

The Effects of an Openness to Trade for Brazilian Cattle Meat¹

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Abstract: This study aims to evaluate the effects of an incentive to the production of cattle meat for the expansion of its exports and market gain in relation to the main competitors. Thus, a scenario of incentive to the sector has been simulated; which comprises a total elimination of production tariffs. For this purpose, we used the database and model from Global Trade Analysis Project (GTAP) - version 9, calibrated to the year 2011. The main results show that the Brazilian cattle meat sector benefits from government incentives, obtaining greater insertion in the international market, mainly in the countries established by NPE, which generates economic growth and welfare gains. In addition, the incentives also have negative effects on the other Brazilian food sectors.

Keywords: Agriculture; Cattle Meat trade; Computable general equilibrium.

JEL Classification: Q17, F10, C68

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1. Introduction

The Brazilian government launched in 2015 the “*National Plan for Exports (NPE) 2015–2018*” that focused on the strengthening of the Brazilian insertion in international trade. The NPE 2015-2018 integrates a national commercial policy that aims to increase the diversification, the aggregation of value and the technological intensification of the Brazilian exports. The plan, according to the Ministry of Development, Industry and Foreign Trade (MDIC), incorporates the idea that international trade is a strategic element to increase the competitiveness and economic growth of the country (Brazil, 2015).

It is important to emphasize that promotion of export is related to productivity and scale gains; incentives for the labor innovation and qualification; and strengthening on the competition basis. Therefore, it is also related to the capacity to generate positive externalities for the whole economy and it constitutes a strategic activity to increase the competitiveness and insertion of Brazilian companies in the international market. A stronger exporter sector can also impact the macroeconomic accounts, such as the trade balance. Finally, it can influence the labor market by raising the income and employment pattern.

Among the activities identified as strategic by the NPE, we can highlight the cattle meat, which is one of the main product exported by Brazil. There are some recent stylized facts that enable us to better understand the movement or perspectives of the cattle meat external market, which is divided into two groups: a) positive aspects – those that have a potential to increase the Brazilian insertion in the external market (e.g. new potential trade agreements); and b) negative aspects – those that have a potential to decrease the Brazilian share in the external market (e.g. high protection degree; phytosanitary barriers).

In general, the recent perspectives are optimistic. There are some new potential markets, a more favorable exchange rate, increase in the Chinese demand and the American market opening for the Brazilian cattle meat. Besides that, Brazil and the United States, in 2016, signed the Letters of Equivalence Recognition of Beef Control, which can strengthen the trade relations between them and consequently increase the share of the Brazilian product in the international market. It is important to highlight that the bilateral agreement between Brazil and the United States is based on import quotas. According to the Bureau of International Agribusiness Relations (SRI) from Agriculture Ministry, with the agreement, Brazil began to have the same quota than Central American countries, 64,800 tons per year with a rate of 4% or 10% depending on the cut of the meat. Outside the quota (with no quantity limit), the tariff is 26.4%.

In addition, at the beginning of 2017 were resumed the negotiations for a bilateral agreement between Mercosur⁴ and European Union (EU) which includes cattle meat and other agricultural products. The negotiations also involve a tariffs reduction. However, it is important to point out that the beef sector is one of the main obstacles in this negotiation (Ramos et al., 2010). Thus, the impact of a beef market liberalization is a subject that has attracted interest. On one side, some studies have pointed positive scenarios. Ghazalian et al. (2009) identified Brazil and Argentina emerging, after tariff reductions (if then), as the Mercosur countries more likely to increase those beef market share on the EU market. Ramos et al. (2010) have shown that, given the current high tariffs, even a small tariff cut or a small preferential margin granted to Brazil and Argentina in the current negotiations between the European Union and Mercosur would increase significantly the market trade flows between them. Junker and Heckeley (2011) have identified possible positive effects on welfare if the

⁴ The Mercosur members are Brazil, Argentina, Uruguay, Paraguay (founder countries), Venezuela (suspended since 2016), and Bolivia (accession process).

EU liberalizes Mercosur's access to its domestic beef markets. Piketty et al. (2009) have also found a positive potential economic impact.

On the other side, the recent positive scenario has changed a little bit after the “*Operação Carne Fraca*” launched on February 17th, 2017, by Brazilian Federal Policy. The Brazilian foreign trade was subject to temporary embargos by the largest beef import markets. So far, some countries have announced that they would restrict beef imports from Brazil in different ways. The sanctions are different and range from a total embargo of the meat from Brazil to partial one (companies that did not go through the federal inspection system). Furthermore, more recently, on June 22th, 2017, the United States has started an embargo to the Brazilian meat.

Protectionist measures against the trade liberalization for agricultural commodities have been a major obstacle to increasing international trade of these goods. Despite a downward trend in trade tariffs around the world, tariffs on agricultural products remain significantly higher than non-agricultural one (Arita, 2017). Thus, while tariffs in many non-agricultural sectors are often reduced to zero in some trade agreements, trade flows in agriculture tend to be blocked by tariff and non-tariff barriers such as sanitary and phytosanitary measures.

Therefore, global beef markets are heavily influenced by sanitary and phytosanitary issues, which makes the beef industry vulnerable to embargos. From this perspective, one of the main problems of sanitary control in Brazil is the foot-and-mouth disease (Rubin et al., 2008; Sbarai and Miranda, 2014). Despite efforts to control it, the country constantly has periods of certification of decontaminated sanitary areas and periods of restrictions on exports after the outbreaks identification of foot-and-mouth disease. In recent years, in several situations, Brazilian meat exports have been affected by outbreaks of animal diseases. Most of the time there was total or partial restrictions on the external market for some regions of the country or for specific producers. The most prominent case in the international press was the suspension of exports in 2008 by the World Organization for Animal Health (OIE) of the Brazilian meat produced in some regions. This embargo started after the Brazilian government announced the outbreaks of foot-and-mouth disease. In 2010, the identification of a case of bovine spongiform encephalopathy, commonly referred to as the mad-cow disease, led to several barriers for Brazilian beef in the main consumer markets.

Instability in the international trade of commodities, specifically beef, is also verified in other countries than Brazil. An outbreak of foot-and-mouth disease in the United Kingdom in 2001 caused losses between US\$ 3.6 and US\$ 11.6 billion, leading to 4.0 million animals slaughtered (Nogueira et al., 2011). The discovery of a cow infected with bovine spongiform encephalopathy in Canada in 2003 caused the closure of international markets for live cattle from Canadian and American beef products (Carlberg et al., 2009). These facts have motivated cattle meat importers to require sanitary, phytosanitary and animal traceability protocols for access to their markets. Thus, countries with well-developed obligatory identification and traceability programs have advantages for beef exports vis-à-vis countries without such systems (Pendell et al., 2013).

In the literature, several studies analyze the restrictions on the beef trade. Nogueira et al. (2011), using a dynamic optimization model, analyzed different scenarios of economic consequences for the domestic and international market of a hypothetical outbreak of foot-and-mouth disease in the Mexican bovine industry. Tozer and Marsh (2012) analyzed the effects on the welfare, through an optimization model, of the impacts on the Australian beef industry of a potential crisis in the production and consumption caused by the foot-and-mouth disease.

The cattle meat trade is therefore exposed to many market failures due to the incidence of animal diseases and possible quality problems in processing stages (Schlueter et al., 2009). This motivates policy-makers to implement sanitary and phytosanitary regulatory instruments, which can also serve protectionist purposes. In this perspective, Park et al. (2008) analyzed the impacts caused by animal disease crises on the meat market. The authors have shown that after a foot-and-mouth

disease it is necessary long periods for the economy recover its previously export level. Bown and Hillman (2017) have identified incentives to deviations from economic efficiency by examining World Trade Organization (WTO) disputes caused by the closing and opening of beef markets after animal disease outbreaks.

The complexity of domestic policy interventions, which influence trade flows, are the subject of substantial international negotiation (Whalley, 2007). In addition, its effects are different from border policies, through export and import tariffs, which are extensively analyzed by the trade literature. This is the case in agricultural policy, where its impacts on trade are significant. However, relatively few papers have used numerical simulation exercises to analyze the impacts of possible production tariffs changes.

Given this context, this study aims to evaluate the effects of the domestic incentive to the production of cattle meat, through the elimination of production tariffs (*ad valorem* production tax rate). We analyze its effects on the exports and the Brazilian market gain in relation to the main competitors. Based on the NPE, we can highlight the main destination countries in terms of the high potential market to the Brazilian cattle meat, that is classified according to four strategies: market maintenance; market consolidation; market openness and market recovery. The potential markets for the Brazilian cattle meat are spread to different regions, leading the Brazilian government to adopt different strategies. We have used the database and model from Global Trade Analysis Project (GTAP) - version 9, calibrated to the year 2011.

The main results show that the Brazilian cattle meat sector benefits from government incentives, obtaining greater insertion in the international market, mainly in the countries established by NPE. In addition, although the incentives also have negative effects on the other food producing sectors in the Brazilian economy, they are able to generate economic growth and welfare gains.

Besides this introductory section, this study is structured as follows. The second section presents a background of the international beef market. The third section describes the computable general equilibrium model used to simulate the policy scenario. The fourth section presents and discusses the results. Finally, the fifth section concludes

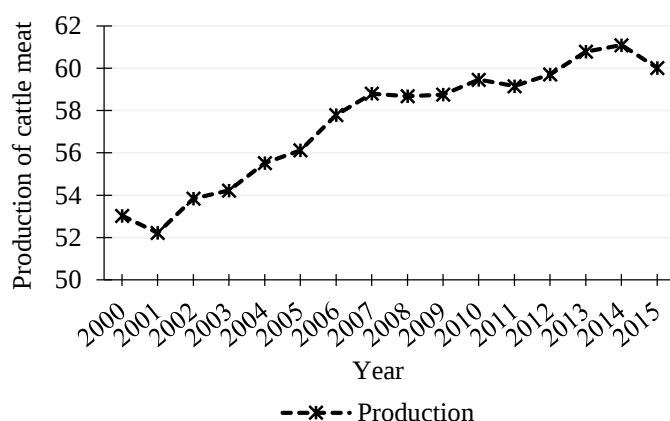
2. The Cattle Meat Market

In this section, we explore different aspects of the cattle meat market, which includes analysis of the international and the Brazilian market. In addition, we present the commercial strategies defined by the Brazilian government in NPE (National Plan for Exports 2015–2018).

2.1. The International Market

Figure 1 shows the world production evolution of cattle meat in million tons carcass weight equivalent (MT CWE). We observe that since 2001 there is a growing tendency in the world production, with cumulative growth from 2000 to 2015 equal to 13.18%. However, although there has been a growth in the world production of cattle meat, it has been possible to observe some decreases in specific years (e.g. 2001). At the beginning of the 21st century, an outbreak of foot-and-mouth disease, initially concentrated in Great Britain and Italy, spread throughout the rest of Europe. Therefore, several cattle meat producers had to sacrifice their animals in order to contain the epidemic. A similar case occurred in Brazil in 2005, however, insufficient to affect the growth of the world production (Figure 1).

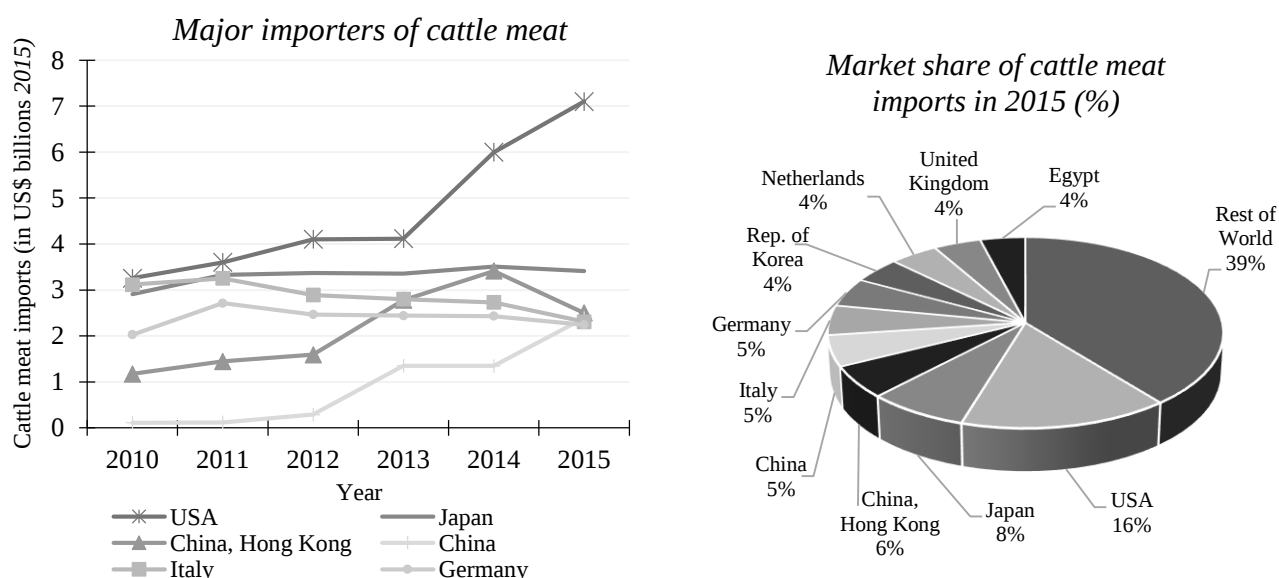
Figure 1 – World production of cattle meat, 2000-2015 (1,000 MT CWE)



Source: United States Department of Agriculture (USDA) – Foreign Agricultural Service.

From Figure 2, it is possible to observe the major importers of cattle meat and the market share among traders. The United States is the major importer, responsible for 16% of total imports in 2015. It is also important to highlight the growth path of the China imports and its market share. China has a large share of imports in 2015, with Hong Kong responsible for 6% and the other Chinese regions for 5%.

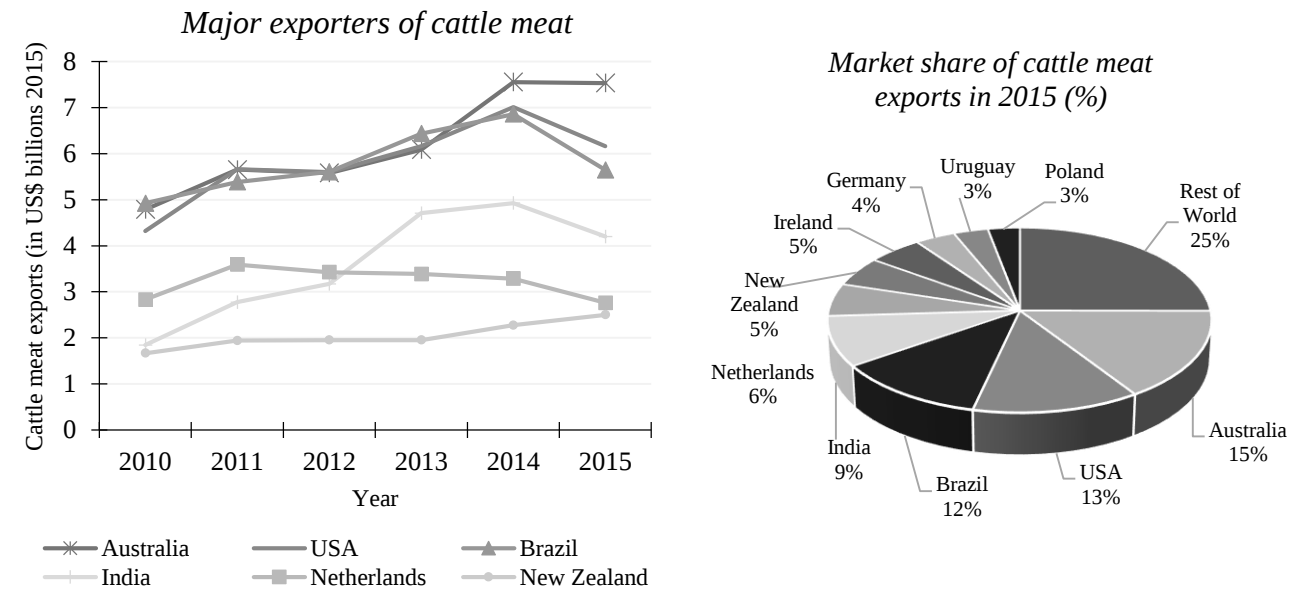
Figure 2 – Major importers of cattle meat and market share among traders



Source: United Nations Comtrade Database (UN Comtrade).

Figure 3 shows the major exporters of cattle meat and the market share among traders. Australia, the United States, and Brazil are the main exporters, responsible for 15%, 13%, and 12% of the market share, respectively, which indicates a high level of concentration. These three countries together are responsible for more than 50% of the total exports in 2015.

Figure 3 – Major exporters of cattle meat and market share among traders



Source: United Nations Comtrade Database (UN Comtrade).

Looking to the Figures 2 and 3, we can see that the United States is the largest importer of cattle meat in the world (Figure 2) and the second major exporter. Thus, considering the net balance in 2015, Australia and Brazil had surpluses, while the United States had a deficit.

2.2. The Recent Brazilian Strategies of Commercial Policy

As previously discussed, the Brazilian government has formulated the “*National Plan for Exports*” (NPE) which aims to increase the diversification, the aggregation of value and the technological intensification of the Brazilian exports and to expand priority markets. In other words, the plan aims to stimulate trade negotiations, to strengthen the bilateral, regional and multilateral trade fronts, as well as to remove some tariff and non-tariff barriers (Brazil, 2015).

The NPE identified 26 countries as priority destinations for the Brazilian exports, classified into four strategies categories: a) market openness – six countries; b) market consolidation – eight countries; c) market recovery – four countries, and d) market maintenance – eight countries (Table 1). “Market openness” focuses on the markets which Brazil has a small share and/or presence of discontinuity in exports. “Market consolidation” is divided into two groups: i) non-consolidated markets; however, where Brazil has shown growth close or even greater than the growth of its competitors; ii) consolidated markets where the main competitor has the greatest expansion, although Brazil concentrates a significant portion of the market. “Market maintenance” includes the target markets where Brazil has a “comfortable” situation vis-à-vis its main competitors. Finally, “Market

recovery" that concentrates the potential markets where Brazil has reduced its market share in recent years.

Table 1. National Export Plan, 2015

Strategy	Region	Value in 2015 (US\$ million)		Average Growth 2012-2015 (%)		Principal Competitor	Market-Share 2015 (%)	
		Competitor imports	Brazil imports	Competitor	Brazil		Principal Competitor	Brazil
Openness	China	2,320.59	286.55	108.9	97.4	Australia	34.2	12.3
Openness	Colombia	7.77	–	27.3	–	United States	82.6	–
Openness	Romania	72.49	–	20.8	0	Germany	54.8	–
Openness	South Korea	1,815.67	–	12.9	–	Australia	53.6	–
Openness	Thailand	92.14	0.76	2.8	3,591.90	Australia	38.2	0.8
Openness	United States	6,404.52	–	22.5	–	Australia	39.9	–
Consolidation	Cuba	8.1	1.53	6.2	13.3	Canada	41.9	18.9
Consolidation	Germany	2,097.24	85.18	-1.9	7.3	Netherlands	26.2	4.1
Consolidation	Italy	2,222.21	199.22	-7.1	7.2	France	19.6	9
Consolidation	Malaysia	552.01	12.33	8.3	70.7	India	76.3	2.2
Consolidation	Morocco	8.63	0.74	-20.8	42.4	Spain	89.2	8.6
Consolidation	Philippines	329.25	26.26	9.8	40.9	India	38.6	8
Consolidation	Spain	635.75	55.76	-7.1	16.8	Netherlands	26.2	8.8
Consolidation	U. Arab Emirates	475.3	72.16	5.9	13	India	23.7	15.2
Recovery	Paraguay	1.49	0.21	30.4	-53.3	Vietnam	21	13.8
Recovery	United Kingdom	1,576.70	26.1	5.9	-1.7	Ireland	65.3	1.7
Recovery	Chile	823.99	269.31	7	-11.8	Paraguay	41.9	32.7
Recovery	Saudi Arabia	540.88	0.61	19.1	-84.2	India	47.4	0.1
Maintenance	Algeria	239.57	94.61	-7.6	18.6	India	49.2	39.5
Maintenance	Angola	115.63	35.27	-16.4	0.7	India	32.3	30.5
Maintenance	Bolivia	0.12	0.12	-100	-63.4	–	–	100
Maintenance	Egypt	1,455.39	1,003.76	6.9	22.7	India	27.9	69
Maintenance	Iran	402.73	382.75	-49.1	5.7	India	4.6	95
Maintenance	Russian	1,497.60	585.2	-20.9	-19.3	Belarus	25.1	39.1
Maintenance	Uruguay	8.13	7.07	–	399.5	Paraguay	13	87
Maintenance	Venezuela	673.06	537.74	-25.7	6.3	Nicaragua	18.6	79.9

Source: Ministry of Development, Industry, and Trade, National Export Plan.

3. Methodology, Database, and Experiment Design

3.1. Methodology

The analysis proposed in this study, evaluate the effects of the domestic incentive to the production of cattle meat, is made based on a general equilibrium approach. Computable General Equilibrium (CGE) models are well adapted to this type of analysis for many reasons. They allow us to measure the welfare impact due to the adoption of different trade policies/scenarios. Furthermore, given their own structure, some CGE models present an integration among the bilateral flows and trade protection data with an input-output table that maps inter-sectoral interdependence within each economy, leading to projections of impacts on the national output of an economy, employment, and income.

In general, as emphasized by Ivus and Strong (2007), the structure of CGE models is related to the scale problem, which means that if there is an increase in the external trade for a product of a

single sector, the magnitude of the impacts depend, in part, on the productive structure within the economy (their backward and forward linkages). Thus, the impacts can be the most diverse one, depending on the economy in question.

Furthermore, the analysis based on CGE models are related to the ex-ante effects of a change in trade policy (Ivus and Strong, 2007; Hosny, 2013). This approach allows us to quantify the effects of a new policy, through a simulation based on the change in commercial policy, for example. In other words, it allows us to evaluate alternatives policy effects using a base year as a reference. Therefore, this helps to better map the possible effects of a preferential trade agreement.

3.2. Database

The GTAP database, version 9, is compiled for 140 regions and for 57 tradable commodities. In this study, we aggregated the GTAP regions in 38 one which includes, besides Brazil, 23 countries listed as priority market by the National Export Plan (Table 1). Algeria, Angola, and Cuba, although considered priority markets by the NEP, were not considered since they are not specified in the GTAP database. We also included eight countries listed by the NPE as Brazil's main competitors in the priority markets, namely Australia, Belarus, France, India, Ireland, Netherlands, Nicaragua, and Vietnam. Furthermore, the analysis includes five countries, Argentina, Canada, Mexico, New Zealand, and Poland, that have an important participation in the production and exports of cattle meat. Thus, these 37 countries are responsible for around 90.0% of the world cattle meat production. The remaining countries considering by GTAP database were aggregated in the Rest of World region.

The model considering 22 sectors as presents in the Table 1A in Appendix. These sectors are related to the food products and are directly related to the cattle meat⁵ sector given its production structure. Our sector aggregation is based on the GTAP model theoretical framework, which predicts competition by production factors among the sectors. In analyses with general equilibrium models, it is expected that scenarios that affect a sector had also effects across the whole economy being stronger in sectors that have greater productive linkages. Thus, this strategy allowed us to measure the degree of interaction between these activities. This also allows us to evaluate the possible consequences of incentive policy to the cattle meat sector on the other agricultural sectors.

3.2. Experiment Design⁶

Governments intervene in markets in a comprehensive way and most of these interventions affect the international trade. Thus, policymakers use mainly two types of intervention that affect the national and the international markets (Gaisford, 2007). First, trade frontier measures, such as import and export tariffs, which directly affects the international trade flows. Second, domestic support measures, such as production subsidies or input ones, which affects the firms on their supply side and indirectly the trade flows.

In this study, the analysis consists of outlining a scenario with the performance of a domestic policy. The simulation consisted of an ad valorem output tax rate (to) elimination for the cattle meat sector in Brazil. The production tariffs in the model are paid by the producers according to the value

⁵ Although NPE specifically addresses exports of Beef in Natura, in this survey was analyzed the total export of cattle meat, since the total of Beef in Natura represents more than 83% of the total cattle meat exported from Brazil.

⁶ For more details see Hertel, W (1997). Global Trade Analysis: modeling and applications. Cambridge University Press.

or quantity of their production (Hertel, 1997). This tariff is a part of the production costs. The production tariff is defined by

$$ps_{(i,r)} = to_{(i,r)} pm_{(i,r)} \quad (1)$$

where $ps_{(i,r)}$ is referred to supply price of commodity i in region r ; $pm_{(i,r)}$ is referred to market price; and $to_{(i,r)}$ is referred to as the power of the ad valorem tax.

Therefore:

$$VOM_{(i,r)} - VOA_{(i,r)} = (1 - to_{(i,r)}) pm_{(i,r)} qo_{(i,r)} \quad (2)$$

where $VOM_{(i,r)}$ is referred to value of commodity i output in region r at market' prices; $VOA_{(i,r)}$ is referred to value of commodity i output in region r at agents' prices; and $qo_{(i,r)}$ is referred to industry output. The expected market effects with the elimination of the *ad valorem* production tax rate are a reduction in the equilibrium price and an increase in the quantity produced.

The elimination of production tariffs has effects on domestic prices, which also depend on world prices and possible export and import tariffs that are already present in the economy. Thus, with the tariff change policy, domestic producers are willing to accept a lower domestic price. Thus, there is an adjustment on the supply side due to the change in the price level, an increase of the production levels.

Interventions in the domestic market through production tariffs elimination has widespread effects on household consumption and firms' production decisions. In this way, trade flows are subsequently affected.⁷ The mechanism by which this policy affects trade is that competitive firms, which maximize profits, choose to produce where price equals marginal cost. Thus, whenever a policy measure reduces its marginal cost, firms choose to increase their supply (Hertel, 1997). While measures to eliminate production tariffs have a smaller impact on trade comparable to a border measure, after the change in supply, exports increase and imports decrease and, as a result, there will be downward pressure on world prices.

4. Results

In this section, we present the results. The Subsection 4.1. presents the macroeconomic and welfare results while the Subsection 4.2. brings the effects of this policy on Brazilian cattle meat exports and the changes in the market share in relation to its main competitors. The Subsection 4.3. shows the sectoral effects generated by the productive linkages among the economic activities, focusing on the food production sectors.

⁷ Many countries still use tariffs to protect their agri-food markets. Thus, the policy measures affect domestic production and the international trade. In cases of market failure, such policy measures may be justified by economic efficiency reasons. For example, WTO Doha Round trade negotiations on agriculture. For more details, see Gaisford (2007).

4.1. Aggregate Global Results

The aggregate macroeconomic results of production tariffs elimination for the cattle meat sector in Brazil are shown in Table 2 (15 largest world producers). Considering the experiment, it is possible to observe an increase of the Brazilian GDP and cattle meat production. The tariff elimination makes the Brazilian cattle meat price cheaper than before, thereby stimulating the increase in its exports, which generates a positive effect on the Brazilian terms of trade. The other countries had a reduction in the quantity of cattle meat produced and, except for Netherlands, a decrease in their GDP and losses in terms of trade.

Table 2. Changes in GDP, output, prices, and trade for main cattle meat exporters (%)

Regions	GDP	Output quantity: Cattle Meat	Market price: Cattle Meat	Exports: Cattle Meat	Terms of trade
Australia	-0.0013	-0.0959	-0.0069	-0.1556	-0.0009
United States	-0.0006	-0.0120	-0.0007	-0.1777	-0.0002
New Zealand	-0.0027	-0.0772	-0.0042	-0.1036	-0.0020
Brazil	0.0032	0.7106	-0.7602	4.2255	0.0045
Netherlands	0.0001	-0.2059	-0.0043	-0.1535	0.0002
Germany	-0.0005	-0.1479	-0.0021	-0.3102	-0.0001
India	-0.0008	-0.2363	-0.0012	-0.4381	-0.0003
Ireland	-0.0009	-0.1440	-0.0024	-0.1696	-0.0002
France	-0.0006	-0.0376	-0.0006	-0.2453	-0.0001
Canada	-0.0005	-0.0119	-0.0005	-0.0904	-0.0001
Argentina	-0.0005	-0.0699	-0.0070	-0.5844	-0.0029
Uruguay	-0.0117	-0.2771	-0.0388	-0.4307	-0.0156
Poland	-0.0008	-0.1182	-0.0017	-0.2808	-0.0002
United Kingdom	-0.0006	-0.0308	-0.0014	-0.1509	-0.0001
Spain	-0.0005	-0.0814	-0.0010	-0.2437	-0.0001

Source: Authors' simulation results.

Table 3 decomposes the welfare results for the major cattle meat producers. Brazil, Netherlands, Germany, and Spain have presented gains in terms of welfare. These welfare gains come from the capacity improved to allocate resources, which increase the efficiency effects. The first component of the welfare decomposition is allocative efficiency, which identifies the ability to efficiently allocate resources across sectors of the economy from changes in tax revenues. Given the increase in Brazilian production, total revenues are also expected to increase, despite the tariff elimination for cattle meat, which implies positive allocative efficiency effects. Brazil has also presented gains in the terms of trade. These gains are due to the exports increase since the tariff elimination makes the Brazilian export prices of cattle meat lower than its competitors. The Investment-Savings effect is negative for Brazil which represents the difference between investment and savings adjust to balance the real trade balance.

Table 3. Welfare Decomposition for main Cattle Meat exporters (in US\$ million)

Regions	Allocative Efficiency	Terms of Trade	Investment– Savings	Total
Australia	–0.3496	–2.5393	0.1464	–2.7424
United States of America	–0.7649	–3.9997	–0.5034	–5.2680
New Zealand	–0.1588	–0.9497	0.0605	–1.0480
Brazil	11.3821	12.5261	–0.7657	23.1425
Netherlands	6.3283	0.7665	0.0322	7.1270
Germany	2.3732	–1.0269	0.0933	1.4396
India	–0.3758	–1.2463	–0.3138	–1.9360
Ireland	–0.0812	–0.5354	0.1117	–0.5049
France	–0.5479	–1.1286	–0.0622	–1.7387
Canada	–0.3179	–0.2857	0.0342	–0.5695
Argentina	–0.2146	–2.2232	–0.1106	–2.5484
Uruguay	–0.4563	–1.7953	–0.0548	–2.3065
Poland	–0.2245	–0.4456	–0.0509	–0.7210
United Kingdom	–0.0398	–0.5373	–0.0672	–0.6443
Spain	1.2255	–0.6105	–0.0230	0.5920

Source: Authors' simulation results.

It should be noted that this domestic tariff elimination policy could be classified as an indirect export subsidy, which is seen by the World Trade Organization (WTO) as a detrimental hindrance to the functioning of international markets (Rude, 2007). Thus, such subsidies punish other domestic consumers and taxpayers and may have detrimental effects on competing exporters by distorting the allocation of resources within the subsidized market and across international borders. In other words, although this policy has beneficial aspects to the Brazilian economy, may contain aspects that can create some trade distortions, which implies difficult to measure welfare impacts.

4.2. Brazilian Cattle Meat Exports

In this subsection, we turn our attention to the Brazilian exports of cattle meat. The different levels of change in exports were caused by the degree of insertion of Brazil in different markets and the performance of products competing in other countries. In this way, the results of the growth in Brazilian exports were explored following the strategies of the National Export Plan for the cattle meat sector (Table 4).

Following the structure of the GTAP database, for 2011, the main destinations of Brazilian exports are Russian (23.19%), Iran (16.86%) and Venezuela (9.20%), which represent about half of the Brazilian exports. After the elimination of the tariffs, production becomes cheaper than in the baseline, which reduces the market prices, thus increasing the competitiveness of the Brazilian product in the external market. This increases the Brazilian exports to all destinations. The results show export increases, in millions of US\$, mainly for Russian (US\$ 37.57 million), Egypt (US\$ 10.04 million) and Venezuela (US\$ 9.78 million). The changes in exports in percentage changes are higher for Romania (5.23%), Belarus (5.23%), South Korea (5.22%), Poland (5.22%), India (5.22%), Morocco (5.21%), Canada (5.21%), and United States (5.16%).

It is also important to highlight that, after the experiment, most Brazilian competitors, in their respective target markets, have lost market share.

Table 4. Cattle Meat Brazilian exports to the countries listed in the National Exportation Plan and main competitors

Strategy	Regions	Brazil exports					Principal Competitor	
		Share of exports (%)	Exports (US\$ Millions)			Change in exports (%)	Region	Change in exports (%)
			Pre-simulation	Post-simulation	Change			
Openness	Romania	0.0002	0.0095	0.0100	0.0005	5.2353	Germany	0.0045
Openness	South Korea	0.0194	0.7951	0.8367	0.0415	5.2232	Australia	0.0219
Openness	United States	0.1461	5.9774	6.2855	0.3082	5.1558	Australia	0.0219
Openness	Colombia	0.0155	0.6356	0.6672	0.0315	4.9615	United States	−0.0576
Openness	Thailand	0.0164	0.6693	0.7024	0.0331	4.9475	Australia	0.0219
Openness	China	0.2560	10.4754	10.9843	0.5088	4.8572	Australia	0.0219
Consolidation	Morocco	0.0005	0.0204	0.0215	0.0011	5.2118	Spain	−0.0266
Consolidation	Malaysia	0.0303	1.2402	1.3006	0.0604	4.8703	India	−0.0265
Consolidation	Germany	1.9644	80.3922	84.2317	3.8395	4.7759	Netherlands	−0.1606
Consolidation	Spain	0.8450	34.5796	36.2091	1.6296	4.7125	Netherlands	−0.1606
Consolidation	Philippines	0.4435	18.1488	18.9951	0.8463	4.6632	India	−0.0265
Consolidation	Italy	4.0386	165.2803	172.8759	7.5956	4.5956	France	−0.2961
Consolidation	Uruguay	0.0224	0.9149	0.9563	0.0414	4.5256	Paraguay	−0.2924
Consolidation	U. A. Emirates	1.2664	51.8285	54.0291	2.2005	4.2458	India	−0.0265
Recovery	United Kingdom	0.4269	17.4688	18.3213	0.8525	4.8799	Ireland	0.0641
Recovery	Paraguay	0.0026	0.1074	0.1121	0.0047	4.3899	Vietnam	0.0000
Recovery	Saudi Arabia	3.1363	128.3521	133.6635	5.3114	4.1382	India	−0.0265
Recovery	Chile	5.1989	212.7653	220.9928	8.2275	3.8669	Paraguay	−0.8917
Maintenance	Russian	23.1913	949.1002	986.6740	37.5739	3.9589	Belarus	−0.8667
Maintenance	Bolivia	0.0197	0.8052	0.8343	0.0290	3.6035	–	–
Maintenance	Egypt	8.6804	355.2442	365.2877	10.0435	2.8272	India	−0.0265
Maintenance	Venezuela	9.2029	376.6276	386.4042	9.7766	2.5958	Nicaragua	−1.6842
Maintenance	Iran	16.8626	690.0983	696.7203	6.6220	0.9596	India	−0.0265
Off-plan	Belarus	0.0004	0.0147	0.0154	0.0008	5.2287	Poland	−0.0044
Off-plan	Poland	0.0004	0.0158	0.0167	0.0008	5.2213	France	−0.0181
Off-plan	India	0.0017	0.0702	0.0738	0.0037	5.2168	United States	−0.0239
Off-plan	Canada	0.0047	0.1926	0.2026	0.0100	5.2048	United States	−0.0114
Off-plan	New Zealand	0.0012	0.0477	0.0501	0.0025	5.1952	Australia	−0.0053
Off-plan	Australia	0.0117	0.4784	0.5028	0.0244	5.0961	United States	−0.0589
Off-plan	Mexico	0.0215	0.8807	0.9247	0.0440	4.9943	United States	−0.0195
Off-plan	Nicaragua	0.0001	0.0039	0.0041	0.0002	4.9642	Canada	−0.2613
Off-plan	Ireland	0.0120	0.4919	0.5162	0.0243	4.9473	Netherlands	−0.0159
Off-plan	France	0.1044	4.2725	4.4835	0.2110	4.9386	United Kingdom	−0.0142
Off-plan	Vietnam	0.0457	1.8709	1.9615	0.0907	4.8456	India	−0.0175
Off-plan	Rest of Wold	18.9362	774.9599	811.5687	36.6088	4.7240	Australia	−0.1389
Off-plan	Argentina	0.1101	4.5066	4.6966	0.1900	4.2167	Chile	−0.4446
Off-plan	Netherlands	4.9638	203.1409	210.8529	7.7119	3.7964	Germany	−1.0860

Source: Authors' simulation results.

As can be seen in Table 5, after the elimination of production tariffs, Brazilian beef exports reached a higher insertion, especially in the countries indicated with the “Openness strategy” in National Export Plan. Although the countries listed in this strategy are the destination of only 0.45% of total Brazilian exports, they obtained the highest average growth (4.98%) after the incentives to

the production of this sector in Brazil. Especially Romania, South Korea and the United States, with an export increase of 5.24%, 5.22%, and 5.16%, respectively.

The countries indicated as “Consolidation strategy” also were obtained significant results. The largest export increases were for Morocco, Malaysia, and Germany, with the growth of 5.21%, 4.87%, and 4.78%, respectively. For the “Recovery strategy”, the increase in exports was higher for United Kingdom (4.87%). Finally, exports to the countries classified as “Maintenance strategy” were those that obtained the smallest percentage changes in the growth of Cattle Meat exports. These results can be justified by the greater market share of Brazil in these markets.

Table 5. Brazilian exports of Cattle Meat by type of strategy of the National Export Plan

Strategy	Share of exports (%)	Exports (US\$ Millions)			Change in exports (%)
		Pre-simulation	Post-simulation	Change	
Openness	0.45	18.56	19.49	0.92	4.98
Consolidation	8.61	352.40	368.62	16.21	4.60
Recovery	8.76	358.69	373.09	14.40	4.01
Maintenance	57.96	2371.88	2435.92	64.04	2.70
Off-plan	24.21	990.95	1035.87	44.92	4.53

Source: Authors' simulation results.

4.3. Brazil's sectoral results

This section presents the sectoral results for the Brazilian economy, focusing on the food production sectors. In addition, it shows the main mechanisms that affect the sectoral production after the tariffs elimination in the cattle meat sector. The macroeconomic results show positive effects for the Brazilian economy after the tariff elimination. However, the effects are different across sectors, depending on the sectoral interdependence with cattle meat in the production structure. Productive linkages between activities generate these effects. While tariff elimination directly affects cattle meat production, results in other sectors are important for policymakers.

The cattle meat sector represents 0.93% of the total Brazilian production, with 10.45% of its production destined for the foreign market (Table 6). As expected, cattle meat production benefited most from tariff elimination. This sector showed an increase of 0.30% in terms of domestic sales, 4.26% of exports and 0.71% of production. The post-simulation changes in the other sectors are determined by the relative variations in prices which indicate a general trend of reduction in the other sectors production, except the production of Other Grains, Cattle, Wool, Forestry, Fishing and Other Food. Cattle Meat production, among other sectors of food production, was the most benefited after the experiment policy. The Cattle sector, which owns 97.71% of domestic sales, although showing a reduction in exports, grew its production by 0.54%. On the other hand, the exports of sugar decreased by (0,07%). It is not a considerable decrease but it is important to highlight due to the relative importance of this product at the Brazilian export basket.

Table 6. Sector results for Brazil: Agriculture activity

Sector	Output share (%)	Destination of Output (%)		Change post simulation (%)		
		Domestic Sales	Exports	Domestic Sales	Exports	Output
Paddy Rice	0.0922	97.5583	2.4417	-0.0027	-0.2956	-0.0098
Wheat	0.0528	63.5298	36.4702	-0.0397	-0.2179	-0.1047
Other Grains	0.3820	84.0197	15.9803	0.0736	-0.0867	0.0480
Veg & Fruit	0.1242	80.7646	19.2354	0.0112	-0.1044	-0.0110
Oil Seeds	0.7485	46.9821	53.0179	-0.0178	-0.0817	-0.0516
Cane & Beet	0.7115	99.9900	0.0100	-0.0240	-0.1809	-0.0240
Plant Fibres	0.1179	67.4069	32.5931	-0.0117	-0.1281	-0.0496
Other Crops	1.0407	73.5532	26.4468	0.0041	-0.1662	-0.0410
Cattle	0.7212	97.7052	2.2948	0.5586	-0.1565	0.5421
Other Animal Products	0.5519	97.7896	2.2104	-0.0095	-0.0759	-0.0110
Raw Milk	0.3282	99.9822	0.0178	-0.0045	-0.2526	-0.0046
Wool	0.1713	99.6817	0.3183	0.0151	-0.3821	0.0139
Forestry	0.2473	99.5481	0.4519	0.0031	-0.0669	0.0028
Fishing	0.0946	99.3616	0.6384	0.0020	-0.0415	0.0017
Cattle Meat	0.9285	89.5478	10.4521	0.3003	4.2255	0.7106
Other Meat	0.6846	63.9216	36.0784	-0.0162	-0.1496	-0.0643
Vegetable Oils	0.8070	79.8913	20.1087	0.0059	-0.0963	-0.0147
Milk	0.6407	99.5927	0.4073	-0.0070	-0.1566	-0.0076
Processed Rice	0.2941	95.6773	4.3227	-0.0000	-0.0896	-0.0039
Sugar	0.8078	55.7667	44.2333	-0.0055	-0.0688	-0.0335
Other Food	2.1822	94.6014	5.3986	0.0317	-0.0698	0.0263
Other Sectors	88.2708	94.7846	5.3638	-0.0020	-0.0747	-0.0058

Source: Authors' simulation results.

Table 7 presents the results for the use of intermediate inputs and primary production factors. The elimination of production tariffs for Cattle Meat sector leads to a reduction in the prices of domestic intermediate inputs for this sector. This leads to an increase in the demand for intermediate domestic inputs (0.71%), induced by the change in prices. Cheaper domestic intermediate inputs reduce production costs, and associated with product growth, drive the demand for primary factors in the Cattle Meat sector. A reduction in the demand for intermediate inputs imported into the Cattle Meat sector (-2.51%) is associated with the reduction of its marginal cost with the elimination of production tariffs, therefore, firms will choose to increase the quantities that they supply. Consequently, their exports are increased and imports are reduced (Gaisford, 2007). In addition, a reduction in the prices of inputs purchased in the domestic market, which make import prices relatively more expensive.

Table 7. Use of intermediate input and primary factors for Brazil (%)

Sector	Intermediate input		Primary factors				
	Domestic	Imports	Land	Un-skilled lab	Skilled lab	Capital	Nature Resources
Paddy Rice	-0.0098	0.1878	-0.0511	-0.0015	-0.0012	-0.0022	-0.0000
Wheat	-0.1047	0.0673	-0.1287	-0.0997	-0.0994	-0.1004	-0.0004
Other Grains	0.0480	0.1076	-0.0038	0.0583	0.0586	0.0576	0.0002
Veg & Fruit	-0.0110	0.0348	-0.0521	-0.0027	-0.0024	-0.0034	-0.0000
Oil Seeds	-0.0516	0.0934	-0.0853	-0.0447	-0.0445	-0.0454	-0.0002
Cane & Beet	-0.0240	0.0695	-0.0627	-0.0161	-0.0158	-0.0168	-0.0001
Plant Fibres	-0.0496	0.0597	-0.0836	-0.0426	-0.0424	-0.0433	-0.0002
Other Crops	-0.0410	0.1022	-0.0765	-0.0337	-0.0334	-0.0344	-0.0001
Cattle	0.5421	0.5593	0.4004	0.5697	0.5700	0.5690	0.0021
Other Animal Products	-0.0110	0.0336	-0.0520	-0.0027	-0.0024	-0.0033	-0.0000
Raw Milk	-0.0046	0.1940	-0.0468	0.0040	0.0043	0.0033	0.0000
Wool	0.0139	0.2566	-0.0317	0.0230	0.0233	0.0223	0.0001
Forestry	0.0028	0.0339	-0.0371	0.0033	0.0035	0.0028	0.0000
Fishing	0.0017	0.0202	-0.0374	0.0029	0.0031	0.0024	0.0000
Cattle Meat	0.7106	-2.5139	0.2082	0.7111	0.7124	0.7082	0.0006
Other Meat	-0.0643	0.0930	-0.1564	-0.0640	-0.0628	-0.0669	-0.0001
Vegetable Oils	-0.0147	0.0602	-0.1328	-0.0139	-0.0127	-0.0168	-0.0000
Milk	-0.0076	0.0874	-0.1295	-0.0070	-0.0058	-0.0099	-0.0000
Processed Rice	-0.0039	0.0545	-0.1279	-0.0035	-0.0023	-0.0064	-0.0000
Sugar	-0.0335	0.0313	-0.1416	-0.0327	-0.0315	-0.0356	-0.0000
Other Food	0.0263	0.0498	-0.1136	0.0269	0.0281	0.0240	0.0000
Other Sectors	-0.0058	0.0273	-0.1366	-0.0050	-0.0035	-0.0083	-0.0000

Source: Authors' simulation results.

Furthermore, the increased demand for domestic intermediate inputs in the Cattle Meat sector results in a reduction of the supply of these inputs to the food producing sectors competing with Cattle Meat for similar inputs. This change in the requisition for inputs is compensated by the increase in market prices to reach the new equilibrium. In sectoral terms, this results in a reduction in the use of domestic intermediate inputs for the other sectors. In addition, it causes an increase in the demand for imported inputs, induced by the prices that become relatively cheaper - the degree of increase in imports depends on the effects of productive linkage of these sectors with Cattle Meat and, its productive structure. Because of the variation of its final product, the other food producing sectors also present change in their demand for primary production factors.

5. Final Remarks

Export promotion is a strategy to boost economic growth. In this perspective, this study is part of an effort to evaluate possible policies to encourage the insertion of a developing economy in the international trade. In this way, the main issue addressed here was to identify whether domestic production incentives to the cattle meat sector are able or not to boost the sector exports and enable market gains in relation to the main competitors. Thus, based on the strategies proposed by the National Export Plan, we have analyzed the Brazilian potential to have gains in terms of the international market after the production tariffs elimination. Based on the analysis with a global computable general equilibrium model, the results, in addition to the effects on the own cattle meat sector, the experiment has allowed us to evaluate the macroeconomic and welfare benefits for the Brazilian economy and the unfolding of the incentive policy on the other sectors.

In general, the analysis has confirmed that an incentive policy to the cattle meat sector is able to create economic growth and welfare gains. Although targeted incentives had negative effects on

other food producing sectors, this policy would be able to generate results in line with the objectives of the National Export Plan. The study contributes by explicitly presents the systemic impacts of the price change in the cattle meat market. In other words, since there is a scarcity of resources, the creation of an artificial competitive advantage, through a tariff elimination, leads to losses in sectors that use intermediate and primary inputs similar to the cattle meat sector.

From the comparative analysis through a global model, it was possible to observe the reaction of the different markets and, therefore, evaluate the feasibility of achieving the aims contained in the NPE strategies. Therefore, the experiment contributes by a detailed mapping of changes in the Brazilian economy and in the other key economies analyzed by the model due to the adoption of an incentive by Brazil (*e.g.* elimination of tariffs on production), which can also be understood as a creation of an "artificial competitive advantage". Such mechanism is valid since it causes a decrease in the price of goods and therefore enhances its insertion in the most diverse markets. However, it is important to point out that, despite production, subsidies are one common form of government intervention in the economy, which affects the world prices and creates distorts on the international markets.

Future work would include fiscal incentives throughout the productive process of the cattle meat, including intermediate transactions and productive factors. It would be possible, considering this new specification, to have results in macroeconomic terms more intense since this would stimulate other productive sectors of the Brazilian economy. Further, it would be interesting to create some alternative scenarios.

References

- Arita, S., Beckman, J., & Mitchell, L. (2017). Reducing transatlantic barriers on US-EU agri-food trade: What are the possible gains? *Food Policy*, 68, 233-247.
- Bown, C. P., & Hillman, J. A. (2017). Foot-and-Mouth Disease and Argentina's Beef Exports: The WTO's US–Animals Dispute. *World Trade Review*, 16(2), 253–277.
- Brazil (2015). National Plan for Exports 2015–2018, Brasília: Ministry of Industry, Foreign Trade and Services.
- Carlberg, J. G., Brewin, D. G., & Rude, J. I. (2009). Managing a border threat: BSE and COOL effects on the Canadian beef industry. *Review of Agricultural Economics*, 952-962.
- Gasford, J. Trade distortion: border measures versus domestic support. In: KERR, W. A. & GAISFORD, J. D. *Handbook on International Trade Policy*, 2007, p. 177-186.
- Ghazalian, P. L., Larue, B., & Gervais, J. P. (2009). Exporting to new destinations and the effects of tariffs: the case of meat commodities. *Agricultural Economics*, 40(6), 701-714.
- Hertel, T. W. (1997). *Global trade analysis: modeling and applications*. Cambridge University Press.
- Hosny, A. S. Survey of recent literature on CGE trade models: with special reference to the case of Egypt. *Journal of World Economic Research*, v. 2, n. 1, p. 9-19, 2013.
- Ivus, O.; Strong, A. Modeling approaches to the analysis of trade policy: computable general equilibrium and gravity models. In: Kerr, W. A. & Gaisford, J. D. *Handbook on International Trade Policy*, 2007, p. 44-56.
- Junker, F., & Heckelei, T. (2012). TRQ-complications: who gets the benefits when the EU liberalizes Mercosur's access to the beef markets? *Agricultural Economics*, 43(2), 215-231.

- Nogueira, L., Marsh, T. L., Tozer, P. R., & Peel, D. (2011). Foot-and-mouth disease and the Mexican cattle industry. *Agricultural Economics*, 42(s1), 33-44.
- Park, M., Jin, Y. H., & Bessler, D. A. (2008). The impacts of animal disease crises on the Korean meat market. *Agricultural Economics*, 39(2), 183-195.
- Pendell, D. L., Tonsor, G. T., Dhuyvetter, K. C., Brester, G. W., & Schroeder, T. C. (2013). Evolving beef export market access requirements for age and source verification. *Food Policy*, 43, 332-340.
- Piketty, M. G., Weissleder, L., Souza Filho, H. M., Batalha, M. O., Adenäuer, M., & Becker, A. (2009). Assessing agricultural trade policies options with the European Union: a Brazilian perspective. *Agricultural Economics*, 40(4), 447-457.
- Ramos, M. P., Bureau, J. C., & Salvatici, L. (2010). Trade composition effects of the EU tariff structure: beef imports from Mercosur. *European Review of Agricultural Economics*, 37(1), 1–26.
- Rubin, L. S., Ilha, A. S., & Waquil, P. D. (2008). O comércio potencial brasileiro de carne bovina no contexto de integração regional. *Revista de Economia e Sociologia Rural*, 46(4), 1067-1093.
- Rude, J. Direct and indirect export subsidies. In: Kerr, W. A. & Gaisford, J. D. *Handbook on International Trade Policy*, 2007, p. 201-214.
- Sbarai, N., & Miranda, S. H. G. (2014). Tarifas equivalentes de medidas não tarifárias sobre exportações brasileiras de carne bovina para a UE (2000-2010). *Revista de Economia e Sociologia Rural*, 52(2), 267-284.
- Schlueter, S. W., Wieck, C., & Heckeley, T. (2009). Regulatory policies in meat trade: Is there evidence for least trade-distorting sanitary regulations? *American Journal of Agricultural Economics*, 91(5), 1484-1490.
- Tozer, P., & Marsh, T. L. (2012). Domestic and trade impacts of foot-and-mouth disease on the Australian beef industry. *Australian Journal of Agricultural and Resource Economics*, 56(3), 385-404.
- Whalley, J. Trade and domestic policy: conduct and modeling. In: Kerr, W. A. & Gaisford, J. D. *Handbook on International Trade Policy*, 2007, p. 201-214.

APPENDIX

Table 1A. Sector Aggregation

N.	Code	Description
1	Paddy Rice	Rice, husked and unhusked
2	Wheat	Wheat and meslin
3	Other Grains	Maize (corn), barley, rye, oats, other cereals
4	Veg & Fruit	Vegetables, fruit and nuts, potatoes, cassava, truffles
5	Oil Seeds	Oil seeds and oleaginous fruit; soy beans, copra
6	Cane & Beet	Sugar cane and sugar beet
7	Plant Fibres	Cotton, flax and other raw vegetable materials used in textiles
8	Other Crops	Live plants; seeds; Raw vegetable materials
9	Cattle	Cattle, sheep, goats, horses, asses, mules, and hinnies
10	Other Animal Products	Swine, poultry, and other live animals; eggs; natural honey; skins
11	Raw milk	Raw milk
12	Wool	Wool, silk, and other raw animal materials used in textile
13	Forestry	Forestry, logging, and related service activities
14	Fishing	Hunting, fishing, service activities incidental to fishing
15	Cattle Meat	Fresh or chilled meat and edible offal
16	Other Meat	Pig meat and offal preserves and preparations of meat
17	Vegetable Oils	Crude and refined oils
18	Milk	Dairy products
19	Processed Rice	Rice, semi- or wholly milled
20	Sugar	Sugar
21	Other Food	Other food
22	Other sectors	Mining, manufacturing, and services

Source: Own elaboration.