DO BRAZILIAN STATES ENGAGE IN THE FISCAL WAR OF PORTS?
AN EMPIRIC STUDY OF TAX COMPETITION AND AN ANALYSIS OF A
NATURAL EXPERIMENT: THE BRAZILIAN SENATE RESOLUTION 13/2012
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Dissertation Thesis presented to the São Paulo School of Economics of Getulio Vargas Foundation, as a requirement to obtain the Master’s Degree in Economics

Knowledge field: Public Economics

Adviser: Prof. Dr. Enlinson Henrique Carvalho de Mattos

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ABSTRACT

The end of the year 2014 marked the second anniversary of the Brazilian Senate Resolution 13/2012 (R13). Briefly, R13 is a Senate act aimed to put an end to the so-called Fiscal War of Ports (FWP), a tax competition among states that takes place by giving tax breaks over interstate operations with importing goods in order to attract importing companies to their territories. R13 has reduced the taxation level over such operations expecting to decrease profits that could be extracted from them and firms willingness to join such special tax break regimes. Nonetheless, R13 has left a great discussion on whether or not the benefits of investments attracted to a particular state exceed the costs to that state of giving up tax revenues by the concession of FWP tax benefits. Our objective at this work is to give a contribution to that discussion by testing whether a strategic interaction behavior among states, such as the one allegedly occurring in the FWP, in fact emerges from the importing sector figures collected from January/2010 through April/2015, and by testing whether R13 has indeed impacted such strategic interaction behavior. We use a model of spatial econometrics, specifying a weights matrix that aggregates the level of imports in competing jurisdictions. In addition, we estimate our equation using a fixed effect panel approach. The results suggest the existence of a strategic interaction behavior among states and the existence of a R13 impact on such interaction behavior.

**Key words:** Public Finance, Taxation, Tax Competition, Tax Benefits, Fiscal War of Ports, Brazilian Senate Resolution 13/2012, Spatial Econometrics.
RESUMO

O fim do ano de 2014 marcou o segundo aniversário da Resolução 13/2012 (R13) do Senado brasileiro. Grosso modo, R13 constituiu-se de um normativo do Senado cujo objetivo era o de por um fim na Guerra Fiscal dos Portos (FWP), uma competição fiscal entre os estados que se dá através da concessão de benefícios fiscais sobre operações interestaduais com mercadorias importadas de modo a atrair empresas importadoras para o território do estado concedente. R13 diminuiu o nível da tributação sobre tais operações, esperando com isso diminuir os lucros auferidos e a propensão das firmas de aceitarem tais regimes especiais de incentivação fiscal. Nada obstante, R13 gerou uma grande discussão sobre se os benefícios da atração de investimentos para um estado em particular superariam ou não os custos que esse estado incorreria em renunciar receitas tributárias em razão concessão desses benefícios fiscais. O objetivo do presente trabalho é o de dar uma contribuição a essa discussão, testando se um comportamento de interação estratégica entre estados, tal como aquele que supostamente ocorre no contexto da FWP, de fato emerge dos dados de importação coletados de janeiro de 2010 a maio de 2015, e, também, testando se a R13 de fato afetou tal comportamento de interação estratégica. Utiliza-se aqui um modelo de econometria espacial, no qual se especifica uma matriz de pesos que agrega o nível de importação das jurisdições concorrentes, organizando os dados em um painel de efeitos fixos. Os resultados sugerem que existe um comportamento de interação estratégica entre os estados e que a R13 de fato impactou tal comportamento.

**Palavras-chave:** Finanças Públicas, Tributação, Competição Fiscal, Benefícios Fiscais, Guerra Fiscal dos Portos, Resolução 13/2012, Econometria Espacial.
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1. Introduction

Brazilian states, in order to attract investments from companies that otherwise, for economic reasons, would decide to settle their subsidiaries in another state, have offered to such companies special tax regimes in which substantial tax benefits are conceded. These tax regimes would take the form of tax credits over interstate sales of imported goods, reducing considerably the amount of sales taxes that would be due by those firms.

Broadly speaking, accepting those special tax regimes, firms need only to change the original port through which they imported their goods to the port of the conceding state. Consequently, sales tax over importing goods operations that would be owed to the state of the original port are then collected to the conceding state, which earns the difference between tax revenue collected and credit tax benefit conceded. Therefore the original state loses all tax revenue from that operation, and firms earn the tax benefit, paying less sales tax eventually.

Several issues have arisen from these special regimes regarding cost benefit analysis to the public point of view, but also related to the fact that Brazilian courts have been considering them to be illegal, implying lawsuits among damaged states and importing firms. The situation installed due to all these issues became commonly named as the Fiscal War of Ports (FWP).

Aiming to cease FWP, Brazilian Senate has passed a legislative act, the Resolution 13/2012 (R13), decreasing the tax rate applied over imported products in interstate sales in order to reduce the amount of tax revenues that these operations generate. Thus, R13 has decreased the profits that could be extracted from the operations in the form of tax benefits, aiming to diminish firms’ willingness to accept those special regimes.

R13, intended to be part of a major reform in Brazilian state tax system, brought forth evidence of the taxation effects over economic efficiency and, ultimately, over economic development, which has been for a long time the main issue in the Brazilian political agenda, and became as well the main issue driving tax reform discussions.

In fact, tax reform is a priority in the Brazilian political agenda, and it has been driven mainly by discussions about the burdensome economic effects tax systems can create. There is no doubt that taxation plays an important role in the economic efficiency and growth determination. Reforming tax systems has its motivation based generally upon bringing the law into closer adherence to certain economic principles and goals. Nevertheless, there is either no or very little understanding, based on empirical research, of how much taxation would affect the economic efficiency or imply economic development. The importance of this
present work relies on presenting an econometric approach to that matter, considering that there isn’t any known econometric work focused on the FWP issue in Brazil.

Therefore, our objective is firstly to apply an econometric model to test for the existence of strategic interaction among states such as the one resulting from FWP, secondly to apply such model to test whether R13 has impacted interstate sales of imported products, changing the strategic interaction among states.

To perform this task, in chapter two we will present an overview of the Brazilian state tax system specially regarding the interstate sales taxation and the FWP working process; in chapter three, we will present a review of relevant previous literature and research in the field of public finance related to tax competition and strategic interaction among jurisdictions; in chapter four, we will explain in detail the equation model specification; in chapter five, we will present data analysis and description; and in chapter six, we will present the regression results and analysis, concluding the work in chapter seven.
2. Brazilian State Tax System

2.1. A Glance at the Brazilian State Tax System

The 1988 Brazilian Constitution was the legal mark of a new, though extremely complex tax system.

The 1988 Constitution has split tax competencies among all Federal units, assigning different types of taxes to each one, for instance: the Union is allowed to levy income tax, whereas the states and the Federal District levy a consumer tax, which freely translating is named Tax over Operations on the Circulation of Merchandise and Services (ICMS - in Brazilian initials).

As the Constitution states, there are also complementary and ordinary laws that establish tax norms. In regulating those laws there is a whole sort of sublegal acts. The complementary laws establish general norms with regard to the definition of taxes, tax bases, taxpayers, and tax obligations, whereas the ordinary laws impose taxes in a detailed manner. Brazilian Congress votes on both complementary and ordinary laws regarding federal taxes, however the former requires a qualified quorum and the latter a simple quorum of relative majority. The states, in turn, can pass only ordinary laws in order to impose their own taxes. At last, there is also taxation at the federative local level, called the municipal level, which will not be addressed at this work.

The Brazilian federation is comprised of 26 states\(^1\) plus the Federal District of Brasilia (DF), and of more than 3,000 municipal units, each of them also imposing their own taxes.

Based on a 2013 research study, the Brazilian Institute of Planning and Taxation (IBPT) accounted\(^2\) that since 1988, Brazilian congressmen, legislative officers and executive officers passed 4,785,194 laws, comprising of complementary and ordinary laws, decrees, executive provisory acts, constitutional amendments and others, representing a daily production of 784 laws. Tax laws amounted to 309,147 in the same period, corresponding to 6.5% of the total laws passed, and a daily production of 51 laws.

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\(^1\) The 26 states, per region, are: a) North: Amapá (AP), Roraima (RR), Amazonas (AM), Pará (PA), Acre (AC) and Rondônia (RO); b) Northeast: Maranhão (MA), Piauí (PI), Ceará (CE), Rio Grande do Norte (RN), Paraíba (PB), Pernambuco (PE), Alagoas (AL), Sergipe (SE) and Bahia (BA); c) West central: Tocantins (TO), Mato Grosso (MT), Mato Grosso do Sul (MS) and Goiás (GO); d) Southeast: Espírito Santo (ES), Rio de Janeiro (RJ), Minas Gerais (MG) and São Paulo (SP); and, e) South: Paraná (PR), Santa Catarina (SC) and Rio Grande do Sul (RS).

Complexity is a key word defining the Brazilian tax law system, not only in terms of the huge quantity of tax laws, but also in terms of the highly unsystematic arrangement amongst them, which is worsened by several types of taxes breaks conceded by each federal stance.

Brazilian geography, human aspects and natural aspects are elements that impose more complexity to the system. The country is divided geographically into five different regions: North, Northeast, Southeast, South, and West-Central. The Southeast region is the most prosperous and most highly industrialized, comprising the states of São Paulo, Rio de Janeiro, Minas Gerais, and Espírito Santo. Conversely, the North and Northeast regions are the least developed due in part to their harsh physical conditions and particular historical process of formation. In addition, there is a lack of investment in the Northeast region due to the fact that the South and Southeast regions have better physical infrastructure to attract capital inversions from both internal and foreign investors.

This present work will focus on the Brazilian state taxation system from which emerges the Fiscal War of Ports issue, specifically due to the imposition of the ICMS tax. ICMS, as previously mentioned, is the initial letters in Portuguese of what in English could be translated, freely, as Tax over Operations on the Circulation of Merchandise and Services. As a state level tax, ICMS structure is highly affected by Brazilian geographic differences and economic disparities, and for this reason we go over more detailed aspects of it in the following paragraphs.

First off, there is a never-ending discussion over the legal meaning of the word merchandise in the ICMS tax name. In this work, for the sake of simplicity, we will treat merchandise and goods interchangeably. Nonetheless, that treatment will not cause any relevant loss for the discussion due to the fact that there will be no difference in the interstate trade analysis regarding the type of goods traded\(^3\). Here, thus, we are interested in one type of transaction: the interstate trade of imported goods. Among other transactions, the ICMS is applied to the trading of goods from one state to another. For such operations the tax rate changes depending on the states involved and is defined by the Brazilian Senate.

Indeed, state ordinary laws establish the tax rate over operations that occur within the state borders, whereas the Brazilian Senate, by means of a resolution, defines the tax rate over operations with goods that cross state borders. For instance, the São Paulo state’s internal flat tax rate over the majority of operations is 18%, whereas other states have internal flat tax rate

\(^3\) Although, as we will see, the percentage of ICMS tax over importing operations depends on the specific type of goods traded.
of 17%. In interstate operations though, the tax rate depends on both the state of origin and the state of destination. In operations between two states from the South and Southeast regions the interstate tax rate is 12%, and is 7% between a state from South or Southeast, the richest regions, and a state from the Northeast, the poorest one. The main idea is to split tax revenues in a manner that the poorer region gets more than the richer one. Indeed, in this mentioned operation the Southeast region state gets 7% of tax over the imposing base and the Northeast region state gets 11% of tax over the same imposing base, splitting not equally the original 18% of tax.

Furthermore, Brazilian Senate, by means of Resolution 13, passed in 2012, aiming to cease the Fiscal War of Ports, has created a new distinction among interstate tax rates. It lowered the tax rate over interstate operations of imported goods to 4%. As a result, when a company is selling its products to a client from another state it is mandatory to separate the sales of goods produced in Brazil from the sales of imported goods from abroad, applying to the former a tax rate of either 12% or 7%, and to the latter a new tax rate of 4%.

Before we explain the reasons behind R13, we need to understand the most important feature of the ICMS tax: its non-cumulative calculation.

The ICMS tax rate is applied over the invoice face value of the acquisition and paid by the selling company, whereas the purchasing company registers this same value, paid by the selling company, as a credit in its ICMS assessment accounts.

Now, when this former purchasing company sells the same product it will apply the tax rate over its selling price, which will be presumably higher than the acquisition price, giving that it makes profit. As a result, the non-cumulative feature determines that this company pays an amount correspondent to the total amount of tax calculated in the sales operation minus the value appropriated as a credit in the ICMS assessment account which is exactly the amount of tax calculated in the precedent acquisition.

In other words, the amount of ICMS levied is equal to the tax value paid in the acquisition plus the tax rate over the value added (profits) in its current operation.

At the end of the day, the company will pay ICMS only over the value that it has added, avoiding double counting, or, in other words, cumulative taxation. This is named the ICMS non-cumulative principle.

In the firms’ accounting books will appear a credit, a value of ICMS that such firm has the legal right to appropriate, corresponding exactly to the tax paid in the former sales

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4 For the sake of simplicity, we will avoid to address too much detailed issues regarding Resolution 13.
operation, and a debit, a value of ICMS that such firm has the legal obligation to pay, corresponding to the tax owed by such firm due to the subsequent sale of those same goods. The balance debit vs. credit will result, in a monthly basis, in the net amount that will be owed and effectively paid by the firm to the State authority.

In the table below we present an example of two firms, a producer, firm A, and a retailer, firm B, located at the same state X, trading one particular type of good over which the ICMS tax rate is equal, lets’ say, to 20%. We assume for simplicity that firm A has no ICMS credit because, for instance, it didn’t have to buy any raw materials or supplies needed to its production process. Conversely, firm B has an ICMS credit of U$200 which corresponds to firm A’s ICMS debit. Both firms pays 20% of ICMS over its sale prices, firm A price is of U$1,000, and firm B price is of U$1,500.

<table>
<thead>
<tr>
<th>Table 1: Non-cumulative principle – internal operation.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>First Seller</strong></td>
</tr>
<tr>
<td><strong>Producer Firm A</strong></td>
</tr>
<tr>
<td>Selling price: $1000</td>
</tr>
<tr>
<td>Tax rate: 20%</td>
</tr>
<tr>
<td>ICMS debt: $200</td>
</tr>
<tr>
<td>ICMS credit: $0</td>
</tr>
<tr>
<td><strong>Second Seller</strong></td>
</tr>
<tr>
<td><strong>Retailer Firm B</strong></td>
</tr>
<tr>
<td>Price of acquisition: $1000</td>
</tr>
<tr>
<td>Profit margin: 50%</td>
</tr>
<tr>
<td>Selling price: $1500</td>
</tr>
<tr>
<td>Tax rate: 20%</td>
</tr>
<tr>
<td>ICMS debt: $300</td>
</tr>
<tr>
<td>ICMS credit: $200</td>
</tr>
<tr>
<td><strong>ICMS paid (Firm A):</strong> $200</td>
</tr>
<tr>
<td><strong>ICMS paid (Firm B):</strong> $100</td>
</tr>
</tbody>
</table>

At the end of this two firm’s chain the total amount of ICMS paid will be $300, firm A paid $200, and firm B paid $100. Eventually, the amount of ICMS firm B pays corresponds exactly to an incidence of ICMS solely over the value it added to the trade chain.

2.2. The so called Fiscal War of Ports

Broadly speaking, fiscal war could be defined as a sort of contest among Federal Units, such as the Brazilian states, to attract to their territories either new factories or old ones already settled in another state.

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5 Effective tax rate includes itself in its own tax base. This detail was omitted for the sake of simplicity. Nevertheless, it worth saying that this procedure of including the tax rate in its own tax base and the fact that ICMS tax base also includes all the operation costs (such as freight) and other taxes (such as the Importing Tax) makes ICMS impact over the sales price to be huge, implying that ICMS tax presents indeed a strong weight in such internal sales operations, as well as in importing and interstate sales operations.
According to Castilho and Silveira (2005), there are two types of fiscal war in Brazil: the industrial and the commercial. The former is designed to attract physical capital either abroad or from another Federal Unit, the latter is mainly focused on deviating the flux of commerce to pass within the conceding states territories in order to grab on part of the tax revenues that could be extract from the trade chain.

The Fiscal War of Ports (FWP), by its turn, could be defined as a competition among Brazilian states to attract investments to their territories by means of conceding fiscal incentives to either Brazilian or foreign trading companies under the condition of doing their importing operations through the conceding state harbors. Because in most cases no constraints are imposed to firms, FWP is becoming more like a commercial type of fiscal war.

Nonetheless, it is of great importance to understand which factors lead to an arrangement of tax incentives like the one presented in the FWP. The ICMS non-cumulative principle is on the background of tax benefits like the FWP ones in the sense that either one or both debit or credit accounts, which are the non-cumulative principle accounting tools, can be managed with government privileges.

In fact, targeted tax breaks can be either one or both of two forms: concession of ICMS credits, increasing the credit account; or, reduction or deferral of tax due, impacting the debit account. The deferral benefit could allow for a long period of time, over 20 years.

To better understand that mechanism we must present a numerical example. The following tables show two firms trading, firm A selling to firm B in three different situations: in table 2, there is no tax benefit conceded and both firms are located in the same state; in table 3, there is no tax benefit, but firms are located in different states; finally, in table 4, firms are in different states and firm A gets tax benefits in the form of direct concession of ICMS credits over interstate sales of imported goods.

At the examples, for the sake of simplicity, we consider internal tax rates as well as the tax rate over the importing operation to be both of 20%. Moreover, for simplicity, we consider the interstate tax rate to be of 10%. We also assume with no loss of generality firm A margin profit of zero. Finally, we assume FWP benefit to be a direct credit concession of 8% over the value of firm A’s interstate sale.

The first example, presented in table 2, shows internal sale of imported goods from abroad in which there is no tax benefit conceded to the importing company, firm A, and both firms are in the same State Y. As one can see, firm A pays to State Y an amount of $200 corresponding to the ICMS over the importing operation, plus the amount of $200 corresponding to the ICMS over the internal operation, minus the amount of $200
corresponding to the ICMS paid over the import operation trade due to the non-cumulative ICMS feature, giving at the end a balance of $200 (200+200-200) eventually. This mechanism seems a bit cumbersome, and in fact it is, but it allows for avoiding cumulative taxation on the trade chain.

Firm B, by its turn, pays to State Y an amount of $300 corresponding to the ICMS over its sales minus an amount of $200 corresponding to the amount paid by firm A due to the non-cumulative principle, yielding a balance of $100 paid to the State Y.

At the end of the day, State Y gets a tax revenue of $300, corresponding to $200 paid by firm A and $100 paid by firm B.

<table>
<thead>
<tr>
<th>First Seller Importing Firm A - State Y</th>
<th>Second Seller Firm B - State Y</th>
</tr>
</thead>
<tbody>
<tr>
<td>Goods importing value: $1000</td>
<td>Price of acquisition: $1000</td>
</tr>
<tr>
<td>Tax rate: 20%</td>
<td>Profit margin: 50%</td>
</tr>
<tr>
<td>ICMS over importing: $200</td>
<td>Selling price: $1500</td>
</tr>
<tr>
<td>Profit margin: 0%</td>
<td>Tax rate: 20%</td>
</tr>
<tr>
<td>Selling price: $1000</td>
<td>ICMS debt: $300</td>
</tr>
<tr>
<td>Internal tax rate: 20%</td>
<td>ICMS credit: $200</td>
</tr>
<tr>
<td>ICMS debt: $200</td>
<td>ICMS credit: $200</td>
</tr>
<tr>
<td>ICMS paid (Firm A): $200</td>
<td>ICMS paid (Firm B): $100</td>
</tr>
</tbody>
</table>

Another situation, presented in table 3, shows the interstate sale of imported goods from abroad, with yet no tax benefit conceded. As we can see, firm A pays to the State X the amount of $200 correspondent to the ICMS over the importing operation, plus the amount of $100 correspondent to the ICMS over the interstate operation, minus the amount of $200 correspondent to the ICMS paid over the importing operation, due to the non-cumulative ICMS feature, corresponding to a balance of $100 (200+100-200) eventually.

Firm B, located at State Y, which buys the imported goods from the trading company A, located at State X, will pay a balance of $200 to the State Y.

Therefore, at the second situation, on table 3, State X gets $100 and State Y gets $200 as tax revenue. Indeed, due to the interstate operation participating states split tax revenues.

Comparing these two preceding situations, one can see that tax revenue generated in the interstate sale is shared between the two States involved, whereas in the internal sale all the tax revenue goes to State Y. This is exactly the principle behind the FWP: States have
incentives to attract importing firms to their territories not only to promote economic
development but mainly to grab some part of the tax revenues generated in sales operations.

Table 3: FWP - interstate operation without tax break.

<table>
<thead>
<tr>
<th>First Seller</th>
<th>Second Seller</th>
</tr>
</thead>
<tbody>
<tr>
<td>Importing Firm A - State X</td>
<td>Firm B - State Y</td>
</tr>
<tr>
<td>Goods importing value: $1000</td>
<td>Price of acquisition: $1000</td>
</tr>
<tr>
<td>Tax rate: 20%</td>
<td>Profit margin: 50%</td>
</tr>
<tr>
<td>ICMS over importing: $200</td>
<td>Selling price: $1500</td>
</tr>
<tr>
<td>Profit margin: 0%</td>
<td>Tax rate: 20%</td>
</tr>
<tr>
<td>Selling price: $1000</td>
<td>ICMS debt: $300</td>
</tr>
<tr>
<td>Interstate tax rate: 10%</td>
<td>ICMS credit: $100</td>
</tr>
<tr>
<td>ICMS debt: $100</td>
<td>ICMS credit: $200</td>
</tr>
<tr>
<td>ICMS paid (Firm A): $100</td>
<td>ICMS paid (Firm B): $200</td>
</tr>
</tbody>
</table>

Suppose that both firm A and B are located at state Y as in table 2 situation, and that state X is willing to attract firm A to within its borders in order to grab on some part of the tax revenues generated by firm’s A sales to firm B, as of table 3 situation.

In order to do that, at the third situation, presented in table 4, State X concedes a tax benefit to the trading company A corresponding to a credit of ICMS of 8% over the value of the imported good. It does that to attract or to keep in its territory the importing firm and eventually either grab or maintain tax revenues in importing operations.

Table 4: FWP - interstate operation with tax break.

<table>
<thead>
<tr>
<th>First Seller</th>
<th>Second Seller</th>
</tr>
</thead>
<tbody>
<tr>
<td>Importing Firm A - State X</td>
<td>Firm B - State Y</td>
</tr>
<tr>
<td>Goods importing value: $1000</td>
<td>Price of acquisition: $1000</td>
</tr>
<tr>
<td>Tax rate: 20%</td>
<td>Profit margin: 50%</td>
</tr>
<tr>
<td>ICMS over importing: $200</td>
<td>Selling price: $1500</td>
</tr>
<tr>
<td>Tax break of 8%: $80</td>
<td>Tax rate: 20%</td>
</tr>
<tr>
<td>Profit margin: 0%</td>
<td>ICMS debt: $300</td>
</tr>
<tr>
<td>Selling price: $1000</td>
<td>ICMS credit: $100</td>
</tr>
<tr>
<td>Internal tax rate: 10%</td>
<td>ICMS debt: $100</td>
</tr>
<tr>
<td>ICMS credit: $200</td>
<td>ICMS credit: $200</td>
</tr>
<tr>
<td>ICMS paid (Firm A): $20</td>
<td>ICMS paid (Firm B): $200</td>
</tr>
</tbody>
</table>

As one can sees, in the present situation state Y receives the same amount of tax revenues as in the previous table 3 situation, but it receives less than in the table 2 situation,
where firm A was still located inside state Y borders. As a result, state Y loses when there is a benefit like that conceded by state X.

Notwithstanding, at this last situation, state X will receive tax revenues of only $20. This small value corresponds to the amount of $100 that firm A would originally pay of taxes in an interstate sale, as in the previous table 3 situation, minus the amount of $80 of ICMS tax privilege. On the other hand, firm A will pay less ICMS due to the direct credit of $80.

The rationale for that behavior is the willingness of states to attract investments by offering tax benefits. In the FWP context, trading companies will be attracted to the conceding state territory and will start importing goods through the conceding state harbors.

Indeed, if we compare situations one (table 2) and three (table 4) we can see that state X increases its tax revenue from zero to $20, reflecting the idea that some is better than nothing. Firm A pays less ICMS and state Y loses part of its ICMS revenues (a decrease from $300 to $200).

As a matter of fact, FWP was originally thought to be an industrial type of fiscal war, by attracting investments in terms of physical capital, however it turn out to be in most of the cases just a commercial kind of fiscal war featuring no capital inversions at all.

Gaining rents and not having to invest at all, firms will only be constrained to move to another state if operational costs incurred are higher than benefits gained. However, empiric evidence shows that the Fiscal War of Ports has increased dramatically among several Brazilian states, implying that firms are actually crossing state’s borders and that benefits gained may exceed by large costs incurred by firms.

In fact, according to Macedo (2006), the state of Espírito Santo (ES), the first to come up with this sort of tax benefits by 1970, has seen the increase of the number of trading companies settled within its borders, from 21 in 1971, to 257 in 2000. Furthermore, during that period, the number of states that actively engaged in this type of fiscal war increased from one to at least ten.

Issued in the beginning of the year 2013, Senate Resolution 13 (R13) has decreased the tax rate applied over imported products in interstate sales aiming to reduce the amount of tax revenues that these operations generate for the states and, thus, the profits that firms could extract in the form of tax benefits, diminishing their willingness to accept that kind of special tax regime.

Say the original interstate tax rate is 10%, like in the previous examples, and that R13 has decreased that tax rate to 4%. The states conceding tax benefits of 8% will not have room to do it anymore at this same level of benefit. In fact, 4% is maximum rate that states could
give as benefits, which would imply a total exemption of tax. However, that wouldn’t be interesting to conceding states due to the fact that the concession is worthless to them if they cannot get any tax revenue of it. For that reason, conceding states will have room to concede tax benefits of less than 4%, let say of only 3% or less.

By its turn, firms will make a decision to move to the conceding state only if the revenues they could extract from tax benefits are higher than the costs of moving. Firms would certainly incur in operational higher costs to start importing through a harbor that is more distant from the consumer market of its products, such as transportation costs. They will also incur in administrative extra costs to settle an operation in another state\(^6\). Eventually, the profits that can be extracted from, let’s say, 3% of tax benefits rate could not be attractive due to such mentioned costs.

During the past two years the tax authorities of some states and the media have reported that the Senate Resolution 13 has effectively caused a decrease in the willingness to concede/accept tax benefits, and has contributed to the put an end to the FWP\(^7\). As an illustration, the Estado de São Paulo newspaper published a series of articles, beginning in November 25, 2013 with one entitled “the end of the war of ports”, defending the effectiveness of R13 in fighting against the FWP.

At this work, we first attempt to test whether there exist a spatial interaction among states. Then, we test whether R13 has affected such strategic interaction among states, in other words whether the spatial interaction on states’ imports has changed due to R13. If we find that the spatial interaction among states didn’t change significantly since the edition of R13 in the beginning of the year 2013 then we will not have evidence that R13 was effective in fighting against the FWP. On the other hand, if we find that the spatial interaction has suffered a significant change from the beginning of 2013 onward, then we can say that our results at least suggest that R13 is one possible cause for that.

2.3. A closer look at the Importing Operations

Before we continue our task, we need to go over some important notions about the actual incidence of ICMS over importing operations.

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\(^6\) Although what actually happens in many cases is that importing firms don’t move, but only operations move. Large firms that are the actual importers just contract a different importing firm located in the tax benefit conceding state.

\(^7\) It is not worthless to say again that this work intends to test the validity of such notion.
Firstly, it is important to start with the notion that the tax rate of ICMS over importing operations depends on the type of goods being traded, exactly in the same way as in the internal operations. For instance, the importation of tabaco, alcoholic beverages, perfumes, and cosmetic products is levied by São Paulo state with an ICMS tax rate of 25%; the importation of some types of vehicles (such as buses) is levied with a tax rate of 12%; and the importation of condoms is levied with a tax rate of 7%.

Nonetheless, such differences by type of goods of tax rates over importing operations don’t affect the FWP mechanism. In fact, as we have previously exemplified, due to the non-cumulative feature of it, the ICMS paid over importing operations is completely compensated later by the importing firm, regardless of the type of goods being imported. As a result, there is no burden to the firm and there is no room for the states to manage the amount of tax collected over importing operations, giving tax breaks.

Conversely, the ICMS over the subsequent interstate operation, when such operation occurs, will be compensated by the firm located in another state, being all the burden supported by the local firm. As result, the local state, in which the importing operation takes place, has the possibility to decrease such tax burden, giving tax breaks. In conclusion, the only operation that really matters for applying the FWP mechanism is the interstate operation, in which, by its turn, the tax rate doesn’t depend on the type of goods being traded.

Furthermore, the arrangement of the ports in Brazil is another important factor in understanding the mechanism of importations. According to the Secretariat of Ports, the Port of Santos, in São Paulo state, is the largest one in terms of tons of bulk cargo handled. The second largest is the Port of Itaguaí, in Rio de Janeiro, and the third is the Paranaguá Port, in Paraná. Together, these three ports accounted for 21.4% of the total movement of all ports in Brazil in the year 2013.

The exploration of ports in Brazil is regulated by the federal authority, based in a national Ordinary Law, no 12.815/2013. According to it, in addition to the supervision of the Secretariat of Ports (SEP), the National Agency of Waterway Transportation (ANTAQ) also regulates and controls the activities of the port operators. SEP, by its turn, has as its area of

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8 In fact, the ICMS law considers importation to be an internal operation.
9 Tax rates also vary depending on the state.
10 Indeed, there are only three different tax rates of ICMS over interstate operations: 7% or 12% for national products; and 4% for imported products, regardless of the type of goods being traded.
12 Total port complex of the country handled 931 million tons of bulk cargo in 2013.
expertise to formulate policies and guidelines for the development and promotion of the sector of ports and maritime port facilities, river and lake.

Additionally, the mentioned law states that the public authority can concede the exploration of ports to particulars, such as private companies. Within the 235 large size ports in Brazil, 37 are administered by the public authority, the rest by particulars. The major flow of importing goods occur through the seaports and through the international airports. Thus, the FWP also takes place in states with no seashore, since importations often occur through their airports. Nonetheless, some states, such as Mato Grosso do Sul (MS), that doesn’t have seashore, have their importations occurring through river ports, receiving imported goods from south american neighbor countries.

According to Campos Neto (2006), the were 24 seaports in Brazil that operate in the foreign commerce. Every single state that has a seashore also has at least one of such seaports. Additionally, although the state of Amazonas (AM) doesn’t have seashore, it has a river port that operates in the foreign commerce.

Finally, It is worth noting that in the past two decades the Brazilian system of ports has being targeted of many reforms that attempt to enhance their performance, being an important part of a major effort to overcome the structural problems of the country.
3. Review of Literature

Our aim at this work is to use the same approach from spatial econometrics as used by Case, Rosen and Hines (1993) to find evidence of strategic interaction among states. However, our empirical specification is derived from a model of tax base inter-jurisdictional mobility rather than of interstate benefit spillover. And also, differently from the cited authors, we use a reaction function based on level of imports, which is actually the innovative element of this work.

In fact, Case, Rosen and Hines (1993), using a model of spatial econometrics, tested the notion that states’ expenditures depend on the spending of neighboring governments, the existence of expenditure’s spillover effect. They concluded that subnational governments do not make their decisions in isolation, in other words, they found strong evidence of strategic interaction among local governments.

An important referential work is Besley and Case (1995) that employ a model of spatial econometrics, finding evidence that vote-seeking and tax-setting are tied together through the nexus of yardstick competition, when an incumbent sets its tax rates to be rewarded by voters considering tax rates in nearby states.

Later on, Dubois and Paty (2010) also tested the presence of yardstick competition, by estimating a vote function in a panel data of French local governments. They concluded that voters might consider not only their close geographical neighbors’ tax rates, but also the nearby cities that are similar according to some socio-economic features such as population size.

Brueckner and Saavedra (1999) is another referential paper insofar as in addition to employ a spatial model they analyze the implications over local government strategic tax interaction of a property-tax limitation measure that took effect in 1981, by testing for the existence of strategic interaction before and after the measure. Also, their work contributes to solidify the notion that fiscal interaction may be the result of either benefit spillovers, where residents of one jurisdiction consume the public goods provided by neighboring jurisdictions, or inter-jurisdictional mobility of the tax base. Following such classification, this present work belongs to the latter one.

Furthermore, Brueckner (2000) presents a study on welfare migration finding evidence in favor of a race to the bottom in neighboring states. Focusing on the results of Figlio, Kolpin, and Reid (1997), Peterson, Rom, and Scheve (1997), Smith (1997), and Saavedra (1998), he tests for strategic interaction based on a regression equation relating the
welfare benefit level in a state to its economic and demographic characteristics, and to benefit levels in other states. At the end of his work, he found out a nonzero coefficient on other-state benefits, indicating the presence of strategic interaction, and showing that benefit levels elsewhere affect a given state's benefit choice.

Brueckner (2003) also presents an overview of empirical models of strategic interactions among governments and a review of three econometric issues relevant to the corresponding reaction function estimation, showing among other things that the empirical frameworks fit into two broad categories: spillover models and resource-flow models, where the former includes yardstick competition and environmental models and the latter includes tax competition and welfare competition models.

As Brueckner states, in spillover models each jurisdiction \( i \) chooses the level of a decision variable \( z_i \) and is directly affected by the level of \( z_j \) chosen by the others, yielding a reaction function of the type \( z_i = R(z; X_i) \), where \( X_i \) is a vector of jurisdiction \( i \) characteristics. In resource-flow models, although a jurisdiction is not affected directly by the others jurisdictions level of the decision variable \( z \), being on the other hand only directly affected by a particular resource that exists within its borders, such as the level of imports or the number of importing companies, its reaction function end up being exactly the same as in the spillover models since the distribution of that particular resource by its turn also depends on the level of \( z \) and of characteristics \( X \) for each jurisdiction.

It turns out that, as long as both categories of models yield the same type of reaction function, it is difficult to identify from which category a determined problem belongs to. In fact, as Brueckner (2003) states, the estimated reaction function does not reveal the nature of the behavior that generated the observed spatial interaction. Since this work aims to estimate this type of reaction function, we need to be aware that it is not possible, \emph{a priori}, to identify whether the observed spatial interaction is due to a tax competition behavior or to a spill-over one. In fact, the level of imports of a particular state could increase due to the increase in its neighbor’s level of imports. However, in such cases the reaction function slope would be positive, whereas in a tax competition such as the FWP it would be expected a negative reaction function slope, as explained in the previous chapter.

Nonetheless, Brueckner (2003) points out that theory doesn’t offer a way to find the sign of the reaction function slope. It could be either positive or negative, and could also be zero in cases where spatial interaction doesn’t exist.

Moreover, Brueckner (2003) distinguishes the vertical interaction from the horizontal one. The former takes place among governments at different levels such as the interaction that
might exist between national and provincial jurisdictions, the latter takes place among
governments at the same level such as the interaction among Brazilian states in the FWP
context.

In early theoretical literature, Williams (1966), Pauly (1970), Oates (1972), and
Boskin (1973) focused interaction due to spillovers. Subsequent work has focused on
interaction due to tax-base mobility, generating what has been known as the “tax competition”
literature. In that sense, the present work is within the tax competition boundaries.

In those tax-competition models, jurisdictions finance provision of a public good with
a tax on locally-employed capital. Capital is nationally fixed but moves among jurisdictions in
response to tax-rate differentials, while community populations are typically immobile. The
same model structure might be thought as well to the importing firm’s mobility under either
tax-rate differentials or, specially, direct concession of tax benefits as usually happens in the
FWP tax arrangements.

In the competitive version of the model, first analyzed by Beck (1983), Wilson (1986),
and Zodrow and Mieszkowski (1986), jurisdictions are small relative to the economy and thus
are unable to affect the net-of-tax return to capital. As a result, tax rates in other jurisdictions
are irrelevant, and strategic behavior is absent.

When individual jurisdictions are large relative to the economy, each jurisdiction is
able to alter capital-net return by varying its tax rate. In this case, which was first analyzed by
Mintz and Tulkens (1986), Wildasin (1988a), and Bucovetsky (1991), the tax rates in other
jurisdictions must be taken into account in a given jurisdiction's choice, leading to strategic
behavior.

In Brazil there are just few works on strategic behavior of government jurisdictions.
As an illustration, one of them presented by Mattos and Politi (2013) investigates whether a
pro-poor tax policy follows yardstick competition in the value-added tax (VAT) base in
Brazilian states. They employ spatial econometrics to assess tax interaction among states.
Mattos (2009) also employs a spatial approach to find that there was no spatial interaction
among states’ expenditures in the USA from year 1999 to year 2000. Mattos and Rocha
(2010) extend the model proposed by Meltzer and Richard (1981) to allow for spatial
interaction in the redistributive in-kind transfers from the local governments, finding a
negative relation between expenditures and median voter income. Mattos, Suplicy, and Terra
(2014) investigate the existence of strategic interaction among Brazilian municipalities
regarding their housing public policies and eventually find a race to the bottom in housing
provision among such federal units.
This present work focuses on a particular competitive interaction among Brazilian states, namely the Fiscal War of Ports (FWP). Casual observation suggests that jurisdictions’ tax benefits levels generated by the FWP do affect the level of foreign commerce in neighboring jurisdictions. Using figures of importing sector to test for strategic interaction among states is an innovation of this paper, besides that it’s not known yet any work in Brazil that applies econometric models to the FWP issue.

There is a well established strand of economists, such as Besley and Case (1995), Figlio, Kolpin and Reid (1997), Saavedra (1999), Shroder (1995), Smith (1997), that also study fiscal interaction at the state level, with the latter four papers focusing on the choice of welfare benefits.

Oates (2001) provides an overview of tax competition literature and explores the presence of tax competition in European Union, whose structure can be considered quite similar to the Federal state one.

Devereux, Lockwood and Redoano (2007) explore a simple model with a spatial structure of only two states to account for simultaneous vertical and horizontal competition in excise taxes allowing for markets of goods characteristics, finding evidence of vertical competition in the gasoline market and of significant and large effect of neighboring states taxing in the cigarettes market.

Moreover, there is a whole set of research papers from which we absorbed some sort of relevant information for this present work that for conciseness matters we only cite at the references section.

Based on the references presented above, the intent of the present study is to provide an indirect empirical test of the tax-competition model used, testing the existence of strategic interaction among Brazilian states in the FWP context.
4. Equation Model Specification

4.1. The Estimation Equation and Strategy

Considering the fact that casual observation\(^\text{13}\) suggests that jurisdictions’ tax benefits levels generated in the FWP context do affect the level of foreign commerce in neighboring jurisdictions, the empirical analysis we attempt to perform at this present work is designed to estimate the level of imports reaction function of each State. This function relates each State level of imports to its own characteristics and to the level of imports in competing jurisdictions. When tax benefits are conceded strategically on importing operations, taking account of capital movements among States, the reaction function must have a nonzero slope, indicating that changes in competitors’ level of imports due to the concession of tax benefits affect the given State’s choice. The theory\(^\text{14}\), however, shows that this slope can be either positive or negative, with the exact sign depending on parameter values.

Alternatively, if strategic interaction is absent, then the reaction-function slope is identically zero. Thus, the empirical question of interest is whether the slope parameter is significantly different from zero. In this case, the absence of strategic interaction can be rejected as a null hypothesis.

At this point we must explain why we decided to choose importing figures, and not something else, to try to capture the FWP effects over the economy. First off, when states grant some sort of FWP tax benefits, they expect to attract importing firms to their territories and grab some part of tax revenues. However, as a direct consequence of that, conceding state’s level of imports increases, decreasing its competitor state’s level of imports, where attracted firm once was established. As a result, if states behave strategically in FWP terms, this behavior must be encrusted in the states level of imports data, and can, thus, be revealed by a model of spatial econometrics, like the one we are attempting to implement, using importing figures as its dependent and explanatory variable of interest.

Hence, the methodology aims to identify from the states level of imports data some evidence of strategic interaction, and the employed technique aims to warrant that, \textit{ceteris paribus}, this identified effect is due to the FWP and not to anything else, such as a necessary econometric procedure outcome or as a result of an unknown and uncontrolled factor.

\(^{13}\)Casual observation refers to a set of reports, presentations, lectures etc. by which tax authorities and specialists have been releasing figures and statistics regarding FWP effects over foreign commerce performance for each state.

\(^{14}\)Specially Besley and Case (1995).
Moreover, the lack of publicly available information about other variables that could constitute good candidates to substitute the importing one, such as the ICMS revenues over importing operations or the number of trading companies in each state, is an actual difficult issue not easy to overcome in the Brazilian reality. In addition, choosing other dependent variable is not a warrant of elimination of all methodological existing problems, for example, if we had chosen the number of trading companies as our targeting variable we would certainly have faced an almost unsolvable problem of separating FWP effect due to the fact that in most of the cases in the FWP context firms don’t move to another territories, only operations do move, in other words, instead of moving to a given state, a firm just have to contract other trading firm services located in such state and proceed its importing operations through the contracted firm.

That being said, following earlier work, our econometric specification uses a spatial model. In such a model, a weight matrix aggregates the level of imports in competing communities into a single variable that appears on the right-hand side of the reaction function. State’s characteristics also appear as explanatory variables, and their effect is to shift the intercept of the reaction function.

The regression equation used in testing for strategic interaction is written as follows:

\[ IMP_i = \phi \sum_j w_{ij} \cdot IMP_j + \beta \cdot X_i + \epsilon_i \]  

Where \( IMP_i \) is the imports level in state i, \( IMP_j \) represents imports levels of each one of the 27 Brazilian federate units, \( X \) is a vector of economic and demographic characteristics for state i, \( \beta \) is the associated coefficient vector, and \( \epsilon \) is an error term. The “\( w_{ij} \)” terms in eq. (1) are weights that indicate the importance attached by state i to imports in the various other j states. \( \sum_j \) is summing importing levels of all 27 states (j=1 to 27) with different weights each one, depending on its importance to the state i importing level. In this equation interest lies in the parameter \( \phi \), which represents the effect of other States level of imports on the each considered State.

Furthermore, we augmented eq. (1) to allow for time effects, including in the equation a series of month and year dummies, which would control for variables that might have a common effect on the states in a given year or month, such as business cycle conditions and national mood towards governments, and also inflation and foreign exchange which are, for the macroeconomic theory, important factors impacting the level of imports. Thus, including
time effects is very important to avoid attributing behavioral significance to any across state
correlations in imports that are due to common national influences.

We also used panel data to account for fixed effects – unobserved characteristic of the
state that influences its importing level and does not change over the time period considered
in our data, like climate, preferences, productive structure etc.

Our estimation equation now is:

\[ \text{IMP}_{it} = \phi \sum_j w_{ij} \text{IMP}_{jt} + \beta \cdot X_{it} + f_i + h_t + \varepsilon_{it} \]  

Where \( f_i \) and \( h_t \) are the fixed individual and year/month effects, respectively. Eq. (2)
attaches time indexes to the initial variables to account for the fact that our sample is
comprised of 64 monthly observations to each one of the 27 states.

The equation above is estimated via OLS in a fixed effect panel data model, where
there are 27 cross section observations defining 27 groups (states) of time series data
(months). The use of panel data model allows for getting rid of any unobserved factor that is
fixed over time or, at least, over the considered time period. On the one hand, if there is a
fixed effect that is not correlated to the imports level then it would be of no interest once it
does not cause any harm to the parameter \( \phi \). On the other hand, if there is an unobserved
variable that is correlated to the level of imports, then keeping it in the error term will
certainly make \( \phi \) biased. Nonetheless, if that unobserved variable is fixed over time then we
could satisfactorily treat it using a fixed effect panel data analysis.

4.2. The Weight Matrix

As we have said, the state level of imports is influenced by its neighbors’ level of
import. For the model to capture this pattern of influence, the weights \( w \) are defined in eq. (2)
as a measure of the relative importance of a given state importing level to another state
importing level that are neighbors, which means geographically close or economically similar
to each other.

In other words, each state level of imports is differently influenced by its neighbors’
level of import. In São Paulo (SP) state, for example, the effects of an increase in Santa
Catarina (SC) state level of imports might be more important than the effect of an increase in
Maranhão (MA) state level of imports. However, a state may have more than one neighbor
and, to account for that, every state is associated with a vector of \( w \)’s that indicates the
relative importance, the neighborliness, of all other states to impact its level of imports. As a result, we can write the system of importing level equations for all states in period t in the following matrix form:

\[ \text{IMP}_t = \varphi \cdot W \cdot \text{IMP}_t + \beta \cdot X_t + \epsilon_t \]  

(3)

Considering the fact that our sample consists of 27 states, then IMP\(_t\) is now a (27x1) vector of states importing level in period t; \(X_t\) is a (27x\(k\)) matrix of \(k\) explanatory variables that includes year and state effects; and W is a (27x27) weighting matrix that assigns neighbors to every state (including the Federal District as the 27\(^{th}\) state). For instance, take the \(i^{th}\) state, it will be accounted at the \(i^{th}\) W matrix row, in other words, the \(i^{th}\) row of W assigns to state i the weighted average of its neighbors importing levels: \(\sum w_{ij} \cdot I_{jt}\). As Case, Rosen and Hines (1993) note, it would be desirable to estimate the elements of the W matrix along with other parameters, however that would be impracticable because of insufficient degrees of freedom. As a consequence, we need to specify W \emph{a priori}.

To find the elements of W matrix we need to understand the impact of each state j on state i’s level of imports. Initially, we can realize that such impact depends on several factors, being some of them the proximity and the economic size. Proximity is important because, due to lower logistic costs, the closer two states are the easier it is to move production factors, in other words, the easier it is for a company to change its importing operations from one state to another. Economic size is also an important factor in the sense that it is less likely for an economically small state to have influence in a lager state level of imports, unless it was one of the most fiscal war aggressive players.

This raises another factor of influence: the more active one state is in conceding tax breaks, the more likely it is that such state impacts other states’ level of imports. As a result, in this work, neighborliness is characterized by these three factors: geographical proximity, economical size and activeness in conceding tax breaks.

To make things simple, after considering those three factors, we assign a weight of either \(w=1\) or \(w=0\) to every state i’s neighbors, depending on the level of neighborliness of each one.

In this work we used some different weight matrixes to test for different neighboring rule significance. Table 5 presents the first weight matrix, named Fiscal War Matrix \(\text{FWM}_1\), based on the three criteria previously discussed.
As one can see, the weight $w=1$ was assigned based on two criteria: geographical proximity, in blue, and activeness in conceding tax breaks, in red and italic. The third criterion, economical importance, impacted the weight of certain states by making it equal to zero regardless of other criteria that might have made it equal to one. As an illustration, the Maranhão (MA) state has been strongly active in the FWP, being a relative small foreign commerce player, though.

One can argue that the assignments based on the activeness criteria are somewhat arbitrary. However, we can effectively reduce this arbitrariness by relying on the various works produced on the FWP subject for defining which states are the most active in such fiscal war. Prado (1999) points out the existence since 1966 of regional tax incentives regimes in states such as CE. Silva (2012) refers to ES, SC, and GO as important players in the FWP. Silva and Almeida (2013) analyze SC tax incentive program (PROEMPREGO). Almeida (2014) analyzes tax benefits of GO state in the FWP.

Reich (2007) refers to the states of ES, RS, MG, GO, SC, and RJ as actively participating in the fiscal war. Macedo and de Angelis (2013) explain that states without harbors such as MG, DF, MT, and GO, also engaged in the FWP by using Internal Customs Stations (“Estações Aduaneiras Internas – EADIs), and they also analyze the case of ES and SC states as the most engaged ones.


A whole set of legal cases$^{15}$ (Direct Actions of Unconstitutionality – ADI) are heard in the Brazilian constitutional court (STF) involving the FWP tax regimes conceded by states such as ES, MS, RJ, SC, PR, DF, CE, GO, and RS.

The FWM$_1$ that follows was based on the evidence obtained in the mentioned works that show that the most active states during the study period were SC, ES, GO, DF, PR, RS, MS, and CE. For instance, SC has been strongly active by means of a whole program of incentives named PROEMPREGO, as well as ES by means of FUNDAP program, and GO by means of PORTO SECO program.

$^{15}$ Legal cases such as the following, by number: ADI 3702 (ES); ADI 4457 (MS); ADI 3413 (RJ); ADI 3794 (PR); ADI 2549 (DF).
Furthermore, we also estimate eq. (3) using a more comprehensive second matrix that considers 14 states plus the Federal District competing with each other as well as a rule of proximity such as states in the same region also compete amongst themselves. This list is based on the works that recently enlarged the number of states engaged in the FWP such as Lima and Lima (2008) that while studying a broad set of tax incentive programs issued by northeast region states found out that, in addition to the state of CE, the states of MA, BA and PE were also important players in the foreign commerce fiscal war. For instance, MA has its Industry and Foreign Commerce Tax Incentive Program (SINCOEX), PE has its Pernambuco State Development Program (PRODEPE), and BA has a program of incentives (DESENVOLVE) and an incentive fund (FUNDESE).
Vieira (2014) presents a study on the tax incentives conceded by the states of MG, BA, PR, PE, and RJ, showing the various types of incentives they concede, such as deferral of ICMS on import of goods: BA, PE, and RJ; credit grants of ICMS on import of goods: PE; and financing imports: BA and PE. Novaes (2014) dedicates its dissertation to analyze the state of MA fiscal incentives. Langemann (2014) also mentions the state of AM as a major player due to its special tax zone.

That being said, the second matrix (FWM$_2$) comprises a larger number of competing states than the first one, considering the most active states during the study period as of MG, SP, RJ, ES, PR, SC, RS, AM, BA, MA, PE, CE, GO, MS, and DF. The way it is assembled is exactly the same as the first matrix, so we are going to avoid useless repetition.

We have also built a third matrix which is based on the fact that the state of SC, regardless all evidences provided by R13 in diminishing imports level of all competing states, has improved its level of imports continually during the whole study period.

This third matrix (FWM$_3$) is almost exactly equal to the second one, except for the fact that it establishes SC as a non-competitor state. The point is to construct a matrix that could serve better for testing R13 effects over FWP considering the fact that SC could function as an outlier and represent a source of error on the test.

Furthermore, we used a fourth matrix (FWM$_4$) that presents a simple rule of neighboring in which only the same region states compete with each other, a simple rule of proximity. For instance, São Paulo (SP) state compete with Minas Gerais (MG) state as much as they belong to the Southeast region, but São Paulo state doesn’t compete with Maranhão (MA) state because the latter belongs to the Northeast region.

Finally, we also estimated eq. (3) using a randomly obtained weight matrix, in which every weight is determined randomly and that would function as a “Placebo Matrix”. Our aim is to check for the model robustness and assess whether there exists evidence of relationship regardless of which matrix we use, in other words, regardless of any measure of neighbor characteristic we choose.

Because a randomly obtained matrix can be pretty much like any of the precedent three matrixes or any other matrix that comprises a relationship among actual competing states, we tried some different random matrixes until we found one, which was named “Random”, that showed no relationship among states, providing evidence of reliability on results presented by preceding matrixes. As a result, there is at least one matrix that does not present any relationship among dependent and explanatory variables, proving that this
relationship emerges only upon certain circumstances. Consequently, the way it was defined, neighborliness matters.

4.3. R13 as a Natural Experiment in a Panel Data Analysis

As already said, it is also of valuable assessment to the test for strategic interaction under two different situations: before and after the Senate Resolution 13, which, as already explained, was a legislative act that took effect in the beginning of 2013 and aimed to reduce the FWP. The hypothesis of effectiveness of the R13 is tested by estimating the model adding interactions terms among certain dummies, which are able to account for changes after the resolution imposition, and the level of imports of competing units.

Thus, we need to augment eq. (3) to account for R13 impact over FWP. In order to do that we must implement an approach similar to a difference-in-differences model by means of including dummy variables that are equal to the value of zero before R13 and to the value of one after R13, and by interacting these dummies with the explaining variable of interest. This approach is similar to that of the natural experiment (or quasi-experiment) literature, which occurs when an exogenous event changes the environment in which economic agents operate. In fact, we could perfectly see R13 as measure that changes a particular government tax policy and works as natural experiment that affects economic environment.

Thus, our estimation equation in matrix form will be:

\[
\text{IMP}_t = \varphi \cdot \text{W} \cdot \text{IMP}_t + \delta_1 \cdot \text{dR13}_t + \delta_2 \cdot \text{dR13}_t \cdot \text{W} \cdot \text{IMP}_t + \beta \cdot X_t + \epsilon_t
\]  

(4)

The only differences between the above equation and eq. (3) are the R13 dummy term (\text{dR13}_t) and the interaction term (\text{dR13}_t \cdot \text{W} \cdot \text{IMP}_t). The rest of eq. (4) terms were already explained and we will avoid useless repetition. Our parameter of interest is \delta_2 and the correspondent null hypothesis implies that there is not enough evidence of R13 impact over FWP. In other words, if we find \delta_2 to be statistically not different from zero, then we can conclude that the coefficient of spatial interaction \varphi remains the same both before and after R13.

Furthermore, to assess the impact of R13 over FWP we will consider not only one but four dummy variables to allow for any lag that might possibly have happened between the moment R13 was launched and the moment its addressees have complied with it. The four
dummies are: dR13a is zero in 2010 and one from 2011 on; dR13b is zero from 2010 to 2012 and one from 2013 on; dR13c starts to be one from the 2013 second semester on; and dR13d is zero from 2010 to 2013 and one from 2014 on, as follows in the Chart 01.

Thus, interaction terms of these dummies variables with the level of imports (our explanatory variable) will account for changes in the strategic interaction among states due to R13, in a strategy close to the difference-in-differences approach. In fact, from eq. (4) we can see that before R13 the coefficient of spatial interaction is \( \varphi \) and after it is \( (\varphi + \delta_2) \), being the difference exactly the value of \( \delta_2 \). Although this approach is similar to the natural experiment literature, it has one difference: the same cross-sectional units (states, in our case) appear in each time period.

Nonetheless, as mentioned above, we can treat R13 similar to a natural experiment (quasi-experiment) that took place in January 2013 changing the ICMS interstate taxation throughout the country, being both the treatment and control group the 27 Brazilian states.

Therefore, estimating eq. (4) with dummies terms such as dR13 (a, b, c and d) and interaction terms such as dR13 (a, b, c and d) times W.IMP\(_j\) (our explanatory variable of interest) will account for any relevant change in the coefficient of spatial interaction in a certain moment in time, the moment in which R13 began to produce its effects.

Chart 01: dummy variables, estimating the R13 effect.
5. Data Analysis

We estimate the model using monthly data on all the 26 Brazilian states plus the Federal District (DF) over the period that goes from January/2010 to April/2015, amounting 64 monthly periods.

The following variables comprise the X vector in eq. (3): Reseller Sales Index (RSI), Square Meter Cost of construction (SMC), Population, Child Mortality (CM) and States Participation Fund (SPF). Population and Child Mortality (CM) account for the possible role of state size and other idiosyncrasies in affecting its level of imports; Reseller Sales Index (RSI) is a measure of the state economic activity; Square Meter Cost of construction (SMC) accounts for the fact that in states with different costs the share of imports in its expenditures might be different; and States Participation Fund (SPF) is a Constitutional Fund from which tax resources are distributed to states in order to complement revenues and it presents a special distribution rule of those resources among states which comprises population size and *per capita* income as relevant factors. In addition, the X matrix contains state, year and month indicator variables, as well as such dummy interactions.

The next table contains descriptive statistics for these data.

<table>
<thead>
<tr>
<th>Name</th>
<th>Source</th>
<th>Obs.</th>
<th>Mean</th>
<th>Std. Dev.</th>
<th>Min.</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Dependent variables</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Imports (IMP)</td>
<td>MDIC</td>
<td>1728</td>
<td>18.6442</td>
<td>2.4287</td>
<td>10.2002</td>
<td>22.9783</td>
</tr>
<tr>
<td>Exports (EXP)</td>
<td>MDIC</td>
<td>1728</td>
<td>18.6696</td>
<td>2.3767</td>
<td>12.0040</td>
<td>22.5583</td>
</tr>
<tr>
<td><strong>Control variables</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>State Part. Fund (SPF)</td>
<td>STN</td>
<td>1728</td>
<td>18.6600</td>
<td>0.6756</td>
<td>16.6522</td>
<td>20.2342</td>
</tr>
<tr>
<td>Population</td>
<td>DATASUS</td>
<td>1620</td>
<td>15.2808</td>
<td>1.0372</td>
<td>12.9627</td>
<td>17.6005</td>
</tr>
<tr>
<td>Child Mortality (CM)</td>
<td>DATASUS</td>
<td>1620</td>
<td>4.3996</td>
<td>0.8948</td>
<td>1.6094</td>
<td>6.5250</td>
</tr>
<tr>
<td>Reseller sales Ind. (RSI)</td>
<td>IPEADATA</td>
<td>1674</td>
<td>6.9712</td>
<td>0.1493</td>
<td>6.2324</td>
<td>7.5848</td>
</tr>
<tr>
<td>Square Met. Cost (SMC)</td>
<td>IPEADATA</td>
<td>1701</td>
<td>11.3082</td>
<td>0.0983</td>
<td>11.0692</td>
<td>11.5589</td>
</tr>
</tbody>
</table>

Notes:

Table 6 presents all variables in logarithmic form, consequently the average population\(^{16}\) value presented as of 15.2808 represents the logarithm of the population mean.

\(^{16}\) As long as it is available only yearly data for population, we had to apply an interpolation rule to obtain monthly data. Hence, we used the population values estimated by IBGE (Brazilian Institute of Geography and...
However, the population mean is approximately equal to 7.2 million people and its minimum and maximum values are respectively 426 thousand and 44 million people.

Child Mortality (CM) corresponds to the number of children’s death by state on a monthly basis. CM mean is approximately equal to 121 children’s deaths per month. Reseller Sales Index (RSI) corresponds to 100 in the year of 2011, and it is obtained by researching gross sales revenues of reseller firms with more than 20 employees. Finally, Square Meter Cost (SMC) is the price in Brazilian Reais of houses over its area by state on a monthly basis. SMC mean value is equal to R$818.83 and its minimum and maximum values are respectively R$641.65 and R$1,047.04.

It is worth emphasizing that we have used all available variables. Since we are using monthly data and our cross-sectional units are the Brazilian states, the available options for control variables become very limited. Also, the fact that R13 was launched less than three years ago only poses more difficulties to the task of gathering relative recent data.

For some control variables, such as CM and SMC, data is missing due to the fact that these figures are collected months later than the date they are related to, and some of them were not collected by the agencies by the time we were implementing our tests. Thus, we are dealing with a not balanced panel because the time periods available for all cross-section units are not the same. Notwithstanding, this unbalanced panel does not cause any sample selection issue because in our case the lack of balance is due simply to a limitation on the process of assembling data by the collecting institutions.

Our dependent variable IMP is the logarithm of the monthly state’s importing levels in US dollar free on board (FOB) values. IMP’s mean value is around US$673 million and its minimum and maximum values are US$27 thousand and US$9.54 billion respectively.

Furthermore, as one can see on table 6, we also use EXP as dependent variable which definition is the logarithm of state’s exporting levels in US dollar free on board (FOB) values. EXP’s mean value is around US$699 million and its minimum and maximum values are US$163 thousand and US$6.27 billion respectively.

The point is to estimate the model testing whether no strategic interaction among states is revealed from exporting figures, strengthening the evidence of the model reliability.

Statistics) for the years 2011 to 2014 and then we calculated the monthly population by applying a linear interpolation rule. To illustrate that, let me take the year 2011 estimated Acre (AC) state population of 734123 people and the estimated population for the same state at the year 2012 of 747516, so the difference between these two populations is 13393 people, which yields a monthly rate of population increase of 1116 people (13393/12). With these results we calculate the February/2011 population as of 735239 people (734123+1116). Finally, we continue to do that for the following months and calculate the whole series from January/2010 to December 2014.
In fact, since there is no possibility for the states to give tax exemptions over exporting operations, which are already not taxed due to constitutional tax immunity, we would expect no strategic interaction among states popping up from exporting figures, being the effects of FWP over exports presumably identical to zero.
6. Regression Results and Analysis

6.1. Strategic Interaction Behavior

First off, we estimate eq. (3) using all dependent and explanatory variables in logarithmic form because it becomes easier to interpret regression coefficients. On the other hand, in the Random matrix we take all variables in level due to the fact that our objective is only to prove that it is possible to reach none strategic interaction depending on the matrix we use.

Table 7 presents the results of estimating eq. (3) using different weights matrixes. The coefficient of interest is the one referred to the spatial explanatory variable W.IMPj, defined as the weighted mean of the importing level of all relevant competing jurisdictions in terms of a particular neighboring rule established by the weighting matrix W.

Table 7: Estimation of state interaction on FWP 2010-2015 using different measures of neighbor characteristic.

<table>
<thead>
<tr>
<th>Explanatory Variables</th>
<th>Model</th>
<th>FWM1</th>
<th>FWM2</th>
<th>FWM3</th>
<th>FWM4</th>
<th>Random</th>
</tr>
</thead>
<tbody>
<tr>
<td>W.IMPj</td>
<td></td>
<td>-0.2372</td>
<td>-0.4851</td>
<td>-0.4620</td>
<td>-0.2992</td>
<td>0.0068</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.0842)***</td>
<td>(0.1061)***</td>
<td>(0.1029)***</td>
<td>(0.0615)***</td>
<td>(0.0207)</td>
</tr>
<tr>
<td>SPF</td>
<td></td>
<td>-0.1398</td>
<td>-0.1403</td>
<td>-0.1396</td>
<td>-0.1228</td>
<td>0.1023</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.0487)***</td>
<td>(0.0485)***</td>
<td>(0.0485)***</td>
<td>(0.0485)***</td>
<td>(0.1394)</td>
</tr>
<tr>
<td>Population</td>
<td></td>
<td>-0.9117</td>
<td>-0.8758</td>
<td>-0.8778</td>
<td>-1.1116</td>
<td>181.78</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.4924)*</td>
<td>(0.4900)*</td>
<td>(0.4900)*</td>
<td>(0.4932)**</td>
<td>(29.723)***</td>
</tr>
<tr>
<td>CM</td>
<td></td>
<td>-0.0405</td>
<td>-0.0474</td>
<td>-0.0458</td>
<td>-0.0381</td>
<td>-474476</td>
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<td></td>
<td></td>
<td>(0.0626)</td>
<td>(0.0624)</td>
<td>(0.0624)</td>
<td>(0.0623)</td>
<td>(339047)</td>
</tr>
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<td>RSI</td>
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<td>0.3136</td>
<td>0.2954</td>
<td>0.2948</td>
<td>0.3119</td>
<td>-567596</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.1974)</td>
<td>(0.1966)</td>
<td>(0.1966)</td>
<td>(0.1966)</td>
<td>(44219)</td>
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<td>SMC</td>
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<td>0.0578</td>
<td>0.0387</td>
<td>0.0350</td>
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<tr>
<td></td>
<td></td>
<td>(0.5280)</td>
<td>(0.5245)</td>
<td>(0.5247)</td>
<td>(0.5238)</td>
<td>(2693.7)***</td>
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<tr>
<td>R-sq</td>
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<td>0.17</td>
<td>0.17</td>
<td>0.17</td>
<td>0.17</td>
<td>0.10</td>
</tr>
<tr>
<td>Observations</td>
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<td>1620</td>
<td>1620</td>
<td>1620</td>
<td>1620</td>
<td>1620</td>
</tr>
</tbody>
</table>

Notes:
(1) FWM - Fiscal War Matrixes; (2) FWM1, FWM2, FWM3, and FWM4 with dependent and explanatory variables in logarithm form; (3) Random Matrix with all variables in level; (4) State, year and month dummy variables omitted; (5) standard error in parenthesis; (6) *, ** and *** means significant at 10, 5 and 1% levels respectively; (7) FWM1 - Matrix with short number of competitor states; (8) FWM2 - Matrix with large number of competitor states excluding SC state; (9) FWM3 - Matrix with a simple rule of proximity; (10) FWM4 - Matrix with randomly generated weights.
The second column shows the results using FWM$_1$ where one can see a statistically significant negative coefficient of the spatial explanatory variable W.IMP$_j$, in other words, a significant effect over a given state imports level from the rest of the states’ imports level, suggesting the existence of strategic interaction among states.

In fact, the quantum and sign of the spatial variable coefficient in the second column implies that the level of imports of a particular state will decrease by 0.24 percent if the level of the average imports of its competing states increases by one percent. The negative sign was expected since, by means of granting tax breaks, competing states attract importing firms to their territories leveraging their imports level and reducing their neighbor’s level of imports, thus implying a negative relationship.

The spatial variable (W.IMP$_j$) coefficient is significant at a level of 1% in all four fiscal war matrixes, but in the Random one. Indeed, in the four fiscal war matrixes t-statistic ranges in absolute value from 2.82 to 4.57, whereas in the Random matrix it is of only 0.33. It suggests, firstly, that all four measures of neighborliness are effective in producing an actual representation of the FWP competitive arrangement. Also, it suggests that this result is neither pure consequence of the econometric procedure nor a merely inherent characteristic of underlying data, but it is directly affected by how neighbors are defined, since we assign weights values randomly and end up with no strategic interaction evidence.

Control variable SPF is significant at a 5% level, and the rest of the control variables are slightly significant or not significant at all at a 10% level. The negative sign of SPF coefficient is due to such control variable inverse correlation with imports variable. Such inverse correlation reflects the fact that SPF distribution among states depends on the states income per capita, being more significant for the poorest states, which, by its turn, present lower levels of imports. In fact, as Piancastelli and Perobelli (1996) emphasizes, the average dependency of the North and Northeast region states in relation to the FPE is the highest throughout the country (of the order of 77.2% and 48.2% respectively, whereas in the whole country it is of 11.3%), confirming SPF as an income redistribution instrument. In the states of AC, AP, RR, TO, MA, and PI, all states from the North and Northeast regions, volumes received through the SPF are substantially higher than their own collection of ICMS. In the Southeast, on the other hand, resources from the SPF account for only 1.6% of the ICMS collection.

Using FWM$_2$ we obtain the largest spatial variable coefficient magnitude, of approximately -0.49, which is also the most statistically significant one with t-statistic in absolute value of 4.57. In fact, this matrix considers a very ample set of competing states,
gathering as a result a larger set of information about the actions of competing states in the FWP. The coefficient implies that the level of imports of a particular state will decrease by 0.49 percent if the level of imports of its competing states increases by one percent.

It is worth noting that the estimation with the fourth fiscal war matrix also produced a significant spatial variable coefficient of -0.2992 of magnitude implying that some relevant part of the states’ strategic interaction is due to the proximity among each other. Indeed, this result is consistent with the fact that FWP tax benefits become less attractive to firms located more distant from the conceding states due to higher logistical and transportation costs.

Population and CM control variables presented negative sign coefficients, although the latter coefficient is not statistically significant and the former coefficient is only marginally significant. The negative sign for the CM coefficient would be expected since high children mortality occurs mainly in poorer states, being for that presumably associated with a smaller level of imports.

However, the negative sign for the Population coefficient is somewhat unexpected since more populous states would presumably present a greater level of imports than the less populated ones. One possible explanation for that is the association between size and economic activity. In other words, if a state is big it is likely that such state produces its own goods, being less dependent on imported ones. Nonetheless, this explanation needs a deeper investigation and further considerations. However, considering our limitations at this present work and the fact that population is a control variable we decided to move on and leave this discussion for another opportunity.

The main result is that the estimates presented above suggest that there exists spatial interaction among states, emerging from the importing figures. In other words, results suggest that Brazilian states do engage in a competition such as the FWP in the way it was modeled here.

6.2. The Change on Strategic Interaction Behavior over Imports due to R13

Table 8 presents the estimation of eq. (4), which adds dummy variables to account for a structural change in the strategic interaction among states as a result of the Brazilian Senate Resolution 13 (R13).

As mentioned before, dummy dR13a changes its value from zero to one at the beginning of the year 2011. However, R13 was put in effect in the beginning of the year 2013, thus if the coefficient of interaction term dR13a.W.IMPj is statistically significant then there
must be some other factors affecting FWP during the time period considered. Nonetheless, by casual observation we expect this not to happen, and this is the hypothesis to be tested.

Table 8: Estimation of R13 effect on FWP 2010-2015 using different FWMs as a measure of neighborhood. Dependent variable: IMP.

<table>
<thead>
<tr>
<th>Interaction terms</th>
<th>Model</th>
<th>FWM₁</th>
<th>FWM₂</th>
<th>FWM₃</th>
<th>FWM₄</th>
</tr>
</thead>
<tbody>
<tr>
<td>dR13a*W.IMPj</td>
<td>-0.0445</td>
<td>-0.0339</td>
<td>-0.0334</td>
<td>-0.0352</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.0240)*</td>
<td>(0.0313)</td>
<td>(0.0312)</td>
<td>(0.0218)</td>
<td></td>
</tr>
<tr>
<td>dR13b*W.IMPj</td>
<td>-0.0627</td>
<td>-0.0837</td>
<td>-0.0843</td>
<td>-0.0217</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.0206)***</td>
<td>(0.0268)***</td>
<td>(0.0267)***</td>
<td>(0.0180)</td>
<td></td>
</tr>
<tr>
<td>dR13c*W.IMPj</td>
<td>-0.0700</td>
<td>-0.1078</td>
<td>-0.1093</td>
<td>-0.0090</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.0218)***</td>
<td>(0.0282)***</td>
<td>(0.0282)***</td>
<td>(0.0191)</td>
<td></td>
</tr>
<tr>
<td>dR13d*W.IMPj</td>
<td>-0.0853</td>
<td>-0.1512</td>
<td>-0.1547</td>
<td>-0.0149</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.0245)***</td>
<td>(0.0321)***</td>
<td>(0.0323)***</td>
<td>(0.0215)</td>
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</tr>
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<td>No. of obs.</td>
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<td>1620</td>
<td>1620</td>
<td>1620</td>
<td></td>
</tr>
</tbody>
</table>

Notes:
(1) FWM - Fiscal War Matrixes; (2) All dependent and explanatory variables in logarithm form; (3) IMPj in the spatial explanatory variable in logarithm of Imports in US dollar FOB; (4) dR13 are R13 dummy variables; (5) Standard errors in parenthesis; (6) *, ** and *** means significant at 10, 5 and 1% levels respectively; (7) Rest of eq. (4) variables omitted for displaying simplicity reason.

Table 8 third column shows the estimation results using FWM₂ in which the coefficient of the interaction term dR13a.W.IMPj is not statistically significant at any of the three considered levels. Hence, the coefficient of interest is statistically not different from zero as we expected, we cannot reject the null hypothesis. This result is maintained in the last two columns, and in the first column the coefficient is slightly significant though.

As we move to the subsequent dummies, all coefficients of interaction become more and more significant not only statistically but also in absolute magnitude. Taking the third column for instance, the coefficient goes in absolute value from 0.08 to 0.10, and to 0.15 eventually, whereas corresponding t-statistic goes from -3.12 to -3.82, and to -4.70 eventually.

This result is consistent with the fact that takes time for the agents to effectively react to a legal measure and change their behavior. Therefore, table 8 suggests that R13 effect was stronger from January 2014 on, as revealed by the coefficient of the interaction term R13d.IMPj, regardless of which matrix is considered.
It is worth noting that the estimation results presented in the fifth column of table 8 are an exception to the pattern verified in the other columns. In fact, table 8 suggests that using FWM4 as the neighboring rule R13 doesn’t affect the strategic interaction among states in the FWP context. Nonetheless, this result is consistent to the notion that fiscal interaction that takes place among states from the same region might have been either less affected or not affected at all by R13, whereas among states that are more distant one from each other the strategic interaction is more likely to be affected by R13 insofar as the higher cost of transportation in this case implies less room to profit from the already smaller size of benefits conceded.

The interaction terms coefficients presented a negative sign in table 8 estimation results. One can argue that those signs should be positive in order to offset the negative sign of the spatial explanatory variable coefficient revealed in table 7 estimations, and that will account for negative R13 effect over FWP, in other words, that R13 has contributed to decrease FWP strategic interaction.

Nevertheless, the rationale must be exactly the opposite of that. In fact, if R13 has decreased the willingness of states to concede FWP tax benefits, then strategic interaction would have seem to increase negatively to account for the reverse movement in the imports level growth trend of competing states that takes place due to the R13 imposition, such as shown in Chart 02, in the next page.

Indeed, after R13, the imports growth trend of some states have decelerated, while the imports growth trend of others states have increased even more, and such reverse movement in growth rates taking place after R13 represents a new movement of interaction among states that must have been captured in our model as an increase in absolute value of the strategic interaction. Thus, since the strategic interaction observed has a negative sign, to increase its absolute value the sign of the terms of interaction between the dR13 dummies and the W.IMPj spatial variable, such as “dR13a*W.IMPj”, must be negative.

One must be careful to analyze Chart 02 once there was an increase in the Dollar/Reais exchange rate during the considered period. However, in most of our studied time period the exchange rate increase was not so great, since its average value from 2010 to 2012 is 1.8 and from 2013 to 2014 it is 2.3. Although there was a huge increase in such exchange rate in 2015 (its average value in the first ten months of 2015 is 3.3) our studied

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17 Selling price exchange rate US dollar to BR Reais.
time period does only comprise the first four months of 2015 where there was no such a great change in the exchange rate.

Chart 02: Growth trend\textsuperscript{18} reversion of some states imports (R13 affected states) against the increase of the growth trend of others states imports (not affected states).

Although such reverse movement in imports level of each state is probably transitory, and should end in some moment in the future when the FWP dynamic reaches a new equilibrium, our model might have been estimated over a period of time that is not sufficient to capture this moment defined by a new equilibrium situation.

Furthermore, it is worth saying that negative pattern in the sign of the interaction term coefficient could also be a result of the short time horizon of our data when compared with the time needed for the economic agents to react to the legal measure taken in effect. Unfortunately, both explanations are equally possible, and we would need to wait a couple of years more to be able to answer this question appropriately.

The next Chart presents the growth trend\textsuperscript{19} of the spatial variable $W_2.IMP_j$ both before and after R13, where $W_2$ corresponds to the FWM$_2$.

\textsuperscript{18} Growth trends are the angular coefficient of the adjusted line obtained by OLS regression over importing figures for each state either before or after R13.

\textsuperscript{19} Growth trends are the angular coefficient of the adjusted line obtained by OLS regression over $W_2.IMP_j$ variable figures for each state either before or after R13.
Chart 03: Growth trend reversion of the spatial variable $W_{2.IMPj}$ after R13 imposition.

As one can see, Chart 03 shows a reversion in the growth trend of the spatial variable $W_{2.IMPj}$. In other words, for each state without exceptions the weighted average value of its competitors’ level of imports presented an increase trend before R13 (before January/2013) and a decrease trend after R13 (since January/2013). As an illustration, the Federal District (DF) spatial variable ($W_{2.IMPj}$) was presenting a monthly increase of approximately US$11.0 Million before R13 and a monthly decrease of approximately US$8.9 Million after R13.

Summing up, this section main result is that such above discussed evidences suggest that R13 has changed the spatial interaction among states, which by its turn has emerged from the importing figures. At this point we must be careful to conclude that R13 was the cause of the change in business environment and of the growth trend reversion observed above. Although it is highly likely that R13 was indeed, if not the main cause, but at least one important factor affecting such strategic interaction observed, our results must be taken with caution since there would possible exist some other hidden relevant factors. Nonetheless, it is not difficult to realize that there wasn’t any known event in the same time period, other than R13, that have taken place at a such relevant level to imply a change in the states spatial interaction like the one observed above.
6.3. Inexistence of Strategic Interaction Behavior over Exports

Table 9 presents the results of eq. (3) estimation considering data of exports instead of imports. In other words, its estimation dependent variable (EXPi) and spatial explanatory variable (W.EXPj) both refer to the state’s level of exports, taken in US dollar FOB values. The procedure is exactly the same as with importing figures, and also control variables are exactly the same as in the previous model. The only change is a switch from imports to exports figures.

Table 9: Estimation of state interaction on Exports 2010-2015 using different measures of neighbor characteristic. Dependent variable: EXP.

<table>
<thead>
<tr>
<th>Variable names</th>
<th>FWM1</th>
<th>FWM2</th>
<th>FWM3</th>
<th>FWM4</th>
</tr>
</thead>
<tbody>
<tr>
<td>EXPj</td>
<td>0.1002</td>
<td>-0.0721</td>
<td>-0.0465</td>
<td>0.4478</td>
</tr>
<tr>
<td></td>
<td>(0.1018)</td>
<td>(0.1252)</td>
<td>(0.1200)</td>
<td>(0.0719)***</td>
</tr>
<tr>
<td>SPF</td>
<td>-0.0361</td>
<td>-0.0262</td>
<td>-0.0275</td>
<td>-0.0456</td>
</tr>
<tr>
<td></td>
<td>(0.0696)</td>
<td>(0.0696)</td>
<td>(0.0696)</td>
<td>(0.0685)</td>
</tr>
<tr>
<td>Population</td>
<td>-0.6996</td>
<td>-0.5810</td>
<td>-0.5949</td>
<td>-1.1136</td>
</tr>
<tr>
<td></td>
<td>(0.7063)</td>
<td>(0.7032)</td>
<td>(0.7026)</td>
<td>(0.6970)</td>
</tr>
<tr>
<td>CM</td>
<td>-0.1139</td>
<td>-0.1151</td>
<td>-0.1147</td>
<td>-0.1196</td>
</tr>
<tr>
<td></td>
<td>(0.0890)</td>
<td>(0.0891)</td>
<td>(0.0891)</td>
<td>(0.0880)</td>
</tr>
<tr>
<td>RSI</td>
<td>0.5189</td>
<td>0.4871</td>
<td>0.4886</td>
<td>-0.5679</td>
</tr>
<tr>
<td></td>
<td>(0.2819)**</td>
<td>(0.2823)*</td>
<td>(0.2830)*</td>
<td>(0.2781)**</td>
</tr>
<tr>
<td>SMC</td>
<td>2.2767</td>
<td>2.2971</td>
<td>2.3101</td>
<td>2.0548</td>
</tr>
<tr>
<td></td>
<td>(0.7490)***</td>
<td>(0.7488)***</td>
<td>(0.7493)***</td>
<td>(0.7405)***</td>
</tr>
<tr>
<td>R-sq</td>
<td>0.07</td>
<td>0.07</td>
<td>0.07</td>
<td>0.09</td>
</tr>
<tr>
<td>No. of obs.</td>
<td>1620</td>
<td>1620</td>
<td>1620</td>
<td>1620</td>
</tr>
</tbody>
</table>

Notes:
(1) Using exports figures; (2) FWM - Fiscal War Matrixes; (3) FWM1, FWM2, FWM3 and FWM4 with dependent and explanatory variables in logarithm form; (4) State, year and month dummy variables omitted; (5) standard error in parenthesis; (6) *, ** and *** means significant at 10, 5 and 1% levels respectively; (7) FWM1 - Matrix with short number of competitor states; (8) FWM2 - Matrix with large number of competitor states; (9) FWM3 - Matrix with large number of competitor states excluding SC state; (10) FWM4 - Matrix with a simple rule of proximity; (11) Random - Matrix with randomly generated weights.

The point is to estimate the model testing whether none strategic interaction among the states is revealed from exporting figures, strengthening the reliability of the strategic interaction over imports model.
Second, third, and fourth columns present estimation results using respectively FWM₁, FWM₂, and FWM₃. In both three estimations the spatial explanatory variable coefficient is not statistically significant, suggesting no strategic interaction among states with exporting data.

This absence of strategic interaction in the exporting sector is a striking result when one compares it with the strong evidence of strategic interaction in the importing sector found earlier, using completely equivalent models.

Far from being a proof of inexistence of any type of strategic interaction in the exporting sector, this result, conversely, strengthens the reliability of the interaction evidence found in the importing sector. In fact, following a model specification identical to the one used in the estimations with imports figures we haven’t found any evidence of strategic interaction using exports figures, which is presumably affected by many factors common to the foreign commerce sector. However, taxation is known to be one major difference²⁰ between the two sides of this sector, the importing and the exporting one. As a result, the strategic interaction found is likely to be due to the taxation factor, in other words, to the possibility of conceding FWP tax benefits in the importing operations.

One single exception to the result discussed above is the estimation presented in the fifth column of table 9, in which we use a fiscal war matrix that forges a simple rule of proximity. Nonetheless, this exception doesn’t constitute a major objection because it could be consequence of one sort of strategic interaction that happens among the same region states due to the high degree of linkage among their economies and that would also affect their exporting activity. For instance, São Paulo (SP) state’s port competes with the Rio de Janeiro (RJ) one, but does not compete with Para (PA) state’s port due to the distance factor.

Thus, the competition in exporting sector between SP and RJ is not driven by the concession of tax benefits because there is no possibility to concede tax benefits in exporting operations, but it is driven simply by their proximity to each other. In other words, since SP and RJ are close to each other, the competition amongst them could still be captured by the model using the proximity matrix.

²⁰ Exporting operations to abroad in Brazil are exempt of taxes by constitutional and legal rules. As a result, states have no room to concede tax benefits in the exporting operations than in the importing ones.
6.4. The Change on Strategic Interaction Behavior over Exports due to R13

Table 10 presents the estimation of eq. (4) switching from the import figures to the export ones. As mentioned before, eq. (4) adds dummy variables to account for a structural change in the strategic interaction among states due to R13.

Table 10: Estimation of R13 effect on FWP 2010-2015 using different FWMs as a measure of neighborhood. Dependent variable: EXP.

<table>
<thead>
<tr>
<th>Interaction terms</th>
<th>Model</th>
<th>FWM1</th>
<th>FWM2</th>
<th>FWM3</th>
<th>FWM4</th>
</tr>
</thead>
<tbody>
<tr>
<td>dR13a*W.EXPj</td>
<td>0.0406</td>
<td>0.0288</td>
<td>0.0292</td>
<td>0.1170</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.0328)</td>
<td>(0.0365)</td>
<td>(0.0359)</td>
<td>(0.0291)***</td>
<td></td>
</tr>
<tr>
<td>dR13b*W.EXPj</td>
<td>0.0387</td>
<td>0.0668</td>
<td>0.0475</td>
<td>0.0571</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.0269)</td>
<td>(0.0300)**</td>
<td>(0.0292)</td>
<td>(0.0238)**</td>
<td></td>
</tr>
<tr>
<td>dR13c*W.EXPj</td>
<td>0.0429</td>
<td>0.0827</td>
<td>0.0656</td>
<td>0.0714</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.0288)</td>
<td>(0.0321)***</td>
<td>(0.0294)**</td>
<td>(0.0258)***</td>
<td></td>
</tr>
<tr>
<td>dR13d*W.EXPj</td>
<td>0.0241</td>
<td>0.0333</td>
<td>0.0806</td>
<td>0.0588</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.0326)</td>
<td>(0.0369)</td>
<td>(0.0314)**</td>
<td>(0.0297)**</td>
<td></td>
</tr>
</tbody>
</table>

No. of obs. 1620 1620 1620 1620

Notes:
(1) FWM - Fiscal War Matrixes; (2) All dependent and explanatory variables in logarithm form; (3) EXP in the spatial explanatory variable in logarithm of Imports in US dollar FOB; (4) dR13 are R13 dummy variables; (5) Standard errors in parenthesis; (6) *, ** and *** means significant at 10, 5 and 1% levels respectively; (7) Rest of eq. (4) variables omitted for displaying simplicity reason.

As one can see, table 10 suggests that R13 or other unknown factor might have affected the exporting sector at least during the year 2013, as is captured by the coefficients of dummy dR13b and dR13c interaction terms, which are switched on in January/2013 and July/2013 respectively.

These results are not conclusive, first because they don’t appear consistently in all four fiscal war matrixes. For instance, the estimations using FWM1 point to the inexistence of structural change in the exports figures in that period. Also because the estimations on table 9 have suggested that there is no strategic interaction among states in the exporting sector. Finally, because it could always be true that some other affecting factors could have taken place during this period.

The latter is also true regarding the results obtained for the importing sector in table 9. In fact, other factors might have taken place instead of the R13 to affect the strategic
interaction among states with imports figures. However, this is unlikely to be an alternative explanation because there is no historical evidence of any such extra factor affecting the importing sector as a whole in that considered period.

Furthermore, the interaction term $dR13d^*W.EXPj$ coefficient is statistically not significant in both matrixes 1 and 2, and even in matrix 4 it seems to be decreasing its significance not only statistically but also in magnitude, suggesting that if there existed any factor affecting the strategic interactions among states in the exporting sector, it would be transitory, not lasting longer than one year.

Another issue that must be addressed is the interaction terms coefficient sign. Table 9 suggested the inexistence of spatial interaction emerging from the export figures. However, using FWM2 table 10 shows that some factor has affected the spatial interaction from July/2013 onward, as one can notice from the t-statistic of the interaction term coefficient $dR13c^*W.EXPj$. Regardless of existing spatial interaction, the sign of all the interaction terms is positive, and that is true for the term $dR13c^*W.EXPj$ as well. Hence, whatever happened since July/2013 that affected the spatial interaction, it contributed to increase the interaction (positive coefficient), and that seems to represent a spillover effect rather than a tax competition behavior. Finally, this result is coherent with the fact that, in the absence of tax competition of any sort, the more one state exports the more others states will also export due to many reasons such as the increase in the Brazilian competitiveness (depreciation in exchange rates, increase in industry efficiency, and improvement in the country physical assets) that affected the country as a whole.
7. Conclusion

We employ monthly data on state importing levels in all Brazilian states plus the Federal District during the period from January 2010 to April 2015 to test a model that allows for strategic interactions among states in the FWP context. We estimate our regression equations by OLS in a fixed effect panel data model.

We find that Brazilian states do engage in a spatial interaction emerging from the figures of states imports, an interaction such as the one expected in the FWP, and at the least optimistic case the level of imports of a particular state will decrease by 0.24 percent if the level of imports of its competing states increases by one percent.

We also test for the R13 impact over the FWP. Evidences suggest that R13 has changed the spatial interaction among states, which has emerged from the importing figures. R13 effects have taken place since the beginning of 2013 and became stronger in the beginning of 2014, being such observation consistent with the fact that it takes time for the agents to effectively react to a legal measure and change their behavior.

We estimate our model also using exports figures and find that evidences suggest no spatial interaction among states and also suggest that R13 effects over the exports data are inconclusive. Since such results suggest the inexistence of spatial interaction emerging from exporting figures, they enhance the reliability of the importing sectors results regarding the existence of spatial interaction.

It’s worth saying that this present work attempts to test for spatial interaction among Brazilian states using data on the level of states imports, being on that part somewhat innovative. Further research may either extend the time period used or apply different strategy by using annual data from the municipal units instead of monthly data from states.

To the Brazilian tax reform literature our contribution is to present a work on the FWP subject, attempting to improve the standards of our currently understandings about such fiscal war by applying one possible econometric approach, rather than relying solely on casual observations.

Currently, there isn’t any published work in Brazil that applies econometric models to the FWP issue, and even regarding the fiscal war wider issue there are just few works that apply quantitative methods. Furthermore, there is a lack of studies in academy that seriously investigate the supposed FWP distorting effects over resource allocation and economic efficiency. To put in briefly, considering the above mentioned facts and the analysis
undertaken at this work, one can make a case for the use of a more econometric approach to investigate fiscal war effects over the Brazilian economy.
References


