# Inter-provincial trade in Argentina: financial flows and centralism.*

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**Abstract**

This paper is part of a broader agenda and constitutes a first step to empirically understand the main determinants of the inter-provincial trade in Argentina. We use a novel database of regional trade flows between the 24 Argentinean provinces for 2017. Using a structural gravity model and novel econometric techniques we analyze the main variables influencing trade between the provinces. In addition to the traditional variables of the canonical gravity model we add some variables of interest that ca possible affect trade between sub national jurisdictions. With an especial focus in financial flows we analyze the impact of co-participation transfers, income distribution and household's payment methods, among other variables that may be correlated with formal trade. Additionally, we analyze the potential impact of trade concentration in the Autonomous City of Buenos Aires (CABA) and Buenos Aires. Trade flows are analyzed considering both, origin and destination. The results indicate that national transfers from the redistribution federal arrangement are an important determinant of inter provincial trade generating relevant (and negative in the origin) spillover effects between the provinces. Also, the concentration in CABA and Buenos Aires discourages inter-provincial trade.

**JEL Classification**: R10, F14, C21.

**Keywords**: Gravity Model, Spatial Interactions, Redistribution Federal Arrangement.

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# 1 Introduction

The international evidence shows that trade between provinces and sub national regions are economically relevant (McCallum, 1995 and Wei, 1996). As emphasized by Álvarez et al. (2018) and as in the case of international trade, economic literature indicates that bilateral trade is one important driver of productivity, catalysts of innovation and economic growth. Also, there is evidence that shocks originating in regions or provinces can spread at the macroeconomic level through trade flows of inputs, goods and services. Financial flows and population migration may be relevant and interact with trade flows to spread economic shocks between sub national jurisdictions (Caliendo et al., 2018). [1] The interaction between shocks of local and national origin provides relevant information for the implementation of macroeconomic policies, which are usually uniform (*"blind"*) at the national level, and designed based on a set of information that should consider the mentioned transmission channels between regions.

Despite its relevance, in our country there are no official statistics on trade between provincial jurisdictions. The countries that have this type of information use surveys or registries. In some cases, the data are based on transportation surveys (or registries) [2], in other, taxation information is used. [3] In the case of our country, as analyzed by Elosegui & Pinto (2018), the information from the Multilateral Agreement on Gross Income Tax (IIBB), established in art. 9 of the Coparticipation Law, offers a unique opportunity to approximate the flows of trade in goods and services between the provinces, since it establishes a uniform criterion for the tax base allocation of provincial turnover tax (IIBB) between the provincial jurisdictions. Based on that methodology and with a more comprehensive national database from the same source, Colina (2019) calculates trade flows for all the provinces in 2017.

In this paper we use that novel database and empirically apply a gravity model to analyze inter-provincial trade for all provinces during year 2017. We analyze the main determinants of trade flows between the provinces, adding to a canonical gravity model several variables that can possibly affect trade between sub national jurisdictions. We take into account the asymmetric economic structure of the economy, highly concentrated in the Autonomous City of Buenos Aires (CABA, from its Spanish initials) and the Buenos Aires province. As we will see, a long lasting feature, which has not been analyzed yet, considering the role of trade between the provinces. In particular, we focus on the impact of financial flows between the provinces, especially those related to transfers aimed to reduce such asymmetries.

The financial flows and the interaction of those flows with inter-provincial trade approximate the relevance of certain regional shocks that can have important consequences

[1] In fact, (Caliendo et al., 2018) indicate that in U.S. the geography of economic activity is actually relevant and the aggregate economic cost of their estimated domestic trade barriers is large both in GDP and productivity terms. See their Appendix Table A7.2 page 2088.

[2] Commodity Flow Survey (CFS) in U.S., https://www.census.gov/programs-surveys/cfs.html.

[3] For example, the "Balanca Comercial interestadual" in Brazil, https://www.confaz.fazenda.gov.br/balanca-comercial-interestadual.

at the aggregate level. To understand the scope of these shocks and their spread to the rest of the economy, it is necessary not only to quantify the degree of economic and trade interrelation between the regions but also to control for the main determinants, including structural economic and financial aspects. The greatest limitation, until now, to develop this task has been the lack of availability of information about inter-provincial trade. Precisely, the type of information that is introduced in this work for the first time for the entire country. It should be noted, that the dataset is based on tax information and it only reflects formal trade of goods and services. In addition, most (but not all) of the formal trade is transacted trough formal financial services, including credit transactions. [4]

Although regional shocks may not be transferred to the rest of the economy, they may have a differential impact on the local economy depending on the economic structure of the different regions or provinces (Blanco et al., 2019). In particular, the database reveals the high relative importance of the main jurisdictions of CABA and Buenos Aires, with respect to the rest of the provinces. This relative asymmetry in size and economic diversification is relevant when considering the potential impact of shocks originating in the provinces, including financial shocks on the economy in general.

The rest of the paper is organized as follows. The second section introduces the main literature and the evidence analyzed with similar models in other economies. Results indicate the relevance of considering trade between provinces, including the interaction between internal trade and fiscal transfers. In the third section, we introduce the novel data set and describe the concentration of economic and social variables and trade. Section fourth introduces the theoretical framework for our empirical application. In the fifth section, the empirical approach is introduced, with the main characteristics of the adaptation of the canonical model to the database and the characteristics of the economy under analysis. Section six includes the estimation results and their analysis. Finally, in section seven, we introduce the main conclusions and the next steps of this research agenda.

## 2 Literature

Argentina is a federal country characterized by a strong asymmetry in the economic development of its provinces. This is a long-standing situation and it has been analyzed by prestigious scholars, like Bunge (1940). He described the regions as a "*folding fan*", with the head in Buenos Aires Port (the main center) from which the socioeconomic indicators decreased with distance (see Asiain, 2014). Since the national organization, with the Constitution of 1853 and 1860, fiscal federalism went through several stages until reaching the current co-participation scheme (Porto, 2018). The current system delimits the fiscal powers of the provinces and the Nation, establishing a "*primary*" distribution between

[4] The extent of informal economy and the use of cash in transactions are correlated and show variations between the provinces (Elosegui et al., 2021).

them and then a "*secondary*" distribution between the provinces. In this scheme, the nation maintains powers to make certain transfers to the provinces. However, it is the secondary distribution the one that establishes the main redistributive mechanism from the richest to the less developed provinces. Also, the provinces keep to themselves the collection of local property taxes and the turnover tax, the IIBB (Elosegui & Pinto, 2018). Moreover, as has been emphasized by Porto (2018) and Porto & Elizagaray (2011), the co-participation scheme generated a relative convergence of different social indicators. However, after many years the asymmetries remain, and the relative increase in co-participation transfers in favor of lagged regions is not reflected in their relative development. The center regions, CABA and Buenos Aires, still hold a dominant position in socio-economic indicators.

In general, economic asymmetries are measured by comparing synthetic indicators such as per capita GDP or the value added by economic sectors or by using registry information, such formal wages or provincial exports to foreign markets. A complementary alternative to understand the profound differences between the provinces is to analyze the internal trade. In our work, we use this novel database to explore the main determinants of asymmetries in trade between provinces. In particular, we empirically analyze the impact derived from the financial flows of the co-participation scheme, as well as the effect of the marked centralization in CABA and Buenos Aires.

Our initial work, within the framework of a more ambitious agenda, contributes and draws on various related literature. It is the first application to Argentina of the gravity interprovincial trade model, since it uses a novel database. The setting is related to a broad literature that evaluates the (negative) impact of regional borders on trade flows within countries. This literature, with different details on the gravity model approach, include mostly developed federal countries, such as the United States (Head & Mayer, 2010; Yilmazkuday, 2012), European countries as Spain (Requena & Llano, 2010) and France (Combes et al., 2005), also Canada (Tombe & Winter, 2021), and China (Poncet, 2005), among others. In the region, the empirical applications are scarce, as domestic trade information is not readily available. Only in the case of Brazil, we can cite the works by Fally et al. (2010) and Daumal & Zignago (2010), both using the same 1999 domestic trade information. This literature analyzes the extent of border effects and domestic bias in internal trade as well as the internal costs derived from domestic trade barriers, distance and/or asymmetries between provinces. It should be noted, that in federal countries the presence of trade barriers between provinces may be a consequence of the multilevel governance system and does not generally take the form of explicit tariffs or taxes. However, there may be tax competition or discriminatory tax treatments of extraterritorial firms, provincial regulations and/or certifications for local provision of professional services, provincial public procurement regulations that privilege local producers among other factors that potentially generate some type of border effects between the provinces. Also, the provinces may have different coverage of financial services that can affect bilateral trade between the provinces, such as different access to credit and/or formal means of payments.

Finally, there is a closely related literature focused on the impact of federal transfers over the provincial and national economic activity using internal bilateral trade. This type of analysis is not very extended, as Tombe & Winter (2021) emphasizes the large literature on the topic, usually " *abstracts from trade*". In fact, literature mainly focus on the impact of financial transfers on the incentives of workers to migrate. In their very interesting and complete quantitative analysis for Canada, the authors incorporate internal trade to quantify the impact of fiscal financial transfers over provincial and national activity. In the particular case of Canada, they find no evidence that fiscal transfers affect the estimated presence of trade costs and border effects between provinces. However, they uncover an important impact of fiscal transfers on trade flows.

## 3 Dataset

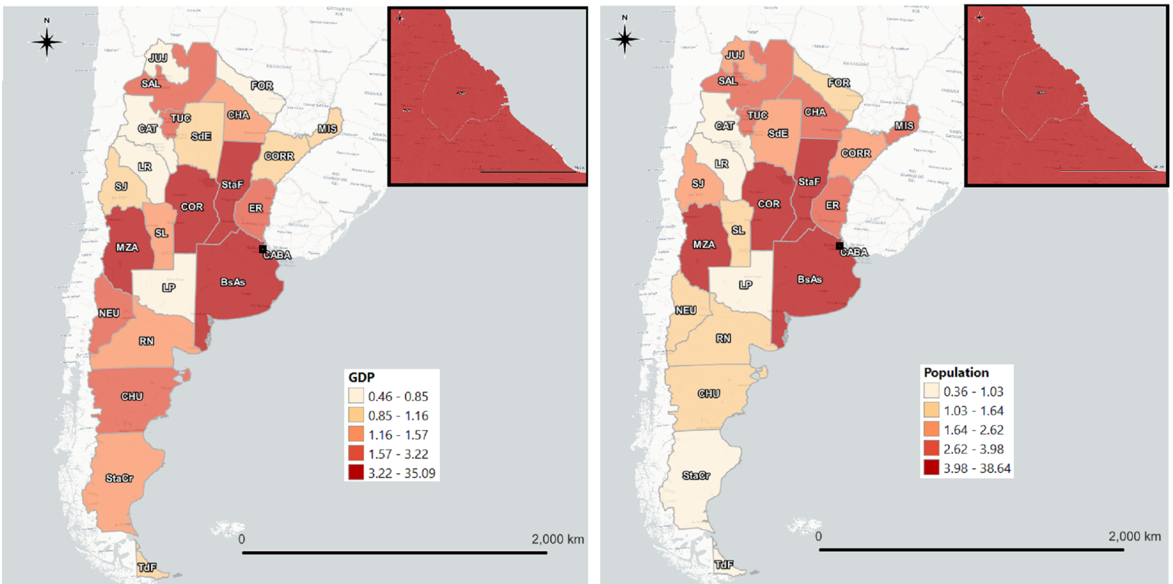
The dataset on internal provincial trade is novel, unpublished and calculated from tax records. The original data comes from the Multilateral Agreement on Provincial Gross Income Tax managed by the Arbitrational Commision (COMARB). [5] This information, based on the provincial turnover sales tax, was processed, as reflected in Colina (2019) and Elosegui & Pinto (2018), to calculate exports and imports of goods and services (including those reached by the aforementioned inter-provincial agreement) between the 24 provinces of Argentina for year 2017. To this novel matrix of trade among provinces we added the within jurisdiction sales (also coming from provincial turnover tax collections) to have a complete cross section of sales within and between provinces. It should be noted that the tax information is reflecting formal transactions. Most of these declared sales come from the automatic retention schemes that operate through the formal financial channels. It should also be noted that provinces have incentives to cross audit and control tax evasion, under reporting and potential fiscal base hoarding arising from non uniform fiscal treatments (Arias, 2011). In fact, there have been substantial progress lately to harmonize the scope of the tax which is auspicious for future processing of this database. As we will show, results remark the relevance of this internal trade information for both national and provincial economic decision making process.

Figure 1 summarizes the geographical distribution of provincial population and economic activity in Argentina. It should be noted that Ciudad Autonoma of Buenos Aires (CABA) (zoomed in a the box) and Buenos Aires province both located at the middle east area of the country are the main economic and social centers. As mentioned before these

[5]The Comisión Arbitral del Convenio Multilateral de Impuesto a los Ingresos Brutos (COMARB) is a federal entity managed by the provinces with the "spirit of ordering the exercise of concurrent tax powers" between the jurisdictions, and to prevent multiple taxation through the distribution of taxable base of the Gross Income Provincial Tax.

social indicators tend to decrease in value for the peripheral provinces, as the distance from the center increases.

Figure 1: Geographical distribution of GDP and population (in percentage).




As can be seen in Figure 2, internal trade among provinces is also highly concentrated in CABA and Buenos Aires, practically a mirror of economic and social concentration. In effect, approximately 60% of total internal trade, including both trade within and between provinces is concentrated in these two provinces. Also, the other two largest provincial economies of the interior of the country Cordoba and Santa Fe show an important level of trade with the rest of the provinces. Indeed, concentration is not too far from the figure used by Bunge (1940), to the extent that the center and the nearby provinces, richer and more populated, are the ones concentrating most of the domestic trade. [6]

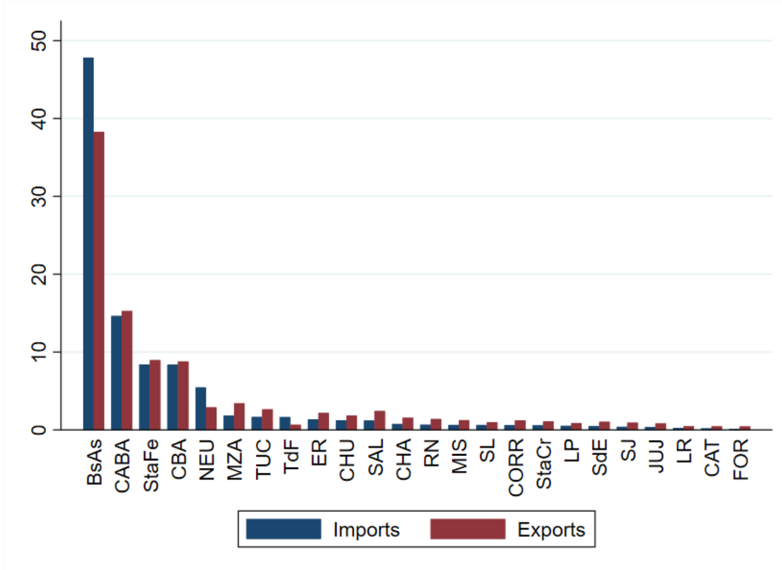
As we will show in the econometric model, inter-provincial trade shows correlation with market dynamics. Therefore, it is interesting to consider a relative measure of bilateral trade between the provinces, such as the localization coefficient. Figure 3 shows internal trade among provinces as measured by the coefficient of localization $LQ_i$ for province $i$, given by:

$$LQ_i \quad = \quad \frac{(T_i/GDP_i)}{(GDP_i/GDP)}, \tag{1}$$

where $T_i$ and $GDP_i$ capture the total interprovincial trade and the gross domestic product for the province $i$, respectively; with $GDP$ as the total sum provincial products.

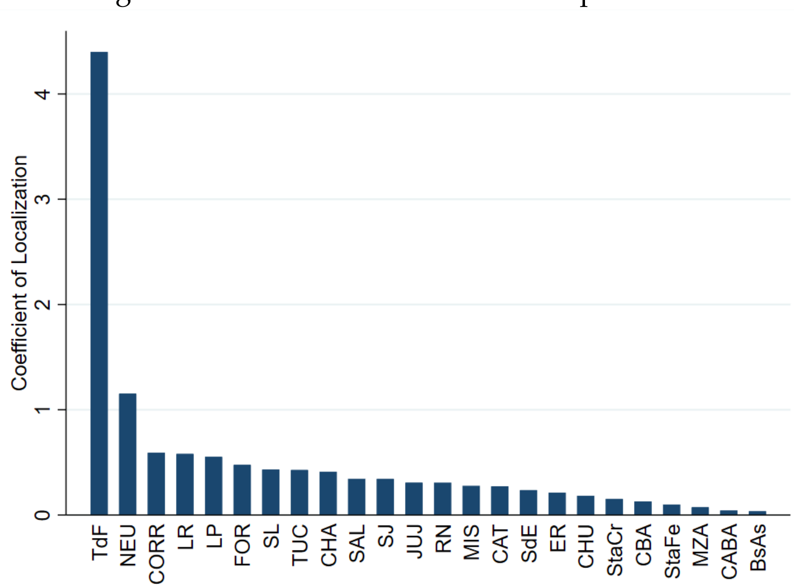
[6] In the Appendix, Table A summarizes the provincial comparison in terms of GDP and Population (%) and Table C indicates the average trade between provinces, including internal transactions (%).

Figure 2: Internal trade among provinces




The internal trade is important for Neuquén and Tierra del Fuego, the two provinces with $LQ > 1$. In the first case, the coefficient is reflecting the important trade of energy resources. In the second case, it is related to the industrial promotion regime of the province, and also the fact that Tierra del Fuego is actually an island. The coefficient is lower than one for all the other provinces indicating that internal bilateral trade seems not to be actually important for the provinces.

Figure 3: Coefficient of localization of provinces



In addition to the internal trade information, we use data from the National Household Survey (ENGHO) of 2017/2018 to measure the extent of the informal economy and the use of formal and informal payments methods by province. In the first case, we calculate the mean income by the two lowest decile to approximate for the informality level at provincial level. In the second case, as proxy for the use of financial services we consider the share of household cash and credit expenditure in each province. Finally, information on provincial GDP and population is from INDEC whereas the co-participation data comes from the National Ministry of Finance.

## 4 Theoretical framework

Our theoretical framework is based on the gravity equation, one of the main econometric technique used by the literature to analyze the bilateral trade and economic factors (Anderson & Van Wincoop, 2003). The model captures the notion that the bilateral trade flow ($T_{ij}$) is determined by important factors related to market dynamics such as the size of the region $i$ and $j$, typically measured by the gross domestic product ($GDP$), or regional income, and the geographical distance between regions (Tinbergen, 1962):

$$T_{ij} = \frac{GDP_i^{\beta_1} \times GDP_j^{\beta_2}}{Dist_{ij}^{\gamma}}. \tag{2}$$

In the literature of regional science, the gravity model has been labelled a spatial interaction model (Sen & Smith, 1995) and it tries to explain the variation in the $n^2$ interaction flows between $n$ regions in a closed regional network. Additionally, the conventional gravity model relies on an $n \times k$ matrix of explanatory variables that we label $X$, containing $k$ characteristics for each of the $n$ regions. The matrix $X$ is repeated $n$ times to produce an $N\ (= n^2) \times k$ matrix representing exporting (origin) characteristics that we label $\mathbf{X}_i$. A second matrix can be formed in similar way to represent importing (destination) characteristics resulting in an $N \times k$ matrix, $\mathbf{X}_j$. Also, different alternatives of distance are used to capture the resistance or deterrence to flow between regions. Using these extensions and applying a log transformation, the equation (1) can be written in general terms as:

$$\ln \mathbf{T} = \beta_0 \boldsymbol{\iota}_N + \mathbf{X}_i \boldsymbol{\beta}_i + \mathbf{X}_j \boldsymbol{\beta}_j + \mathbf{D}\boldsymbol{\gamma} + \boldsymbol{\varepsilon}, \tag{3}$$

where $\ln \mathbf{T}$ is an $N \times 1$ vector of logged flows constructed by stacking the columns of the $n \times n$ flow[7]; $\mathbf{X}_i$ includes $\ln GDP_i$, $\mathbf{X}_j$ includes $\ln GDP_j$, and $\mathbf{D}$ includes a function of the geographical distance and other measures of proximity between regions; $\boldsymbol{\varepsilon}$ is an $N \times 1$ vector of error terms with each element independent and identically distributed, $i.i.d.\ (0, \sigma^2)$.

The gravity models assume that the use of geographical distance and/or other similar proxies, as explanatory variables can eradicate the spatial dependence of the trade flows between pairs of regions. However, this assumption has long been criticized from the perspective of spatial econometrics. (Fischer & Griffith, 2008; LeSage & Pace, 2008). Indeed, the usual spatial econometric approach captures the spatial dependence in the error term by using spatial weighting structures between the $N$ exporting-importing pairs in a manner consistent with the conventional model given by equation (2). Under this perspective, the model can be transformed in the following spatial econometric exporting-importing flow model:

$$\begin{aligned} \ln \mathbf{T} &= \beta_0 \boldsymbol{\iota}_N + \mathbf{X}_i \boldsymbol{\beta}_i + \mathbf{X}_j \boldsymbol{\beta}_j + \mathbf{D}\boldsymbol{\gamma} + \mathbf{u}, \\ \mathbf{u} &= \lambda \mathbf{W}\mathbf{u} + \boldsymbol{\varepsilon}, \end{aligned} \tag{4}$$

where $\mathbf{W}$ is a spatial weighting matrix that represents an $N \times N$ array; $\lambda$ is a scalar parameter capturing the degree of spatial dependence known as the spatial autoregressive parameter in the literature; $\mathbf{u}$ is a $N \times 1$ error vector term and $\boldsymbol{\varepsilon}$ is a $N \times 1$ innovation vector with uncorrelated and homoscedastic innovation terms $(\mathbf{0}_N, \sigma^2 \mathbf{I}_N)$.

It should be noted that spatial econometrics introduces the spatial dependence by using a spatial weighting matrix $W$. The construction of this matrix is something actually important in the field. By convention, this spatial structure is a positive square matrix of order $n$. It is usually pre-specified by the researcher, and describes a hypothesis of a particular interaction of the spatial units in the sample (Anselin, 1988). The elements of $W$, $w_{ij}$, are non-zero when the region $i$ and region $j$ are hypothesized to be neighbors, and zero otherwise. By convention, the diagonal elements, $w_{ii}$, are equal to zero, that is, the self-neighbor relation is excluded:

$$W = \begin{bmatrix} 0 & w_{12} & \cdots & w_{1n} \\ w_{21} & 0 & \cdots & w_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ w_{n1} & w_{2n} & \cdots & 0 \end{bmatrix}. \tag{5}$$

There are many alternatives to create the spatial matrix $W$, In fact, it should be observed that the dimensions of $W$ and $\mathbf{W}$ are different. To obtain the $\mathbf{W}$, in this research we follow this sequence of steps:

[7]Specifically, we apply *vec* operator such as the model of equation (2) is exporting-centric ordering, know as origin-centric ordering in the literature of interaction models. See chapter 8 of LeSage & Pace (2009) for more details.

- First, we create two different matrices using geographical information. The first matrix uses the contiguity criterion (common boundaries) to define the neighbors for each polygon (province), $W_{cont}$. The second matrix is calculated by using the inverse of the squared distances, in kilometers, between provincial capital cities, $W_{inv-dist2}$.

- Second, we combine the two previous matrices into a $W_{mix}$, where every weight is the product of $w_{ij,\,cont} \times w_{ij,\,inv-dist2}$, such as the nearest neighbor (with a common boundary) is more influential than the other neighbors. Therefore, each weight of $W_{mix}$ is defined as:

$$w_{ij,\,mix} \quad = \begin{cases} 0 & if\ i,j\ are\ not\ contiguous. \\ d_{ij}^{-2} & if\ i,j\ are\ contiguous\ neighbors \end{cases}, \tag{6}$$

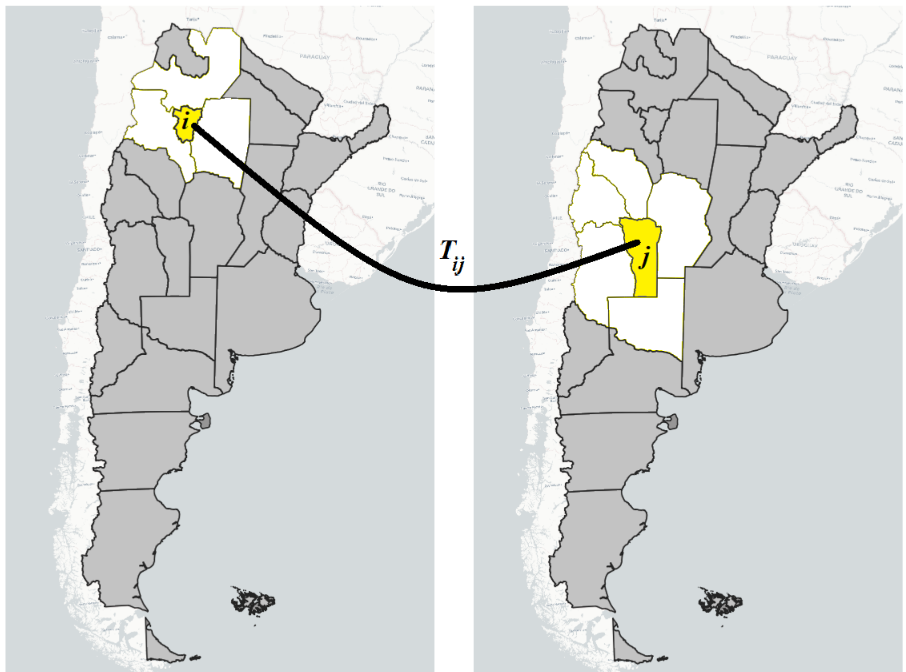
  where $dist_{ij}$ is the distance in kilometers between provincial capital cities $i$ and $j$.

- Finally, we generate two $N \times N$ ($n^2 \times n^2$) matrices that capture two points of view:
  - $\mathbf{W}^i = W_{mix} \otimes I_n$ that captures exporting neighborhood dependence.
  - $\mathbf{W}^j = I_n \otimes W_{mix}$ that captures importing neighborhood dependence.

Figure 4 explains the idea of exporting and importing neighborhood and the spatial dependence. For two particular regions, the traditional model uses the information from region $i$ (in this case Tucuman) and region $j$ (in this case San Luis), $X_i$ and $X_j$, to explain the trade flow (black line). Our spatial econometric extension includes the information from the neighborhood region (white regions): $\mathbf{W}^i$ is created using the neighborhood of the $i-th$ region (graph on the left) and $\mathbf{W}^j$ is created using the neighborhood of the $j-th$ region (graph on the right).

The weighting matrix for the regression models is row-standardized: the sum of weights for each row is equal to one. Also, we perform a robustness check by using an alternative spatial matrix replacing the contiguity matrix by a 4-nearest neighbors matrix (more information about these alternative results are presented in the appendix).

Figure 4: Example of provincial trade and the neighborhood.




Other important issue related to the possible presence of spatial dependence is the distinction between origin and destination factors. Under equation (2), we use Moran's I test (Moran, 1950) to test the null hypothesis that the error term $\varepsilon$ is spatially uncorrelated. When Moran I test is rejected, we explore two specific channels of spatial dependence: (i) a local spatial dependence through the explanatory variables (**WX**); and (ii) a global spatial dependence through the error term (**Wu**). Finally, the model that includes both spatial effects is known as Spatial Durbin Error Model, $SDEM$ (Elhorst, 2014):

$$\begin{aligned} \ln \mathbf{T} &= \beta_0 \boldsymbol{\iota}_N + \mathbf{X}_i \boldsymbol{\beta}_i + \mathbf{X}_j \boldsymbol{\beta}_j + \mathbf{D}\boldsymbol{\gamma} + \mathbf{W}^i \mathbf{X}_i \boldsymbol{\theta}_i + \mathbf{W}^j \mathbf{X}_j \boldsymbol{\theta}_j + \mathbf{u}, \\ \mathbf{u} &= \lambda \mathbf{W}\mathbf{u} + \boldsymbol{\varepsilon}, \end{aligned} \tag{7}$$

where $\boldsymbol{\theta}_i$, $\boldsymbol{\theta}_j$ and $\lambda$ capture the spatial dependence in the explanatory variables (exporting and importing centre) and the error term, respectively; $\boldsymbol{\varepsilon}$ is an idiosyncratic innovation term with each element independent and identically distributed, $i.i.d.\,(0, \sigma^2)$. The inclusion of a spatial error term can help to evaluate the extent of spatial clustering of trade flows that is not explained by the explanatory variables. In this sense, the coefficient $\lambda$ captures the spatial effect of unmeasured explanatory variables and the spatial mismatch scale between the different sources of available information (Anselin, 2002). Also, depending on which **W** is defined in the error term, we obtain two alternatives $SDEM$: $SDEM_{exp}$ if the spatial weighting matrix corresponds to the exporting regions ($\mathbf{W}^i$) or $SDEM_{imp}$ if the spatial weighting matrix corresponds to the importing regions ($\mathbf{W}^j$).

Finally, depending on the linear restriction imposed in equation (7), we can obtain a Spatial Lag in X's model ($SLX$), with $\lambda = 0$:

$$\ln \mathbf{T} = \beta_0 \boldsymbol{\iota}_N + \mathbf{X}_i \boldsymbol{\beta}_i + \mathbf{X}_j \boldsymbol{\beta}_j + \mathbf{D}\boldsymbol{\gamma} + \mathbf{W}^i \mathbf{X}_i \boldsymbol{\theta}_i + \mathbf{W}^j \mathbf{X}_j \boldsymbol{\theta}_j + \mathbf{u}, \tag{8}$$

or a Spatial Error Model ($SEM$), with $\boldsymbol{\theta}_i = \boldsymbol{\theta}_j = \mathbf{0}$:

$$\begin{aligned} \ln \mathbf{T} &= \beta_0 \boldsymbol{\iota}_N + \mathbf{X}_i \boldsymbol{\beta}_i + \mathbf{X}_j \boldsymbol{\beta}_j + \mathbf{D}\boldsymbol{\gamma} + \mathbf{u}, \\ \mathbf{u} &= \lambda \mathbf{W}\mathbf{u} + \boldsymbol{\varepsilon}, \end{aligned} \tag{9}$$

These nested models are tested in the empirical section using LR tests.

# 5 Empirical Approach

In the empirical literature, the basic model of equation (2) is commonly augmented to include additional control variables of interest for both the exporter and the importer regions. Also, the concept of distance is usually extended to a broader group of trade costs that constitutes potential barriers to trade. Our basic gravity model, in logarithm form, is expressed as follows:

$$\begin{aligned} \ln T_{ij} = {} & \beta_0 + \beta_1 \ln GDP_i + \beta_2 \ln GDP_j + \beta_3 CONTIG_{ij} + \beta_4 \ln DIST_{ij} \\ & + \beta_5 \ln POP_i + \beta_6 \ln POP_j + \beta_7 \ln COPA_i + \beta_8 \ln COPA_j \\ & + \beta_9 Quantile12_i + \beta_{10} Quantile12_j + \beta_{11} GtoTotCash_i + \beta_{12} GtoTotCash_j \\ & + \beta_{13} GtoTotCred_i + \beta_{14} GtoTotCred_j \\ & + \beta_{15} CABSAS_{ij} + \beta_{16} PROVCABSAS_{ij} + \varepsilon_{ij}, \end{aligned} \tag{10}$$

where the $i$ and $j$ subscripts denote the exporting and importing provinces; $T_{ij}$ (exports plus imports) are the annual average flows between province $i$ and $j$, including internal trade for $i = j$; $GDP_i$ and $GDP_j$ are the gross domestic product of the exporter and importer, respectively; $CONTIG_{ij}$ is a binary variable that indicates whether $i$ and $j$ share a border or not; $DIST_{ij}$ represents the two different bilateral physical distance between provinces $i$ and $j$.

A summary of the descriptive statistics for the main variables is presented in Table 1. It should be noted that, our dependent variable only contains two pairs of flow with zero trade: provinces of Formosa and Chubut, and Formosa and Santa Cruz; then, the potential bias due to zero values is practically null (0.7% of the sample). The data includes the usual gravity model variables, as the provincial GDP and population, as well as a distance variable and a contiguity dummy. In addition of the standard model, we introduce several control variables of interest. These control variables aim to capture the impact of financial flows as well as CABA and Buenos Aires concentration over the interprovincial trade. First, we include the $\ln COPA_i$ and $\ln COPA_j$ as the coparticipation flow to the exporting and importing regions, to capture the relevance impact of the federal redistribution flows over provincial bilateral trade. Second, we control for $Quintile12_i$ and $Quintile12_j$ measuring the average of the two lowest categories of income at the exporting and importing provinces, respectively. Third, we also consider the use of different payment methods, both cash and non cash, by controlling for the variables $GtoTotcash_i$ and $GtoTotcash_j$ that correspond to the proportion of household expenditure realized in each province using cash; and the variable $GtoTotcred_i$ and $GtoTotcred_j$ that corresponds to credit expenditure, for the exporting and importing provinces.

Table 1: Descriptive statistics of main variables

| Variable | N | Mean | s.d. | min. | max. |
|---|---|---|---|---|---|
| $\ln T$ | 576 | 19.83 | 3.09 | 0.00 | 28.02 |
| $\ln GDP$ | 576 | 26.01 | 1.07 | 24.61 | 28.95 |
| $CONTIG$ | 576 | 0.16 | 0.37 | 0.00 | 1.00 |
| $\ln DIST$ | 576 | 6.50 | 1.55 | 0.00 | 8.14 |
| $\ln POP$ | 576 | 13.80 | 0.97 | 11.99 | 16.65 |
| $\ln COPA$ | 576 | 10.87 | 0.65 | 9.81 | 12.80 |
| $Quintile12$ | 576 | 12.72 | 0.21 | 12.23 | 13.25 |
| $GtoTotCash$ | 576 | 72.71 | 10.06 | 45.89 | 86.21 |
| $GtoTotCred$ | 576 | 8.35 | 3.93 | 2.96 | 20.93 |
| $CABSAS$ | 576 | 0.01 | 0.08 | 0.00 | 1.00 |
| $PROVCABSAS$ | 576 | 0.15 | 0.36 | 0.00 | 1.00 |
| $Rcuyo$ | 576 | 0.13 | 0.33 | 0.00 | 1.00 |
| $Rnea$ | 576 | 0.17 | 0.37 | 0.00 | 1.00 |
| $Rnoa$ | 576 | 0.25 | 0.43 | 0.00 | 1.00 |
| $Rp$ | 576 | 0.25 | 0.43 | 0.00 | 1.00 |

Note: Rcuyo=Cuyo region, Rnea= northeast region, Rnoa=northwest region and Rp=Pampean region.

In addition, in order to estimate the centrality impact of CABA and Buenos Aires over provincial bilateral trade, we include the following binary control variables: $CABSAS_{ij}$ is equal to 1 for all trade flows between the Buenos Aires province and CABA and zero if not; $PROVCABSAS_{ij}$ is equal to 1 for trade flows between all provinces with Buenos Aires province and/or CABA. The $CABSAS_{ij}$ and $PROVCABSAS_{ij}$ dummy variables do not add up to 1, as we set both $CABSAS_{ij} = 0$ and $PROVCABSAS_{ij} = 0$ for interprovincial trade, $PROVPROV_{ij}$, which constitute the baseline for these two dummy variables. Therefore, a negative coefficient for both dummies would be a sensible test for the hypothesis that the centrality of CABA and Buenos Aires discourage the interprovincial trade. Furthermore, as in Daumal & Zignago (2010) the exponential of this estimated coefficients reflect the degree of internal fragmentation of Argentina's internal market. Finally, the $\varepsilon_{ij}$ is the error term with the usual assumption, $i.i.d\left(0,\sigma^2\right)$.

Also, we extend the initial model to include spatial lags in some main variables like $\ln GDP$ and $\ln COPA$. This new model is the SLX version:

$$\begin{aligned}
\ln T_{ij} &= \beta_0 + \beta_1 \ln GDP_i + \beta_2 \ln GDP_j + \beta_3 CONTIG_{ij} + \beta_4 \ln DIST_{ij} \\
&\quad + \beta_5 \ln POP_i + \beta_6 \ln POP_j + \beta_7 \ln COPA_i + \beta_8 \ln COPA_j \\
&\quad + \beta_9 Quintile12_i + \beta_{10} Quintile12_j + \beta_{11} GtoTotCash_i + \beta_{12} GtoTotCash_j \\
&\quad + \beta_{13} GtoTotCred_i + \beta_{14} GtoTotCred_j \\
&\quad + \beta_{15} CABSAS_{ij} + \beta_{16} PROVCABSAS_{ij} \\
&\quad + \beta_{17} \sum w_{ij}^i \ln GDP_i + \beta_{18} \sum w_{ij}^j \ln GDP_j \\
&\quad + \beta_{19} \sum w_{ij}^i \ln COPA_i + \beta_{20} \sum w_{ij}^j \ln COPA_j + \varepsilon_{ij}, \qquad (11)
\end{aligned}$$

Additionally, we explore the SDEMs including a spatial correction in the error term:

$$\begin{aligned}
\ln T_{ij} &= \beta_0 + \beta_1 \ln GDP_i + \beta_2 \ln GDP_j + \beta_3 CONTIG_{ij} + \beta_4 \ln DIST_{ij} \\
&\quad + \beta_5 \ln POP_i + \beta_6 \ln POP_j + \beta_7 \ln COPA_i + \beta_8 \ln COPA_j \\
&\quad + \beta_9 Quintile12_i + \beta_{10} Quintile12_j + \beta_{11} GtoTotCash_i + \beta_{12} GtoTotCash_j \\
&\quad + \beta_{13} GtoTotCred_i + \beta_{14} GtoTotCred_j \\
&\quad + \beta_{15} CABSAS_{ij} + \beta_{16} PROVCABSAS_{ij} \\
&\quad + \beta_{17} \sum w_{ij}^i \ln GDP_i + \beta_{18} \sum w_{ij}^j \ln GDP_j \\
&\quad + \beta_{19} \sum w_{ij}^i \ln COPA_i + \beta_{20} \sum w_{ij}^j \ln COPA_j + \lambda \sum w_{ij} u_{ij} + \varepsilon_{ij}. \qquad (12)
\end{aligned}$$

These models are called $SDEM_{exp}\left(\mathbf{W}^i\right)$ when the model includes a spatial correction from exporter's neighborhood, $w_{ij}^i$, and $SDEM_{imp}\left(\mathbf{W}^j\right)$ when the model includes a spatial correction from importer's neighborhood, $w_{ij}^j$.

The literature criticizes the gravity models arguing that they do not necessarily capture the bilateral resistance or border effect terms leading to biased estimates. As a possible answer, Feenstra (2002) proposes the inclusion of exporter and importer fixed effects as the most appropriate method. In our models, the inclusion of such fixed effects leads to the exclusion of other variables such as $\ln GDP$ and $\ln COPA$ of exporter and importer regions. However, the spatial lags of both variables can be maintained and evaluated in this fixed effects strategy framework. Therefore, the models for exporter and importers become:

- $SDEM_{exp}\,(\mathbf{W}^i)$

$$\begin{aligned}\ln T_{ij} \;\; = \;\; & \beta_0 + \beta_1 CONTIG_{ij} + \beta_2 \ln DIST_{ij} + \beta_3 CABSAS_{ij} + \beta_4 PROVCABSAS_{ij} \\ & + \beta_5 \sum w_{ij}^i \ln GDP_i + \beta_6 \sum w_{ij}^j \ln GDP_j \\ & + \beta_7 \sum w_{ij}^i \ln COPA_i + \beta_8 \sum w_{ij} \ln COPA_j + \lambda \sum w_{ij}^i u_{ij} \\ & + FE_i + FE_j + \varepsilon_{ij}, \end{aligned} \tag{13}$$

- $SDEM_{imp}\,(\mathbf{W}^j)$

$$\begin{aligned}\ln T_{ij} \;\; = \;\; & \beta_0 + \beta_1 CONTIG_{ij} + \beta_2 \ln DIST_{ij} + \beta_3 CABSAS_{ij} + \beta_4 PROVCABSAS_{ij} \\ & + \beta_5 \sum w_{ij}^i \ln GDP_i + \beta_6 \sum w_{ij}^j \ln GDP_j \\ & + \beta_7 \sum w_{ij}^i \ln COPA_i + \beta_8 \sum w_{ij}^j \ln COPA_j + \lambda \sum w_{ij}^j u_{ij} \\ & + FE_i + FE_j + \varepsilon_{ij}, \end{aligned} \tag{14}$$

Indeed, as we will see in the section, the models (13) and (14) corroborate, with the controls for borders fixed effects, the results of the originally proposed strategies.

## 6 Estimation Results

All the previously presented models were estimated by using robust standard errors and regional fixed effects for macro-regions (not showed in the tables). Also, for each SDEM, the maximum likelihood estimation was implemented.

Table 2 contains the results of the main models. The first column shows the traditional OLS model, whereas the second one includes the SLX estimation model. Columns 3 and 4 include the SDEM for both, exporter and importer regions.

The initial model corresponds to the OLS. With the residuals of the model and using the Moran's I test we analyze the presence of spatial auto-correlation. The results are presented in the bottom of the Table 2, considering the two alternative matrices (origin and destination). In both cases, the results does not reject the presence of spatial correlation. Then, we include in the second column of Table 2 the SLX estimation of the equation (11), the alternative model suggested by Halleck Vega & Elhorst (2015). For this model, we also consider the most relevant variables to be included in the spatial effects: ($\ln GDP$ and $\ln COPA$). The LR test shows the importance of spatial lags, $LR(4) = 2[Loglik(SLX) - Loglik(OLS)] = 13.54$ with a $p - value = 0.0089$. However, the SLX residuals still show a strong spatial dependence according to the Moran's I test. Therefore, the SDEMs in the last two columns of Table 2 introduce the parameter $\lambda$ to capture the omitted spatial autocorrelation. As result, in both models we observe a significant coefficient for this parameter, with practically the same goodness of fit.

It is interesting to note that, the variables corresponding to the baseline gravity specification ($\ln GDP_i$, $\ln GDP_j$, $CONTIG_{ij}$, $\ln DIST_{ij}$) are highly significant in all models and display coefficients with the expected signs. The income elasticity of bilateral trade is not significantly different to unity in origin and destination provinces, but it seems to be higher in the latter case, showing a higher relative effect from the attracting market. In the case of the population, a proxy variable of local market dynamic, the results are similar, but for the spatially adjusted models, the origin population elasticity is higher than the destination one.

The distance coefficient is $-0.82$ for the OLS model, and this value is very close to the number obtained for the spatial models, which means that the inclusion of spatial information does not generate any important correction for the geographical distance. The distance coefficient is also in line with the international results, McCallum (1995) founds a distance coefficient ranging from $-1.12$ to $-1.42$, Anderson & Van Wincoop (2003) show values from $-0.79$ to $-1.25$, and Millimet & Osang (2007) found that in their basic model the elasticity with respect to distance is approximately one in absolute value. In the case of Brazil, Daumal & Zignago (2010) found a larger distance coefficient of $-1.82$, in a model that also includes foreign trade by Brazilian states.

It should be noted that the contiguity effect is always positive and with an elasticity close to one. Again, the effect is robust not only for the OLS but also in the case of the spatial models, where the coefficient is slightly reduced. As we shall see, in Table 3, the contiguity result is supported by the borders effects model.

In general, the results of the canonical gravity model extended to consider origin and destination hold and are coincidental with those observed in applications to the bilateral domestic trade of other countries. This result is an interesting indication of the benefits of the database, which, as we indicated, is novel in Argentina.

After controlling the consistency of the basic model, we analyzed the impact on trade of the financial flows from the federal coparticipation arrangement, informality level, the use of different payments methods and the centrality effect of CABA and Buenos Aires.

First, as can be seen in Table 2, in the case of federal financial transfers, the coefficients are significant and negative, both for origin $\ln COPA_i$ and destination $\ln COPA_j$. In fact, the negative effect is significant for the origin rather than for the destination.[8] Furthermore, when we introduce the neighborhood effects, we see that the origin, given by $\sum w_{ij}^i \ln COPA_i$ is significant with a negative effect closed to one. This means that an increment of 1% of coparticipation for the neighboring provinces of origin region reduces trade flow in more than 1% in all models, all other things being equal (the impact is greater for spatial models).

Second, the lowest income at the provincial level, a proxy for the informality level, results in a negative effect over bilateral trade. The coefficient seems to be larger in the origin province, but are significant and negative in both cases.

[8] For the destination province the effect is significant only for some specifications.

Table 2: Estimation of Alternative Models.

| Models | OLS | SLX | SDEM exp | SDEM imp |
|---|---|---|---|---|
| $\ln GDP_i$ | 1.04*** | 0.93*** | 0.89*** | 0.99*** |
| | (0.24) | (0.24) | (0.29) | (0.23) |
| $\ln GDP_j$ | 1.13*** | 1.20*** | 1.25*** | 1.19** |
| | (0.34) | (0.36) | (0.39) | (0.47) |
| $CONTIG_{ij}$ | 1.03*** | 1.00*** | 0.95*** | 0.97*** |
| | (0.14) | (0.14) | (0.20) | (0.20) |
| $\ln DIST_{ij}$ | −0.82*** | −0.83*** | −0.81*** | −0.81*** |
| | (0.06) | (0.06) | (0.05) | (0.05) |
| $\ln POP_i$ | 1.01*** | 1.51*** | 1.57*** | 1.33*** |
| | (0.35) | (0.46) | (0.52) | (0.43) |
| $\ln POP_j$ | 1.02** | 1.20** | 1.02** | 1.20* |
| | (0.52) | (0.48) | (0.51) | (0.63) |
| $\ln COPA_i$ | −1.19** | −1.73*** | −1.71*** | −1.49*** |
| | (0.49) | (0.60) | (0.65) | (0.52) |
| $\ln COPA_j$ | −0.82 | −1.38** | −1.09* | −1.27 |
| | (0.55) | (0.68) | (0.63) | (0.81) |
| $Quintile12_i$ | −1.52*** | −2.04*** | −2.08*** | −1.84*** |
| | (0.39) | (0.47) | (0.55) | (0.40) |
| $Quintile12_j$ | −1.85*** | −1.85*** | −1.73*** | −1.89*** |
| | (0.62) | (0.59) | (0.44) | (0.61) |
| $GtoTotCash_i$ | 0.04** | 0.06*** | 0.07*** | 0.06*** |
| | (0.02) | (0.02) | (0.02) | (0.02) |
| $GtoTotCash_j$ | 0.08*** | 0.08*** | 0.08*** | 0.09*** |
| | (0.03) | (0.03) | (0.02) | (0.02) |
| $GtoTotCred_i$ | 0.15*** | 0.17*** | 0.18*** | 0.18*** |
| | (0.05) | (0.05) | (0.04) | (0.03) |
| $GtoTotCred_j$ | 0.20*** | 0.20*** | 0.21*** | 0.21*** |
| | (0.07) | (0.07) | (0.04) | (0.05) |
| $CABSAS_{ij}$ | −4.46*** | −4.83*** | −5.05*** | −4.96*** |
| | (0.65) | (1.31) | (1.52) | (1.49) |
| $PROVCABSAS_{ij}$ | −0.27 | −0.41 | −0.61 | −0.55 |
| | (0.18) | (0.50) | (0.60) | (0.58) |
| $\mathbf{W}^i \times \ln GDP_i$ | | 0.47** | 0.50* | 0.46** |
| | | (0.23) | (0.26) | (0.20) |
| $\mathbf{W}^j \times \ln GDP_j$ | | 0.46 | 0.48 | 0.47 |
| | | (0.35) | (0.33) | (0.38) |
| $\mathbf{W}^i \times \ln COPA_i$ | | −0.91*** | −0.90*** | −0.90*** |
| | | (0.29) | (0.34) | (0.25) |
| $\mathbf{W}^j \times \ln COPA_j$ | | −0.77 | −0.72 | −0.70 |
| | | (0.55) | (0.46) | (0.56) |
| $\widehat{\lambda}$ | | | 0.20*** | 0.20*** |
| | | | (0.04) | (0.04) |
| Moran's I ($\mathbf{W}^i$) | 0.19*** | 0.20*** | | |
| Moran's I ($\mathbf{W}^j$) | 0.22*** | 0.20*** | | |
| AIC | 2325.97 | 2320.43 | 2301.16 | 2300.81 |
| Loglik | −1141.99 | −1135.22 | −1123.58 | −1123.41 |

Note: Constant term omitted. Robust SE in brackets. Regional Fixed effects included. $^{*}\ p < 0.10$, $^{**}\ p < 0.05$, $^{***}\ p < 0.01$.

Third, in the case of payments methods, the results indicate a positive correlation with bilateral trade, that is more important and significant in the case of credit payments methods. Traditionally, the sales achieved by the turnover tax (both final and intermediate) involve transactions along the production chain that are, in many cases, financed by using credit both formal and informal. This effect is captured in the empirical model where the credit variable shows a positive and significant effect.

Fourth, the border effect of CABA and Buenos Aires ($CABSAS_{ij}$) discourages the interprovincial trade. In all models the coefficient is negative and significant, indicating that the centralism of CABA and Buenos Aires has, overall, a negative and significant impact on bilateral provincial trade. These results indicate a relative trade bias associated with the strong relative importance of CABA and Buenos Aires both in production and market size. It is interesting to note that this centralism, already observed in historical times, continues to have an influence on bilateral trade between the provinces.

As proposed by Feenstra (2002) we include the estimations with exporter and importer fixed effects. The inclusion of these fixed effects allows capturing unobserved characteristics of the regions. However, these inclusion excludes province-specific variables, such as $\ln GDP$ and $\ln COPA$ of the exporter and importer regions. Hence, only bilateral and spatial lags can be included in the model. Table 3 indicates the results of the alternative models with border effects. As mentioned before, the contiguity coefficient maintains its significance with an elasticity close to one. Whereas the distance parameter shows a negative and significant elasticity, coinciding with the parameters found in the previous specifications.

Figures 5 and 6 allow comparing the results of the two spatial specifications. In the figures, the value of the coefficients is given by the central point and the length of the segment indicates the significance (with a significance level of 5%). If the segment cut the zero line, indicates that the parameter is not significant for the econometric specification under analysis.

Table 3: Estimation of Alternative Models with Border Effects.

| Models | OLS | SLX | SDEM exp | SDEM imp |
|---|---|---|---|---|
| $CONTIG_{ij}$ | $1.01^{***}$ | $0.90^{***}$ | $0.82^{***}$ | $0.84^{***}$ |
| | (0.16) | (0.16) | (0.19) | (0.20) |
| $\ln DIST_{ij}$ | $-0.80^{***}$ | $-0.77^{***}$ | $-0.75^{***}$ | $-0.75^{***}$ |
| | (0.06) | (0.06) | (0.05) | (0.05) |
| $\mathbf{W}^i \times \ln GDP_i$ | | $2.36^{***}$ | $2.40^{***}$ | $2.38^{***}$ |
| | | (0.32) | (0.52) | (0.37) |
| $\mathbf{W}^j \times \ln GDP_j$ | | $1.09^{***}$ | $-0.05$ | $-0.03$ |
| | | (0.20) | (0.37) | (0.35) |
| $\mathbf{W}^i \times \ln COPA_i$ | | $-2.07^{***}$ | $-2.10^{***}$ | $-2.09^{***}$ |
| | | (0.39) | (0.64) | (0.42) |
| $\mathbf{W}^j \times \ln COPA_j$ | | $-1.45^{***}$ | $-0.90^{**}$ | $-0.91^{*}$ |
| | | (0.33) | (0.38) | (0.54) |
| $\widehat{\lambda}$ | | | $0.22^{***}$ | $0.22^{***}$ |
| | | | (0.04) | (0.04) |
| Moran's I ($\mathbf{W}^i$) | $0.22^{***}$ | $0.22^{***}$ | | |
| Moran's I ($\mathbf{W}^j$) | $0.26^{***}$ | $0.22^{***}$ | | |
| AIC | 2382.78 | 2338.11 | 2313.41 | 2313.19 |
| Loglik | $-1145.39$ | $-1120.05$ | $-1105.71$ | $-1105.59$ |

Note: Constant term omitted. Robust SE in brackets. Regional Fixed effects included. $^{*}\ p < 0.10$, $^{**}\ p < 0.05$, $^{***}\ p < 0.01$.

Figure 5 shows the direct effect of coparticipation, both for origin and destination. In the case of origin, all the coefficients are significant for all the econometric specifications. However, the direct effect for the destination is only significant for the SLX model. The indirect effects are significant for the origin, but not significant for the destination province. This result indicates that the indirect effect derived from the co-participation received by the neighboring provinces of origin has a negative impact on bilateral trade. However, the indirect effect derived from the neighborhood of the destination province is not significant.

Figure 6 includes the coefficients corresponding to the indirect coparticipation effects for the model with border effects (Table 3), when the fixed effects of origin and destination are considered. The graphs show that the indirect impact of the origin neighborhood remains significant. On the other hand, the indirect impact of the destination neighborhood is only significant for SLX be model and SDEM be (imp).

Figure 5: Regression coefficients from alternative models (at 95% CI).

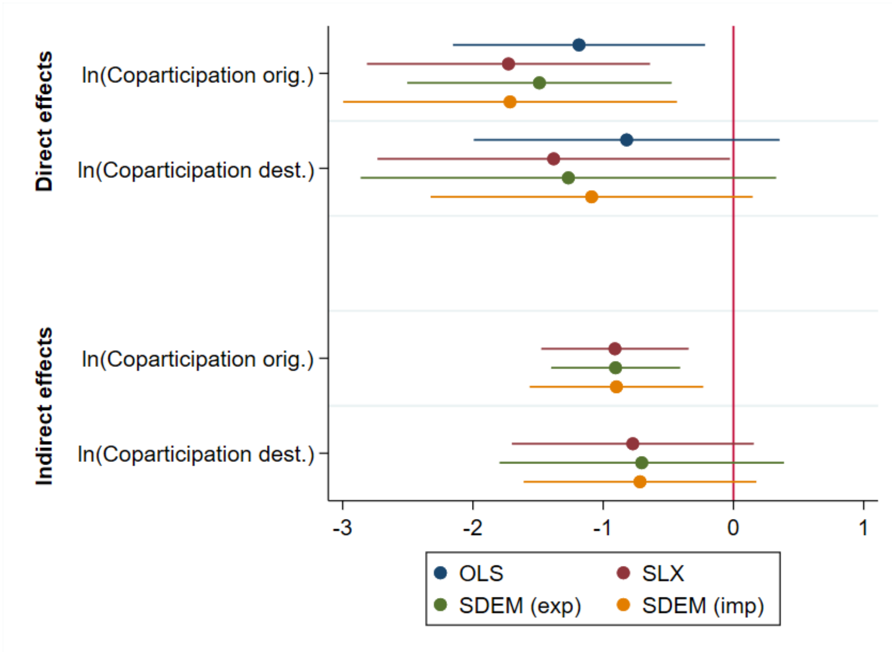
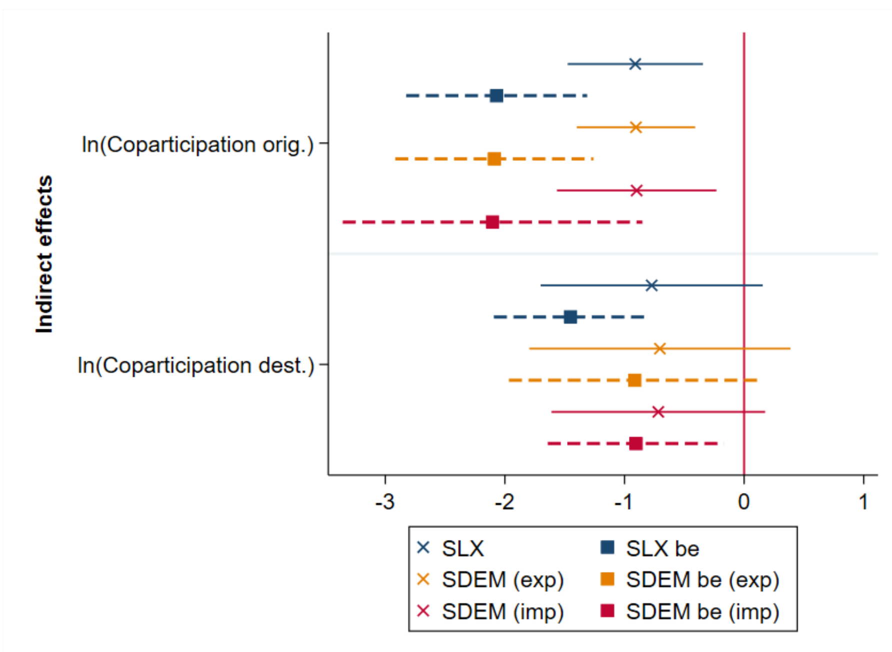



Figure 6: Comparison regression coefficients: basic and with border effects (at 95% CI).



## 7 Conclusions and Next Steps

This paper explores the standard gravity model for Argentina with a novel database of trade finding similar results to the literature. This a factor that emphasizes the relevance of systematizing the processing of this database to generate a proxy for bilateral trade between the provinces.

It should be noted that income distribution, measured as the two lowest quintiles in the province reduces bilateral trade. Also, formal payments have effect in bilateral trade. Cash and especially credit card payments have a positive effect, reflecting differences related to the type of expenditures and/or the fiscal implications of using different formal payments methods as well as the relevance of credit in commercial transactions.

We control for several socioeconomic variables and the results are consistent and robust. Our spatial models are robust using different spatial weighing matrices, $\mathbf{W}$'s, and the spatial local effects of $GDP$ are positive on trade in origin, but these spatial effects are negative for coparticipation.

These last results indicate that national transfers from the redistribution federal arrangement are an important determinant of the inter-provincial trade generating negative spillover effects between the provinces. Indeed, the coparticipation as a redistribution mechanism of income towards lagging provinces discourages the inter-provincial trade flows (received in the origin, not in the destination). This negative impact is reinforced by the coparticipation received by the provinces located in the vicinity of the origin province.

This home bias effect may be related to several factors, including the presence of tax surcharges on extraterritorial goods and services as well as provincial professional enrollment regulations and local public procurement incentives. These factors may end up enhancing the consumption of locally produced goods and services and discouraging their export to other provinces.

Next steps in our agenda include different extensions. On one hand, we pretend to explore competitive models in spatial econometrics, including new advances in estimation techniques. On the other hand, we will explore the border and interaction effects of CABA/Buenos Aires and the rest of the provinces, including the economic sectors desegregation and the effect of provincial foreign trade.

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# Appendix

Table A: Provinces, size of GDP and population (%).

| Name | Acronym | Region | G.D.P. % | POP. % |
|---|---|---|---|---|
| Buenos Aires | $BsAs$ | Pampean | 35.09 | 38.64 |
| Autonomous City of Buenos Aires | $CABA$ | Pampean | 18.57 | 6.96 |
| Santa Fe | $StaFe$ | Pampean | 9.78 | 7.84 |
| Córdoba | $CBA$ | Pampean | 8.32 | 8.28 |
| Mendoza | $MZA$ | Cuyo | 4.00 | 4.38 |
| Neuquén | $NEU$ | Patagonic | 2.70 | 1.45 |
| Entre Ríos | $ER$ | Pampean | 2.49 | 3.06 |
| Chubut | $CHU$ | Patagonic | 2.13 | 1.33 |
| Tucumán | $TUC$ | Northwest | 1.66 | 3.71 |
| Salta | $SAL$ | Northwest | 1.61 | 3.11 |
| San Luis | $SL$ | Cuyo | 1.41 | 1.11 |
| Santa Cruz | $StaCr$ | Patagonic | 1.40 | 0.77 |
| Río Negro | $RN$ | Patagonic | 1.23 | 1.63 |
| Chaco | $CHA$ | Northeast | 1.18 | 2.65 |
| Misiones | $MIS$ | Northeast | 1.16 | 2.77 |
| Santiago del Estero | $SdE$ | Northwest | 1.00 | 2.15 |
| San Juan | $SJ$ | Cuyo | 0.99 | 1.72 |
| Corrientes | $CORR$ | Northeast | 0.96 | 2.48 |
| Tierra del Fuego | $TdF$ | Patagonic | 0.85 | 0.36 |
| La Pampa | $LP$ | Patagonic | 0.84 | 0.79 |
| Jujuy | $JUJ$ | Northwest | 0.78 | 1.69 |
| Catamarca | $CAT$ | Northwest | 0.74 | 0.92 |
| La Rioja | $LR$ | Northwest | 0.67 | 0.86 |
| Formosa | $FOR$ | Northeast | 0.46 | 1.34 |

Table B shows the information of the matrix used in the paper, $W_{mix} = W_{contd2}$, and the alternative weighting matrix used in Tables D and E.

Table B: Information of spatial weighting matrices.

| ***Elements*** | $W_{cont}$ | $W_{4nn}$ | $W_{contd2}$ | $W_{4nnd2}$ |
|---|---|---|---|---|
| *Minimum weight > 0* | *0.167* | *0.250* | *0.0004319* | *0.0008657* |
| *Mean weight* | *0.428* | *0.250* | *0.0017361* | *0.0017361* |
| *Non zero weights (%)* | *0.667* | *0.696* | *0.667* | *0.696* |
| *Mean neighbors* | *3.83* | *4* | | |

Table C: Average trade between provinces, including internal transactions (%).

| ID | CABA | BsAs | CBA | StaFe | ER | LP | MZA | SJ | SL | CAT | CHA | CORR | FOR | JUJ | LR | MIS | SAL | SdE | TUC | CHU | NEU | RN | StaCr | TdF |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CABA | 7.83 | 4.93 | 0.44 | 0.45 | 0.08 | 0.02 | 0.15 | 0.05 | 0.06 | 0.02 | 0.05 | 0.05 | 0.02 | 0.02 | 0.02 | 0.04 | 0.06 | 0.03 | 0.12 | 0.05 | 0.30 | 0.05 | 0.02 | 0.10 |
| BsAs | | 27.81 | 1.96 | 2.31 | 0.46 | 0.19 | 0.63 | 0.18 | 0.27 | 0.07 | 0.24 | 0.21 | 0.07 | 0.10 | 0.09 | 0.21 | 0.43 | 0.12 | 0.42 | 0.32 | 0.97 | 0.29 | 0.15 | 0.64 |
| CBA | | | 4.31 | 0.73 | 0.07 | 0.03 | 0.15 | 0.04 | 0.10 | 0.03 | 0.07 | 0.03 | 0.01 | 0.03 | 0.03 | 0.04 | 0.06 | 0.05 | 0.11 | 0.03 | 0.20 | 0.02 | 0.01 | 0.03 |
| StaFe | | | | 4.02 | 0.21 | 0.04 | 0.09 | 0.03 | 0.03 | 0.02 | 0.10 | 0.05 | 0.02 | 0.02 | 0.02 | 0.05 | 0.07 | 0.05 | 0.08 | 0.03 | 0.17 | 0.03 | 0.02 | 0.04 |
| ER | | | | | 0.75 | 0.00 | 0.01 | 0.00 | 0.01 | 0.00 | 0.01 | 0.04 | 0.01 | 0.00 | 0.00 | 0.02 | 0.01 | 0.00 | 0.01 | 0.00 | 0.05 | 0.00 | 0.00 | 0.01 |
| LP | | | | | | 0.35 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.03 | 0.01 | 0.01 | 0.00 |
| MZA | | | | | | | 1.29 | 0.05 | 0.03 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 | 0.00 | 0.01 | 0.00 | 0.13 | 0.01 | 0.03 | 0.01 |
| SJ | | | | | | | | 0.24 | 0.01 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.04 | 0.00 | 0.00 | 0.00 |
| SL | | | | | | | | | 0.24 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 | 0.01 | 0.03 | 0.00 | 0.00 | 0.00 |
| CAT | | | | | | | | | | 0.12 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 | 0.00 | 0.01 | 0.00 | 0.02 | 0.00 | 0.01 | 0.00 | 0.00 | 0.00 |
| CHA | | | | | | | | | | | 0.50 | 0.06 | 0.03 | 0.00 | 0.00 | 0.02 | 0.01 | 0.01 | 0.01 | 0.00 | 0.04 | 0.00 | 0.00 | 0.01 |
| CORR | | | | | | | | | | | | 0.37 | 0.02 | 0.00 | 0.01 | 0.03 | 0.01 | 0.00 | 0.00 | 0.00 | 0.03 | 0.00 | 0.00 | 0.00 |
| FOR | | | | | | | | | | | | | 0.09 | 0.00 | 0.00 | 0.01 | 0.01 | 0.00 | 0.00 | - | 0.01 | 0.00 | - | 0.00 |
| JUJ | | | | | | | | | | | | | | 0.29 | 0.00 | 0.00 | 0.08 | 0.00 | 0.03 | 0.00 | 0.02 | 0.00 | 0.00 | 0.00 |
| LR | | | | | | | | | | | | | | | 0.13 | 0.00 | 0.01 | 0.00 | 0.01 | 0.00 | 0.01 | 0.00 | 0.00 | 0.00 |
| MIS | | | | | | | | | | | | | | | | 0.47 | 0.01 | 0.00 | 0.00 | 0.00 | 0.04 | 0.00 | 0.00 | 0.00 |
| SAL | | | | | | | | | | | | | | | | | 0.80 | 0.02 | 0.11 | 0.02 | 0.08 | 0.00 | 0.00 | 0.00 |
| SdE | | | | | | | | | | | | | | | | | | 0.38 | 0.05 | 0.00 | 0.03 | 0.00 | 0.00 | 0.00 |
| TUC | | | | | | | | | | | | | | | | | | | 1.12 | 0.00 | 0.04 | 0.00 | 0.00 | 0.01 |
| CHU | | | | | | | | | | | | | | | | | | | | 0.86 | 0.11 | 0.02 | 0.07 | 0.01 |
| NEU | | | | | | | | | | | | | | | | | | | | | 1.56 | 0.14 | 0.06 | 0.08 |
| RN | | | | | | | | | | | | | | | | | | | | | | 0.45 | 0.01 | 0.00 |
| StaCr | | | | | | | | | | | | | | | | | | | | | | | 0.45 | 0.01 |
| TdF | | | | | | | | | | | | | | | | | | | | | | | | 0.20 |

Table D: Estimation of Alternative Models under $W_{mix} = W_{4nnd2}$.

| Models | OLS | SLX | SDEM exp | SDEM imp |
|---|---|---|---|---|
| $\ln GDP_i$ | $1.04^{***}$ | $0.95^{***}$ | $0.94^{***}$ | $0.96^{***}$ |
| | (0.24) | (0.26) | (0.29) | (0.24) |
| $\ln GDP_j$ | $1.13^{***}$ | $1.14^{***}$ | $1.12^{***}$ | $1.13^{**}$ |
| | (0.34) | (0.34) | (0.38) | (0.45) |
| $CONTIG_{ij}$ | $1.03^{***}$ | $0.99^{***}$ | $0.94^{***}$ | $0.95^{***}$ |
| | (0.14) | (0.14) | (0.20) | (0.20) |
| $\ln DIST_{ij}$ | $-0.82^{***}$ | $-0.83^{***}$ | $-0.80^{***}$ | $-0.80^{***}$ |
| | (0.06) | (0.06) | (0.05) | (0.05) |
| $\ln POP_i$ | $1.01^{***}$ | $1.47^{***}$ | $1.49^{***}$ | $1.42^{***}$ |
| | (0.35) | (0.44) | (0.51) | (0.43) |
| $\ln POP_j$ | $1.02^{**}$ | $1.21^{**}$ | $1.20^{**}$ | $1.20^{*}$ |
| | (0.52) | (0.49) | (0.50) | (0.62) |
| $\ln COPA_i$ | $-1.19^{**}$ | $-1.71^{***}$ | $-1.69^{***}$ | $-1.62^{***}$ |
| | (0.49) | (0.57) | (0.65) | (0.52) |
| $\ln COPA_j$ | $-0.82$ | $-1.35^{**}$ | $-1.27^{*}$ | $-1.24$ |
| | (0.55) | (0.70) | (0.68) | (0.87) |
| $Quintile12_i$ | $-1.52^{***}$ | $-2.04^{***}$ | $-2.06^{***}$ | $-1.92^{***}$ |
| | (0.39) | (0.44) | (0.55) | (0.42) |
| $Quintile12_j$ | $-1.85^{***}$ | $-1.89^{***}$ | $-1.84^{***}$ | $-1.91^{***}$ |
| | (0.62) | (0.60) | (0.46) | (0.60) |
| $GtoTotCash_i$ | $0.04^{**}$ | $0.07^{***}$ | $0.07^{***}$ | $0.07^{***}$ |
| | (0.02) | (0.02) | (0.02) | (0.02) |
| $GtoTotCash_j$ | $0.08^{***}$ | $0.08^{***}$ | $0.08^{***}$ | $0.08^{***}$ |
| | (0.03) | (0.03) | (0.02) | (0.03) |
| $GtoTotCred_i$ | $0.15^{***}$ | $0.17^{***}$ | $0.17^{***}$ | $0.18^{***}$ |
| | (0.05) | (0.05) | (0.04) | (0.04) |
| $GtoTotCred_j$ | $0.20^{***}$ | $0.20^{***}$ | $0.20^{***}$ | $0.20^{***}$ |
| | (0.07) | (0.07) | (0.04) | (0.05) |
| $CABSAS_{ij}$ | $-4.46^{***}$ | $-4.49^{***}$ | $-4.52^{***}$ | $-4.48^{***}$ |
| | (0.65) | (1.10) | (1.45) | (1.44) |
| $PROVCABSAS_{ij}$ | $-0.27$ | $-0.25$ | $-0.35$ | $-0.32$ |
| | (0.18) | (0.39) | (0.56) | (0.55) |
| $\mathbf{W}^i \times \ln GDP_i$ | | $0.40^{**}$ | 0.41 | 0.39 |
| | | (0.17) | (0.26) | (0.20) |
| $\mathbf{W}^j \times \ln GDP_j$ | | 0.34 | 0.35 | 0.32 |
| | | (0.27) | (0.35) | (0.42) |
| $\mathbf{W}^i \times \ln COPA_i$ | | $-0.86^{***}$ | $-0.85^{***}$ | $-0.85^{***}$ |
| | | (0.21) | (0.33) | (0.25) |
| $\mathbf{W}^j \times \ln COPA_j$ | | $-0.65$ | $-0.63$ | $-0.55$ |
| | | (0.51) | (0.56) | (0.69) |
| $\widehat{\lambda}$ | | | $0.17^{***}$ | $0.18^{***}$ |
| | | | (0.04) | (0.04) |
| Moran's I ($\mathbf{W}^i$) | $0.17^{***}$ | $0.18^{***}$ | | |
| Moran's I ($\mathbf{W}^j$) | $0.19^{***}$ | $0.17^{***}$ | | |
| AIC | 2325.97 | 2322.80 | 2309.08 | 2308.54 |
| BIC | 2417.45 | 2431.70 | 2426.69 | 2426.16 |

Note: Constant terms are omitted. Std. errors in parentheses. Fixed effects included. $^{*}$ $p < 0.10$, $^{**}$ $p < 0.05$, $^{***}$ $p < 0.01$.

Table E: Estimation of Alternative Models with Border Effects under $W_{mix} = W_{4nnd2}$.

| Models | OLS | SLX | SDEM exp | SDEM imp |
|---|---|---|---|---|
| $CONTIG_{ij}$ | 1.01*** | 0.90*** | 0.83*** | 0.84*** |
| | (0.16) | (0.16) | (0.20) | (0.20) |
| $\ln DIST_{ij}$ | −0.80*** | −0.77*** | −0.75*** | −0.75*** |
| | (0.06) | (0.06) | (0.05) | (0.05) |
| $\mathbf{W}^i \times \ln GDP_i$ | | 2.31*** | 2.34*** | 2.33*** |
| | | (0.31) | (0.50) | (0.37) |
| $\mathbf{W}^j \times \ln GDP_j$ | | 1.64*** | −0.02 | −0.01 |
| | | (0.14) | (0.36) | (0.34) |
| $\mathbf{W}^i \times \ln COPA_i$ | | −1.96*** | −1.98*** | −1.97*** |
| | | (0.38) | (0.61) | (0.43) |
| $\mathbf{W}^j \times \ln COPA_j$ | | −1.67*** | −0.96** | −0.97* |
| | | (0.31) | (0.38) | (0.53) |
| $\widehat{\lambda}$ | | | 0.19*** | 0.19*** |
| | | | (0.04) | (0.04) |
| Moran's I ($\mathbf{W}^i$) | 0.19*** | 0.19*** | | |
| Moran's I ($\mathbf{W}^j$) | 0.23*** | 0.19*** | | |
| AIC | 2382.78 | 2338.11 | 2320.70 | 2320.50 |
| BIC | 2583.16 | 2551.56 | 2542.86 | 2542.67 |

Note: Constant terms are omitted. Std. errors in parentheses. Fixed effects included. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.