in the general model. In this simplified case, the government collects taxes and uses the proceedings to hire workers and repay debt (the general model includes investments and government consumption).

EXTERNAL BALANCE

Note that in this version, the external sector does not buy domestic bonds, which is also a strong assumption that we leave aside in the general model. Given these assumptions, we can obtain an equilibrium in the following current account as:

[12] $$p^x x = p_m m + \sum_{j=1}^{2} (1-\varphi_j) r_j K_j + \sum_{j=1}^{2} (1-\eta_j) \pi_j .$$