THE IMPACT OF CATTLE FOOT AND MOUTH DISEASE IN THE BRAZILIAN ECONOMY

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Poster paper prepared for presentation at the EAAE 2014 Congress 'Agri-Food and Rural Innovations for Healthier Societies'

August 26 to 29, 2014
Ljubljana, Slovenia

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Abstract

This paper aims to assess the economic impact of Cattle Foot and Mouth Disease (FMD) outbreaks in Brazil for 2006. This is done by using an input-output system for Brazilian economy and two basic scenarios: one which considers FMD outbreaks and decreases in exports and other which considers the status change for FMD-free without vaccination. In the first scenario the results show a decrease of total output in the Brazilian economy between R$ 3.3 billion and R$ 10.2 billion, while in the second scenario the results show an increase of total output between R$ 3.8 billion and R$ 12.5 billion.

Keywords: Foot and Mouth Disease (FMD), scenarios, input-output models.

1. Introduction

Brazilian beef sector accounted for US$ 167.5 billion in 2010. In 2012, 18% of produced beef was exported, 73% of which *in natura* (fresh beef) (Abiec, 2013). These figures are an example of the beef sector importance to the economy, as well as for its foreign trade. However, as is well known, the bovine meat international market is very sensible to sanitary barriers.

Silva and Miranda (2006: 10) provide examples of losses around US$ 6.8 billion in a 2001 study and the case of Mato Grosso do Sul State in October 2005, after which there was a "decline in exported volume by 27.18% over the same period for 2004. In December, still no reflections of the new surge in Paraná, there was a growth of 9.45% in export value". In the same way, Guanziroli (2006, p.13) points that "in 2001, a reduction of about 55% of Argentina's exports occurred due to detected cases of FMD in the country". For South-East Asian countries, an interesting list of economic impacts is shown by Perry at al. (1999).

The research problem can be stated as follows: "what are the economic impacts of problems related to animal health, particularly FMD, on the Brazilian economy?". It is known that such problems are reflected in exports and domestic consumption, with consequences in different sectors related to their supply chains. Assessment of the impacts is fundamental to guide public policies related to the theme. Recent example is the discussion about *status* change in several Brazilian states, for "FMD free without vaccination".

The main purpose of this study is to arrive at estimates of total impacts (direct and indirect) due to FMD outbreaks. This goal depends on the development of a specific methodology for the Brazilian case. As specific objectives we have:

- Get the Input-Output Matrix for Brazil disaggregated for the relevant sectors;
- Set up scenarios of FMD effects in two directions: the losses in foreign sales and the gains with eradication;
- Estimating the impacts (direct and indirect) of FMD occurrences on the production value.

2. Methodology

The use of input-output models for impact assessment related to certain economic shocks requires two main work fronts. Firstly, a survey of the shocks themselves. In the present study, this activity was carried out by observing FMD events in Brazil from 1995 to 2008 and

referring to the literature (e.g. Silva and Miranda, 2006). Thus, it was possible to obtain estimates of losses due to FMD outbreaks. Scenarios regarding effects of changing country's status about disease control were assembled and correspond to shocks in final demand. This choice is due to the difficulty of obtaining primary data and was based on Costa and Guilhoto (2011) study whose methodology and results led to satisfactory scenarios[1]. The scenarios (shocks) correspond to the ΔY in the equation $\Delta X = (I - A)^{-1}\Delta Y$ (Miller and Blair, 1985).

The second work front refers to obtaining the input-output matrix with the disaggregation required for the study: Livestock and Cattle and Other Animal Slaughtering. Using the information from the Brazilian System of National Accounts (SNA), released by the Brazilian Statistical Office (IBGE), and the methodology presented by Guilhoto and Sesso Filho (2010) it was possible to estimate the input-output (IO) system for Brazil for 2006. The estimation of the industries and commodities, not available in the SNA and presented in expanded IO system used in this paper, is made accordingly to the methodology presented by Guilhoto et al. (2010). With the IO Matrix for Brazil in 2006 and shocks in hand, estimates of impacts were made considering the direct and indirect effects, which correspond to the ΔX in the quoted equation and are the main research results.

FMD can affect the foreign beef trade and impact the Brazilian economy in two major ways, leading to two groups of scenarios:

i) Effect of a FMD outbreak

The procedure was based on scenarios of shocks related to FMD to subsequently calculate their direct and indirect impacts via IO model. For the present study, we have that, according to the Brazilian Ministry of Agriculture, Livestock and Supply (MAPA, 2013), in 2006 Brazil exported 1.5 million tons of beef, of which 1.225 million t fresh beef (80.4%). In values, were US$ 3.9 billion of beef, of which US$ 3.1 billion of fresh beef (79.9%). Based on this background information, the first three scenarios were assembled.

- Scenario 1. Taking a timely example, Russia closed its market for Brazilian beef in 2004. In annualized values corresponding to 2006 it would mean US$ 750 million, i.e., a reduction of 23.7% in Brazilian fresh beef exports. Considering Brazilian fresh beef exported to Russia in relation to total beef exported by Brazil, that amount means a reduction of 18.9%. Thus, for Scenario 1 it is considered that the value exported by Cattle and Other Animal Slaughtering sector is 81.1% of the original value from the IO Matrix for 2006.
- Scenario 2. Top ten destinations amounted 72.4% of Brazilian fresh beef exports in 2006 according to MAPA. Considering a 50% reduction in exports of Brazilian fresh beef to such destinations, the reduction in total exports of Brazilian beef would be 28.9%. Thus, for Scenario 2 it is considered that the value exported by Cattle and Other Animal Slaughtering sector is 71.1% of the original value from the IO Matrix for 2006.
- Scenario 3. Considering a 100% reduction in exports of Brazilian fresh beef to its top ten destinations, the reduction in total exports of Brazilian beef would be 57.9%. Thus, for Scenario 3 it is considered that the value exported by Cattle and Other Animal Slaughtering sector is 42.1% of the original value from the IO Matrix for 2006.

ii) Effect of status change to FMD free without vaccination

According to Ekboir et al. (2002), world beef market has been divided into segments, one of which the FMD-free and FMD-endemic market, with the former being expected to offer higher prices for beef than the FMD endemic markets in which they previously sold.

[1] Scenarios were also used, for example, by Ekboir et al. (2002) and Perry et al. (1999). The later also quoted cost-benefit analysis and implications for trade in their framework to asses FMD impacts.

FAOSTAT data were used for the second group of scenarios. Taking major world importers of fresh beef, almost or fully closed to the Brazilian product, such as Canada, China, Japan, Mexico and the U.S., it is observed that they represented 28.6% of world total imports in 2006 (Table 1).

Table 1. Selected fresh beef importers and estimated potential for Brazilian fresh beef

Destination	Amount (t)	Value (US$ 1000)	Average Price (US$/kg)	% fresh beef*	Potential** (t)
Canada	98,392	455,765	4.63	1.5	96,916
China	75,498	325,524	4.31	10.6	67,495
Japan	460,618	1,942,384	4.22	0.0	460,618
Mexico	270,665	973,279	3.6	0.0	270,665
USA	902,576	2,914,839	3.23	1.0	893,550
World	6,328,185	22,972,947	3.63	-	-

Notes: * represents how much of Brazilian beef exports to the country in quantity refers to fresh beef, based on MAPA data. ** The potential is obtained by deducting from total imports by countries the proportion of fresh beef that Brazil already exports to such countries.
Source: elaborated by the authors based on FAOSTAT and MAPA.

The potential described in Table 1 represents 146% of the Brazilian fresh beef exported in 2006. Obviously it is not expected that it will be totally supplied by Brazil in a case of status change. Based on these considerations, the last three scenarios of the study were assembled.

- Scenario 4. The average fresh beef price exported by Brazil in 2006, according to FAOSTAT, was US$ 2.56 / kg and the average price of imported fresh beef by the selected countries was US$ 3.65 / kg. Taking a 15% increase in Brazilian exports and considering the higher price, having as target the selected countries, for Scenario 4 it is considered that value exported by Cattle and Other Animal Slaughtering sector is 21.4% larger than the original value from the IO Matrix for 2006.

- Scenario 5. Starting from Scenario 4 and taking a 30% increase in Brazilian exports, having as target the selected countries, for Scenario 5 it is considered that value exported by Cattle and Other Animal Slaughtering sector is 42.9% larger than the original value from the IO Matrix for 2006.

- Scenario 6. Starting from Scenario 4 and taking a 50% increase in Brazilian exports, having as target the selected countries, for Scenario 6 it is considered that value exported by Cattle and Other Animal Slaughtering sector is 71.5% larger than the original value from the IO Matrix for 2006.

3. Findings

Based on the scenarios and on simulations of direct and indirect reductions and increases in beef exports impacts were made. The results in terms of values are summarized in Table 2.

It is observed that the impacts are significant, with a degree of concentration in the sectors most directly linked to beef exports. Anyway, the product multiplier for Cattle and Other Animal Slaughtering Sector was 2.3608, which corresponds to say that changes in the final demand of that sector, for example an increase of R$ 1 million, has an impact on the economy production as a whole of R$ 2.3608 million. In Scenario 1, the reduction in exports was R$ 1.404 billion, corresponding to a reduction of R$ 3.315 billion in the production value of the economy. The most affected sectors were Cattle and Other Animal Slaughtering; Cattle; Agriculture and Forestry; Commerce; Transportation, storage and postal services. The impacts for the other scenarios can be seen in Table 2 itself. According to the model, the order of importance of the impact is the same for all scenarios, varying the magnitudes.

Table 2. Value of sectoral output (X0) and main sectoral impacts (DXi) of changes in beef exports for different scenarios of shocks (R$ million for 2006)

Sector	X0	DX1	DX2	DX3	DX4	DX5	DX6
Cattle and Other Animal Slaughtering	40,405	-1,469	-2,247	-4,501	1,664	3,335	5,559
Feed	38,901	-566	-865	-1,733	641	1,284	2,140
Agriculture and forestry	127,015	-155	-237	-476	176	352	587
Commerce	332,074	-151	-231	-462	171	343	571
Transportation, storage and postal services	195,716	-102	-156	-313	116	232	386
Feeds	12,946	-99	-151	-303	112	225	374
Poultry	19,915	-85	-130	-260	96	193	321
Petroleum refining and coke	133,908	-69	-105	-211	78	156	260
Vegetable Oils	32,826	-65	-100	-200	74	148	247
Electricity, gas, water, sewage and urban sanitation	142,179	-64	-97	-195	72	144	240
Swine	6,758	-50	-76	-152	56	113	188
Total	4,096,010	-3,315	-5,068	-10,154	3,753	7,524	12,539

Source: research results.
Note: DXi corresponds to the change in the value of production for the i*th* scenario (i = 1..6, described in item 3)

Table 3 lists the main impacts proportionally. In this case the order is different from the previous one: the sectors proportionally more affected by changes in beef exports are Cattle and Other Animal Slaughtering; Cattle; Feed; Swine; Other Livestock. Obviously, this difference in order is due to baseline values.

Table 3. Proportional main sectoral impacts (%DXi) of variations on beef exports (%)

Sector	X0	%DX1	%DX2	%DX3	%DX4	%DX5	%DX6
Cattle and Other Animal Slaughtering	127,015	-3.64	-5.56	-11.14	4.12	8.25	13.76
Bovine	38,901	-1.45	-2.22	-4.46	1.65	3.30	5.50
Feed	6,758	-0.76	-1.17	-2.34	0.87	1.73	2.89
Swine	19,915	-0.73	-1.12	-2.25	0.83	1.67	2.78
Livestock, Others	1,770	-0.53	-0.82	-1.63	0.60	1.21	2.02
Poultry	4,234	-0.43	-0.65	-1.30	0.48	0.97	1.61
Vegetable Oils	86,221	-0.20	-0.30	-0.61	0.23	0.45	0.75
Swine Slaughtering	25,114	-0.19	-0.29	-0.57	0.21	0.42	0.71
Fertilizers	13,764	-0.17	-0.26	-0.53	0.19	0.39	0.65
Agriculture and forestry	40,405	-0.12	-0.19	-0.37	0.14	0.28	0.46

Source: research results.
Note: %DXi corresponds to the proportional change in the value of production for the i*th* scenario (i = 1..6, described in item 3)

Regarding the set of scenarios, we observe that smaller impacts correspond to a reduction of R$ 3.315 billion and an increase of R$ 3.753 billion. These values are significantly higher than the National Program for Eradication of FMD (PNEFA) costs in 2006, of R$ 528.6 million (BRASIL, 2008). Such differences are well known, as quoted in Paarlberg et al. (2008, p. 1) comments on Cost-Benefit Analysis for "U.S. programs aimed at preventing or mitigating impacts of livestock diseases".

4. Concluding remarks

The study allows us to observe that there are significant potential gains in terms of international market, as well as significant impacts on Brazilian economy. The same applies to losses due to eventual new FMD outbreaks.

Although the number of FMD outbreaks occurrences in Brazil has reduced significantly over the National Program for Eradication of FMD, the issues raised here are still valid, since there is possibility of new events as well as of status changes. In the latter case, not necessarily for the country as a whole, but especially for certain states.

Finally, it is noteworthy that the figures confirm highly favorable cost-benefit ratios in relation to the FMD control. As future extensions we can mention: updates, regionalized studies, other diseases.

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