

Economic Loss to the Brazilian Regions Due to the Doha Round Failure

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Abstract: We build a database and model to develop general equilibrium analysis of the Brazilian economy at the level of the five macro regions. The model is multiregional at global level as also at the Brazilian level. The project is coupled to the GTAP model through disaggregation of the original Brazilian input-output matrix and trade flows and follows the GTAPinGAMS structure and syntax to generate the General Equilibrium Analysis Project for the Brazilian Economy (PAEG). The regional database is that of the GTAP version 6 and represent the 2001 world economy. We aggregate the data in seven regions plus the five Brazilian sub-regions and nineteen commodities/sectors to apply the scenario Doha Round to determine the probable losses to the Brazilian regions from the failure of the Doha round of negotiations. It is analyzed cuts in the agricultural and manufactures (NAMA proposal) import tariffs via the application of the Swiss formula, reduction in the agricultural production subsidies and elimination of agricultural export subsidies. The results show that although the regions are affected in different ways, the Doha Round failure generates losses for all Brazilian regions. The losses are greater for the Midwest and South regions, the most important for the Brazilian agricultural production.

JEL classification: F13; F15; Q17

Keywords: Brazilian regions, General equilibrium, Agribusiness, Trade liberalization.

1. Introduction

The failure of the Doha Round in Hong Kong at the end of 2008 generated frustration among the countries involved, especially in developing countries that have their main source of income from agriculture, due to the expected decrease in agricultural subsidies by 2010. The new date for the agreement is 2013. This means that the high import tariffs and subsidies for agricultural production and export are still in place.

* Sponsored by CNPq-Brazil

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Brazil stands out by virtue of agribusiness in the formation of GDP and the generation of surplus in the trade balance, which makes the results of the Doha Round failure seen as a loss to the Brazilian society. It is important to emphasize that there are different degrees of development among the agribusiness sectors in the Brazilian's regions such that some regions face higher losses than others. Accordingly, it is of great importance considering the costs of not implementing the Doha Round separately to each Brazilian region.

In the south and southeast regions of Brazil more than 50 % of the farms are smaller than 100 ha, with production systems highly diverse in terms of employment generation. In the Midwest region less than 3 % of the farms are less than 100 ha, with most production concentrated in areas larger than 1,000 ha and it is highly capital-intensive agriculture. The northern region is highly extractive and agricultural production is concentrated mainly in the transition area between the Amazon forest and the cerrado. In the Northeast there are areas of cerrado holding the bulk of production in irrigated fields while most farmers produce only for self consumption (IBGE, 2009).

The objective of this paper is to determine the probable losses to the Brazilian regions from the failure of the Doha Round of negotiation. It is investigated agricultural import tariff cuts via the “Girard draft” or Swiss formula. Import tariff cuts for manufactured goods follow Non-Agricultural Market Access (NAMA) recommendations. Agricultural production and export subsidies are treated as suggested by the World Trade Organization (WTO). To do this we built a software, a database and a model to develop a general equilibrium analysis of the Brazilian economy for the five macro Brazilian regions. This package is known as the Brazilian Economy General Equilibrium Analysis Project (PAEG).

2. The Model

PAEG is a static, multiregional and multi sector model built to analyses the Brazilian economy at regional level. It represents the production and distribution of goods and services in the world economy. Each region is represented by a final demand structure composed of public and private expenses in goods and services. The model is based on the optimizer behavior in which the consumers look to maximize their well-being subject to budgetary restriction, considering fixed the levels of investment and public production. The productive sectors combine intermediary inputs and primary factors of production to minimize costs, given the available technology. The database includes bilateral trade flows between countries and regions, as well as the costs of

transport, import tariffs and taxes (or subsidies) on exports. Table 1 describes the data sets represented in the model.

Table 1 – Data set description

Legend	Description
i, j	Sectors and goods
r, s	Countries and regions
$f \in m$	Factors of production of free mobility inside a given region: qualified work, non-qualified work and capital
$f \in s$	Fixed production factors: land and other natural resources

Figure 1 presents the general structure of the PAEG model. The presented symbols correspond to the variables of the economic model. Y_{ir} represents the production of goods i in the r region. C_r , I_r and G_r represent the private consumption, the investment and the public consumption respectively. M_{jr} represents the imports of goods j for the region r . HH_r indicates the consumer representative agent, and $GOVT_r$ represents the public sector or government. FT_{sr} represents an activity through which specific factors of production are allocated to particular sectors.

In Figure 1, the flows in the markets of factors and goods are represented by solid lines or dotted lines in an irregular form, while the payments of taxes are presented by the dotted regular line. Domestic and imported goods markets are presented in vertical lines on the right side of the figure. The domestic production (vom_{ir}) is distributed between exports ($vxmd_{irs}$), international transport services (vst_{ir}), intermediary demand ($vdfm_{ijr}$), private consumption ($vdpm_{ir}$), investment ($vdim_{ir}$) and government consumption ($vdgm_{ir}$). The accounting identity in the database, represented by the social accounting matrixes, referring to the domestic production is presented by equation 1.

$$vom_{ir} = \sum_s vxmd_{irs} + vst_{ir} + \sum_j vdfm_{ijr} + vdpm_{ir} + vdgm_{ir} + vdim_{ir} \quad (1)$$

Imported goods, additionally represented by vim_{ir} , are used in intermediary consumption ($vifm_{ijr}$), in private consumption ($vipm_{ir}$) and in government consumption ($vigm_{ir}$). Equation 2 presents the accounting identity of these flows.

$$vim_{ir} = \sum_j vifm_{ijr} + vipm_{ir} + vigm_{ir} \quad (2)$$

The inputs to the production of Y_{ir} include intermediary inputs (domestic and imported), mobile production factors (vfm_{fir} , $f \in m$) and consumption of the public agent ($vigm_{ir}$). The income from production factors services is distributed to the representative agent. The equilibrium in the factors market is given by an identity that relates the factors service payment to the income generated by them (equation 3).

$$\sum_i vfm_{fir} = evom_{fr} \quad (3)$$

The equilibrium conditions in the international markets require that the exports of goods i for region r (vxm_{ir}) are equal the imports of the same goods for all commercial partners ($vxml_{irs}$), as represented in equation 4.

$$vxm_{ir} = \sum_s vxml_{irs} \quad (4)$$

Likewise, equilibrium conditions are also applied to the international transportation services. The supply added from the transport service j , vt_j , is equated to the value of the export transport services (equation 5).

$$vt_j = \sum_r vst_{jr} \quad (5)$$

The equilibrium in the transport services market equates the supply of these services to the sum of the bilateral flows of transport services acquired through imports ($vtwr_{jisr}$), as in equation 6.

$$vt_j = \sum_r vtwr_{jisr} \quad (6)$$

The taxes revenue and transfers, indicated by the dotted line, are represented by R . The tax flows consist of indirect taxes on production and exports (R_{ir}^Y), on consumption (R_r^C), on government demand (R_r^G) and on imports (R_{ir}^M). The government income also includes direct taxes to a representative agent, represented by R_r^{HH} , as well as transfers from abroad, vb_r . The government budgetary restriction can be represented by equation 7.

$$vgm_r = \sum_i R_{ir}^Y + R_r^C + R_r^G + \sum_i R_{ir}^M + R_r^{HH} + vb_r \quad (7)$$

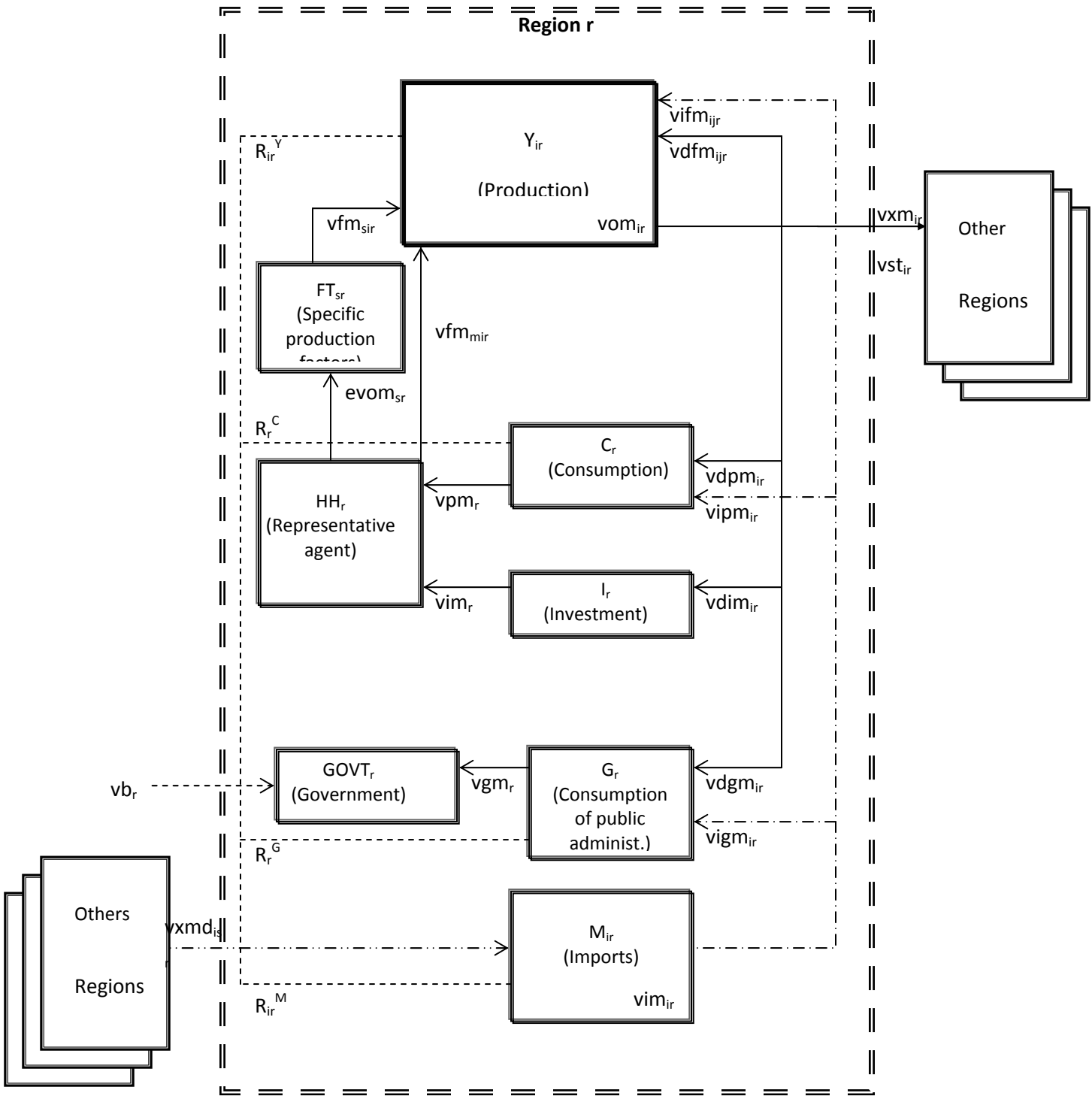


Figure 1 – Flows in PAEG's open economy

The budgetary restriction of the representative agent relates the income of the production factors when they were deducted from the tax payments to the consumption and private investment expenses, as in equation 8.

$$\sum_f evom_{fr} - R_r^{HH} = vpm_r + vim_r \quad (8)$$

From the previous equations, it is possible to visualize two condition types for the consistency of the database contained in the input-output and social accounting matrices: the market equilibrium (supply is equal to demand for all goods and production factors), and the income equilibrium (net income is equal to net expenses). A third set of identities is concerned with the operational net profits in the economic sectors. The PAEG model, like the GTAP, takes into account perfect competition and constant returns to scale in such a way that costs with intermediary inputs and primary factors are equated to the production value, and profits are equated to zero. Such condition is applied to each one of the productive sectors and activities, according to equations 9 through 15 as follows.

$$Y_{ir}: \quad \sum_f vfm_{fir} + \sum_j (vifm_{jir} + vifm_{jir}) + R_{ir}^Y = vom_{ir} \quad (9)$$

$$M_{ir}: \quad \sum_s \left(vxmd_{isr} + \sum_j vtwr_{jisr} \right) + R_{ir}^M = vim_{ir} \quad (10)$$

$$C_r: \quad \sum_i (vdpm_{ir} + vipm_{ir}) + R_{ir}^C = vpm_r \quad (11)$$

$$G_r: \quad \sum_i (vdgm_{ir} + vigm_{ir}) + R_{ir}^G = vgm_r \quad (12)$$

$$I_r: \quad \sum_i vdim_{ir} = vim_r \quad (13)$$

$$FT_{fr}: \quad evom_{fr} = \sum_i vfm_{fir} \quad f \in s \quad (14)$$

$$YT_j: \quad \sum_r vst_{jr} = vt_j = \sum_{irs} vtwr_{jirs} \quad (15)$$

The GTAP database version 6.0 (GTAP 6) has data for 89 regions of the world, including Brazil, and 59 commodities/sectors. A complete discussion on GTAP 6 database can be seen in McDougall (2005). Generally, regions and commodities are aggregated in small sets due to computational problems related to the task dimension. In the case of the PAEG, Brazil is substituted by 5 Brazilian regions.

The relationships previously presented show the economical identities of the model. Nevertheless, they do not describe the behavior of the economical agents, whose complete description is in Rutherford (2005).

The closure of the model takes into consideration that the total supply from each production factor doesn't change, but such factors are mobile across sectors inside a region. The land factor is specific to the farming sectors while natural resources are specific to mining and energy sectors. There is no unemployment in the model; this makes the factor prices flexible. On the side of the demand, capital flows and investments are maintained fixed, as well as the balance of payment. This way changes in the real exchange rate should occur to accommodate changes in the flows of exports and imports after the shocks. Government consumption can be altered by changes in the prices of goods, just as the income resulting from taxes is subject to changes in the level of activity and consumption.

The model uses the syntax from the algorithm Modeling Programming System for General Equilibrium (MPSGE) developed by Rutherford (1999). The MPSGE represents a general equilibrium model through blocks of production functions, demand equations and specific restrictions. As soon as the blocks of the model are described, MPSGE transforms the information into algebraic equations that are processed in the GAMS software. The produced equations characterize conditions of zero profit, equilibrium between supply and demand in the markets and the definition of the income for the consumers in the form of a mixed complementary problem (MCP) (Rutherford, 1995).

2.1. Reconciling the Brazilian regional data matrix and the GTAP database.

In order to represent the five Brazilian regions in the model, it is necessary to substitute the Brazilian input-output table in GTAP6 for matrices developed for the Brazilian regions. The construction of regional Brazilian input-output matrices was based on Parré (2000).

The GTAP data as well as the regional Brazilian data are aggregated into regions and sectors. The Brazilian regional data matrices are calibrated in such a way that the Brazilian GDP, formed by the sum of the GDPs from the regional matrices, is compatible in magnitude to the Brazilian GDP on the GTAP database. The GTAP data on Brazilian imports are then distributed between the regions, using the regional Brazilian data matrix to define the relative participation of the imports of each region in total Brazilian imports. The same procedure is used to regionally distribute the Brazilian exports on the GTAP database. From these procedures, the exports and imports data at the regional Brazilian matrix are substituted by the GTAP trade data flow. This guarantees the consistency of the trade relations between the Brazilian regions and the remaining regions and countries in the GTAP database. The supply and demand accounts in the Brazilian

regional matrix lose equilibrium once its original export and import data were substituted by the GTAP data. To recompose the equilibrium, the values of the investments in the Brazilian regions were adjusted, as well as the capital flows. Since the general equilibrium model closure maintains these aggregates fixed, the adjustments in those values to balance the regional supply and demand and the balance of payment does not interfere in the simulation results. This process of adjustment also avoids the drawback of having to change the input-output coefficients of the imbalanced sectors.

After these adjustments are made the elasticity parameters contained in the database of the GTAP for Brazil are attributed to the Brazilian regions. Therefore, the Brazilian data matrix is removed from the GTAP database, leaving only the adjusted regional Brazilian matrix data and the remaining regions of the GTAP.

2.2. The data aggregation used in the PAEG.

The aggregation used in this paper is composed of 19 sectors and 12 regions (Table 2), which mainly highlights the agribusiness sectors, due to the importance of agribusiness in income generation and in the export list of Brazil. The sector aggregation assumes: rice (pdr), corn and other grains (gro), sugar-cane, sugar-beet and sugar industry (sgr), meats and live animals (oap), dairy and derivatives (rmk), other farming goods (agr) and food goods (foo). Also some manufactured goods are separated in Textile Industry (tex), Clothing and Shoes (wap), Paper goods, publishing (ppp), Chemical, rubber, plastic goods (crp) and the remainder of the manufactured goods in a single sector (man). Last of all, the services sector is separated into Industrial Services of Public Usefulness (siu), Construction (cns), Commerce (trd), Transport (otn) and public services and administration (ser).

Besides the 5 Brazilian regions, the aggregation considers Argentina and Uruguay¹ together as the MERCOSUR countries (MER), while the rest of the Latin American countries are joined in a single region called Rest of America (ROA). Due to its importance in the international scene, the USA will be treated as a single region outside of the rest of NAFTA (NAF)². Regarding the European Union, the 15 member-countries³ (EUR) will be considered, since in this study the economical environment of 2001 is considered, thus, before the reform that incorporated 10 new

¹ Paraguay will not be analyzed separately, for not being separated in the GTAP 6 database; it is in Rest of America.

² This will be composed of Canada and Mexico.

³ They are: Germany, Austria, Belgium, Denmark, Spain, Finland, France, Greece, Holland, Ireland, Italy, Luxembourg, Portugal, United Kingdom and Sweden.

members into the EU in May of 2004. China is also treated as a separated country in this study (CHN). The remaining countries contained in the GTAP database are combined in the Rest of the World (ROW). A chart reconciling the GTAP sectors with the PAEG database is shown in annex (Table A1).

Table 2 – Data aggregation

Regions	Sectors*
1 - Northern Brazil region (NOR)	1 - Rice (pdr)
2 - Northeast Brazil region (NDE)	2 - Corn and other grains (gro)
3 – Mid-West Brazil region (COE)	3 - Soy and s. oleaginous (osd)
4 - Southeast Brazil region (SDE)	4 - Sugar-cane, sugar-beet., sugar industry (c_b)
5 - South Brazil region (SUL)	5 - Meats and live animals (oap)
6 - Rest of the Mercosur (MER)	6 - Dairy and raw milk (rmk)
7 - United States (USA)	7- Other farming goods: wheat, fibers, fruits, vegetables (agr)
8 – Rest of NAFTA (NAF)	8 - Food goods: Other food goods, drinks and tobacco (foo)
9 - Rest of America (ROA)	9 - Textile Industry (tex)
10 - European Union 15 (EUR)	10 - Clothing and Shoes (wap)
11 - China (CHN)	11 - Wood goods (lum)
12 - Rest of the World (ROW)	12 - Paper goods, publishing (ppp)
	13 - Chemical, rubber, plastic goods (crp)
	14 - Manufactured: Non Metal Minerals, mechanical-metal, mining, diverse industries (man)
	15 - Useful Public Industrial services (siu)
	16 - Construction (cns)
	17 - Trade (trd)
	18 - Transport (otp)
	19 - Services and public administration (ser)

Note: * The nomenclature presented in parentheses will be used to make the presentation of the data easy.

Source: Prepared by the authors.

2.3. Brazilian regional outlook

Table 3 presents the production, exports and imports values for the five Brazilian regions in the benchmark. Figure 2 shows the political map of Brazil divided by regions.

The Northern Region (NOR) is the largest region in Brazil, with 42 % of the national territory. Also it is the region where most of the Amazon Forest is contained. However, it presents the smallest demographic density of all regions⁴. It excels in the production of other farming goods (agr), in particular Amazonian fruits such as açaí, guarana and cupuaçu, and extractives vegetable goods; and foods (foo). Also it excels in the rubber, chemistry, pharmaceutical and plastic industries (crp); wood and furniture (lum); and manufactured goods (man) produced in the Free-trade area of Manaus, which is the most important industrial center of the region. In this region, the services and public administration sector (ser) represented nearly 26% of the gross output value in 2001.

Regarding the production value in the Northeast Region (NDE) in the agribusiness sectors, it excels in the production of other farming goods (agr), especially in the production of cocoa and fruits; and food goods (foo). Also, it stands out in the textiles (tex); clothing and shoes (wap); and chemistry, pharmaceutical and plastics (crp) sectors. Services and public administration sector (ser) corresponds to 32 % of the gross production value in the NDE.

The Midwest Region of Brazil (CEO) stands out mainly in farming production, especially meat production (oap); soy (osd); food goods (foo) and other farming goods (agr). This region is located predominantly in the cerrado area with large scale production and high capital-intensive technology. On the other hand, it is the least populous region of the country and has the second smallest population density, losing only to the Northern Region.

The Southeast region of Brazil (SDE) concentrates more than half of the Brazilian production, approximately 54 % of the production value in 2001, and is located in the states of Sao Paulo, Minas Gerais, Espirito Santo, and Rio de Janeiro, which are the main Brazilian states in GDP formation. In agribusiness, this region emphasizes the production of food (foo), especially coffee production; other farming goods (agr), especially orange juice production; meats (oap); dairy and raw milk (rmk) ; and corn and other grains (gro). The main industries of Brazil are in this region and it contains the majority of the population.

⁴ Demographic density of Brazil is 21.64 inhabitants / km² compared to 3.31 inhabitants/km² in the Northern region (IBGE, 2009).

Table 3 – Production, exports, and imports value in the Brazilian regions in 2001 (US\$ million).

Regions	Setores*																		
	pdr	gro	osd	c_b	oap	rmk	agr	foo	tex	wap	lum	ppp	crp	man	siu	cns	trd	otp	ser
Production Value (US\$ million)																			
NOR	27.73	132.80	35.26	57.86	555.70	60.85	2,632.15	1,425.78	918.49	146.77	1,425.52	973.67	1,923.25	8,609.22	1,605.28	8,417.02	2,666.67	671.49	11,139.99
NDE	344.76	615.08	896.52	2,869.67	1,882.98	189.33	3,546.88	6,328.60	1,864.25	1,227.68	561.50	501.57	10,739.51	6,642.82	3,840.66	19,175.04	10,522.91	2,960.38	35,240.01
COE	627.99	255.66	3,414.19	347.07	4,806.66	306.07	2,168.25	3,632.58	722.15	560.88	597.55	675.22	3,049.71	2,108.04	1,500.65	10,881.74	4,246.17	1,623.68	31,196.88
SDE	669.84	1,242.98	1,904.61	1,427.27	4,189.85	1,490.58	12,905.24	31,918.49	7,684.78	4,818.08	3,308.84	10,598.99	50,670.36	119,742.83	15,910.49	21,016.28	32,000.22	21,886.71	174,051.52
SUL	1,373.46	1,618.50	4,191.59	1,283.51	4,958.26	873.22	10,050.14	22,253.15	8,248.31	13,908.78	5,208.60	3,557.73	8,369.19	21,372.03	9,330.28	16,215.73	14,822.19	8,649.44	55,398.25
Export Value (US\$ million)																			
NOR	11.39	80.31	23.15	34.41	314.83	26.04	1,411.26	269.67	26.18	41.61	1,090.65	690.05	343.15	5,448.30	0.30	0.79	728.20	145.89	161.12
NDE	38.65	254.40	478.60	1,037.27	566.33	15.46	776.16	1,238.90	836.82	284.82	30.42	16.65	3,721.99	1,973.72	0.07	0.00	3,763.59	249.14	1,875.03
COE	316.74	83.40	2,240.69	168.78	2,815.24	148.84	1,251.83	1,072.45	103.12	136.69	126.61	153.57	466.62	723.17	236.95	385.31	567.20	212.92	3,282.15
SDE	24.24	234.56	474.92	217.96	767.21	76.18	1,756.79	4,718.08	1,759.18	1,464.71	703.52	2,209.76	11,905.06	40,204.84	291.81	1,485.11	984.37	1,287.54	15,635.44
SUL	439.44	593.92	2,111.17	718.87	2,242.21	179.11	3,413.30	9,467.24	1,848.70	9,703.71	2,499.00	681.96	1,381.73	7,426.01	1,106.42	991.69	1,862.60	1,579.99	16,854.65
Import Value (US\$ million)																			
NOR	7.07	9.10	12.05	9.34	30.13	9.00	197.09	767.67	288.33	606.74	169.56	168.13	1,302.32	6,324.03	503.84	15.64	180.07	227.26	2,176.59
NDE	59.79	51.73	107.40	43.96	204.28	50.69	629.67	2,742.46	899.89	1,446.91	374.20	263.57	4,333.66	6,327.31	236.50	31.67	467.29	644.16	2,010.17
COE	51.58	29.93	124.77	33.64	145.14	36.96	379.78	575.32	435.16	377.30	280.63	425.17	2,631.32	4,795.98	105.25	15.63	562.59	288.35	2,481.92
SDE	770.42	430.00	1,761.40	534.69	3,169.76	422.10	4,710.53	8,401.44	1,695.81	6,506.00	1,383.75	814.09	10,849.66	37,182.70	2,151.54	932.28	5,473.61	3,293.19	17,355.49
SUL	97.97	93.04	168.23	89.48	253.53	102.40	1,335.88	1,315.11	1,574.41	442.75	213.39	684.58	7,039.29	14,512.27	590.69	1,866.62	1,717.03	1,029.76	16,498.38

* The sectors are: rice (pdr); corn and other grains (gro); sugar-cane and sugar industry (c_b); meats (oap); dairy and raw milk (rmk); other agriculture goods (agr); other processed foods (foo); textiles (tex); clothing and shoes (wap); wood and furnishings (lum); paper goods, publishing (ppp); Chemical, rubber, plastic prods (crp); manufactured (man); Industrial Services of Public Usefulness (siu); civil construction (cns); trade (trd); transport (otp); services and public administration (ser).

Source: Research Data.



Figure 2 – Political Map of Brazil divided by region.

The South region, in spite of being the smallest Brazilian region (6.75 % of the territory), it is the main agribusiness production region and the second largest producer in terms of the gross production value in 2001. Because of its different climate from the other regions, predominantly subtropical, other cultures that need a more temperate climate can be cultivated, as is the case of wheat, among other farming goods (agr) and rice (pdr), and it mainly excels in the production of meats (oap), soy (osd), food goods (foo), and corn and grains (gro); it also excels in the clothing and shoes (wap), and textile (tex) industries.

Regarding the benchmark trade flows for the Northern region (NOR), the exports of other farming goods (agr) stand out, in particular Amazonian fruits. Furthermore, the wood and furniture (lum) exports and especially manufactured goods (man) with a main destination for other South American countries also are notable. The imports of the rubber, chemistry, pharmacist and plastics (crp), food sector (foo), and the manufactured goods sector (man), which receives imported raw material to be put together in the Free-trade zone factories is also important.

In the Northeast (NDE), the exports of food (foo); and sugar cane, sugar industry (sgr); and the imports of the chemical industry (crp), food goods (foo) and manufactured goods (man) are relevant. The Midwest (COE) excels in the exportation of meats (oap), soy (osd), food goods (foo) and other farming goods (agr). The main imports are from the chemical industry (crp), once the

greater part of the fertilizers and agricultural chemicals used in production are imported. It also imports large amount of manufactured goods (man).

Regarding the trade flow of the southeast region (SDE), the most important exports are from the manufactured sectors (man), especially minerals, iron and steel, and vehicles; the rubber, chemistry, pharmacist and plastics (crp), cellulose and paper (ppp), food goods (foo) and other farming goods (agr). Regarding the imports: rice (pdr), corn (gro), and soy (osd) are considerable. It also excels in the importation of food goods (foo) and other farming goods (agr).

The exports of the agribusiness goods from the South region are mainly: meats (oap), soy (osd), other farming goods (agr), food goods (foo), corn (gro) and rice (pdr). The Clothing and Shoes (wap) and textile (tex) exports also excel. The main imports are manufactured goods (man) and from the rubber, chemistry, pharmacist and plastics (crp) industry. That happens because, like the COE Region, a large part of the fertilizers and agricultural chemical used in production are imported.

3. Scenarios

3.1 WTO proposal for agricultural production subsidies and export subsidies

The results from the Uruguay Round frustrated the expectations of most of the involved countries. For this reason, the WTO proposed the Doha Round to specifically address this issue through a more detailed examination of the agriculture production subsidies. To facilitate this examination, agriculture production subsidies were subdivided into the following five categories: green box, S&D box, red box, amber box, and blue box.

Provided that they comply with all relevant criteria, green box production subsidies are not prohibited and therefore unlimited. This green box encompasses resources destined for government programs directed toward research and extension, infrastructure, control of plagues and diseases, and emergency support will be agricultural producers. According to the WTO (2007), this type of subsidy is justified due to the intrinsic characteristics of agricultural activities, such as the exposure to environmental risks that generally provoke great harvest losses. These subsidies are considered non-distorting with regard to international trade.

The S&D box encompasses production subsidies provided by governmental programs directed toward agricultural development and are also not prohibited. These subsidies are intended to give special assistance to agricultural activities in developing countries.

The production subsidies included in the red box are prohibited due to their strong capacity to distort commercial flow between countries.

The production subsidies included in the blue and amber boxes distort international trade and must be reduced. Blue box subsidies are those that are not in accord with multilateral agreements. According to the WTO (2005), this type of subsidy is present in Japan and countries belonging to the European Union (EUR), such as Slovenia, Iceland, Slovakia, and Norway, which have until 2010 to eliminate them. Some countries insist that blue box subsidies are an important tool for supporting and reforming local agriculture and argue that they must be kept. Amber box subsidies are those designed to maintain a particular market price, i.e., policies to achieve a particular price level and include direct payments to farmers. Subsidies in the amber box that total less than 5 % of the production value are exempt from the WTO mandated cuts.

The WTO presented a proposal for the reduction of global agricultural subsidies that divided world economies into three groups, determined by the total amount of subsidies provided (Table 4). The subsidy reductions listed are the minimum proposed by the WTO for each group.

The United States of America (USA) fall into Group 2, the EU falls into Group 3, and other countries providing agricultural subsidies fall into in Group 1.

Currently, Doha Round negotiations have put forward a ban on export subsidies.

Table 4 - Proposal by the WTO for the reduction of the global agricultural subsidy expenditure

<i>Group</i>	<i>Expenditure in US\$ billion</i>	<i>Reduction</i>
1	0 - 10	31 %
2	10 - 60	53 %
3	> 60	70 %

Source: WTO (2005)

3.2 Proposal for the border tariffs reduction

The Girard method or the Swiss approach, used in this paper, has been suggested as a reasonable approach to tariff reduction. This method applies the Swiss formula and would result in steeper reductions in higher tariffs than in lower tariffs. The formula was put forward by the Chairman of the WTO Non-Agricultural Market Negotiating Group, Pierre-Louis Girard in an attempt to set targets for negotiation. According to the formula, all non-agricultural tariffs are to be reduced on a line-by-line basis using the following formula:

$$T_1 = \frac{t_a T_o}{t_a + T_o}, \quad (16)$$

where, t_1 is the final rate, to be bound in *ad valorem* terms, t_a is the national average of the bound rates within each band, and T_o is the initial rate. Table 5 contains stipulated WTO tariff reduction limits, clearly stating permitted divergence. The advantage this methodology has is that it harmonizes proposed reductions within each tariff grouping.

Table 5 - Proposal by the WTO for the agriculture tariff reduction (Girard or Swiss approach).

<i>Group</i>	<i>Current Tariffs</i>	<i>Reduction</i>
1	0 % – 20/30 %	20 %-65 %
2	20/30 % – 40/60 %	30 % - 75 %
3	40/60 % - 60/90 %	35 % - 85 %
4	> 60/90 %	42 % - 90 %

Source: WTO (2005)

To reflect Non-Agricultural Market Access (NAMA) negotiations, tariff reductions are shown in Table 6. It is hoped that by reducing both agricultural and non-agricultural tariffs, potential negotiating friction between developing and developed countries will be diminished.

Table 6 – Proposal for the tariff reduction of manufactured goods

<i>Group</i>	<i>Current Tariff</i>	<i>Reduction</i>
1	0 %-20 %	42.5 %
2	20 %-40 %	52. %
3	40 %-60 %	60 %
4	> 60 %	66 %

Source: WTO (2005)

4. Results

4.1. Global results from the Implementation of the Doha Round

The first results presented in Table 7 refer to the welfare gains and growth in the Gross Domestic Product (GDP) originating from the implementation of the Doha Round. The measure of welfare adopted is given in terms of equivalent variation (EV) which is obtained through the

product of initial expenditure, before the simulations, by the percentage variation in *per capita* utility. This indicator takes into consideration the size of the economies.

Table 7 – Change in the welfare and GDP growth

Regions*	Change in EV		Δ % GDP
	Δ US\$ billion	Δ %	
NOR	0.0509	0.32	0.16
NDE	0.2006	0.5	0.12
COE	0.3448	1.56	0.15
SDE	1.0465	0.54	0.23
SUL	0.7226	1.16	0.26
RMS	1.3091	0.62	0.16
USA	7.8951	0.11	0.04
RNF	3.1929	0.35	0.11
ROA	3.6382	1.09	0.18
EUR	15.2778	0.31	0.11
CHN	19.3617	3.91	0.62
ROW	55.6723	1.06	0.23

* NOR stands for the Brazilian North region; NDE, for the Northeast; COE, for the Midwest; SDE, for the Southeast; and SUL, for the Brazilian South region; RMS, for the rest of Mercosur; USA, for the U.S.; RNF, for the rest of NAFTA; ROA, for the rest of the Americas; EUR, for the E.U 15; CHN, for China; and ROW, for the rest of the world.

Source: Research data.

The implementation of the Doha Round, taking into account the simulation of the proposed scenario, would produce welfare gains to all regions. China is a single country with the highest welfare gains of US\$ 19.36 billion or an increase of 3.91 % relative to the benchmark. All the Brazilian regions would present welfare gains, with a distinction for the Southeast region (SDE) with a benefit of US\$ 1.04 billion and welfare growth rate of 0.54 % relative to the benchmark. The Midwest region (COE) has a welfare gain of US\$ 0.34 billion and the highest rate of welfare growth, 1.56 % relative to the benchmark.

The GDP changes follow the welfare ones, however the percentage variations are much lower. China (CHN) gets the largest GDP growth rate of 0.62 % followed by the South region of Brazil (SUL) with a growth rate of 0.26 %. These results can be viewed as the loss to the regions due to the Doha Round failure. In times of international economic crisis, in which a decrease in the world-wide demand is expected to be around 9 % (Gamberoni and Newfarmer , 2009), the results of the Doha Round would contribute to the recovery of global demand growth.

4.2. Regional impacts in production from the Doha Round of negotiation

Table 8 shows the main results in terms of changes in the production value if the Doha Round were to be implemented. As such, the results of this section can be interpreted as losses that would occur (in the case of positive variations) if the Doha Round was not implemented.

The results for the Northern region (NOR) show an expressive growth in agribusiness sectors with a distinction for growth in the production of meats (oap) (31.14 %), and dairy and raw milk (rmk) (12.25 %). The wood and furniture production (lum) would also have expressive growth. Those are the main sectors to lose the opportunity to grow due to the Doha Round failure. On the other hand, the manufactured sector (man), which is an important sector for the region, would have a reduction in production value by -6.39 %⁵ with the Doha round.

Table 8 – Percentage changes in production value - Doha Round scenario (%)

	NOR	NDE	COE	SDE	SUL
pdr	6.68	1.51	-2.18	2.48	0.83
gro	16.93	14.76	10.43	8.11	9.57
osd	10.67	5.01	-1.55	3.70	2.89
c_b	4.79	-0.47	-2.55	-0.03	-0.49
oap	31.14	21.22	14.25	14.63	17.43
rmk	12.25	1.77	0.91	2.64	3.36
agr	5.65	0.43	-1.92	1.37	0.28
foo	2.32	1.25	0.28	0.71	0.65
tex	0.05	-6.43	-4.96	-2.38	-5.01
wap	-0.29	-1.99	-4.46	-1.44	-2.67
lum	5.76	-0.63	-2.07	0.69	-0.91
ppp	3.97	-1.88	-3.35	-0.53	-1.31
crp	0.57	-4.29	-4.29	-1.35	-1.87
man	-6.39	-5.90	-9.36	0.56	-2.64
siu	0.60	-1.07	-1.98	0.23	-0.40
cns	-0.01	-0.01	-0.25	0.14	-0.13
trd	1.18	0.01	-0.77	0.29	-0.05
otp	1.75	0.19	-0.73	0.65	0.20
ser	-0.59	-0.36	-0.64	-0.53	-0.68

Source: Research results.

In the Northeast region (NDE) an expressive growth of agribusiness sectors can be noticed, with a distinction in the sectors of meats (aop), corn (gro) and soy (osd), with a small reduction of

⁵ The study does not allow saying what the effect of the increase in production of the agribusiness sectors on the deforestation in the Northern region will be. More details on the subject can be seen in Ferraz (2001).

the planted sugar-cane (sgr) area. On the other hand, all the northeastern sectors of manufactured goods would present losses, caused by the increase in competition with foreign manufactured goods.

In the Midwest region (COE) the strong increase in production in the sectors of meats (oap) and corn (gro) causes a reduction in the available area for the rice (pdr), soy (osd) and sugar-cane (sgr) cultures that present small decreases. However, the increase in production value considerably surpasses the losses in the agribusiness value of production. As in the NDE, all the manufactured goods sectors are negatively affected, with a 9.36 % reduction in the output of manufactured goods (man), which suggests such sectors are relatively less efficient⁶ in the COE region.

The Southeast (SDE) and South (SUL) regions present very similar results with growth in agribusiness especially in the sectors of meats (aop), corn (gro) and dairy and raw milk (rmk). This could imply a decrease in the planted area of sugar-cane (sgr). The manufactured goods sectors in general present small decreases (sectors tex, wap, ppp, crp). However, while the manufactured goods sector (man) in the SUL presents a decrease, the SDE present a small growth. Since a large part of the production value is concentrated in the SDE, this result becomes important to this research, which means that the industrial complex of the Southeast region is able to face the external competition.

4.3. Regional impacts in trade flows with the Doha Round.

Table 9 shows the percentage changes in trade flows of the Brazilian regions with the introduction of the Doha Round. Contrary to the small GDP growth rate, significant changes in the trade flows can be observed, which mainly happen due to a decrease in the reduction in trade barriers.

The increase in the production of the agribusiness sectors in the Northern region (NOR) would be followed by a strong increase in its exports and a decreases in its imports. The increase in the exports would be greater in the sectors of meats (oap), corn (gro) and milk (rmk). Increase in the wood and furnishings (lum) exports would also occur (7.37%). The exports from the manufactured goods (man) sector would decrease considerably. This indicates that some implementation of policies to increase competitiveness should be adopted before implementing the Doha Round.

⁶ If we consider the competitiveness as a structural characteristic, conceptualizing it as the capacity of a country producing determined goods equaling or surpassing the observable levels of efficiency in other economies.

Similar to the Northern Region (NOR), expressive increase in the exports of the agribusiness goods and decreases in the imports were observed in the Northeast (NDE). The highest increase is in the sectors of meats (oap), corn (gro) and milks (rmk). Following the decrease in production, all sectors of manufactured goods would experience decreases in the exports under the Doha Round.

Table 9 – Variation in trade flows resulting from the implementation of the Doha Round (%).

	Variation in the value of exports (%)					Variation in the value of imports (%)				
	NOR	NDE	COE	SDE	SUL	NOR	NDE	COE	SDE	SUL
pdr	11.99	3.60	-4.93	3.18	1.69	-3.32	-0.50	6.22	-0.56	1.90
gro	22.38	34.14	13.85	35.94	19.52	1.31	0.40	3.39	0.68	2.43
osd	13.89	8.24	-2.16	8.54	5.23	-1.71	-0.04	5.06	-0.17	2.71
c_b	6.81	-1.05	-5.76	0.15	-1.06	-1.88	-1.34	2.38	0.18	0.84
oap	49.11	68.05	21.70	71.68	37.82	-1.63	-0.43	4.68	-0.17	2.16
rmk	20.04	18.05	-1.40	17.79	5.77	-4.05	-2.53	1.01	-2.59	-1.71
agr	8.67	3.64	-3.44	5.17	0.34	-1.29	0.26	2.98	0.12	2.52
foo	5.27	4.26	-3.05	3.97	0.95	-0.67	0.22	2.83	-0.17	1.24
tex	8.39	-9.32	-12.67	-3.75	-6.95	0.71	-0.06	2.01	1.62	2.13
wap	-6.03	-8.27	-16.51	-6.08	-2.97	-0.81	0.56	4.32	-0.26	20.48
lum	7.37	-5.51	-5.31	2.41	-0.84	-3.13	0.47	2.72	-0.24	9.95
ppp	5.50	-3.28	-5.89	1.10	-0.23	-0.45	0.29	1.25	7.91	2.74
crp	1.97	-6.14	-7.85	-0.30	-2.23	1.86	0.97	2.14	6.18	1.08
man	-7.81	-7.18	-14.93	6.42	1.26	-0.04	1.33	0.84	7.09	2.85
siu	6.25	0.45	-8.07	0.01	-1.38	-1.71	-1.37	3.12	-1.42	0.17
cns	6.48	0.00	-5.58	1.77	-0.73	-2.31	0.20	2.40	-0.81	0.24
trd	3.71	0.47	-5.41	2.06	-0.99	-0.77	-0.63	2.63	-0.66	0.69
otp	4.70	0.88	-4.46	2.72	-0.37	-1.48	0.13	2.15	-0.72	0.40
ser	4.16	0.44	-5.06	1.76	-0.47	-1.25	-0.22	2.82	-0.71	0.71

Source: Research results.

In the Midwest (COE) a strong increase in the exports of meats (oap) and corn (gro) by 21.7% and 13.9% respectively, would be observed. All the other sectors would present decreases in exports, with a distinction for decreases in the manufactured goods (man), which indicates that there would be specialization in favor of the meats and corn sectors in this region. The increase in imports of all sectors in this region would still be noticeable.

In the Southeast (SDE), as well as in the regions previously presented, a strong growth in the sectors of meats (oap) and corn (gro) would be observed. However, it should be added the expressive increase in the exports of dairy and raw milk (rmk), soy (osd), other farming goods (agr) and other foods (foo), which are important sectors in this region. The exports of manufactured

goods (man) increase by 6.4 %. Summed up, the non-implementation of the Doha Round prevents the trade flow in the Southeast from growing considerably.

In the South Region (SUL), similar to other regions, a strong increase in the exports of meats (oap) and corn (gro), and also in the rest of the agribusiness sectors were observed; except for the sugar-cane (sgr). The exports decrease for all manufactured products except for the manufactured goods (man) which increases its exports. On the other hand, increases in the imports of all sectors for this region are expected, except in dairy and milk (rmk) which present a decrease. In general a specialization is observed in the South Region on behalf of the agribusiness goods in this region.

5 - Final considerations

The main objective of this study is to identify the losses in the Brazilian regions resulting from the failure of the Doha Round. To reach this goal, it is developed an applied general equilibrium model, a software to run the model for simulated scenarios, and a database putting together Brazilian regional data and the GTAP database. This package is known as General Equilibrium Analysis Project of the Brazilian Economy (PAEG).

The results suggest modest gains in GDP and in welfare for all regions. On the other hand, the Brazilian trade flow increases considerably with the implementation of the Doha Round.

The Brazilian regions with larger economic growth are the South and the Southeast. These are the regions that would lose more in absolute terms with the failure of the Doha Round. The Midwest is the Brazilian region that present the highest increase in welfare, thus it would be the area that would lose the most with the failure of the Round.

The agribusiness sectors register strong production increase in the Brazilian regions. This is especially true for the sectors of meats, corn, dairy and soy. The failure of the Doha Round must be seen as a lost opportunity to expand production in the agribusiness sectors.

The manufactured activities such as chemicals, textiles, shoes, wood and furniture, and paper present, in general, small negative production changes reflecting the lack of competitiveness of those sectors in the main regions. However, there is a small production increase in the manufactured sector (man) in the Southeast region. We can see that the improvement of the internal business environment and domestic conditions of production are basic factors to the encouragement of Brazilian competitiveness. So, policies that would reduce indirect taxation and

increase investment in infrastructure are basic for the competitiveness improvement in the Brazilian economy.

Due to trade liberalization, some Brazilian regions can specialize in the production of determined goods. This would happen visibly in the South and Midwest regions in favor of the agribusiness activities. In general, exports in the agribusiness sectors will grow rapidly, while the manufactured sectors exports will decrease in lesser intensity. Thus, policy makers should get ready to face this new reality after the implementation of the Doha Round of negotiations.

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Appendix

Table A1 - Compatibility among the sectors of the PAEG and GTAP

Sectors PAEG	Sectors of the GTAP
Rice (pdr)	pdr "Paddy rice", pdr "Processed rice"
Corn (gro)	gro " Cereal grains nec ",
Soy (osd)	osd " Oil seeds " vol " Vegetable oils and fats "
Sugar cane (sgr)	c_b "Sugar cane, sugar beet" sgr "Sugar"
Meats (aop)	ctl " Cattle, sheep, goats, horses " oap "Animal products nec" cmt " Meat: cattle, sheep, goats, horse " omt "Meat products nec"
Dairy and deivates (rmk)	rmk "Raw milk" mil " Dairy products "
Other farming goods (agr)	wht " Wheat " v_f " Vegetables, fruit, nuts " pfb " Plant-based fibers " ocr " Crops nec " wol " Wool, silk-worm cocoons "
Food Products (foo)	ofd " Food products nec " b_t " Beverages and tobacco products "
Textile Industry (tex)	tex " Textiles "
Clothing and Shoes (wap)	wap " Wearing apparel " lea " Leather products "
Wood and Furniture (lum)	lum " Wood products "
Pulp, Paper and publishing. (ppp)	ppp " Paper products, publishing "
Rubber, chemistry, pharmaceutical and plastics Ind (crp)	crp " Chemical, rubber, plastic prods "

Table A1 - Compatibility among the sectors of the PAEG and GTAP (cont.)

Sectors PAEG	Sectors of the GTAP
Manufactured goods (man)	frs " Forestry " fsh " Fishing " coa" Coal " oil " Oil " gas " Gas " p_c " Petroleum, coal products " nmm " Mineral products nec " i_s " Ferrous metals " nfm " Metals nec " fmp " Metal products " mvh " Motor vehicles and parts " otn " Transport equipment nec " link " Electronic equipment " ome " Machinery and equipment nec " omf " Manufacture nec " omn " Minerals nec "
Siup (siu)	ely " Electricity " gdt " Gas manufactures, distribution" wtr " Water "
Civil construction (cns)	cns " Construction "
Commerce (trd)	trd " Trade "
Transports (otp)	otp " Transport nec " wtp " Sea transport " atp " Air transport "
Services (ser)	cmn " Communication " ofi " Financial services nec " isr " Insurance " obs " Business services nec " ros " Recreation and other services " osg " PubAdmin/Defence/Health/Educat " dwe " Dwellings "