BRAZILIAN ENDOGENOUS TRADE POLICY: 1991-1998*

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ABSTRACT: This paper presents an empirical contribution to the identification of Grossman-Helpman's "Protection for Sale" parameters model for Brazilian trade policy, based on robust estimations techniques, which means the use of instrumental variables in a 2SLS for Generalized Method of Moments and Limited Information Maximum Likelihood methods for weak instruments with corrections of size tests, in order to correct endogenous bias. The results suggest that the political economy of Brazil's trade policy is an *outlier* in international comparisons, as the identification of structural parameters for Protection for Sale model shows a low part of population represented by an interest group and low weight of the welfare function.

KEYWORDS: political process; rent-seeking; lobbying; elections; legislatures; and voting behavior; trade policy; international trade organizations; country; industry studies of trade.

JEL Code: D72; F13; F14.

POLÍTICA COMERCIAL ENDÓGENA BRASILEIRA: 1991-1998

RESUMO: O presente trabalho é uma contribuição empírica para a identificação dos parâmetros do modelo "Protection for Sale" de Grossman e Helpman para a política comercial brasileira, baseado em técnicas de estimação robustas, o que significa o uso de variáveis instrumentais em um procedimento de Mínimos Quadrados em Dois Estágios (MQ2E) para o Método dos Momentos Generalizados (GMM) e o Método de Máxima Verossimilhança com Informação Limitada (FIML) para instrumentos fracos com correções dos tamanhos dos testes para a correção da tendência de endogamia. Os resultados mostram que a economia política da política comercial

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brasileira é *atípica* em relação às comparações internacionais, pois a identificação dos parâmetros estruturais para o modelo de Proteção de Vendas mostra uma pequena parcela da população representada por um grupo de interesses e uma baixa ponderação da função de bem-estar social.

PALAVRAS-CHAVE: processos políticos; busca de renda; lobbying; eleições; legislaturas e comportamento em votações; política comercial; organismos de comércio internacional; país; estudos especializados do comércio.

1. INTRODUCTION

The literature on the *Endogenous Trade Policy Theory* reveals that the research object should not be only the economic system, but also the political influence of agents and coalition formation in political system. Therefore, the inference about optimal results extrapolated the scope of economic analysis. For Nelson (1988), the research agenda imposed the condition, in which, the decision making should be based on the structure of hypothesis on political system and in the interaction amongst governments and private agents, either represented by lobbies or not.

The Endogenous Trade Policy Theory has been an important role for economic literature, in response to the liberalization policies support and their endorsement by decision-makers. Also, it is observed tariff line specification depended on the results of two stage game involving internal that the agents, private agents against a incumbent govern, a and external agents, represented by discussions amongst trade partners or members in an international forum.

The theory would be the result of the intellectual effort, from economists and political scientists, to explain the determination of the domestic protection levels. The endogenous approach has been promoted by the following observations: (i) the awareness of a disparity between the propositions held by economists about free trade and economic authorities' practices; (ii) the lack of a relation to economic optimum and the political optimum; and, (iii) the existence of a political market where the protection level was negotiated and determined.

The literature of endogenous policy theory was an answer to the non-exogenous aspect in domestic protection's level. So, in the eighties, it sourced a set of frameworks for endogenous protection to substitute the *ad hoc* models 70's, namely:

a) Hillman (1982), Cassing, Hillman and *van* Long (1985), Hillman and Ursprung (1988), *van* Long and Vousden (1991), Brainard and Verdier (1994), Laphan and Ware (2001) and Hillman, *van* Long and Soubeyran (2001) derived a political support function that edged the policymakers trade actions constraints that causes welfare reduction;

b) Tariff formation function derived from Findlay and Wellisz (1983), Feenstra and Bhagwati (1983), Rodrik (1986), and Wellisz and Wilson (1986) that established a linear relationship amongst contributions from lobbies and tariffs;

c) Median elector model derived for Mayer (1984) suggested that the median elector chooses the level of protection;

d) Magee, Brock, and Young (1992) set up a campaign contributions model in a system composed by two opposed candidates and to economic sectors; and

e) Grossman and Helpman (1994) derived the political contributions model, a parsimoniously framework from game theory in a first price menu auction under complete information, in which interest groups and incumbent government interaction results in a level of protection. Trade wars and trade talk's model, in Grossman and Helpman (1995a), and free trade area, in Grossman and Helpman (1995b), sourced from PS Model.

So, for a small country, Grossman and Helpman (1994) established a single model, to determine endogenous trade protection through and parsimonious contributions by organized and prominent sectors, named Protection for Sale model, PS model hereafter.

The framework is based on a two stage game amongst an incumbent government and industrial sectors. The objective of incumbent government is maximize the govern function, which weighted political contributions from organized sectors and aggregated well-being. Through contributions, the sectors accessed the political decisions on tariffs barriers. Empirical literature suggested the opposite relation between parts of government function. So, with the both parameters, namely, a weight of well--being function and proportion of organized population in interest groups determined the sectors protection levels.

In Brazil, events as record of tariff preference lists in the Latin American Association of Integration (ALADI), in the beginning of 1994; the creation of lists of adequacy to the Common External Tariff (CET), in 1995; after the creation of the Southern Cone Common Market (MERCOSUR), the creation of lists of exceptions to the CET; the creation of the Dallari's list that was valid until April, 1995, (BACEN, 1996); the creation of an origin regime by the Common Market Council (CMC) (Decision Number 05/96); and the creation of the technical groups for strategic sectors, among other items, led to a study on the influence of the interest groups on the formation process of the protection structure for domestic industries. As period coincides with a preferential trade agreement, even harmonizing of tariffs, we use the small country model, as PS model, to the evidence of creation and collapse of MERCOSUR, as a main characteristic of interest groups pressure captured on parameters identification. So, as appointed by Baer, Cavalcanti e Silva (2002), the lobbying channel and risk channel from main partners, classified as absence of coordination of macroeconomic policies, contributed to the collapse of common market.

Table 1 – Basic statistics of sectorial tariffs

SIC–3[1]	Sector	Average[2]	Standard deviation[2]
501	Basic Metallic Products	0,0431	0,0145
601	Non-ferrous Metallic Prod.	0,0947	0,0176
701	Other Metallic Products	0,1864	0,0321
802	Tractors and Agricultural Machines	0,2018	0,0410
1001	Electrical Equipment	0,2234	0,0412
1101	Electronic Equipment	0,2196	0,043-
1201	Cars, Trucks and Buses	0,4132	0,0655
1301	Vehicles and Other Parts	0,2011	0,0324
1401	Wood and Furniture	0,1141	0,0222
1501	Paper, Cellulose and Paperboard	0,1077	0,0182
1601	Rubber Products	0,1789	0,0593
1701	Non-petrochemical Chemical Elements	0,0889	0,0277
1903	Other Chemical Products	0,1400	0,0407
2001	Pharmacy Products and Perfumery	0,1166	0,0431
2101	Plastic	0,1919	0,0400
2202	Natural Textile	0,2113	0,0555
2301	Clothes	0,2575	0,0642
2603	Other Food Products	0,1572	0,0554

Notes: [(1)]Standard Industrial Code (three digits),[(2)]Parameters referring to the period of 1991-1998.
Source: Results achieved and organized by the author.

With the basic statistics of the ad valorem tariffs, summarized in Table 1, it was observed that the average of the sector tariffs, like: Basic Metallic Products and Non--Ferrous Metallic Products, would be considered as low. Sectors as Automobiles, Trucks and Buses, Clothes, Natural Textiles, Electrical Equipment and Electronic Equipment would be considered as high. By taking the standard deviation, since the period of 1991-1998 includes the launching process of the MERCOSUR Agreement, and the beginning of the deterioration of the commercial relations amongst members as of 1997, because of the Asian crisis, it was observed that sectors as Automobiles, Trucks and Buses, Rubber Products, Natural Textiles, Clothes and Other Food Products presented a high standard deviation in comparison to the other sectors.

Considering the references of Calfat, Ganame, and Flores (2001) and Facchini *et al.* (2010) that implied partial identification of PS Model for Argentina, Brazil, Paraguay, and Uruguay, by the first and for Latin America and South Cone, the second one, is suggested that Brazilian trade policy had been established endogenously.

So, the identification of the structural parameters of the PS model, as it was achieved for Australia, European Union, Poland, Turkey and United States demonstrated the endogenous perspective of the formulation of the Brazilian trade policy.

So, the hypothesis of the present paper is to verify if the model was suitable or not for the Brazilian economy in the period of 1991-1998, although the influence of trade agreement amongst Argentina, Brazil, Paraguay and Uruguay.

This paper uses panel data methodology that refers to multidimensional data to reveal the Brazilian data support to PS model framework. The dimensional perspective is shown by eighteen industrial sectors, by cross-section dimension, and eight years (1991 to 1998), by time series dimension. We added *Armington*'s elasticity[1], which is time invariant. For the indicator estimation for interest group organization, we use random effects Tobit regression censored. In response to endogenous bias, presented in endogenous protection models, we use weak instruments in 2SLS for the Generalized Method of Moments (GMM) and Limited Information Maximum Likelihood (LIML) procedures, with correction of size tests.

2. EMPIRICAL RESULTS WITH ENDOGENOUS TRADE POLICY MODELS[2]

Besides some theoretical empirical contributions in literature of Endogenous Trade Policy, only after PS model, suggested by Grossman and Helpman (1994), a new theoretical line of propositions, with rigorous empirical tests, corroborates endogenous trade policies endogenous properties.

The contributions outfitted by Grossman and Helpman' paper (1994) considered the following modifications: the greater number of agents involved in the deal, the formulation of agreements of free trade with and without symmetry, and the participation of foreign lobbies in the domestic scenery[3]. It must be included the endogenous aspect of lobbies, proposed by Mitra (1999).

The pioneering characteristic of the empirical treatment, related to the PS model, was due to Goldberg and Maggi (1999) seminal paper. Those authors observed that the predictions of the PS model were consistent with the data of the North-American economy in 1983, identifying the structural model parameters in their original formulation.

Besides, they tested whether the inclusion of other variables, which were important in ad-hoc models, affects the model explanatory power. Such variables are rele-

[1] The use of the *Armington*'s elasticity for the PS model test was initially proposed by Gallaway, McDaniel, and Rivera (2003).

[2] Gawande and Krishna (2005) reviewed some empirical papers on endogenous protection, until 2001, without incorporating the results of Eicher and Osang (2002), Calfat, Flôres, and Ganame (2000), and posterior publications.

[3] See Gawande and Bandyopadhyay (2000).

vant to the equations of tariff and non-tariff barriers (employment rate, sectorial unemployment rate, unionization, changes in the import penetration and concentration of buyers and sellers, among others).

The specification was also tested for Argentina, Brazil, Paraguay, and Uruguay by Calfat, Flores and Ganame (2000). Those authors concluded that the model also would be applicable to the MERCOSUR case, since the partial results allowed the identification of the correct signs for Brazil and Uruguay. It was also identified, in 1996, the proportion of the voting population that should be represented by an interest group in Brazil and Uruguay, with parameter values of 0.67 and 0.86, respectively, without the identification of the weighted parameter.

The empirical strategy suggested by authors evolved a Three-Stages Leas Squares (3SLS) that combines 2SLS with Seemingly Unrelated Regression (SUR). The problem with procedure was that authors take the SUR stage equivalent to Ordinary Least Square (OLS).

The heteroscedasticity were used in the same procedure as Goldberg and Maggi (1999). In the same way, although with the aim of measuring Latin America's reaction about the increase in imports from China and India, Facchini *et al.* (2010) identified the aggregated weight well-being function to Latin America (a = 918), and South Cone (a = 1639). Those authors used China and India's participation in product's world trade and US capital-labor as instrumental variables. They do not presented any test to the quality of instruments or the correction of sample size.

Considering the partial results and procedure limitations for Calfat, Flores and Ganame (2000) and, also, the aggregation for Latin America and limitations of empirical procedure to Facchini *et al.* (2010), our paper presents the identification of all Brazilian PS model parameters based on robust procedure.

The Eicher and Osang (2002) test, applied to the American economy in 1983, proved that the PS model were superior to the Tariff Formation Function model, by Feenstra and Bhagwati (1983).

Conventional use of the original equation also produced favorable results for Turkey. Mitra, Thomakos and Ulubasoglu (2002) applied the model in periods from 1983 to 1990, which resulted in a higher weight of the welfare function in democratic period, and changes in the specification of the original model allowed the inclusion of theoretical relevant variables. Gawande and Bandyopadhyay's paper (2000), and McCalman's paper (2004) enrolled the list of empirical papers for PS model.

The results demonstrated that, for the American economy, similarly to the results originally found by Goldberg and Maggi (1999), for 1983, the PS model presented results consonant to the *Endogenous Trade Policy Theory*.

On the other hand, McCalman's paper (2004), applied to Australia using the same method, demonstrated that, with data to the periods from 1968 to 1969, and from 1991 to 1992, the percentage of the voting population organized in an interest group increased due to the commercial liberalization, which took place in the second period. There was no statistically significant difference for the weight of welfare function in both periods. Bohara, Gawande, and Sanguinetti (2004) pursued to empirically identify the Argentinean and Brazilian sectors presented in the list of exceptions to the Common External Tariff (CET). They adapted Grossman and Helpman's model (1995a, 1995b), an extension of the PS model. With information regarding to tariffs and non-tariff barriers, during period from the first quarter of 1992 to the fourth quarter of 1994, they concluded that the model was not able to explain the reason for the exclusion of some CET sectors.

Finally, modification presented by Gawande, Krishna, and Robbins (2006), applied to the data concerning USA economy, in periods of 1978-1979 and 1981-1982, was specified to include the foreign lobbies in the protection equation of the PS model. The objective was to verify the influence of foreign interest groups in the determination of the American protection structure.

Results reveal that PS model, modified for the inclusion of external lobbies, was strong and statistically significant. In other words, the signs of the estimated parameters were not altered with the inclusion of other variables.

The differences proposed for the empirical treatment in the present paper are the use of the *Armington*'s elasticity, as proxy of the price elasticities in demands for imports; the specification of instrumental variables compatible with sectorial structures and conjunctures; the use of panel data techniques for a period of eight years, aiming at the capture of the inter- and intra-sectorial dynamic effects in the time interval studied and, since PS model structure is a balance result, statistical significance reveals consistency; and, finally, the use of tariff aliquots, which would originally be represented in the PS model.

Estimation procedures used were the GMM and the LIML. The advantage of the first would be the achievement of better results when the procedures of maximum likelihood require nonlinear optimization; the advantage of the second would be the fact that the use of weak instrumental variables could cause bias, mainly when their number varied according to the sample size. The second procedure would represent an innovation, in comparison to the other estimates limited in LIML procedure with sample correction for weak instruments. Our contribution managed structural specification for price import elasticity used in the left-hand side or in the right-hand side of equation. Also, in the use of instrumental variables, we detailed the technique for the quality of instruments, and the sample size correction for the tests on

instruments to control the bias of endogenous aspect. Finally, we managed the problems of heteroscedasticity and autocorrelation.

3. METHODOLOGY

The methodology was based on the use of panel data techniques with the specification of instrumental variables, for the elimination of the endogenous bias presented in such models, as proposed by Trefler (1993). Estimates were applied for the data concerning Brazilian economy, in period from 1991 to 1998, comprising the commercial openness, started in 1991, the admission of the country in the MERCOSUR in 1995, and the beginning of its collapse in the end of 1998.

3.1 THE EMPIRICAL MODEL TESTED

The basic model developed by Grossman and Helpman (1994) considers an objective function of an incumbent government given by:

$$G = \sum_{h \in L} C_h(p) + aW(p) \tag{1}$$

in which:

C = campaign contributions;

L = sectors organized in interest groups;

h = h–th activity sector;

a = weight of the welfare function;

W = welfare function;

$\boldsymbol{p}$ = price vector.

The government objective-function demonstrated to be additive to the resources from contributions of interest groups and some weight of the welfare function.

The public welfare function W(p) would represent the sum of these functions to the results of each of the i–th sectors of the economic activity, according to the identity (2):

$$W(p) = \sum_{i=1}^{n} W_i(p) \tag{2}$$

in which:

n = number of activity sectors.

The structure of protection is derived from a *menu-auction problem*, or a two-stage game, in which sectors contributions through lobbies are limited to a feasible set. Based on contributions, government established the optimal trade policy with maximization of his objective function. As this game is repeated, the strategic contributions forced government to best choices to lobbies as a *Truthful Nash Equilibria*, as equation (3) described:

$$\nabla W_j^{\,0}\left(p^0\right) - \nabla C_j^{\,0}\left(p^0\right) + \sum\nolimits_{i \in L} \nabla C_i^{\,0}\left(p^0\right) + a\nabla W\left(p^0\right) = 0, \forall j \in L \qquad (3)$$

Solving the problem for (3), based on equations (1) and (2), generates equation (4).

$$\left(I_j - \alpha_L\right) y_j\left(p_j\right) + \alpha_L\left(p_j - p_j^*\right) m_j^{'}\left(p_j\right) + a\left(p_j - p_j^*\right) m_j^{'}\left(p_j\right) = 0 \qquad (4)$$

By rearranging equation (4), and solving it for $\tau_i = (p_i - p_i^*)/p_i^*$, result the expression (5), plus an index for specification to time:

$$y_{it} = \frac{\tau_{it}}{1 + \tau it} = \frac{I_{it} - \alpha_L}{\alpha + \alpha_L}\left(\frac{z_{it}}{e_{it}}\right) \qquad (5)$$

in which:

y = tariff relation;

τ = *ad valorem* import tariff;

z = inverse import penetration;

I = interest group representation indicator;

e = price–elasticity of the demand for imports;

i = activity sector, i = 1, ..., n; and

t = time unit, t = 1991, ..., 1998.

3.2 ECONOMETRIC MODEL: THE PANEL DATA METHOD

The panel data structure presents countless advantages over the simultaneous equation systems, the *cross-section*, and time series structures, according to Greene' propositions (1997), as general reference; (Hsiao, 1999; Lee, 2002; Wooldridge, 2002; Arellano, 2003; and Baltagi, 2005), as specific references, on panel data literature. Among the advantages, it is worth pointing out that the method allowed the individual heterogeneity identification, presented in several data structures, being more informative when presenting more variability, more degrees of freedom, more efficiency and less

collinearity among variables, and the possibility of interaction between cross-sections and time units of those sets, significant to the study of dynamic adjustment.

The inferences on the model results would be done based on the estimations of equations (6) and (7), written with the price elasticity of demand for imports in first member, Model 1, or with the price elasticity of demand for imports in second member, Model 2, namely:

$$y_{it}e_i = \frac{\tau_{it}}{1+\tau_{it}}e_i = yz_{it} + \delta z_{it} + \upsilon_{it} + \mu_{it} \tag{6}$$

in which:

$$\gamma = \frac{\hat{I}_{it}^{0}}{a+\alpha_L};$$

$$\delta = \frac{\alpha_L}{a+\alpha_L};$$

$$\alpha_L = -\frac{\delta}{\gamma}$$

$$a = \frac{1+\delta}{\gamma}$$

z = inverse import penetration;

υ = random residuals to measure *random* effects;

μ = deterministic residuals to measure *fixed* effects.

$$y_{it} = \frac{\tau_{it}}{1+\tau_{it}}e_i = \gamma\frac{z_{it}}{e_i} + \delta\frac{z_{it}}{e_i} + \upsilon_{it} + u_i \tag{7}$$

Some problems appear in estimation process for PS model. So, an empirical strategy must nullify them.

3.3 DATA TREATMENT AND EMPIRICAL STRATEGY

In the verification of the endogenous aspect of the Brazilian trade policy, two econometric difficulties were found. The first econometric difficulty was the specification of the *dummy* variable to the organization in industrial sectors.

Empirical strategy is diverse, covering since the structure of equation to be estimated to the estimation method used. All the estimation process also involved the identification of interest group organization indicator and the treatment of endogenous bias caused by the tariffs effects on price import elasticity.

The empirical literature presented some alternatives to estimate the organization's indicator in interest group. Goldberg and Maggi (1999) tried a double censored Tobit model using non-trade barriers. That proposal was followed by other authors, such as Gawande and Bandyopadhyay (2000), Mitra, Thomakos and Ulubasoglu (2002), Eicher and Osang (2002), McCalman (2004), and Gawande, Krishna, and Robbins (2006).

Beloc and Guerrieri (2008) used an arbitrary level of 70% to characterize an organized sector in a probit model. Likewise Hagemejer and Michalek (2008) used the sample mean to identify an organized sector, but without an estimation process. A discriminant analysis was used by Mitra, Thomakos and Ulubasoglu (2002) and Mitra, Thomakos and Ulubasoglu (2006).

In the present work, sectors that presented a concentration index, for hypothesis, are protected by an import tariff superior to 10%[4]. So, a *Tobit* model for a censored variable was estimated.

$$I_{it}^{0} = w_{it}\beta + \varphi_{i} \tag{8}$$

in which:

I_{it}^{0} = interest group indicator;

w_{it} = vector of independent variables;

β = vector of coefficients; and

φ_i = *random* effect.

The set of independent variables corresponds to inverse import penetration (z_{it}) industrial concentration index *(ici$_{it}$)*, number of firms *(ne500$_{it}$)*, employment turnover rate *(tre$_{it}$)*, export annual coefficients *(cae$_{it}$)*, annual coefficients of net openness *(caal$_{it}$)* and annual coefficients of imported input participation *(capii$_{it}$)*, real wage per worker *(w$_{it}$)* sectorial employment *(l$_{it}$)*, increase in sales *(cv$_{it}$)*, general liquidity *(lg$_{it}$)*, industrial physical production index *(ipfi$_{it}$)*, and imports *(m$_{it}$)*, all of them presented in the Appendix.

For intervals to the estimation of censored Tobit model[5], we have: left side corresponding to non-organized sectors, inferior to "a" level, and right side, the organized sectors, corresponding to level superior to "b". The estimation results are showed on Table 2.

[4] Basic statistics to 18 sectors, from 1991-1998, shows the mean of 14.51%, and standard-deviation of 6.72% in tariffs. The minimum ad valorem tariff was 2.2% and maximum was 37.6%. So, the choice of 10% corresponds to two units of standard-deviation in an asymmetric distribution frequency.

[5] The specification requires the joint density of censored Tobit Model, the observed data in panel data, unconditional of φ_i.

Table 2 – Tobit censored specification

Random effects Tobit regression	
	Dep. Variable: $\hat{I}_{it}^{0}$
z_{it}	0.0000255 ^{NS}
	(0.0000633)
m_{it}	–3.36e–06**
	(1.61e–06)
l_{it}	2.71e–08 ^{NS}
	(6.36e–09)
w_{it}	–0.0005772***
	(0.000059)
wp_{it}	0.036347***
	(0.0127263)
cv_{it}	0.0009725***
	(0.0001408)
lg_{it}	–0.002441 ^{NS}
	(0.0072362)
ici_{it}	0.000935***
	(0.0001492)
$ne500_{it}$	–0.0001454 ^{NS}
	(0.0001166)
cae_{it}	–0.0018581***
	(0.0003993)
$capii_{it}$	–.0005219 ^{NS}
	(0.0005661)
$caal_{it}$	–0.0003353*
	(0.0001733)
$ipfi_{it}$	–0.0003326***
	(0.0001212)
tre_{it}	0.0011482 ^{NS}
	(0.0025369)
constant	0.3627568***
	(0.0228093)
$Wald\ \chi^{2}(14)$	310.91***
	(0.0000)
σ_u	0.0560148***
	(0.0031861)
σ_e	0.0161463***
	(0.001292)
ρ	0.9232855

left-censored: 39 observations.
right-censored: 23 observations.
uncensored: 82 observations.

Notes: (*)10% of significance; (**)5% of significance; (***)1% of significance; (NS)non-significant; ( ) = standard errors.

The second problem was the endogenous bias presented in endogenous protection models, defined as the inverse import penetration as an explanatory variable, as well as the price import elasticity.

From empirical literature, differences amongst alternatives were identified in the estimation process with Maximum Likelihood for Goldberg and Maggi (1999), and Hagemejer and Michalek (2008); Two Stage Least Square for Gawande and Bandyopadhyay (2000), McCalman (2004), and Belloc and Gerrieri (2008); Minimum Distance Estimator for Eicher and Osang (2002); Non-Linear Two Stage Least Square Estimation for Mitra, Thomakos and Ulubasoglu (2002), and Gawande, Krishna, and Robbins (2006); Non-Linear Tobit Limited Information Maximum Likelihood for Gawande and Li (2009).

The strategy to treat price import elasticity endogenous was solved using the elasticity variable in the left-hand side of equation. Strategy was proposed by Goldberg and Maggi (1999), and followed by Eicher and Osang (2002), and McCalman (2004). Differently, this paper considered the both structures with elasticity in the left-hand side, as equation (6), and in the right-hand side, as equation (7).

Besides the elasticity measurement error problem, due to empirical data set that corresponds to a single year, in the case of Goldbeg and Maggi (1999) and Eicher and Osang (2002), this paper used a larger dataset in which elasticity measurement errors should be less intensive compared to a single year. Moreover, Armington's elasticities, time invariant, can do better that price import elasticities.

Likewise when you used the price import elasticities in the left-hand side of equation or in the right-hand side, endogenous bias should appear either with tariff effects on domestic production, as a small open country model, or with tariff effects on imports, and consequently on inverse import penetration.

A generalized solution is based on instrumental variables referring to an estimation technique used to a variety of violations including measurement error, simultaneity, and omitted variables. Two-Stages Least Squares (2SLS) is generally used as a standard technique. Exception is attributed to Mitra, Thomakos and Ulubasoglu (2004) that used Weighted Two-Stages Least Square (W2SLS) to manage the endogenous aspect, measurement error problem, and heteroscedasticity problem.

Instrumental variables were used by Eicher and Osang (2002), McCalman (2004), Hagemejer and Michalek (2008), Belloc and Gerrieri (2008), and also Gawande and Li (2009). The main problem with procedure is the quality of used instruments. In empirical literature, some tests are used to corroborate the instrumented variables, but in Gawande and Li (2009), difficulties with small-sample properties were solved using Limited Information Maximum Likelihood (LIML).

Generally, the advantage of 2SLS is an instrumental variable estimation technique that is formally equivalent in linear case, referring this paper. Although, even in an applied instrumental variables procedures to eliminated endogenous bias, another problem appears in instruments' quality, namely, weak instruments.

In the estimation procedures, we used the Generalized Method of Moments (GMM)[6] that allows the achievement of estimated parameters, when the maximum likelihood requires the non-linear optimization, which is observed in procedures with instrumental variables. The procedure covers the proposal of Mitra, Thomakos, and Ulubasoglu (2002), and Gawande, Krishna and Robbins (2006). To corroborate the results with this procedure, tests were necessary, since weak instruments cause bias, according to Baltagi (2003).

Classical and robust standard errors are obtained for arbitrary heteroscedasticity to 2SLS instrumental variables procedure in GMM estimation. For Arellano (2002), Sargan's test is a test of the validity for instrumental variables, basically over identification restrictions.

Using weak instruments in procedure, we need Sargan's test for Generalized Method of Moments (GMM). So, using instrumental variables is necessary to test the hypothesis requiring correct size when instruments are weak as well as strong[7].

Now, the Limited Information Maximum Likelihood procedures (LIML) present advantages in comparison to the other methods, mainly when the number of instruments varies in relation to the sample size. Besides, the results of the Monte Carlo simulation showed that the LIML method presents consistent results, even when the instruments are weak, which happened in the analysis, according to Baltagi (2003).

Using weak instruments in LIML procedure requires Anderson-Rubin test (AR), as a test of structural parameters. Also, Lagrange multiplier test (LM) called score test. Recently, Moreira (2003) proposed the Conditional Likelihood Ratio (CLR) test, evaluating tests in the presence of weak instruments[8].

For identification of instruments, according to Greene (1997), it was necessary to adjust the choice of the instruments and the procedure that comprises the following:

- Estimation of the original equation and residuals capture;
- Estimation of a regression between residuals and several potential instruments, including a constant, a trend variable, the lagged dependent variables and the lagged explanatory variables. The non-significant parameters

[6] To GMM procedure with weak instruments, see Baum, Schaffer, and Stillman (2003).

[7] See Moreira (2003).

[8] To the tests, we need to specify the Q matrix as proposed by Mikusheva and Poi (2001).

were potential instruments, because they did not present correlation with residuals;

• Estimation of the explanatory variables according to the instruments, where the significant parameters were potential instruments, provided that they had not been significant in the previous procedure.

In the procedure, the weak and strong instruments used in the two-stage procedure were selected. The weak instruments were the non-significant ones for equation of the residuals and weakly correlated with endogenous explanatory variables, while the strong or consistent instruments were the non-significant for residues and correlated with the endogenous explanatory variable.

Finally, to verify the procedure consistency, the regression residues were regressed in two stages, according to the instruments; the non-significance of the parameters proved that the residues are consistent.

The advantages of this paper over general literature are (i) it manages the price import elasticity using the both specification for Model 1 and Model 2; (ii) it considered the Armington's import elasticity that is time invariant; (iii) the quality of instruments were checked out with a rigorous procedure that determines weak and strong instruments that not appears in other related papers; (iv) even using weak or strong instruments, the Sargan's test to overidentification of restrictions was executed; (v) the used alternative of GMM and FIML, the first based in the non-linear optimization estimation process attributable to the use of instrumental variables, the last based on the variable number of instruments; (vi) the Anderson-Rubin test, Lagrange multiplier test, and conditional likelihood ratio test in the presence of weak instruments in the use of LIML procedure; (vii) the procedure were robust to autocorrelation, heteroscedasticity, or both.

Specifically for Brazilian estimation or aggregated results for Latin America, this paper presented all advantages summarized above.

4. RESULTS AND DISCUSSION

The procedures to reach PS model parameters, as presented in previous section, were based on the estimation of original equation, corresponding to the equations specified as equation (6), as Model 1, and equation (7), as Model 2.

The first step of empirical strategy evolves the estimation of indicator variable for sectors organized on interest groups. Through the observation of Table 2, implied that censoring the data for *ad valorem* import tariffs, in right at level superior to 0.2, and in left at level or inferior to 0.1, for a random effects, Tobit regression results in 23 observations right censored.

Then, in second step, as implied in Table 3, the residuals estimated were, then, regressed according to the instruments presented in groups of section 3.3, with addition of the lagged dependent variable, and the lagged of endogenous variables, as suggested by Greene (1997). Then, the endogenous variable is regressed (only the inverse of import penetration) according to the variables of the previous regression, as showed on Table 3.

Table 3 – Instruments identification – maximum likelihood method

Dep. Variable:	Model 1		Model 2	
	$Residuals_{it}$	z_{it}	$Residuals_{it}$	z_{it}
$y_{it}\,(-1)$	–0.0009 NS (0.006331)	–0.46472 NS (7.972824)	-0.01607 NS (0.018639)	3.642128 NS (18.07565)
$\hat{I}^0_{it}\, z_{it}(-1)$	0.007547*** (0.000936)	2.174525** (0.942147)	0.007424*** (0.000945)	-0.32307 NS (0.916337)
$z_{it}\,(-1)$	–0.00133*** (0.000192)	0.284549 NS (0.202159)	-0.00125*** (0.000174)	0.965525*** (0.168569)
m_{it}	2.65E–06** (1.27E–06)	0.001014 NS (0.001328)	2.17E-06*** (7.79E-07)	0.00117 NS (0.000756)
l_{it}	1.05E–08* (5.76E–09)	–7.16E–06 NS (6.92E–06)	8.20E-09** (3.34E-09)	-7.67E-06** (3.24E-06)
w_{it}	–0.00026*** (7.28E–05)	–0.09775 NS (0.073743)	-0.0003*** (5.57E-05)	-0.08096 NS (0.053984)
wp_{it}	0.013521 NS (0.009451)	–6.31524 NS (10.73951)	0.00336 NS (0.005968)	2.136429 NS (5.788089)
cv_{it}	–0.00053*** (0.000105)	–0.24832** (0.105099)	-0.00054*** (7.46E-05)	-0.20491*** (0.072346)
lg_{it}	0.018712*** (0.004875)	12.9512*** (4.774898)	0.012764*** (0.003283)	8.360778*** (3.183677)
ici_{it}	7.98E–05 NS (0.000115)	0.002245 NS (0.129914)	0.000268*** (6.83E-05)	0.011648 NS (0.066193)
$ne500_{it}$	–6.47E–06 NS (8.48E–05)	0.052951 NS (0.110251)	2.33E-05 NS (5.34E-05)	0.046761 NS (0.051823)
cae_{it}	–0.00035 NS (0.000289)	0.024102 NS (0.332068)	-0.00062*** (0.000189)	-0.02899 NS (0.183387)
$capii_{it}$	0.000363 NS (0.000455)	–0.10521 NS (0.455311)	0.000731*** (0.00027)	-0.08648 NS (0.261618)
$caal_{it}$	–4.9E–05 NS (0.000135)	–0.01986 NS (0.1231)	-6.1E-05 NS (8.81E-05)	-0.02792 NS (0.085451)
$ipfi_{it}$	1.53E–05 NS (9.04E–05)	–0.01161 NS (0.086407)	-1.7E-05 NS (5.66E-05)	-0.02334 NS (0.054907)
tre_{it}	0.002123 NS (0.001983)	3.136002* (1.866036)	0.000696 NS (0.001264)	1.825303 NS (1.225324)

Table 3 – Instruments identification – maximum likelihood method

Dep. Variable:	Model 1		Model 2	
	$Residuals_{it}$	z_{it}	$Residuals_{it}$	z_{it}
Constant	0.067859*** (0.019194)	32.61897* (18.51088)	0.078526*** (0.01506)	26.15835* (14.60543)
R^2 – *within*	0.5866	0.7265	0.709	0.641
R^2 – *between*	0.9437	0.962	0.986	0.9903
R^2 – *overall*	0.7352	0.869	0.8503	0.8803
Wald $\chi 2$ *(k)*	271.06***	442.97***	618.89***	801.42***
σ_u	0.00262939	6.275	0	0
σ_e	0.01276545	11.174	0.00834	6.8233
ρ	0.04069975	0.239741	0	0
strong instruments	$\hat{I}_{it}^{0}\ z_{it}(-1)$ *and* tre_{it}		*empty set*	
weak instruments	y_{it} (–1), wp_{it}, ici_{it}, $ne500_{it}$, cae_{it}, $capii_{it}$, $caal_{it}$, and $ipfi_{it}$		y_{it} (–1), wp_{it}, $ne500_{it}$, $caal_{it}$, $ipfi_{it}$, and tre_{it}	
Weight	$ipfi_{it}$		$ipfi_{it}$	

Notes: (*)10% of significance; (**)5% of significance; (***)1% of significance; (NS)non-significant; ( ) = standard errors.

Through the observation of the parameter significance, the following initial results were found: (a) Model 1: weak instruments[9] (y_{it} *(–1),* wp_{it}, ici_{it}, $ne500_{it}$, cae_{it}, $capii_{it}$, $caal_{it}$, *and* $ipfi_{it}$) and strong instruments[10] (z_{it}*(–1) and* tre_{it}); and (b) Model 2: weak instruments (y_{it}*(–1),* wp_{it}, $ne500_{it}$, $caal_{it}$, $ipfi_{it}$, *and* tre_{it}) and no strong instruments. To these instruments, an intercept variable and a trend variable, which refers to the years from 1991 to 1998, may be added.

Then, the results for Model 1 and Model 2, using the GMM and LIML methods, were summarized in Table 4 (GMM) and Table 5 (LIML).

[9] It can be seen that the variables considered weak instruments were those which simultaneously presented no correlation with the residuals and weak correlation with the endogenous explanatory variables.

[10] The consistent instruments presented non-significance in the residuals regression and were statistically significant in the regression of the endogenous explanatory variable.

Table 4 – Results of the endogenous protection for the GMM method

Model 1: $y_{it}e_i = \frac{\tau_{it}}{1+\tau_{it}}e_i = \gamma z_{it} + \delta z_{it} + \upsilon_{it} + \mu_i$		Model 2: $y_{it}e_i = \frac{\tau_{it}}{1+\tau_{it}}e_i = \gamma\frac{z_{it}}{e_i} + \delta\frac{z_{it}}{e_i} + \upsilon_{it} + u_i$	
$\gamma z_{it} = \frac{\hat{I}^0_{it}}{a+\alpha_L} z_{it}$	0.10749** (0.0445)	$\gamma\frac{z_{it}}{e_{it}} = \frac{\hat{I}^0_{it}}{a+\alpha_L}\frac{z_{it}}{e_{it}}$	0.0186142*** (0.0094404)
$\delta z_{it} = \frac{\alpha_L}{a+\alpha_L} z_{it}$	–0.02279** (0.009163)	$\delta\frac{z_{it}}{e_{it}} = \frac{\hat{I}^0_{it}}{a+\alpha_L}\frac{z_{it}}{e_{it}}$	–0.0040473*** (0.0020437)
Constant	0.2954094*** (0.0557)	*Constant*	0.15078*** (0.01684)
Instrument Variables	*year,* $\hat{I}^0_{it}$ $z_{it}(-1)$, tre_{it}, $y_{it}(-1)$, wp_{it}, ici_{it}, $ne500_{it}$, cae_{it}, $capii_{it}$, $caal_{it}$, *and* $ipfi_{it}$	Instrument Variables	wp_{it}, $ne500_{it}$, $caal_{it}$, $ipfi_{it}$, *and* tre_{it}
Instrumented Variables	$\hat{I}^0_{it}$ z_{it} *and* z_{it}	Instrumented Variables	$\hat{I}^0_{it}$ z_{it} *and* z_{it}
n. observations	144	n. observations	144
F(2, 141)	3.09**	F(2, 141)	1.93^{NS}
SQ Residuals	11.674	SQ Residuals	0.30332
SQ Centered Residuals	9.4585	SQ Centered Residuals	0.336724
R^2 Centered	–0.2343	R^2 Centered	0.0992
Sargan's Statistics χ^2_9	26.594***	Sargan's Statistics χ^2_3	13.252***
Standard errors robust in the presence of arbitrary heteroscedasticity.		Standard errors robust in the presence of arbitrary heteroscedasticity.	

Notes: (*)10% of significance; (**)5% of significance; (***)1% of significance; (NS)non-significant. The statistics are consistent with autocorrelation. The GMM method involved the correction of the heteroscedasticity for the weight alternative that took into account the square root of the variance of *ipfi* variable.
Source: Results achieved by the author using Stata Program.

In the basic results corresponding to Table 4, GMM method indicates the significant representation to Model 1. Exceptions could be ascribed to the signal of the centered R^2. However, Stata procedures show that their negative values did not hinder the inferences about the regression parameters (Sribney, Wiggins, and Drukker, 2003)[11].

Sargan's statistics (Wooldridge, 2002, p. 123; Baum, Schaffer, and Stillman, 2003, p. 17), evidenced the overidentification of the instruments, specifying that, under the null hypothesis, the set of instruments excluded would be valid, besides the non--correlation with residuals for strong instruments. According to the test, the set of instruments are valid, even the correct size is required when they are weak or strong. The Model 2 F-test rejects the structure based on original purpose with the elasticity on second equation member.

[11] StataCorp (2005).

Structural parameters estimated, through the significance of gamma and delta parameters, which correspond to both variables (inverse import penetration and inverse import penetration by the organization of an interest group), result in the part of population represented by an interest group, $a_L = 0.21$, and the weight of the welfare function, **a** = 9.09.

Table 5 – Results of the endogenous protection for the LIML method

Model 1: $y_{it}e_i = \frac{\tau_{it}}{1+\tau_{it}}e_i = \gamma z_{it} + \delta z_{it} + \upsilon_{it} + \mu_i$		Model 2: $y_{it}e_i = \frac{\tau_{it}}{1+\tau_{it}}e_i = \gamma\frac{z_{it}}{e_i} + \delta\frac{z_{it}}{e_i} + \upsilon_{it} + u_i$	
$\gamma z_{it} = \frac{\hat{I}^0_{it}}{a+\alpha_L} z_{it}$	0.656234** (0.327027)	$\gamma z_{it} = \frac{\hat{I}^0_{it}}{a+\alpha_L} z_{it}$	0.0980684*** (0.0269773)
$\delta z_{it} = \frac{\alpha_L}{a+\alpha_L} z_{it}$	–0.12993** (0.064973)	$\delta z_{it} = \frac{\alpha_L}{a+\alpha_L} z_{it}$	-0.0190798*** (0.0051416)
Constant	0.73344** (0.29961)	*Constant*	0.2216979*** (0.0304048)
Instrumental Variables	$\hat{I}^0_{it}\ z_{it}(-1)$, tre_{it}, $y_{it}(-1)$, wp_{it}, ici_{it}, $ne500_{it}$, cae_{it}, $capii_{it}$, $caal_{it}$, z_{it}, and $ipfi_{it}$	Instrumental Variables	tre_{it}, $y_{it}(-1)$, $ne500_{it}$, $caal_{it}$, $\hat{I}^0_{it}\ z_{it}$, and $ipfi_{it}$
Instrumented Variables	z_{it}	Instrumented Variables	z_{it}
n. observations	126	n. observations	126
F(2, 123)	1.98^{NS}	F(2, 123)	6.88***
SQ Residuals	84.915	SQ Residuals	1.72536
SQ Cent. Residuals	7.7842	SQ Cent. Residuals	0.242238
R^2 Centered	–9.9087	R^2 Centered	–6.1226
H_0:_b[z_{it}]	–0.33392	H_0:_b[z_{it}]	–0.018963
Anderson-Rubin = χ^2_9	*empty****	Anderson-Rubin = χ^2_5	[–0.037, –0.012679]***
Score (LM)	(–∞,–0.133] U U [0.00098, 0.001] U U [0.6338, ∞)***	Score (LM)	[–0.03712, –0.01266] U U [0.000302, 0.000346]***
Conditional LR	(–∞,–0.133] U U [0.64, ∞)***	Conditional LR	[–0.030206,–0.01377]***
k = 1.22152; λ = 1.24784 e Fuller (#) = 3		k = 1.09094; λ = 1.09941 and Fuller (#) = 1	

Note: (*)10% of significance; (**)5% of significance; (***)1% of significance; (NS)non-significant. The statistics are consistent with autocorrelation.

Source: Results achieved by the author using Stata program version 9.

The basic results corresponding to Table 5, now for LIML method, result in the significance for Model 2, and no significance for Model 1. On the LIML method, results were more robust, since the procedure allows the inclusion of weak instruments, without causing bias in the estimated parameters (Cruz and Moreira, 2005). The basic statistics for the use of weak instruments is given by Anderson-Rubin test, Lagrange multiplier (LM) – score test, and conditional probability of CLR statistical that provides the correct sizes for parameters.

The Anderson-Rubin test, a chi-squared test with 5 degrees of freedom, with statistics consistent with autocorrelation produces an instrumented variable coefficient equal to –0.018963. For LM or score test, the results confirm the parameter for the inverse import penetration relation.

Finally, the conditional probability of CLR statistical, for a = 0.1, results in a significant parameter for delta equal to –0.018963. Combining results for both structural parameters, we achieved part of population represented by an interest group, $a_L = 0.19$, and the weight of the welfare function, **a** = 10.

In synthesis, the estimations procedures result in adequacy of Model 1 for Brazilian economy estimated by GMM method, and Model 2 by LIML method. It provides the adequacy of the model to the Brazilian economy data for the period of 1991-1998, since the parameters α_L (referring to the part of the voting population represented by an interest group), and the parameter *a* (which indicates the weight that the government attributes to the welfare function) corroborated for the endogenous protection hypotheses suggested by Calfat, Flores and Ganame (2000), related to the presence of interest groups in the formulation of the Brazilian trade policy.

5. CONCLUSIONS

The extent of empirical results linked to the proposal of endogenous protection in the trade policy was motivated in the beginning of the 90's by the series of structured works with the use of the Game Theory by Grossman and Helpman (1994). As a result, the contributions of those authors became an important paradigmatic mark of the international economy literature, as well as the empirical results achieved from the econometric works based on their parsimonious structure.

Based on a robust empirical estimation techniques, adding Armington's elasticity, time invariant, the estimation of Tobit censoring for indicator of interest group organization in industrial sectors, instrumental variables to correct the endogenous bias, present in the endogenous protection models, including GMM and LIML methods in 2SLS procedure for use of weak instruments with corrections of size tests, we conclude that political economy of Brazil's trade policy verified Grossman-Helpman

model adequacy based in the identification of structural parameters for Protection for Sale Model.

Table 6 – Comparative results with the empirical literature

Country	Period	a	α_L
Australia	1968/1969	43.41	0.96
	1991/1992	40.88	0.88
Brazil	1991-1998	9.09[2]	0.21
		10.00[3]	0.19
European Union	2001	82.61	0.73
Poland	1996-1999	8332.67	0.67
Turkey	mean (1983, 1984, 1988, 1990)	84.23	0.60
United States	1983	61.19	0.88

Source: McCalman (2004); GMM-Model 1; LIML-Model 2; Belloc and Gerrieri (2008); Hagemejer and Michalek (2008); Mitra, Thomakos, and Ulubasoglu. (2002); Goldberg and Maggi (1999).

Once Brazilian trade policy supported results to PS model, a benchmark, based on results for Australia, European Union, Poland, Turkey, and United States, give us support to international comparisons for new results from empirical literature.

For international comparisons to the results of empirical literature – see Table 6, the parameters, besides the significance of structural parameters – Brazilian economy produces an *outlier*, as well as a Poland economy. Based on Mitra, Thomakos and Ulubasoglu (2006), searching for realistic parameters, they identified the opposite relation between both PS model parameters that implies higha_L and low **a,** or lowa_L and high **a**.

The Brazilian results indicate low a_L and low **a,** and Poland results indicates a_L, following international tendency combined with an expressive **a** level, causing another *outlier*.

Although the results were significant for a parsimonious model, in comparison to the *ad hoc* structures in force in literature between the 60's and the 90's, the empirical evidence demanded a considerable econometric effort, in comparison to the *ad hoc* structures. Besides, there may be some questioning for the theoretical model and application in the Brazilian economy.

The basic question refers to the relation between the parameters α_L and **a**, which, apparently, present an inverse relation, when partial results of countless estimates are observed. To explain the *outlier* results, we suggest the inclusion of exchange rate regime in the PS model[12]. Partial derivative for the *ad valorem* tariff against nominal

[12] $p_i = p_i^* (1+\tau_i)$, $p_i^* = r_i^* E$, r_i^* = international prices in foreign currency; E = exchange rate expressing domestic currency per unit of foreign currency; p_i^* = foreign prices in terms of domestic currency.

exchange rate results in $\partial\tau/\partial E > 0$, for $p > \frac{1}{E-1}$. A higher difference between domestic and foreign prices, that includes exchange rate level causes a low a_L and low **a** for Brazilian's parameters.

As appointed by Baer, Cavalcanti, and Silva (2002), two channels are considered for exporters and importers in South America in the beginning of 90's – exchange rate volatilities chanel and lobbying channel that determinates the level of protection to domestic goods.

In this point of view, we consider the result as an *outlier* for Brazilian economy as a consequence of endogenous trade policy mixed with exchange rate policy.

This paper provided many advantages amongst other papers, mainly in empirical strategy and econometric procedure used. The quality of instruments were checked out with a rigorous procedure that determines weak and strong instruments, included Sargan's test to overidentification restrictions, the Anderson-Rubin test, Lagrange multiplier test, and conditional likelihood ratio test in the presence of weak instruments, using GMM and LIML procedure. Finally, robustness was used to autocorrelation, heteroscedasticity, or both.

In spite of the doubts concerning the streamline of the research on endogenous protection, it can be concluded that Brazilian economy has suffered influence of interest groups in the determination of the level of tariff coverage imposed by the central government, according to what can be observed during 1991-1998, based on the Grossman and Helpman (1994) model structure.

APPENDIX

One of the main difficulties for the econometric tests of this subject was the availability of statistical information, aggregated in a way to enable inferences on the subject. So, efforts were made to offer the widest set of information to establish a credible basis for the endogenous protection test applied to the Brazilian economy.

The information represented a set of sectorial disaggregated variables, at level 80 in statistics of the Brazilian Institute of Geography and Statistics (IBGE), compatible with the SIC-3 digit level. Part of the information was taken from secondary bases already mentioned, or those elaborated by the author, such as the industrial concentration index, with the need to make it compatible with the specification of level 80.

The statistics made available as follow:

- *Tariff in Relation:* $y_{it} = \tau_{it}/(1 + \tau_{it})$ – comprises the level of domestic protection for the sectors specified in Table 3. This information was originally constructed by Kume, Piani, and Bráz de Souza (2000), and made available by Muendler (2001a);

- *Inverse Import Penetration* (z_{it}) – shows the relation between imports and the domestic production. The statistics were elaborated by Ramos (1999), and Ramos and Zonenschein (2000), and made available by Muendler (2001b);
- *Armington Elasticity* (ea_i) – proxies of the true elasticities. By definition, the *Armington* elasticity reflects the degree of replacement between the domestic and imported goods. Thus, such elasticities would take into account the changes in the relative prices, attributable to tariff changes. The data was achieved from the paper of Tourinho, Kume, and Pedroso (2002);
- *Industrial Concentration Index* (ici_{it}) – based on Herfindahl-Hirschman Index (HHI), (Source: Revista Exame Maiores e Melhores – several issues). The data was available for the years of 1990, 1992, 1993, 1994, 1995, 1996, 1997, and 1998. So, the data referring to 1991 refers to the year of 1990;
- *Number of Firms* ($ne500_{it}$) – number of companies in the sector among 500 main companies. The criterion is based on the main variables and indicators selected by the Getulio Vargas Foundation (FGV) – *Source*: Revista Conjuntura Econômica – As 500 Maiores Empresas do Brasil;
- *Wage Premium*[13] (wp_{it}) – the wage premium is a variable ascribed to the workers' industrial affiliation. In other words, it depends on the sector in that the individual works. Industrial affiliation is important in the evaluation of the effects for commercial openness, or block formation, on the workers' wage in models of short and medium term, and imperfect competition. This variable was made compatible for eighteen out of the fifty sectors presented in Table 1;
- *Employment Turnover Rate* (tre_{it}) – monthly employment turnover rate. Use of data referring to December of each year. (Source: IBGE – Monthly Industrial Research – General Data);
- *Export Annual Coefficients* (cae_{it}) – comprise the division of the exported value by the domestic production value (Ribeiro and Pourchet, 2002:12) – Nota Técnica FUNCEX;
- *Liquid Openness Annual Coefficients* ($caal_{it}$) – difference between the export coefficient and the imported input coefficient (Ribeiro and Pourchet, 2002:12) – Nota Técnica FUNCEX;

[13] The data was taken from Table 4 of Pavcnik *et al.* (2004), so insignificant values were taken as zero.

- *Annual Coefficients of Imported Input Participation ($capii_{it}$)* – division of the imported inputs used in production by the domestic production value (Ribeiro and Pourchet, 2002:12) – Nota Técnica FUNCEX;
- *Real Wage per Worker (w_{it})* – real payroll per worker per kind of index, and genders of the transformation industry – Fixed Base 1985 = 100. Source: IBGE – Monthly Industrial Research – General Data;
- *Sectorial Employment (l_{it})* – statistics of this variable were taken from the Statistical Yearbook at www.midc.gov.br. With such information, the problem with the lack of data availability referring to 1991 was solved by the estimation based on the variation of the industry employment level in1992;
- *Increase in Sales (cv_{it})* – index with fixed basis 1990 = 100. The data was found in the Revista Exame – Maiores e Melhores, several issues;
- *General Liquidity (lg_{it})* – long term receivables over the liabilities. From 1995, the concept made available by the Exame Magazine was that of "Current Liquidity", which results from the relation between the "Assets" and the "Liabilities";
- *Industrial Physical Production Index ($ipfi_{it}$)* – index of the monthly physical production per index, and type of transformation industry with monthly fixed basis and annual adjustment, average of 1991 = 100. (Source: IBGE – Monthly Industrial Production – Physical Production);
- *Imports (m_{it})* – value of imports in US$ thousands. This variable was available at www.ipeadata.gov.br.

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