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The Impact of Tax Substitution on the price of pharmaceutical products in the state of São Paulo

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Abstract:

The mechanism of the Tax Subsitituion has been widely adopted by the Brazilian states in order to simplify tax colletion and combat evasion. Since mid-2007 the São Paulo State Treasury Office began adopting the tax substitution as means of receiving the ICMS due by the pharmaceutical sector. This work seeks to test the effects of the change in the form of taxation on consumer prices. For this, three alternative approaches are used to test the existence of structural break in the series of prices of pharmaceuticals in the state, and the relationship of co-integration of this series with the other states. The results suggest that, after the replacement tax, there was an increase of consumer prices.

Keywords: : tax substitution, tax incidence, co-integration, structural break

JEL Codes: C32, H22, I18

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1. Introduction:

Tax burden in Brazil is high and the way taxation is carried out suffers from severe distortions that impair efficiency (CAVALCANTI; PRADO; 1998; VIOL, 1999; VERDI; RODRIGUES, 2002; PAES, 2001). Nonetheless, there is an impasse created by diverging interests of different groups, especially over the risk of loss of income by some states, momentary as it may be, which is merely the tip of the iceberg of federation issues in Brazil (NASCIMENTO, 2009; CARDOZO, 2010; PAES, 2011; KHAIR, 2011). While the Tax Reform is not done, the so called "fiscal war", which includes offers of tax reliefs, indirect subsidies and other benefits offered by the poorest states to attract direct private investments, escalates. Although this practice is not necessarily new[1] it acquires new characteristics in the 90s for a number of reasons.

The practice of collecting consumption taxes on the origin (which makes these taxes more similar to production taxes) is one more issue in this controversial relationship between federative states[2]. Since, under these conditions, tax collection depends more on production than consumption, there is an incentive for states to attract companies, at the expense of the federation. It is in this context that Tax Substitution (ST) emerges, at first as a way to fight tax evasion and simplify taxation.

TS is a tax collection legal institution, which predates the current Federal Constitution, created and implemented by several states through infra-constitutional legislation, such as partnerships and protocols, celebrated between the states Treasury Offices. For some time its legitimacy and constitutionality were questioned by different agents, alleging lack of constitutional provision and complementary laws for its implementation.

Article 150, paragraph 7, of the 1988 Constitution, and the Complementary Law number 87/96, incorporated and legitimized the institution of TS. After that, and with growing frequency, it has been used as a way to fight tax evasion and simplify enforcement of ICMS collection to the states[3]. With this instrument, instead of taxing the many agents along the distribution chain of a good until its end consumer, only the manufacturing industry is responsible for paying theses taxes. In its implementation the tax collecting agent

[1] In fact, according to Cavalcanti and Prado (1998) the ICMS fiscal war has two major outbreaks in Brazil: one from the second half of the 60s until 1975 and the current one, which began in the early 90s. Acording to the authors, "the use of tax exemptions, reductions and deferrals by state governments to increase regional industrialization can be traced back to the 60s. After a period of higher use and visibility, on the second half of the 60s, this type of practice apparently loses momentum and disappears from debates and the media. In the beginning of the 90s this practice returns, at first timidly and then very strongly in 1993/94, in a large national polemic".

[2] The ICSM regime is a mix of origin and destination. Since interstate tax rates are lower than internal tax rates the consumer states can keep the difference. Despite that, the heavy concentration of production and consumption in the richest states has been bringing ICMS closer to a origin regime (VIOL, 1999).

[3] TS is applied to a large selection of products. In the state of São Paulo the products subjected to TS include, but are not restricted to, household goods, auto parts, alcoholic beverages, bicycles, cigarettes, cement of any type, tools, musical instruments, lamps, building materials , electrical supplies, stationary, fuel, cosmetics, phonographic material, drinks, ice cream, vehicles and others.

calculates the value added margin along the chain by stipulating the price to the end consumer and deducting the price at the factory. The tax to be collected by the factory, which is due throughout the distribution chain, is then calculated based on this margin using the tax rate defined by law.

The value added margin must be determined by the weighted average of prices normally practiced by the market, obtained by survey, be it by sample or by information and other elements provided by sector representative institutions. However, this determination cannot account for all of the complexity of the economic system and taxes equally unequal agents. Additionally, the change in taxation, brought by the use of TS, creates an incentive toward price increases along the distribution chain from the manufacturing industry to the end consumer. The consequences of this system must be more carefully analyzed when the taxation is levied on an essential product, such as medicines.

In regards to the simplification of taxation process, which gives the State Treasury more power to police and control the payment of taxes in the whole chain by concentrating in only one tax payer the responsibility for the taxes of the chain, its real effects on the "economic development and competitiveness" are yet to be empirically tested. The simple fact that TS makes tax collection easier should not be enough for its widespread and unchecked use. It is desirable that a tax system be based on the principles of efficiency and fairness (MUSGRAVE; MUSGRAVE, 1973; ATKINSON; STIGLITZ, 1980; STIGLITZ, 2000; REZENDE, 2001).

The objective of this work is to analyze the impact of the use of TS on the price of medicines in the state of São Paulo starting in 2007. The choice of this sector is justified by many reasons. The main one being the fact that those are essential consumer goods. In this case, an increase on prices of the goods caused by taxation has a detrimental effect on social welfare. Another reason is the fact that prices are more regulated in this sector, with maximum retail prices fixated by the CMED – Câmara de Regulação do Mercado de Medicamentos (Pharmaceutical Market Regulation Board), a division of the Government Council, and drugstore are under the specific control of the regulatory agency.

This article is organized in the following manner: on the next section the drug retail market structure in Brazil will be presented. After that, the implications of the TS over economic efficiency, specifically in this market, will be discussed. On the next section three approaches to estimate the effect of the TS on consumer prices will be discussed, using co-integration analysis in time series.

2. Pharmaceuticals retail market.

The retail market in Brazil is made up of a very large number of independent drugstores and by chain drugstores. Independent drugstores are the many small and few medium sized stores, with an occasional couple of branches under the same administrator, mostly commonly the owner. In recent years "associativism" has become common among independent drugstores and wholesalers as a strategy to gain leverage on negotiations with suppliers (VALOR ECONÔMICO, 2007). In 2011, independent drugstores were responsible for 48% of the sector's revenue, while the chains of drugstores and supermarkets were responsible for 50% and 2% respectively (BRAZIL PHARMA, 2012). According RAIS-MTE data, there were in 2011, in Brazil, 69,469 establishments dedicated to retail of pharmaceutical products for human and veterinary use. Drugs retail generated, in 2011, R$ 43 billion reais in revenue, which represents an increase of 19.0% in relation to the previous year, according to data from IMS Health, specialized Consulting Company in the sector (BRAZIL PHARMA, 2012).

Pharmaceutical prices are regulated by CMED – Pharmaceutical Market Regulation Board, a division of the Government Council. This division, created by Law 10,742 10/06/2003, is presided by the Health Minister and includes the Minister and Chief of Staff, Ministry of Justice, Treasury, and Development, Industry and Trade. CMED is responsible for the definition of policies and procedures related to the economic regulation of the pharmaceutical market. It establishes criteria for pharmaceuticals' price setting and adjustment, retail margins to be observed by sales representatives, wholesalers, pharmacies and drugstores, including margins of pharmacies specifically created to privately supply hospitals or other equivalent medical facilities.

In Brazil drugs are classified in 4 different categories[4]: Brand Leader, Medicines comparable with brand leaders, Generics and OTC (over the counter)[5]. The calculation of yearly drug prices adjustment is done for each therapeutical class and is based on inflation rates, productivity and the relative prices within and between sectors[6] . After each adjustment CMED publishes a list of prices for the sector containing Factory Prices (FP), which is the maximum price producers or importers of pharmaceuticals and wholesalers can charge drugstores and government agencies. CMED also publishes the Maximum Retail Price, which is the maximum price pharmacies and drugstores can charge consumers and it includes all taxes levied in each state.

The determined prices aren't necessarily the ones practiced by the market. Sales discounts from industries, wholesalers and retailers mean that market prices are usually lower than determined by CMED. Such discounts are consequence of increased competition in the market, brought about by the transformation in the drugstore and pharmacy sector that started in the 90s with the introduction of computers to control stores and stocks. The 90s also mark the beginning of the expansion of drugstore chains, with a significant increase in the number of stores, which made purchasing large quantities from industries possible. This way the drugstore chains began to offer products are a lower price than the

[4] Law 9,787 in 02/10/1999.

[5] - Brand Leaders: Known as brand leader or originator, are the new medicines released by pharmaceutical companies after large investment, research, tests and finally the approval of governmental regulatory agencies. These are protected by patents, which in Brazil, can last up to 20 years.
- Medicines comparable with brand leaders: Contain the same active principles, present the same concentration in the same dosage and concentration form, route of administration, therapeutical use of the brand leader registered in the federal agency responsible for regulamentation. They can differ only in size and form of the product, expiration date, packaging, labeling, excipients and vehicles, and should always be identified by commercial name or brand.
- Generic Medicines: Medicines similar to a brand leader or innovative product, with claims of being interchangeable with those. Usually produced after the expiration or yielding of patent protection and other exclusivity rights, with proven safety and efficiency, and labeled with the BNN (Brazilian Nonproprietary Name) or INN (International Nonproprietary Name – name of pharmaceutical or pharmaceutical active principle recommended by the WHO)
- Over the counter medicines: Are medicines that can be freely sold and bought, without a prescription. They are used to relieve symptoms which are easily self-diagnosed, such as medicines for cough, pain and flue and antacids. In Brazil they are also known as MIP (medicines that do not require prescription).

[6] Every year, CMED publishes the adjustment index, based on a price celling model calculated over a price index, a productivity factor, a part intra-sector relative prices adjustment and a part of inter-sector relative price adjustment (BRASIL, 2013, CMED Resolution 01/13, 03/08/2013). The price index used is the IPCA (Broad National Consumer Prices Index); the productivity factor is calculated based on the estimation of prospective productivity gains in the pharmaceutical sector, in the form of a AR(1) model of manufacturing industry labor productivity described by IPCA, GDP, current interest and exchange rates; the price adjustment factor between sectors is calculated based on the variation of input prices, if those costs are not recovered by IPCA; and the price adjustment factor within sector is calculated based on market power, determined by, among others, by the information asymmetry, barriers to entry and monopoly power (in the composition of this factor the generic medicines are used as an indicator of greater competition in the sector).

independent drugstore, creating more competition in the sector (VALOR ECONÔMICO, 2007).

In the last decade the drugstore chains started to give significant discounts as a strategy to attract consumers. Another strategy used has been the promotion and marketing campaigns to improve consumer loyalty. The movement of drugstore chains, which became stronger in the market, caused the environment to become more competitive for independent drugstores. The growing difficulties lead a part of the independent drugstores to adopt strategies to better compete with the chains.

Notwithstanding the greater competition, the sector is still characterized by regulatory barriers to entry. It is ANVISA's (National Health Surveillance Agency) responsibility to perform the sanitary control of drugs, pharmaceuticals, medicines and such by issuing an authorization permit which allows, for a period of one year, the opening of pharmacies and drugstores[7]. This authorization must be renewed each year. The conditions for obtaining the authorization include: sanitary location; independent installations and equipment that is technically adequate to the intended manipulation and commercialization; and the assistance of a professional pharmacist who will be responsible for the store (SEBRAE-SP, 2010). On top of ANVISA's regulations, pharmacies and drugstores are also subject to rules specific to each city and state.

3. Tax Substitution and Taxes Levied

3.1 ICMS tax substitution and its impacts on the economic system efficiency.

By estimating the value added margin and concentrating the tax payment in only one part of the production process TS loses most of the benefits from a value added tax and adds undesirable distortions to the economic system.

The first and main problem stems from the fixation of the basis to calculate the taxes, or the value added margin. According to the current legislation, the value added margin can be calculated considering:

- Weighted average of end consumer prices usually practiced by the market, obtained by approved and published price survey by the São Paulo State Treasury Office, according to disposition in article 43, paragraph 2 of ICMS Regulation;
- Percentage of value added margin obtained by approved and published price survey by the São Paulo State Treasury, according to provision in article 41, caput, of ICMS Regulation;
- Final price to consumer, single or maximum, authorized or prescribed by the competent authorities and published by São Paulo State Treasury Office, according to provision in article 40-A of ICMS Regulation;
- Price to end consumer suggested by the producer or importer, approved and published by São Paulo State Treasury Office, according to article 41, sole paragraph, of ICMS Regulation;
- Percentage of value added margin or retail price fixated in agreements between the State of São Paulo and other states of the Federation, according to provision in article 44, paragraph 2, of ICMS Regulation

[7] Pharmacies are establishments with an authorization to handle, compound and sell medicines. Drugstores are not authorized to compound medicine, only sell medicines in its original package. Super drugstores are establishments, with self-service or not, which focus on the sales of food items, hygiene products and etc., but are also authorized to sell medicines. (Law 5,991, 12/17/1973).

- Prices practiced by the passive subject including amounts regarding shipping and handling, insurance, taxes and other charges transferrable to the consumer, plus the value added obtained by the multiplication of the prices used by the Sectorial Value Added Index, according to provision in article 43, paragraph 3, and article 44 of ICMS Regulation, and in case none of the other provisions can be fulfilled.

The distortions of the efficiency of the economic system, created by the use of the systematics described above, stem from the fact that the fixation of value added margins, even when done through market prices survey, cannot encompass all the complexities of the economic system, ignoring, among others:

Difference in regional prices. Margins fixated by law, through surveys or not, are usually based on averages calculated in a specific territory. However, the large regional differences in the state of São Paulo, and even in the city of São Paulo, involves a variability in prices not negligible. The taxation by average margin represents a "bonus", when it comes to tax rate, over higher prices and a "penalty" over lower prices;

Differences in prices over time (seasonality). Fixating value added margins, based or not on averages surveyed in a specific period of time, causes the agents to not adjust properly to the normally observed changes due to seasonality. In this case, in the periods when demand is higher, and that market prices tend to increase beyond those fixated, there is a "bonus" in terms of tax rates, at the same time, in the months that the market dips below the fixated margins, there will be a "penalty" in terms of tax rates;

Other idiosyncratic factors. Apart from the regional and temporal issues, there are other factors that affect the price averages (such as cost structure of the companies, financing conditions, market niches and etc.) which could create a "bonus" or "penalty" in the directions pointed above.

By imposing a tax rate penalty for prices below average and, at the same time, a bonus for higher prices, incentives for price competition on only one direction, in this case up, are created. This can be observed by checking the decrease in the sales discounts in the retail market and the increase in prices to end consumers of products subject to tax substitution. It can be said that the value added margins can be altered by new surveys done periodically. However, because of the incentive toward higher prices caused by the tax substitution procedures described above, the probability that these surveys will present lower prices is very low. That way, even the mechanism to review margins is not efficient, seeing that it will always obtain prices that are equal or higher than the previously determined.

Additional problems are caused by the fixation of the value added margin by the taxation authority. The hypothesis behind this fixation is that the future condition of the market in the time horizon for which the determination was done will remain the same as the one observed when the fixation was done. This hypothesis keeps anti-cyclical policies, such as those needed in times of crisis, from been created. Considering that taxation has been already carried out at the time of the sales from the factory to the wholesaler or retailer, the sales price of taxed products, in case of crisis, will be already increased by the tax. In this manner, the tax substitution cannot be described as an efficient instrument for tax policies.

Finally, a smaller problem, given how simple it is to correct, but also important, is the impact of the tax substitution over the cash flow in the whole chain. By bringing forward tax collection of the whole chain to its beginning, the present value collected, minus the appropriate rate of discount is greater than the actual amount, minus the same rates, that

would be collected by an value added mechanism, creating thus a "bonus" for the state over the economic agents, consumers included, and a new incentive to the increase of relative prices. Even if tax collection is deferred, with the possibility of a gap between tax collection and the sales from producers, such postponement may not represent the correct temporal structure (considering as correct the taxation at the moment or after the generating factor). Not only that, but the front-loaded tax collection requires that only one agent be responsible for non-payment, a risk that used to be shared with the state (as it should be).

3.2 Tax Substitution over pharmaceuticals

The collection of ICMS of pharmaceuticals, done through tax substitution, is codified by the ICMS Agreement 76/94 (BRASIL, 1994), which established the bases for tax substitution in interstate operations. In 1997, the state of São Paulo renounced the dispositions in the agreement, and returned to the conventional ICMS taxation of pharmaceuticals (COTEPE/ICMS Act 15/97, BRASIL, 1997). However, since May 2007, with a protocol celebrated between the states of São Paulo e Mato Grosso do Sul (ICMS Protocol 12/97, BRASIL, 2007b), the state of São Paulo has returned to TS in the remittance operations of pharmaceuticals to that state. In July of the same year a similar protocol was celebrated with the state of Alagoas (ICMS 37/07 Protocol, BRASIL, 2007a). In the end of 2007, in a specific protocol, which stipulated reciprocity of treatment, the transactions with the state of Rio de Janeiro began to adopt the TS system (ICMS Protocol 68/07, BRASIL, 2007c).

Finally, the decree 52,364/2007 from 11/13/2007 (SÃO PAULO, 2007), regulates the definitive return to the application of TS in the internal pharmaceutical operations. The justification for the change in the tax collection system for these operations was that "the objective of the measure is to give the State Government an important instrument in tax policies, including the mentioned products subjected to taxation in the TS regime, thus simplifying the tax obligations relative to the tax collection in above mentioned operations, contributing in the strengthening the social and economic development policy and the economic competitiveness of the state of São Paulo" (SÃO PAULO, 2007, Diário Oficial do Estado de São Paulo, 11/14/2007, Section I, p. 3).

A change in the taxation regime that changes the market price along the distribution chain can have not only an impact on the pricing system (and efficiency), but also on the distribution of economic surpluses among the many market agents. The consequence of this change in the short run could be the increase of prices to consumers, the reduction of the profit margin for companies and the increase the deadweight loss of taxation. In the long run it could contribute to the market concentration, since it undermines small companies making it impossible for them to compete in the market.

The sector in question has characteristics that make it interesting for the study of TS impact. Differently from other sectors, such as drinks, pharmacies and drugstores are largely formal commercial establishments, because their opening and operation must comply with standards from the health surveillance agencies. The sales of pharmaceuticals outside regulated establishments is not only forbidden, it is also better enforced than in other segments. In these conditions the informality of the sector is smaller and concentrated in tax evasion practices, such as underreporting of business income. The predominance of small and medium sized companies in the sector could lead to an increase in these practices. However, the creation of national regulation to small and medium enterprise (SIMPLES Nacional), with simplified federal, state and city tax collection has already reduced tax evasion in the sector.

4. The impacts of Tax Substitution on consumer prices

There are many types of difficulties in the estimation of the impact of policies over prices and consumer welfare. Normative and theoretical aspects, as well as imperfections in the measuring units are the main ones. Analyzing the impact of a tax is even more complicated, since specific normative instructions for certain sectors or products most often impedes the calculation of the real amount of taxes collected by an agent or chain of agents.

When dealing with time analysis it is necessary to determine the period of time that is needed for an increase or change in the tax collection systematics in the beginning of the productive chain to reach the end consumer. The existence of a stock of product held along the chain can cause the impact to be delayed for many months. Evidently, when dealing with a product with a relatively low unit price (when compared to the consumer's average wage), and a relatively high degree of necessity, it is to be expected that stocking times will not be elevated. However, it is a product without a short term expiration rate, which makes inventories more likely.

Another difficulty of the empirical study is related to the time difference between "before and after". Even though the tax implementation begins in a generally well defined date, its effects can be felt a long time after or, eventually, even before, depending on the impact of the agents' expectations. The anticipation of producers and retailers in regards to the expected taxation (rational expectations) could cause prices to increase even before the tax is adopted, at the same time, the existence of stock and long term contracts could contribute to prices staying the same after the law goes into effect.

Finally, the association of behavioral changes in a time series to a specific event might be skewed the by fact that other events happen at the same time (identification problem).

Considering that two regions maintain commercial relations, *R* e *S*. According to the expanded law of one price it should be:

$$p_t^R = E \times p_t^R + C_t^{RS}$$

where p^R and p^S are the prices of the same goods in regions *R* e *S* respectively. *E* is the tax rate between the currencies of *R* and *S* and C^{RS} represents the cost of transactions related to the transportation of goods between regions. The traditional law of one price stipulates that, for equal products in competition market and perfect mobility, the costs of transaction tend to zero. If that is not the case, then a cost transaction function in *R* related to the price in *S* could be proposed as such:

$$C^{RS} = \overline{C}_t + \bar{c} p_t^S$$

where $\overline{C}$ denotes the specific costs of location *R*, not related to the inter-regional trade (economies or diseconomies of agglomeration, for example) and $\bar{c}$ is a cost coefficient specific to trade between the regions. When competition is perfect, $\overline{C}$ tend to zero.

Considering that in the same monetary region (a country) the currency is the same, then the tax rate is 1, and the relation between prices in both regions is

$$p_t^R = \overline{C} + (1 + \bar{c}) p_t^S \qquad (1)$$

This long term relation can be impacted in the short term by external events, random or not, such as regional seasonality, random supply or demand shocks and etc. Thus, a more complete and testable specification of (1) would be,

$$p_t^R = \overline{C} + (1+\bar{c})\, p_t^S + \xi_t \qquad (2)$$

where ξ represents a factor of error. The econometric estimation of (2) presents the problems normally found in the estimation of time series. Specifically, in case the series show a unit root the estimation of (2) through Ordinary Least Squares could be spurious (HAMILTON, 1994; ENDERS, 2004). Not only that, but changes in policy (changes in the form of taxation, for example) in the time period of the sample can lead to structural breaks in the data, adding other problems to the estimation.

4.1 Estimation Strategy

If a series must be differentiated d times before it becomes stationary, then it contains d unit roots and it is said to be integrated of order d, denoted as $I(d)$. If the price series p_t^R e p_t^S are both $I(d)$, in general, any linear combination of these two series would also be $I(d)$. For example, the residuals obtained from the regression of p_t^R against p_t^S will be $I(d)$. If, however, there is a vector β, such that the regression error $(\xi_t = p_t^R - \beta p_t^S)$ of a smaller integration order, $I(d-b)$ where $b>0$, then Engle and Granger (1987) define p_t^R and p_t^S as integrated of order (d,b). Therefore, if p_t^R and p_t^S are both $I(1)$ and $\xi \sim I(0)$, both series are co-integrated of order $CI(1,1)$. In the presence of structural breaks the usual co-integration tests can yield imprecise results, which could lead to a rejection of the co-integration hypothesis when it should have been accepted. Three approaches will be adopted in this work to test the co-integration between the price series p^R and p^S: the Gregory and Hänsen test (1996), indicated for the bivariate case; the test proposed by Lütkepohl, Saikonnen and Trenkler (2004) which generalizes the (JOHANSEN; JUSELIUS, 1990) test when there is a structural break in the series; finally a structural approach where it is imposed an ad-hoc co-integration relation between the series, theoretically obtained in (2) and the existence of structural break is tested in the co-integration vector of this relation, based on the Quant-Andrews (ANDREWS, 1993) structural break test for an unknown date.

In the Gregory and Hansen procedure (GH), a co-integration test of the Engle and Granger type is proposed for two variables. In the case of an intercept dummy variable, the model would be:

$$P_t^R = \overline{C} + \delta d_{t\tau} + \beta p_t^S + \xi_t \qquad (3)$$

where d is a dummy variable, so that

$d = 0$ if $t \le \tau$ and $d = 1$ if $t > \tau$

The null hypothesis of non-co-integration is tested with the structural break. The approach of the co-integration method with structural break is an extension of the unit root with structural break test developed by Zivot and Andrews (1992). The model considers a sole endogenous break in the co-integration relations. The correct date of the occurrence of the structural break is identified using the co-integration equations, where all possible dates with possible identified structural break are evaluated in the series in question. The identification of a structural break is done where the statistical test t presents a minimum value, that is, when, in absolute terms, the ADF test presents the maximum value. It should be noted that Gregory and Hänsen (1996) tabulate the critical values from the critical value of MacKinnon (1991), procedure used in the co-integration test of Engle and Granger (1987).

In the Lütkepohl, Saikonnen and Trenkler (LST) approach, a test for the co-integration order is proposed for a system of auto-regressive equations with a structural break at an unknown date. In this test, the structural break is modeled as a change in the intercept and is estimated based on an unrestricted VAR model. Two estimators for the break are proposed and the authors derive their asymptotic properties. The implementation of the test considers a VAR

$$p_t = \mu + \delta d_{t\tau} + x_t \tag{4}$$

where $p_t = (p^R p^s)'$ is an auto-regressive dependent variables vector, $\mu_i (i = 0.1)$ and δ are unknown parameters vectors and x_t has a VAR(p)

$$x_t = A_{1xt-1} + \ldots A_{qxt-q} + \xi_t$$

where A_j are unknown coefficient matrixes. The vector error correction representation for the x_t process is given by

$$\Delta_{xt} = \Pi_{xt} + \sum_{j=1}^{q-1} \Gamma_j \Delta_{xt-j} + \xi_t \tag{5}$$

where $\Pi = -(I_n - A_1 - \ldots - A_q)$ and $\Gamma_j = -(A_j + \ldots + A_q)$.

The authors prove that, in this context, the breaks can be endogenously estimated based on an unrestricted VAR model.

$$\Delta_{p_t} = v_0 + \delta_1 d_{t\tau} + \sum_{j=0}^{q-1} \gamma_j \Delta d_{t-j,\tau} + A_1 p_{t-1} + \ldots + A_q p_{t-q} + \xi_t \tag{6}$$

where $v_0 = v + \Pi_\mu$, $\delta_1 = -\Pi\delta$, $\gamma_0 = \delta - \delta_1$ and $\gamma_j = \gamma_n^*$. The structural break date is estimated as

$$\hat{\tau} = \arg\min_t \det\left(\sum_{t=q+1}^{T} \hat{\xi}_{t\tau} \hat{\xi}_{t\tau} \right)$$

where $\hat{\xi}_{t\tau}$ are residuals of least squares regressions. Since it is possible that the impulse q *dummies* in (6) make it difficult to estimate the true brake date, given that they eliminate information associated to observations in the periods that they take on value one, the authors also propose to estimate the break through:

$$\Delta_{p_t} = v_0 + \delta_1 d_{t\tau} + A_1 p_{t-1} + \ldots + A_q p_{t-q} + \xi_{t\tau}^* \tag{7}$$

where $\xi_{t\tau}^* = \sum_{j=0}^{q-1} \gamma_j \Delta d_{t-j,\tau} + \xi_t$. In this case, the date for the structural break is estimated as

$$\tilde{\tau} = \arg\min_t \det\left(\sum_{t=q+1}^{T} \hat{\xi}_{t\tau}^* \hat{\xi}_{t\tau}^* \right).$$

Once the deterministic terms are estimated, Lütkepohl, Saikonnen and Trenkler (2004) propose a Johansen test for the transformed variables in this way:

$$\hat{x}_t = p_t - \hat{\mu}_0 - \hat{\delta} + t\hat{\tau} \tag{8}$$

The authors prove that the Johansen test is valid in these conditions, and that its asymptotic properties are preserved.

Finally, in our structural procedure, starting at (2), and knowing the structural relation between the series, it is possible to construct a co-integration relation between them in the form

$$\frac{p_t^R}{p_t^S} = \frac{\overline{C}}{p_t^S} + (1 + \bar{c}) \tag{9}$$

Assuming that the transportation costs between regions are negligible $\overline{C}$ will tend to have a very low value, close to zero. In this case, the co-integration relation between the series can be tested through Least Squares in the following manner

$$\frac{p_t^R}{p_t^S} = (1 + \bar{c}) + \xi_t \tag{10}$$

The break in this relation can be estimated using a stability test of residuals in (10), such as the Quandt-Andrews test that estimates by iteration an unknown break point (ANDREWS, 1993)

4.2 Data Used

For the analysis here presented the IPCA (Broad Consumer Price Index) series was used. IPCA is calculated by IBGE, the official statistics agency in Brazil, for families that earn up to 40 times the minimum wage, in 9 metropolitan regions of the country. Because of its broadness this index is also used as the official inflation indicator by the Central Bank for inflation control goals. This index has a sub-group called "Pharmaceutical products"[8].

The analysis was concentrated in the January/2004 – December/2012 period. Earlier periods have the disadvantage of being more susceptible to other types of shocks, besides the TS in São Paulo, because of the many successive TS agreements celebrated between states and in the pharmaceutical sector[9]. To remove any possible seasonality problems, the series were deseasonalized using a centered seasonal dummy variable (JOHANSEN, 1995, P. 84).

The state of Rio de Janeiro was, among the large São Paulo state neighbors, the first to celebrate the agreement to establish the TS in São Paulo. Coincidentally, it is one of the regions mostly surveyed by IBGE and for which there is plenty of data for comparisons. Additionally, the state of Rio de Janeiro had signed the ICMS Agreement in 76/94 and already used tax substitution in its internal operations before the Agreement signed with the state of São Paulo, in 2007. There is no record of any significant alteration in the systematic of ICMS collection for pharmaceuticals in Rio de Janeiro in the studied period (2007 to 2008). This way, the prices in this state are a reflection of expected price behavior in the sector, without the changes in taxation created by TS in internal operations.

Figure 1 shows the evolution of pharmaceutical products prices in the metropolitan region of São Paulo. The prices in April 2010 are, in average, 50% above prices in the base period

[8] The series of pharmaceutical products is formed from the aggregation of 15 sub-series, where most of the medicines such as hypotensive, hypocholesterolemics, pain killers and antipyretics, anti-inflamatory and anti-rheumatic, anti-infective and antibiotics and symptomatic influenza relieve medicine and antitussives.
[9] However, the reported robustness tests will be performed with a larger analysis period.

(January 2004), in the series without seasonal adjustment, and 44% in the adjusted series. Almost half of this expansion was due to the increases between 2004 and 2007. There was an important increase in prices in 2009, when pharmaceuticals went up 7.02%.

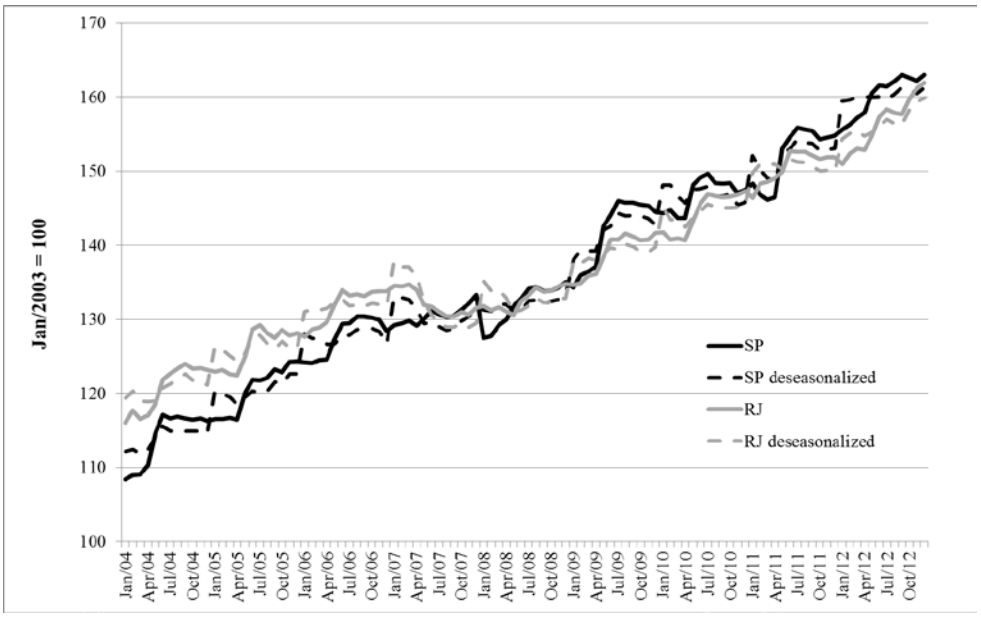

Figure 1: Price series of pharmaceutical products in the metropolitan regions of São Paulo and Rio de Janeiro; 2004:01 to 2012:12

In comparison, the graph also shows the evolution of prices for the metropolitan area of Rio de Janeiro. It can be noted that, at the end of the series, the prices for pharmaceutical products in the region of São Paulo are higher than the prices in the metropolitan region of Rio de Janeiro, having started at a much lower level[10]. The series seem to show a similar tendency in the first years, up until 2007, with a steady difference in price levels. After that, the prices in São Paulo start to increase more rapidly than those of Rio de Janeiro, and the difference is kept ever since. It can be speculated that a shock will have occurred in this period, shifting upwards, apparently permanently, the behavior of prices of pharmaceuticals in the region of São Paulo in relation to the prices in Rio de Janeiro.

5 Results

5.1 Unit Root Tests

The table 1 shows the results for the unit root tests in the São Paulo and Rio de Janeiro price series. The conventional ADF (DICKEY; FULLER, 1981) and Phillips and Perron (1998) tests were used. In both tests the null unit root hypothesis is not rejected. However, since our objective is to investigate the existence of a structural break in the relation of these series the test of Zivot and Andrews (1992) is also reported. In this test a structural break is included endogenously. The estimated dates for the breaks are also reported. It is noted that, for the price series in São Paulo, a structural break was estimated at 2007:12, while for the prices in Rio de Janeiro the break was estimated at 2009:01. This test does not reject the unit root null hypothesis for the series either.

[10] The accumulated variation of pharmaceutical products in Rio de Janeiro was 39.5% and 33.9%, respectively in the series with and without seasonal adjustment.

Table 1: Unit Root Tests

	Test's Statistics					
Variable	Defasagem	ADF		Phillips-Perron		Zivot-Andrews	
Price - SP	1	-3.6798	***	-3.6803	***	-3.0673	**
Break						[2008:11]	
Price - RJ	1	-2.6724	***	-2.6602	***	-2.7744	**
Break						[2009:12]	

*** significant at 1%; ** significant over 5%.

Source: Prepared by the author

This way, given that the series are *I*(1) the existence of a long term relation between them can be tested. The results for the co-integration tests with structural break are reported in the next section.

5.2 Co-integration tests with structural break

The results for the Gregory and Hänsen (1996) test can be found at table 2. The tests are conclusive in accepting a structural break between the months 2007:07 and 2007:06. In fact, it was during these months that the state of São Paulo returned to the system of collecting taxes on pharmaceutical products using Tax Substitution, as well as the signing of agreements with the state of Rio de Janeiro. For the tests done over the models relating the prices in São Paulo with those in Rio de Janeiro, the coefficient associated with the structural break dummy variable is positive and significative, indicating an increase in prices of pharmaceutical products in São Paulo from 4.8 to 4.9 p. p. The results for the constant term and the prices in the other region are consistent with our hypotesis.

The table 2 shows the results for the Lütkepohl, Saikonnem and Trenkler (2004) co-integration test with structural break. This test is also conclusive on the existence of a structural break in 2007;5. The estimative for the break dummy is that, after this date, the prices of pharmaceutical products in Rio de Janeiro are about 2.2 p.p. lower than the average, while in São Paulo this variation is 1.15 p.p. higher, even though the dummy for São Paulo is not significant.

Table 2: Gregory-Hansen Test Results

Selection Criteria		ADF	PP
	t-stat	-4.2843	
	Lag	1	
	Za-stat		-34.7924
	Zt-stat		-4.5054
Dependent Variable:		Price - SP	
Variables			
Constant		-20.7108	-20.8511
		(2.503)	(2.4208)
Price - RJ		1.1362	1.1366
		(0.0201)	(0.0194)
Dummy		4.8315	4.9000
		(0.447)	(0.4346)
	Break	[2007:7]	[2007:6]
R2		0.987	0.987
R2-adjusted		0.987	0.987
SE regres		280.67	268.24
F		2612.98	2735.71
Prob > F		0.000	0.000

Source: Prepared by the author

The coefficients suggest the existence of a long term relation between the variables, as expected in the law of one price; however, the error correction term for São Paulo is also not significant. This fact suggest weak exogeneity in the prices in São Paulo, compatible with the exogenous shocks in the series of that region[11]

[11] I thank an anonymous referee in regards to this point.

Table 3: Lütkepohl, Sakkonen and Trenkler Test Results

H0: posto = *k*	Statistics Trace	Critical Values	Statistics Maximum Eigenvalue	Critical Values
k = 0	17.8635	12.322	17.7293	11.2244
k = 1	0.1342 §	4.130	0.1342 §	4.1300
Normalized Co-integration Coefficients: 1 co-integration equation				
	Price - SP	Price - RJ	Constant	
	1.0000	-1.1632 ***	2.9171 ***	
		(0.0120)	(0.1601)	
Adjustment Coefficients: 1 co-integration equation				
	Price - SP	Price - RJ		
	-0.1095 ns	0.1522 *		
	(0.1081)	(0.0824)		
Structural Break [2007:5]				
	Price - SP	Price - RJ		
	1.1566 ns	-2.2832 ***		
	(1.1007)	(.8464)		

*** Significant at 1%; ** Significant at 5%; * Significant at 10%; ns: non-significant.
Critical Values from MacKinnon, Haug e Michelis (1999).

Standard Errors between parentheses.
Source: Prepared by the author.

Finally, imposing a structural relation of co-integration between the variables, compatible with the law of one price in its original form (that is, assuming that there are no transaction costs, which would make prices the same between regions) the regression (10) was estimated. The Quandt-Andrews test (ANDREWS, 1993) for structural break was applied on the residuals of this regression. The results are reported in table 4. Once again, there is evidence of a structural break in the relation between the prices of the two regions in 2007:06. In this approach, the intercept dummy coefficient starting at this date suggests that prices in São Paulo are 5.35 p.p higher than the average of the previous period. Considering that the prices in São Paulo, until this date, where estimated at 96.8% of the prices in Rio de Janeiro, the high after the break more than compensates for the lower prices that existed in São Paulo.

5.3 Robustness Tests

As a robustness test, a larger period was included in the analysis (Jan/00 to Dec/12)[12] **.**

[12] The period searched for structural break was made compatible with the previous series to reduce the chances of finding shocks at other time periods due to other reasons .

Table 4: Structural Test Results

Quandt-Andrews test for structural break		
H0: There is no structural break in the data		
	Value	Prob*
Statistical maximum-F LR [2007:6]	175.213	0.0000
Statistical maximum-F Wald [2007:6]	175.213	0.0000
Exp stat-F LR	84.417	0.0000
Exp stat-F Wald	84.417	0.0000
Med stat-F LR	124.279	0.0000
Med stat-F Wald	124.279	0.0000
Dependent Variable:	Price - SP / Price RJ	
Variables		
Constant	0.9680	
	(0.0022)	
Dummy	0.0535	
	(0.0028)	
Break	[2007:6]	
R2	0.752	
R2-adjusted	0.748	
SE regres	0.02	
F	176.90	
Prob > F	0.000	

*Probabilities calculated according to Hansen (1997).

Source: Prepared by the author.

Moreover, the impact of the relations of the metropolitan regions of Curitiba, Porto Alegre and Belo Horizonte were also analyzed. These are the metropolitan regions close to São Paulo and for which there are available data from IBGE, and also those with easier access starting from São Paulo. For these reasons, these are the regions for which the assumption of the Law of one price can be used without much trouble (Porto Alegre is more distant and, maybe for this region, the results should be taken in more carefully). It should be noted, however, that unlike Rio de Janeiro, these states went through changes in the system for ICMS collection for pharmaceuticals, as will be commented. Table 5 reports the results from the tests.

Table 5: Robustness test: Wider sample and other regions

		Rio de Janeiro		Curitiba		Porto Alegre		Belo Horizonte	
GH-adf	Break	[2007:12]		[2009:9]		[2009:4]		[2008:3]	
	beta	6.546	***	5.888	***	2.949	***	-4.954	***
	p-value	0.0000		0.0000		0.0000		0.0000	
GH-pp	Break	[2008:1]		[2009:8]		[2009:4]		[2008:3]	
	beta	6.405	***	6.034	***	2.949	***	-4.954	***
	p-value	0.0000		0.0000		0.0000		0.0000	
LST	Break	[2007:6]		[2009:6]		[2008:12]		[2008:2]	
	beta-SP	2.002	*	3.380	***	1.326	ns	-1.920	ns
	p-value	0.0725		0.0072		0.2347		0.2171	
	beta-Região	-3.277	***	-2.051	ns	-1.426	ns	4.707	***
	p-value	0.0016		0.1315		0.2538		0.0001	
QA	Break	[2007:7]		[2009:8]		[2008:5]		[2008:7]	
	beta	0.051	***	0.029	***	-0.009	***	-0.010	***
	p-value*	0.0000		0.0000		0.0008		0.0019	

*** Significant at1%; ** Significant at5%; *** Significant at10% ; ns: non-significant.

GH-adt: adf Gregory-Hansen Test

GH-pp: pp Gregory-Hansen Test

LST: Lütkepohl. Saikonnen and Trenkler Test
QA: Quandt-Andrews Test
Probabilities calculated according to Hansen (1997)

Source: Prepared by the author

The results for the tests comparing São Paulo with Rio de Janeiro remain qualitatively the same as found in the previous section, with a slight improvement in the inference (in the case of the LST test). It should be noted that, in relation to Curitiba (capital of Paraná State), the signals are similar to those observed in Rio de Janeiro, however slightly smaller in magnitude. The break is, however, slightly posterior than to previous one. It is believed that this is due to the changes in the system of ICMS collection in Paraná, which started to adopt TS in its internal operations in 2009. However, the implementation of TS changed the internal tax rate from 18% to 12%. The result found is impacted by two structural breaks in internal tax collection – São Paulo, in the end of 2007 and Paraná in the beginning of 2009. In both cases, the break should act to increase prices to consumer, but, in the case of Paraná, the reduction of the tax rate should decrease prices. In the end, São Paulo-Curitiba should be smaller than the comparison São Paulo-Rio de Janeiro.

Rio Grande do Sul (whose capital is Porto Alegre), following the example of Rio de Janeiro, is also part of the old ICMS Agreement 76/94. However, the state went through significant changes in the procedures for ICMS collection for pharmaceutical products, moreover, but not only, in 2010, when the t from 90% to 85%. Because of that, the results found in the tests, even though in line with those found in Rio de Janeiro and Curitiba, have smaller magnitudes (with the exception of the Quandt-Andrews structural test, which suggests break with a negative sign but with a coefficient very close to zero). Also the break dates are closer to the ones found in the Curitiba test than in the Rio de Janeiro. This could be due to the fact that the South regions of the country have a higher degree of integration among themselves than with the other regions.

The same cannot be said for Belo Horizonte (capital of Minas Gerais State). For this region the results are highly conclusive when identifying a break in the year 2008, but with a negative signal that is, the prices of pharmaceutical Products in São Paulo would have varied less than those of Belo Horizonte from this date on. However these results could also be due to the TS, but in this case the implementation of these mechanisms in Minas Gerais. In fact, Minas Gerais had also abandoned the ICSM Agreement 76/94 in the early 2000s and starting in 2005 the state went back to TS (Resolution 3728/05, 12/20/2005). For the pharmaceutical sector the definite regulamentation happens in 2009, with ICMS Protocol 29/09 in 06/05/2009 and Decree 45,138/09 in 07/20/2009. The variations in prices seen in São Paulo-Belo Horizonte are slightly smaller (in module) than those estimated for São Paulo-Rio de Janeiro, which, possibly, reflects part of the increase effect of the TS in São Paulo (with a negative impact on the coefficient module) and, in larger part, the effect of the increase of the coefficient module brought about by the alterations of the TS in Minas Gerais.

As another robustness test, the series for the four most important types of pharmaceuticals (hypotensives and hypocholesterolemics, pain killers and antipyretics, anti-inflamatories and anti-rheumatic, and anti-infective and antibiotics) were considered. Table 6 supports the results. In qualitative term, the results are not different from those previously obtained (only one negative break coefficient was estimated - in the structural test for anti-infective and antibiotics). In relation to the prices in the state of Rio de Janeiro, the prices in São Paulo have become systematically higher. The identification of breaks is less evident in the degraded series, because they are more susceptible to greater variation and specific shocks. However, in 10 of the 16 tests the break was identified between the months 2007:01 and 2008:02.

For the São Paulo-Curitiba difference however, there is not great discrepancy from the previously obtained results. In the hypotensive and hypocholesterolemics segment the identified break is between 2010:01 and 2010:5 and the fact that the coefficient is potentially negative already reflects the changes in tax collection in the state of Paraná. For all the other segments, the results of the tests suggest more recent breaks, between 2009:1 and 2009:9, with positive coefficients.

In relation to Porto Alegre, the degraded results are less conclusive. Half the tests indicate a break with positive coefficients, between 2009:1 and 2009:8. The greatest differences were found in pain killers and antipyretics and anti-infective and antibiotics, where the identified breaks presented a negative coefficient. The break period also shows greater dispersion, varying from 2007:1 to 2009:7. Specific studies about the repeated changes in the way ICMS is collected for pharmaceuticals in that state can answer the questions left in relation to the results found here.

Finally, in relation to Belo Horizonte, in 13 of the 16 tests a break with a negative coefficient can be observed. Even though the break period presents great variation (2007:2 to 2009:7) there is a higher prevalence in 2009:7, in line with the results of previous test.

Table 6: Robustness test: sub-item price analysis series.

Hypotensive and Hypocholesterolemics										
		Rio de Janeiro		**Curitiba**		**Porto Alegre**		**Belo Horizonte**		
GH-adf	Break	[2007:7]		[2010:5]		[2009:4]		[2009:7]		
							**			**
	beta	6.546	***	-6.857	***	2.482	*	-6.484	*	
	p-value	0.0000		0.0000		0.0007		0.0000		
GH-pp	Break	[2008:1]		[2010:5]		[2009:4]		[2009:7]		
							**			**
	beta	6.405	***	-6.857	***	2.482	*	-6.484	*	
	p-value	0.0000		0.0000		0.0007		0.0000		
LST	Break	[2007:6]		[2010:1]		[2009:7]		[2009:1]		
	beta-SP	2.002	*	-0.794	ns	2.021	ns	3.115	ns	
	p-value	0.0725		0.6388		0.1691		0.2527		
	beta-Region	-3.277	***	-0.676	ns	-1.970	ns	-2.944	ns	
	p-value	0.0016		0.7889		0.2214		0.2517		
QA	Break	[2007:7]		[2010:5]		[2010:6]		[2009:7]		
							**			**
	beta	0.051	***	-0.020	***	-0.075	*	-0.070	*	
	p-value*	0.0000		0.0003		0.0000		0.0000		
Pain killer and antipyretics										
		Rio de Janeiro		**Curitiba**		**Porto Alegre**		**Belo Horizonte**		
GH-adf	Break	[2007:3]		[2009:9]		[2010:4]		[2008:7]		
							**			**
	beta	5.844	***	6.085	***	-4.610	*	-11.099	*	
	p-value	0.0000		0.0000		0.0000		0.0000		
GH-pp	Break	[2007:3]		[2009:9]		[2010:4]		[2008:7]		
							**			**
	beta	6.216	***	6.085	***	-4.610	*	-11.099	*	
	p-value	0.0000		0.0000		0.0000		0.0000		
LST	Break	[2007:6]		[2009:6]		[2010:2]		[2007:8]		
										**
	beta-SP	3.591	**	4.670	**	N/A		-4.483	*	
	p-value	0.0460		0.0191		N/A		0.0087		
										**
	beta-Region	-1.014	ns	-3.270	ns	N/A		3.860	*	
	p-value	0.6646		0.1120		N/A		0.0050		
QA	Break	[2007:1]		[2009:8]		[2008:5]		[2007:1]		
							**			**
	beta	0.020	***	0.025	***	-0.057	*	0.029	*	
	p-value*	0.0000		0.0000		0.0000		0.0000		
Anti-inflamatory and anti-rheumatics										
		Rio de Janeiro		**Curitiba**		**Porto Alegre**		**Belo Horizonte**		
GH-adf	Break	[2009:3]		[2009:9]		[2009:4]		[2007:2]		
							**			**
	beta	9.894	***	13.671	***	7.890	*	-5.169	*	

	p-value	0.0000		0.0000		0.0000		0.0000	
GH-pp	Break	[2009:3]		[2009:9]		[2009:3]		[2007:2]	
							**		**
	beta	9.894	***	13.671	***	7.895	*	-5.169	*
	p-value	0.0000		0.0000		0.0000		0.0000	
LST	Break	[2009:1]		[2009:5]		[2009:1]		[2007:12]	
	beta-SP	3.629	**	3.746	**	2.959	**	-7.096	ns
	p-value	0.0251		0.0319		0.0204		0.1602	
	beta-Region	-1.052	ns	-2.861	*	-1.107	ns	2.238	ns
	p-value	0.4747		0.0732		0.4288		0.4872	
QA	Break	[2009:6]		[2009:8]		[2009:8]		[2009:6]	
							**		**
	beta	0.054	***	0.082	***	0.022	*	0.012	*
	p-value*	0.0000		0.0000		0.0000		0.0088	

Anti-infective and Antibiotics

		Rio de Janeiro		**Curitiba**		**Porto Alegre**		**Belo Horizonte**	
GH-adf	Break	[2008:2]		[2009:3]		[2010:5]		[2008:3]	
							**		
	beta	13.720	***	8.227	***	-3.555	*	-2.420	**
	p-value	0.0000		0.0000		0.0001		0.0183	
GH-pp	Break	[2007:9]		[2009:3]		[2010:5]		[2008:4]	
							**		
	beta	14.168	***	8.227	***	-3.555	*	-2.496	**
	p-value	0.0000		0.0000		0.0001		0.0152	
LST	Break	[2007:6]		[2009:1]		[2009:5]		[2008:2]	
									**
	beta-SP	2.628	ns	3.982	**	-0.800	ns	-8.307	*
	p-value	0.1448		0.0243		0.8385		0.0040	
									**
	beta-Region	-3.841	**	-2.053	ns	-2.355	ns	8.369	*
	p-value	0.0116		0.2580		0.6282		0.0002	
QA	Break	[2009:7]		[2010:5]		[2010:6]		[2009:7]	
							**		**
	beta	-0.028	***	-0.020	***	-0.075	*	-0.070	*
	p-value*	0.0000		0.0003		0.0000		0.0000	

*** Significant at 1%; ** Significant ta 5%; *** Significant at 10%; ns: non-Significant.

GH-adt: Test adf Gregory-Hansen

GH-pp: Test pp Gregory-Hansen

LST: Lütkepohl. Saikonnen and Trenkler test

QA: Structural Quandt-Andrews test

N/A: Not Availabe

*Probabilidades calculadas de acordo com Hansen (1997).

Source: Prepared by the author

6 Conclusions

In this work the impacts of tax substitution over pharmaceutical products in the state of São Paulo were estimated. It can be noted that the tax collection appeal, represented by tax substitution (TS), has been prevailing over the principles of efficiency and tax fairness. The use of TS causes, in principle, incentives price increases, which represents a greater participation of the state over the economic activity. The mechanism of value added margin revision (time surveys) do not guarantee the reduction of the tax burden, since the surveys are done in a TS environment (and its incentive to higher prices), reducing the possibility of revision of margins set in the future.

The fixation of maximum prices, in the case of controlled pharmaceuticals, establishes a limit in which the distribution of taxation is no longer possible. In the case where the market price, after taxation, is lower than the maximum, after taxation, the company can increase prices to that limit, depending on its market power – given by existing demand. If the demand allows an increase in prices caused by the taxation to be less than proportional to the increase in taxes, then the taxation will contribute to increase prices, reduce demand, create larger companies and reduce the number of companies in the market.

Measuring this impact has several practical difficulties. In this work, a co-integration model between regional prices of pharmaceuticals is proposed. The impact of taxation is modeled as a structural break in the series of prices in São Paulo in relation to the series in the reference region (Rio de Janeiro). The tests suggest a structural break, associated with the change in tax policy in the state, between 2007:05 and 2007:12, period in which the state reinstated the tax substitution method. When compared with the prices in the metropolitan region of Curitiba, closest metropolitan region to São Paulo after Rio de Janeiro, results seem rather robust and suggest a positive, but slightly later (mid-2009), break. The results in this case seem to be connected to the changes in tax policies in Paraná, which introduced the TS in the analyzed period, but with a decrease in tax rate.

In relation to Porto Alegre and Belo Horizonte, the results are less robust when it comes to identifying positive breaks. In the case of Porto Alegre, this can also be connected with the several changes in tax policies for pharmaceuticals. In the case of Belo Horizonte, the negative coefficient found seems to be related with the introduction of TS in that state, with reinforces the evidence of an end price increase after the introduction of this tax method.

It is understood that these results should be confirmed by new tests in the future, as the TS legislation is improved and new data becomes available. However, the evidences now found seem to be very clear in regards to the negative effects of the TS for consumers, especially in the case of essential goods

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