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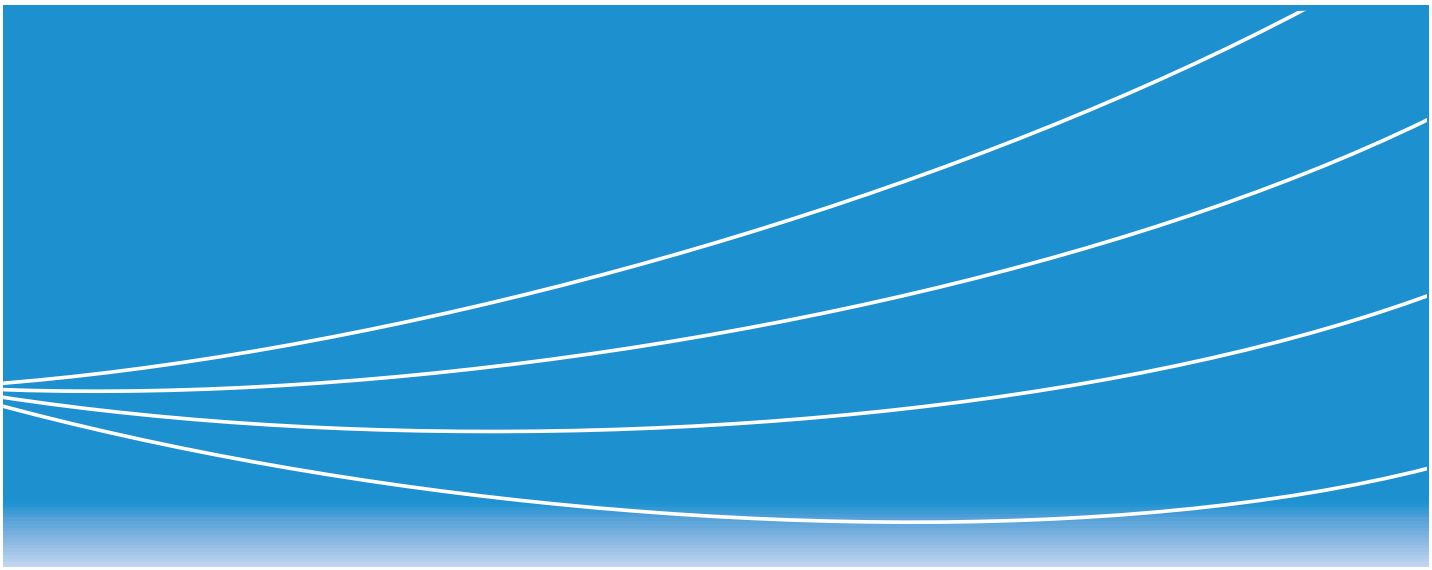
The Transport Costs of Brazil's Exports: A Case Study of Agricultural Machinery and Soybeans



Jorge Chami Batista

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The Transport Costs of Brazil's Exports: A Case Study of Agricultural Machinery and Soybeans[1]

Jorge Chami Batista

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Abstract

This report is a case study aimed at shedding some light on the magnitude and determinants of Brazil's exporting costs. Two exporting firms were selected to provide information on these costs: one exports primary goods (soybeans), while the other exports manufactured goods (agricultural equipment). It is shown that non-policy trade costs tend to be much higher than policy trade costs, especially in the case of Brazil's exports of soybeans. International freight costs are also significant in the case of agricultural equipment. Therefore, much larger cost reductions might be achieved through cuts in non-policy trade costs than in policy trade costs.

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[1] Background paper for the IDB Report "Unclogging the Arteries. The Impact of Transport Costs on Latin American and Caribbean Trade." Inter-American Developing Bank (IDB) and David Rockefeller Center for Latin American Studies. Harvard University. 2008.

Associate. Professor of the Instituto de Economia at the Federal University of Rio de Janeiro. Address: Avenida Pasteur, 250, Praia Vermelha, Rio de Janeiro, 22290-240, RJ-Brazil. Telephone and fax: (5521) 22956644. E-mail: jchami@uol.com.br

I. Introduction

Goods producing firms in Brazil have been confronted with a number of well known difficulties. High levels of taxation, bureaucracy, corruption, and uncertainty concerning the stability of rules and enforcement of contracts, plus poor public services, have often been pointed out by entrepreneurs and analysts as some of these difficulties; see, for instance, the series of annual reports by the World Bank (World Bank [2004] [2005] [2006a] and [2006b]). The bad quality of the country's infrastructure, particularly transportation, has also been identified as one of the major factors helping to raise the costs of Brazilian goods.

These inefficiencies reduce welfare, regardless of the final destinations of these goods. However, the problem for the firms and, consequently, for investment, growth, and long term employment, is aggravated when goods are produced for exports, since foreign competition will not necessarily bear the same difficulties. The costs of exporting goods include transporting them to ports, airports or to bordering countries, going through home and foreign customs, and transporting the goods from country of origin to destination countries. These costs can also be broken down into freight costs, time costs, information costs, contract enforcement costs, costs associated with the use of different currencies, and legal and regulatory costs (See Anderson and van Wincoop [2004] pp. 691-692).

To the extent that these non-policy trade costs are much higher in Brazil than in competing countries, they may represent a more significant factor restraining export growth than foreign import tariff and non-tariff barriers. Furthermore, the policies and initiatives aimed at reducing these costs are matters of domestic political decisions and, therefore, do not depend on negotiations with other countries.

The principal objective of this report is to shed some light on the magnitude and the determinants of these exporting costs in Brazil. To do that, two exporting firms were selected to provide information on these costs. Bearing in mind that both primary and manufactured goods are relevant to Brazil's exports, exporting firms were selected so as to cover both types of goods. The literature on the main characteristics and trade costs of the sectors of these two firms is also reviewed, so as to put the two case studies into a broader perspective.

One of the selected exporting firms, Grupo Caramuru, is a major exporter of soybean. As the planted areas of this grain have tended to expand and move towards the Center-West of the country, away from the coast line, domestic transportation has become a major cost

factor. A number of articles published by the press have already reported the bad conditions of Brazilian highways and the incapacity of major ports to deal with the large export volume of grains, causing very long lines of trucks filled with soybean, waiting to deliver their cargo at these ports (for recent articles, see Barrionuovo [2007]; and Veja [2007]). Moreover, international transportation has also increased its relevance to the final export price of Brazilian soybean, as demand has become more concentrated in Asian countries, China in particular, much further away from Brazil's coast than the traditional European markets. Therefore, exports of soybean were a natural and almost inevitable case to study.

The other selected firm, Maquinas Agrícolas Jacto S.A., is a producer and a major exporter of agricultural or horticultural appliances and equipment for projecting, dispersing or spraying. Although Brazil's export revenue from these products is relatively small as a share of total revenue from exports of manufactures, the two main products exported by this firm may represent two important types of Brazil's exports of manufactured goods. One is small equipment transported in large quantities and packed to fit into a container. The other is a large machine, very much like a vehicle, so that only one unit of it can be transported on a truck and it does not fit into a container. As this firm is located in the state of Sao Paulo, Brazil's most industrialized state and main exporter of manufactured goods, the distance and routes these appliances and equipment travel in the country, before going through customs, are typical of most of the manufactured goods exported by Brazil. As Argentina, Mexico, and Russia are large importers of Jacto's equipment, this case study will illustrate how the costs of international freights vary with distance and mode of transportation.

It should be noticed that Brazil's exports of manufactures are much more diversified than exports of primary goods. As a result, no single product accounts for a very large share of Brazil's total manufactured export revenue. Moreover, products like aircrafts, which account for a significant share of Brazil's export revenue, may have very specific modes of transportation, not representing the problems confronted by the vast majority of exporters. The same would apply to some primary goods, like mining products, petroleum, and derivatives, which may account for significant shares of Brazil's export revenue, but have very specific modes of transportation and idiosyncratic problems.

2. Case Study One: Soybean

2.1. Soybean Output and Exports

Brazil is the world second largest producer and exporter of soybean, after the United States. According to the United States Department of Agriculture (USDA), production in the U.S. reached a record 87 million tons in 2006, but the 2007 U.S. harvest is projected to be 71 million tons only. This is equivalent to 2.625 billion bushels (See Feed & Grain, 2007)[2]. Brazil's soybean output was 55 million tons in 2006 and is forecast to reach 58 million in 2007 (Conab, 2007). Argentina, Paraguay and Canada are also large producers, as shown in Table (1), and exporters of soybean.

Brazil's revenues from exports of soybean have been around $5.5 billion since 2004, equivalent to almost 80% of Brazil's revenues from exports of agricultural and livestock products. As a share of total export revenue, export of soybean has declined from 5.6% in 2004 to 4.5% in 2005 and 4.1% in 2006. The United States shipped 28.1 million tons of soybean to foreign markets in 2006 with revenue of $6.7 billion, whereas Brazil sold abroad 24.9 million tons or $5.7 billion worth of soybean in the same year. Given the potential for expanding its planted area, Brazil is expected to surpass the U.S. as the world largest exporter of soybean in the future.

China has been the largest importer of soybeans, taking 43% of Brazil's export volume[3], after Holland with 15%. But the European Union (15 countries), as a group, takes as much as 40%. China is also the largest buyer of soybeans from the U.S., taking 37% of the domestic export volume from 2004 to 2006, followed by Mexico with 13%, and Japan with 12%. But the EU-15, as a group, only takes 12% from U.S. soybean total domestic export volume.

[2] The primary source is USDA's World Agricultural Outlook Board (WAOB). http://www.usda.gov/oce/commodity.
[3] Exports in tons from 2004 to 2006.

Table (1): Soybean Production (Million MT)

Country	2003	2004	2005
United States	67	85	84
Brazil	51	53	57
Argentina	33	39	41
Paraguay	4	4	4
Others	32	35	36
Total	187	216	222

Note: Brazil and Argentina estimates have been adjusted to a consistent October -September marketing year. Estimates of other countries (including the United States) are on a local marketing year.
Source: USDA, April 2006.

2.2. Soybean Costs and Prices

2.2.1. Production Costs

Production and land costs are much lower in the Center-West of Brazil than in the United States. Table (2) reveals that the farm values of one ton of soybean in this region of Brazil were indeed much lower than in the South of the country, and in the areas of Minneapolis and Davenport in the United States in the fourth quarter of 2005 and in the first quarter of 2006. On the other hand, the farm values of soybean in the South of Brazil are at about the same levels as in the United States.

Table (2): Farm Values of Soybean in Brazil and in the United States

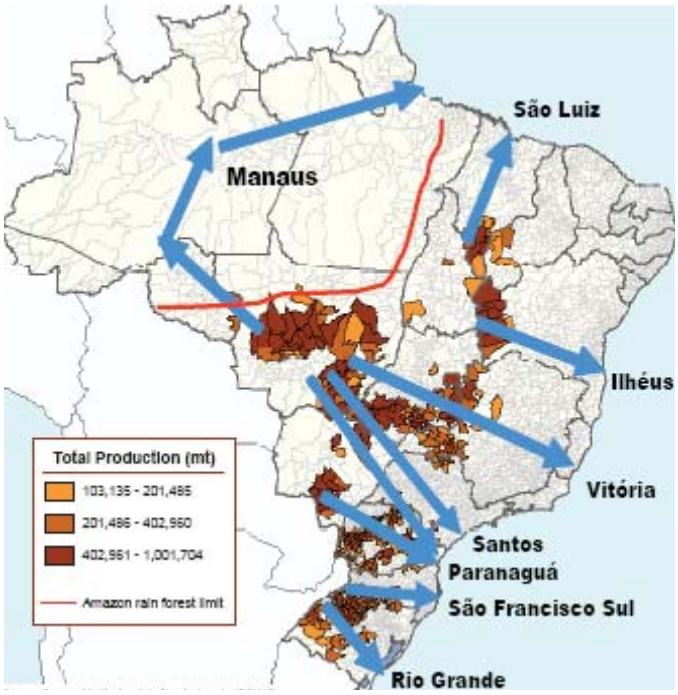
($/ton)		
Brazil	4th Qtr 2005	1st Qtr 2006
North Mato Grosso	174.28	157.86
Southeast Mato Grosso	174.28	157.86
South Goias	184.89	180.71
North Center Parana	214.81	206.88
North West Rio G. do Sul	206.36	202.56
United States	4th Qtr 2005	1st Qtr 2006
Minneapolis, MN	207.11	202.34
Davenport, IA	207.60	204.78

Source: USDA, August 10, 2006.

2.2.2. Domestic Transportation Costs

Figure (1) and Table (3) show that the largest soybean producing and exporting area is located in the Center-West of Brazil. This area is quite a long way from the coast and comprises the states of Mato Grosso, just south of the boundaries of the Amazon rain forest, Mato Grosso do Sul, Goias, and Distrito Federal, in the so-called cerrado region. As it has just been showed, this is also the lowest cost soybean producing area in Brazil. In 2006, 14 million tons of soybeans were moved from these states to Brazilian ports for export. This was almost 60 percent of that region's output. The soybean transported load to the ports from Mato Grosso only totaled almost 10 million tons in the same year.

Figure (1): Planted Areas and Main Export Routes for Soybean



Source: Salin and Faust, April 2006.

The ports of Santos and Paranagua accounted for 28 and 16 percent, respectively, of the soybean exported from Brazil in 2006. The ports of Rio Grande (RS) and Sao Francisco do Sul (SC) accounted for 14 and 12 percent, respectively. Considering that trucks account for about 60 percent of general cargo transport in Brazil, and bearing in mind that 75 percent of exports of soybean take place in the months from April to September and 40 percent in the three months from May to July - see Figure (2), it is possible to have an idea of the traffic flow generated by this crop exports on already very busy roads crossing the states of Sao Paulo and Parana. Assuming that exports of soybean departing from the ports of Manaus (1584 tons) and Santarem (954 tons) are originally from the state of Mato Grosso, it is possible to estimate that about 7.3 million tons of soybeans had to be transported along approximately 2.2 thousand kilometers from this state only to the ports of Santos and Paranagua in 2006[4].

[4] It is possible to roughly estimate the number of truck journeys used to transport soybean from Mato Grosso to the ports of Santos and Paranagua in 2006. Given that a truck carries on average 35 ton of soybean, 927 truck journeys per day were necessary in the months from May to July, and 811 trucks per day in April, August and September.

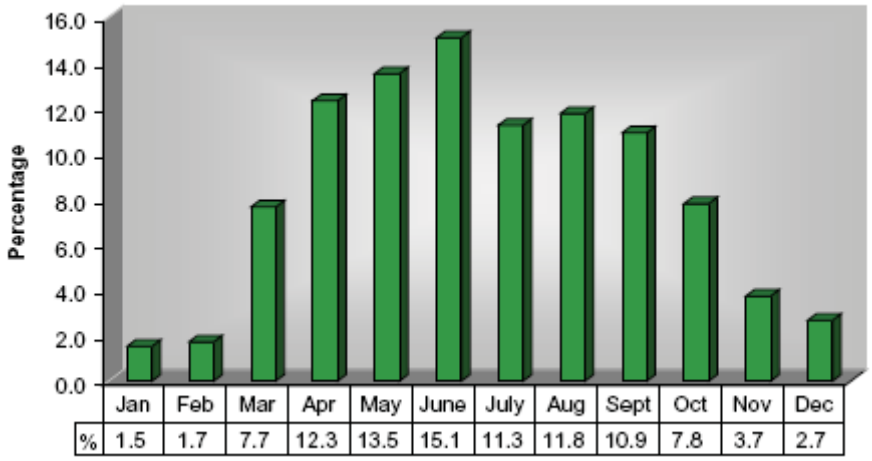
Table (3): Brazil's Soybean Planted Area, Output and Exports by States

Regions and States	Planted Area (1000 hectares)		Output (1000 MT)		Exports (1000 MT) 2006
	2005/2006	2006/2007	2005/2006	2006/2007	
Center-West	10743	9106	27825	26410	13961
Mato Grosso	6197	5125	16700	15272	9921
Mato Grosso do Sul	1950	1737	4445	4881	1182
Goias	2542	2191	6534	6114	2800
DF	54	52	146	142	58
South	8295	8200	18249	22721	6372
Paraná	3983	3931	9646	11753	2890
Rio Grande do Sul	3967	3892	7776	9925	3278
Santa Catarina	345	377	828	1044	204
Other states	3711	3334	8953	8909	4617
BRAZIL	22749	20640	55027	58040	24950

Source: Conab, julho 2007; and Secretaria de Comercio Exterior – Secex-Sistema Alice.

Table (4) clearly reveals that the transportation costs from the cheapest producing area in Brazil to the main port in Parana by truck are much higher than the cost of bringing down the soybean produced around Minneapolis and Davenport by truck and barge, along the Mississippi River, to the Gulf ports in the United States.

Figure (2): Brazil Soybean Average Exports



	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
%	1.5	1.7	7.7	12.3	13.5	15.1	11.3	11.8	10.9	7.8	3.7	2.7

Mean: 2003-2005
Source: Salin and J Faust, April 2006.

The high cost of transportation from farms in Mato Grosso to the port of Paranagua is partly because of the long distance, but also due to the lack of intermodal competition. In Mato Grosso, the rail system is almost non-existent. As a result, grains have to be moved by trucks either directly to ports or to railway or waterway transfer terminals far away from the farms of the north of the state. The high cost of transporting soybean by trucks is exacerbated by the poor condition of the roads - see figure (3). In point of fact, both the highways from the north of the state to the transfer terminal of the Madeira River in Porto Velho (RO) (BR-364) and to the Amazon River Port of Santarem-Para (BR-163) are still unpaved (See Confederacao Nacional do Transporte [2005])[5]. Although paving these roads is said to be a major federal government priority, environmental restrictions and lack of funds have been inhibiting this project.

[5] "…only 12% of the 999,857 miles of Brazilian roads are paved. The condition of the paved roads varies across the country, with half the paved roads ranging from passable to very bad".

Table (4): Transportation Cost from Farms to Ports ($/ton)

North of Mato Grosso to Paranagua	Minneapolis to the Gulf	Davenport to the Gulf
by truck	by truck and barge	by truck and barge
1st Qtr 200569.96	7.58+18.42=26.00	7.58+18.16=25.74
2nd Qtr 200579.07	7.82+18.93=26.75	7.82+14.67=22.49
3rd Qtr 200580.67	8.90+28.88=37.78	8.90+23.63=32.53
4th Qtr 200580.86	10.06+36.71=46.77	10.06+30.91=40.97
1st Qtr 200684.65	9.42+25.38=34.80	9.42+21.42=30.84

Source: USDA, August 10, 2006.

Figure (3): Condition of Major Brazilian Highways

Source: Salin and Faust, April 2006.

On the other hand, more than half of the U.S. soybean exports traverse some portion of the Mississippi River System. Bulk transportation costs for barges do not increase so much the farm price of American soybean (See Ash et al. [2006])[6]. Indeed, transportation costs, including trucks and barges, from Minneapolis and Davenport were between 13 and 18 percent of the Gulf price, whereas the truck costs from north of Mato Grosso were between 32 and 35 percent of the price at Paranagua[7].

Table (5) adds the farm values, shown in Table (2), to the domestic transportation costs from the main areas of production to the main ports of soybean export, shown in Table (4). It is clear that the cost of transporting soybean to the port of Paranagua more than erodes the farm cost advantage of the cheapest producing area of Brazil. Minneapolis and Davenport soybeans at the Gulf ports were cheaper than the soybeans from the north of Mato Grosso at the Paranagua port in 2005/2006.

Table (5): Soybeans Costs at Ports in Brazil and in the United States ($/ton)

Brazil	**4th Qtr 2005**	**1st Qtr 2006**
Rio Grande from Northwest RS	219.56 (6%)	216.10 (6%)
Santos from South Goias	227.45 (19%)	223.20 (19%)
Paranagua from North Center Parana	236.06 (9%)	226.29 (9%)
Paranagua from North Mato Grosso	255.14 (32%)	242.5` (35%)
United States	**4th Qtr 2005**	**1st Qtr 2006**
Gulf of Mexico from Davenport, IA	248.57 (16.5%)	235.62 (13%)
Gulf of Mexico from Minneapolis, MN	253.88 (18.0%)	237.14 (15.0%)

Note: Inside the parenthesis is the share of domestic transportation in soybean costs at the port.
Source: USDA, August 10, 2006.

However, the costs of soybean at the Ports of Rio Grande, Paranagua, and Santos from the Northwest of Rio Grande do Sul, North Center of Parana, and South of Goias, respectively, were lower than at the Gulf ports of the United States. Transportation costs were decisive for

[6] According to the USDA, the Mississippi barge transportation rates can be further reduced through a modernization of the locks on the river system, avoiding splitting of tows, and thus allowing cuts in transit times.
[7] The soybean price at Paranagua is used by traders as the general reference price for the Brazilian soybean premium compared to Chicago stock exchange prices.

this price advantage, as they accounted for only 6 percent, 9 percent, and 19 percent of soybeans costs at the ports of Rio Grande, Paranagua, and Santos, respectively, in 2005/2006.

The principal determinants of freight rates for the transport of soybean on trucks in different states in Brazil have been analyzed in an econometric study (See Correa Junior and Caixeta [2003]) for the period between 1998 and 2000. Applying a multiple regression model, several equations were estimated based on the ordinary least-squares method: two equations per year, one for the harvest period and the other for the off season period; and one equation for each of the analyzed states: Goias, Mato Grosso, and Parana. The following explanatory variables were tested: distance, road conditions, number of toll roads, and specific port destinations. The effect of demand seasonality is assumed to be picked up by the difference between the two equations covering the high and the low season.

No theoretical model for the demand and supply of freights is presented. The econometric model is an attempt to explain freight rates through factors that are expected to change the cost of transporting soybean by truck. While the data for the dependent variable, freight rates, and for the distance variable are available and well documented, the data for the other variables are difficult to obtain and, when available, are imprecise.

Road conditions, for instance, were measured as a zero or one variable, according to a highway survey (See Pesquisa Rodoviaria da Confederacao Nacional de Transporte [2000]). A route was given a value equal to one if at least one of its roads was classified among the best roads by the survey and none was listed among the worst roads in any of the two years of the survey. A route was given a value equal to zero if it used a road classified in any of the lists of the worst roads of the survey. Thus, the coefficient of this variable is expected to be negative.

The number of toll roads is assumed to pick up the effect of toll roads on freight rates independently of the direction of the toll road and the actual paid fee. The specific destination variable is an attempt to measure the possibility of the truck getting a return freight. It is also a binary variable which assumes a value equal to one if the final destination is the cities of Paranagua, Santos, or Guaruja. It is assumed that trucks are very likely to get a return freight from these cities.

The coefficients of the distance variable were significant at the 1% level in all eighteen regressions (combining three states, three years and two seasons) and revealed that the cost

per kilometer was highest in Parana and lowest in Mato Grosso. The coefficient of the number of toll roads variable was also significant (1% level) and had the expected sign in all six regressions for the states of Goias and Mato Grosso during the high season. On the other hand, this coefficient was only significant in the off season period of 2000/2001 in the states of Goias and Mato Grosso. This coefficient was always either not significant or had the wrong sign in the regressions for the state of Parana. The road conditions variable was significant and had the expected sign only in one regression: in the high season of 1998 in the state of Goias. The coefficient of the specific destination variable was significant only in the high season of 1999 and 2000 for the state of Parana.

Although the regressions statistics such as the F statistic, the coefficient of determination, and the Durbin-Watson statistic were generally good, it is quite possible that the bad performance of road conditions, as an explanatory variable, may have been due to the binary way the variable was measured, plus the fact that the number of tool roads is likely to be positively correlated to actual road conditions.

The authors of the study concluded that the direct effect of distance on freight rates is very robust, but their magnitudes as well as the effects of other variables depend on the time of the year and on the state trucks are departing. Out of the grain harvest period, demand is low compared to the supply of truck transportation, so that competition forces freight rates to be almost insensitive to all other factors but distance. Freight rates in the high grain harvest season in the state of Parana is likely to have been high due to the delays caused by heavy traffic, as opposed to bad conditions of the roads in the state, and by traffic jams in the vicinity of the port of Paranagua.

2.2.3. Ocean Freight Rates

Brazil's competitive position in soybean exports is further deteriorated once ocean freight rates are taken into account, as the examples of freight rates from Brazil and from the United States to Shanghai (China) and Hamburg (Germany) in Table (6) clearly illustrate.

Ocean freight rates for transporting soybean from Brazil depend, among other things, on the export volumes of soybean and iron ore. The availability of vessels tends to increase, relative to the volume of soybean exports, as exports of iron ore decline, reducing the freight rates.

Table (6): Ocean Freight Rates for Shipping Soybeans ($/MT)

To	Shanghai	Hamburg	
	2006	2005	2006
From	1st Qtr	4th Qtr	1st Qtr
Santos	50.13	56.73	39.51
Paranagua	49.13	55.73	38.51
Rio Grande	48.63	55.23	37.06
From			
Gulf of Mexico	35.71	22.81	19.53

Source: USDA, August 10, 2006.

2.2.4. Landed Costs

Table (7) shows soybean costs from Brazil and from the United States in Shanghai and in Hamburg. Note that the shares of transportation costs in landed costs both in Shanghai and in Hamburg tend to be higher for soybean from Brazil than from the United States, especially for soybean produced in the Center-West region of Brazil.

Examining the market shares of Brazil and the United States in imports of soybeans in different countries, it seems that Brazil is more competitive than the U.S. in European countries and became more competitive in China in 2006. On the other hand, U.S. is still more competitive in Japan and totally dominates the import markets of Canada and Mexico. Ocean freight costs still maintain U.S. soybeans competitive in neighboring countries, Mexico and

Canada, where the U.S. supplies between 98 and 100 percent of these countries' soybean imports.

Table (7): Landed Costs and Shares of Transportation Costs
($/ton in the 1st Qtr 2006)

To	Shanghai	Share	Hamburg	Share
From Brazil				
Northwest RS – Rio Grande	264.73	23%	253.16	20%
South Goias – Santos	273.33	35%	262.71	31%
North Center PR – Paranagua	275.42	25%	264.79	22%
North Mato Gross-Paranagua	291.64	46%	281.02	44%
From the United States				
Davenport-Gulf	271.33	25%	255.15	20%
Minneapolis –Gulf	272.85	26%	256.67	21%

Note: Inside the parenthesis is the share of transportation costs in landed costs.
Source: USDA, August 10, 2006.

Table (8): Market Shares of Brazil and the U.S. in Selected Importing Countries

Importers	China		Japan		Germany		Netherlands
Exporters	**2005**	**2006**	**2005**	**2006**	**2005**	**2006**	**2005**
Brazil	30%	41%	13%	9%	59%	51%	71%
United States	42%	35%	75%	80%	28%	36%	18%

Based on imports by countries of HS 120100.
Source: Comtrade, United Nations.

Because the peak of the United States exports of soybean is from December to April, while most of Brazil' exports take place from April to September, changes in prices and in exchange rates make any comparison between annual CIF prices rather tricky. Table (9) shows that the annual CIF unit values of soybean from Brazil were higher than those from the United States in 2005, except in Japan, but became lower in all selected importing countries in 2006. It seems quite clear that changes in annual CIF unit values are inadequate to explain the shifts in market shares of exporters in these importing countries as seen in Table (8).

Table (9): Import Unit Values – CIF ($/ton)

	China		Japan		Germany		Netherlands
From	**2005**	**2006**	**2005**	**2006**	**2005**	**2006**	**2005**
Brazil	299.42	259.87	307.37	274.29	266.24	263.97	252.49
United States	286.05	275.06	322.13	304.00	260.43	270.33	224.75

Based on 6-digit HS 120100.
Source: Comtrade, United Nations.

Perhaps more fruitful is the comparison made in Table (10) between the CIF-FOB unit value differences of soybean exports from Brazil and from the United States in large importing countries. The "Dif Log" columns calculate the differences between the CIF-FOB unit values of Brazil and the United States in logs and are thus relative measures of these differences[8]. Note that Brazil's differences between her CIF and FOB unit values are much larger than those of the United States, especially in Japan and China in 2005, but negligible in Germany both in 2005 and 2006. This is a rough measure of the higher ocean freight and insurance rates to Asia paid by Brazilian exporters as compared to U.S. exporters. Measures of transportation costs based on matched partner trade statistics are known to be quite unreliable (See Hummels. [2006] pp. 69-86). Anderson and van Wincoop (2004) also provides a discussion on these data, less critical though.

Table (10): CIF-FOB Unit Values ($/MT)

	2005			2006		
	Brazil	**U.S.**	**Dif. Log**	**Brazil**	**U.S.**	**Dif. Log**
China	59.54	46.23	0.253	34.08	30.10	0.124
Japan	76.39	44.82	0.533	47.96	43.06	0.108
Germany	30.75	30.79	-0.001	32.91	30.76	0.068

Source: Comtrade, United Nations.

2.2.5. Import Tariffs

Soybean imports enter countries of the European Union, Japan, and Taiwan free of import tariffs. China charges a MFN tariff between 0 and 3%[9] (average 2.4% according to Unctad), but Brazilian soybean pays no import tariff. Mexico imports free of import tax from February 1st to July 31st, but charges 15% MFN tariff from August 1st to January 31st. Brazil and

[8] Alternatively, one could find the CIF-FOB values as a proportion of either the FOB or CIF values. The difference in log is just approximately equal to the ratio of the CIF-FOB value to the average of the CIF and FOB values.
[9] These tariffs refer to the group of products classified at the 6-digit level of the Harmonized System (HS 120100).

Mexico trade agreement (ACE 53) gives a preference of 80% of the Mexican tariff to Brazil. Chile and Peru have an ad valorem MFN tariff of 8% and 4%, respectively.

2.3. The Case of Grupo Caramuru[10]

The Grupo Caramuru is a large exporter and manufacturer of soybean in Brazil, processing 3500 tons of this grain per day, producing lethicin (900 tons/month), soy oil (600 tons/day) and biodiesel (300 tons/day). It is also a corn manufacturer, processing 2054 tons of this grain per day, and operates grain-handling facilities such as grain storage facilities for 1.6 million tons, facilities for load transfer at an intermodal railway-waterway terminal in Pederneiras (SP), on the banks of Tiete and Parana Rivers, a waterway terminal in Anhembi (SP), and port terminals in Tubarao (ES) and Santos (SP). It employs 2150 workers.

Because trade costs vary enormously according to the area of production, we here focus on trade costs associated with the production in the north of the state of Mato Grosso, which is the greatest and lowest cost producing area. In the state of Mato Grosso, production is concentrated in the area around the city of Sorriso. From this area, there are seven basic alternative routes to transport this crop to a port for export. They are all quite expensive, as transport costs account for about one third of the FOB price of the product, whatever the selected route. The FOB price at a particular port and at a given moment in time is fixed independently of the final destination. The farm price is also independent of the port of destination. They are both set in advance and are related to the prices at the Chicago stock exchange, allowing an expected gross margin for the exporter. Because futures market can provide hedge for the prices paid and received by the exporter, but not for local transportation costs, the actual margin will largely depend upon these costs.

In Mato Grosso, the rail system is almost non-existent. As a result, grains have to be carried by trucks:

(i) Directly to the ports of Santos (SP), Paranagua (PR), or Santarem (PA);

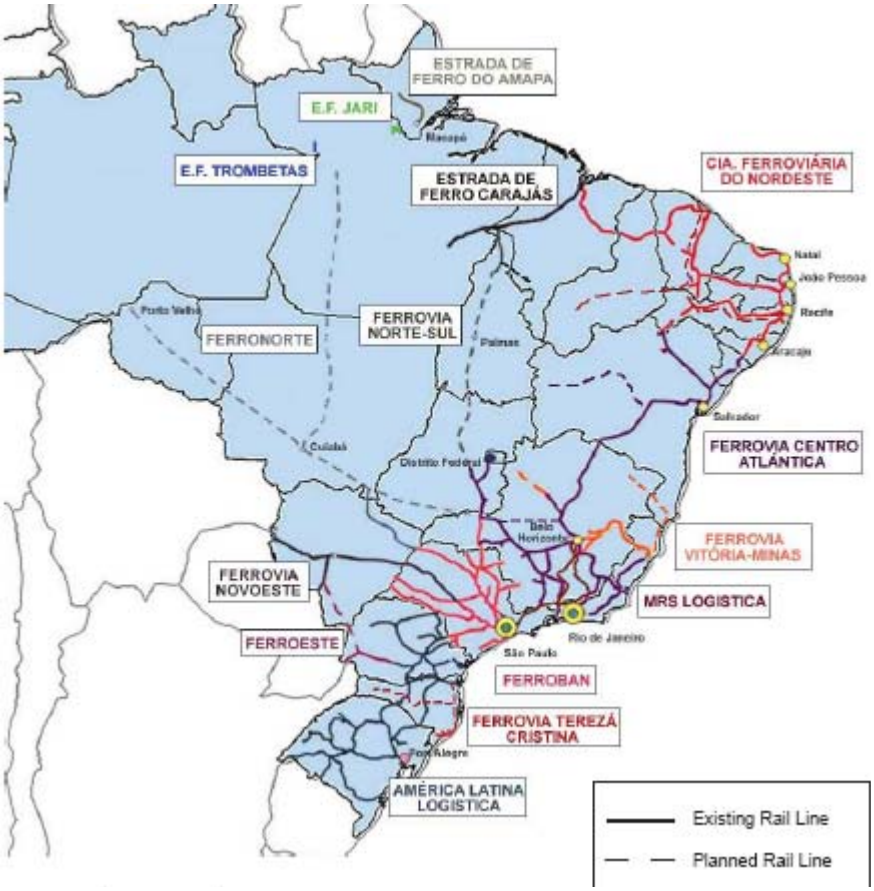
(ii) To Porto Velho (RO), then on barges to the port of Itacoatiara (AM);

(iii) To the railway terminal in Alto Araguaia in the south of the state of Mato Grosso, near the border with the state of Goias and Mato Grosso do Sul, and from there to the port of Santos on railway; or

[10] This section is based on a questionnaire and interview with Mr Antônio Ismael Ballan, logistic director of Grupo Caramuru. Mr Cristiano Faria also helped with useful information.

(iv) To the railway terminal in Maringa, in the state of Parana, and from there to the port of Paranagua on railway - See Figure (4).

Figure (4): Brazilian Rail System



Source: Salin and Faust, April 2006.

Table (11) shows the costs of inland transportation as a share of the FOB price for the above seven alternative routes, based on prices in July 2007 at the port of Paranagua, which is the reference price for other ports in Brazil. In this period, the farm price was 66.45 percent of the FOB price of $310/ton at Paranagua. It should be observed that the cheapest route at that time was from Sorriso to Paranagua, using trucks up to Maringa and from there on railway. The shortest and fastest route is to the port of Santarem on the Amazon River, but this is also the most expensive. The main reason is that the highway from Sorriso to Santarem (BR-163) is not paved and its conditions are very bad indeed. The same applies to the highway from

Sorriso to Porto Velho (BR-364), from where the load goes into barges to travel on the Madeira River to the port of Itacoatiara on the Amazon River.

Table (11): Transportation Costs from the Area Around Sorriso in Mato Grosso

Destination State	Transportation mode	Distance km	Duration days	Quantity tons	Cost as a % of FOB price
1. Paranagua – PR	Highway-railway	2321	5	2000	32.08
2. Santos – SP	Highway-railway	2249	5	3000	32.77
3. Santos – SP	Highway	2164	3	1500	32.95
4. Paranagua-PR	Highway	2183	5	1500	32.95
5. Vitória-ES	Highway-railway	2863	8	1000	33.64
6. Itacoatiara-AM	Waterway-highway	2761	8	2000	34.33
7. Santarem-PA	Highway	1371	2	1000	34.68

Source: Grupo Caramuru.

The Madeira-Amazon waterway was constructed by a private company, the Maggi Group, and its subsidiary Hermasa Navegacao da Amazonia SA transports two million tons of grains, almost ten percent of Mato Grosso grain output. From Porto Velho to Itacoatiara, grains are carried on 16 barges with a capacity of 32 tons altogether and travels 1150 km. In Itacoatiara, the grains are then embarked into large ships that travel 1100 km on the Amazon River until reaching its mouth on the Atlantic. Waterways are by far the cheapest way of transporting grains. According to the secretary of rural development of the state of Mato Grosso, grain transportation by railways costs three times the cost by waterways, while transportation by highways costs as much as nine times (See Agencia de Noticias Brasil-Arabe, ANBA, 2004).

It is noteworthy that although the share of inland transportation in FOB prices has not changed much compared to the figures of the 4th quarter of 2005, see Table (5), the sharp increase in the FOB price of soybean means that inland transportation cost to Paranagua rose by as much as 21.6 percent in dollars, slightly more than the 19.5 percent it would have risen just on account of the appreciation of the real in the period.

In order to calculate the costs of Brazilian soybean from Sorriso at any port in Brazil, it is necessary to add the costs of stocking, loading and unloading, and all the legal rates at the

port of embarkation. The port of Santos was selected, since it is the largest exporter of Brazilian soybean[11]. At the port of Santos the product stays on average seven days. Grupo Caramuru estimates that these port costs total US$7.00/ton in Santos. Transport is by truck from Sorriso to Alto Araguaia and by railway to Santos.

The cost from Santos to China is US$50 per ton (of which 90 percent for the freight and 10 percent for insurance) and sixty tones of soybean are embarked per vessel. The distance is 18,734 km and the average time is thirty seven days. There are no regular lines, so transportation is taken by tramp ships. Among other things, freight costs depend on the export volume of other commodities, especially iron ore in this case. But the main structural problem appears to be the low levels of dry cargo imports to fill bulk carriers on the way to Brazil. This seems to raise significantly Brazil's ocean freight rates for grains. Table (12) sums up all these costs. It should be noted that trade costs are equivalent to 78.5 percent of the farm price.

Table (12): Trade Costs from Brazil to China: Sorriso-Shanghai

	US$/Ton	**% of farm price**
Farm Price	**206.00**	**100.0**
Transport to Santos	**101.59**	**49.3**
Port costs	**7.00**	**3.4**
Transport to China	**50.00**	**24.3**
Other cost*	**3.10**	**1.5**
TOTAL	**367.69**	**178.5**

* Legal, contracts, and information costs.
Source: Grupo Caramuru.

According to Caramuru, trade costs could be reduced through investments in the transportation infrastructure. The supply of railway services is low in the existing lines. Much has to be done to improve the efficiency of the railways. The Brazilian railway system carries 21 billion tons per kilometer-year, compared to 2700 billion tons in the United States, and the average speed of trains for load transportation in Brazil is still 25 km per hour, compared to 64

[11] Paranagua used to be the top Brazil soybean export port, but lost its leadership to Santos when it banned genetically modified soy passing through the port from October 2003 to April 2006.

km per hour in the United States (Veja, 2007)[12]. Extending the railway lines into Mato Grosso would help to reduce transportation costs, but not the efficiency of the system. The Paranaíba-Tiete-Parana waterways could also be improved through investments in protecting bridge pillars and in dredging the rivers to allow larger vessels. Unpaved highways ought to be paved, paved highways ought to be kept in good conditions, but toll roads are expensive for transporting grains. Ocean freight rates could be reduced through investments in harbor dredging that could allow larger ships into the ports.

3. Case Two: Trade Costs of Agricultural Mechanical Appliances

According to the Mercosur system of merchandise trade classification (NCM), there are two products classified under the head of agricultural or horticultural appliances and equipment for projecting, dispersing or spraying (HS 842481). The first is manual appliances (NCM 84248111) and the second is any other equipment to spray fungicide and insecticide (NCM 84248119). Brazil exported $13.2 and $16.1 million of manual appliances and $38.4 and $39.0 million of other equipment in 2005 and 2006, respectively. Table (13) shows that Mexico and Peru were the main destination countries for manual appliances, while Argentina and Russia were the two main importers of other equipment from Brazil in 2006.

The port of Santos accounted for 89% of export revenues of manual appliances and 48% of other equipment in 2006, followed by Foz do Iguacu which accounted for 3% and 23%, respectively. FOB unit values of manual appliances from Brazil to Mexico were $29.62 in 2005 and $32.23 in 2006, less expensive than to Peru, $34.81 in 2005 and $32.61 in 2006, but higher than to Argentina, $21.97 in 2005 and $22.75 in 2006. FOB unit values of other equipment varied enormously, suggesting that quite different products are aggregated under this heading. To Russia unit values were $13021 in 2005 and $19305 in 2006, while to Argentina they were $6996 in 2005 and $13734 in 2006. Therefore, examining the trade costs of these two products will illustrate both the cases of a relatively low and a relatively high price manufactured good.

[12] Associacao Nacional de Transportes Ferroviarios and CIA- World Factbook, both were primary sources quoted in Veja.

Table (13): Brazil's Exports of Agricultural or Horticultural Sprayers: 2006 (US$)

Destinations	manual appliances[1]	share	other equipment[2]	share
Argentina	494,601	3%	9,696,342	25%
Russia	17,402	0%	5,637,099	14%
Mexico	3,677,326	23%	2,478,450	6%
Peru	1,577,398	10%	346,487	1%
Other contries	10,358,368	64%	20,822,683	53%
Total	16,125,095	100%	38,981,061	100%

(1) NCM 8424111; (2) NCM 84241119.
Source: Secretaria de Comercio Exterior – Secex-Sistema Alice.

3.1. Imports from the United States[13]

U.S. imports from Brazil of agricultural or horticultural appliances and equipment for projecting, dispersing or spraying (HS 842481) are concentrated in two products, according to the U.S. Harmonized Trade System (HTS): sprayers, except self-contained having a capacity not over 20 liters, for agricultural or horticultural (HTS 842481000); and agricultural or horticultural, sprayers self contained, having a capacity not over 20 liters (HTS 842481040). The first product (sprayer-00 for short) accounted for 48 percent and the second (sprayer-40) accounted for 52 percent of Brazil's revenue from exporting all sprayers (HS 842481) to the U.S. in 2006.

Canada, Denmark, and China were the main exporters of sprayer-00 to the U.S., with market shares of 44 percent, 13 percent, and 11 percent, respectively, in 2006. Brazil's share in U.S. imports was 4 percent in this year. This product is free of import tariff. There are no data on quantities, hence unit values are unavailable. However, it is possible to have an idea of freight and insurance rates per country, dividing the difference between the CIF and FOB total values by the latter figure. This ratio in percentage for the leading exporters was 1.3 percent for Canada, 0.8 percent for Denmark, and 17.0 percent for China. Brazil's ratio was 14.3 percent. These ratios for China and Brazil are also high compared to Italy's 5.5 percent and Taiwan's 7.4 percent, but not compared to Colombia's 16.4 percent[14] These were other

[13] Data are from the United States International Trade Commission (USITC) database: http://dataweb.usitc.gov/; access in August 2007.
[14] Although CIF and FOB values are both from the same source (USITC), the data do not allow for a break down by mode of transportation.

important exporting countries to the United States in 2006. These figures seem to suggest that international freights for similar distances are much higher for developing countries.

The main exporters of sprayer-40 to the U.S. were China and Mexico. China sold 42 percent of U.S. imports in 2006, while Mexico and Brazil sold 26 percent and 11 percent, respectively. However, the products from China under this head have much lower unit values than Mexico's and Brazil's. In 2006, China's FOB unit value was $2.52 per unit, whereas Mexico's and Brazil's unit values were $33.31 and $28.43, respectively. Per unit differences between CIF and FOB values were $0.44 for China, $0.27 for Mexico, and $2.68 for Brazil. Relatively to FOB unit values, these differences were 18 percent for China, 9 percent for Brazil and 2 percent for Mexico. In addition to paying higher freight and insurance rates, China paid import tariffs of 2 percent, while Brazil and Mexico paid no import tariffs on this product in 2006.

3.2. Import Tariffs

Sprayers enter Mexico free of import tariff. Russia has a MFN import tariff between 5 and 10 percent. Brazil's sef-propelled sprayers pay 10 percent of import tariff in Russia. Brazilian sprayers are imported in Argentina free of import tariffs, but a 16 percent MFN tariff is imposed on Non-Mercosur exporters.

3.3. Maquinas Agrícolas Jacto S.A.[15]

Jacto was founded in Brazil in 1948 by a Japanese immigrant who still owns the company. It is located in the city of Pompeia in the state of Sao Paulo. Jacto produces and exports agricultural or horticultural appliances and equipment for projecting, dispersing or spraying. Farmers of over sixty countries use Jacto's appliances and equipment. It employs over 1700 workers and offers over 100 different models of sprayers, from backpack manual sprayers to state of the art self-propelled sprayers for agricultural use. In 1998, Jacto Inc, a subsidiary of Jacto, was founded in the United States to sell, market (through independent dealers and distributors), and give technical support to Jacto's products throughout that country.

Table (14) reveals the relative price of each type of sprayer at the most important final destinations, considering the factory prices of both products equal to 100. From the plant in

[15] This section is based on a questionnaire received from Mr Antonio Roberto de Assis, administrative manager of Maquinas Agricolas Jacto S.A.

Pompeia to Foz do Iguacu (or Uruguaiana) on the Brazilian border, a truck takes sixteen hours to travel 800 km, carrying one unit of the self-propelled sprayer or 1300 units of the backpack sprayer. From the plant to the port of Santos, a truck takes eight hours to travel 530 km, carrying one unit of the self-propelled sprayer or 1252 units of the backpack sprayer. The inland relative transport costs per unit range from 3.1% of the factory price, in the case of backpack sprayers, to 4.3%, in the case of the self-propelled sprayer going to Santos.

It takes on average 3 days to go through customs (2 days for backpack sprayers in Foz do Iguacu). The relative customs cost of self-propelled sprayers is much higher than that of backpack sprayers. In Santos, storing and embarking costs at customs for self-propelled sprayers are 4.4 percent of the factory price, and legal and tax costs represent 1.1 percent of the same price. For backpack sprayers, storing-embarking costs and legal-tax costs are 0.4 percent and 0.5 percent of factory price, respectively.

In Argentina, delivery is near Buenos Aires, which means that trucks takes eighteen hours, traveling 1300 km, after going through customs. But freight, insurance and other costs total 3 percent of the factory price for both self-propelled and backpack sprayers. However, it takes 45 days to ship self-propelled sprayers from Santos to Russia, and ocean freights and insurance cost is equivalent to 14 percent of factory price. Ships take 15 days to carry backpack sprayers from Santos to Mexico and ocean freight and insurance cost 8 percent of factory price.

According to Jacto, competition among ocean shipping companies is generally high, with many companies offering regular freights to the main destinations. Mexico and Russia are exceptions, since there are only six shipping companies offering freights to Mexico and three to Russia, but they are quite aggressive in price competition. Freight rates are per container for backpack sprayers and per volume for self-propelled spayers.

Table (14): Relative Trade Costs of Exporting Brazilian Sprayers

Product	Self-propelled sprayer		Backpack sprayer	
Destination	Argentina	Russia	Argentina	Mexico
Price at the factory	100.0	100.0	100.0	100.0
Inland transportation				
Foz Iguacu	3.3	-	3.1	-
Santos	-	4.3	-	3.1
Customs	5.4	5.5	0.9	0.9
FOB Price	108.7	109.9	104.0	104.0
International freight	3.0	14.0	3.0	8.0
Price at destination	111.7	123.8	107.0	112.0

Source: Maquinas Agricolas Jacto S.A.

4. Final Considerations

Non-policy trade costs of soybean from the north of the state of Mato Grosso in Brazil to Shanghai in China were estimated by a major exporter to be 78.49 percent in terms of their ad-valorem tax equivalent. This considers the CIF price at the port in Shanghai compared to the farm price in Sorriso and does not include local transportation and distribution costs in China. This tax equivalent of soybean non-policy trade costs breaks down into 49.32 percent domestic transportation costs, 3.28 percent non-policy export costs (port, legal, contracts, and information costs), and 15.78 percent ocean freight and insurance costs.

MFN import tariff for soybean in China ranges from 0 to 3 percent with an average of 2.4 percent (TRAINS). Brazil's soybean enters China free of import tariff. There are non-tariff measures (NTMs) according to Unctad, but no ad-valorem equivalent information is available. In any case, Brazil's non-policy trade costs seem to be much higher than policy trade costs for soybean in China. The European Union and Japan have no policy trade costs for soybean.

According to Anderson and van Wincoop (2004, p.692), a rough estimate of the tax equivalent of 'representative' (policy and non-policy) trade costs for industrialized countries is 170 percent. This number breaks down as: 21 percent tax equivalent of transportation costs[16]; 44 percent border-related barriers, and 55 percent retail and wholesale distribution

[16] This is based on estimates for U.S. data.

costs. The tax equivalent estimate of transportation (domestic and international) costs for our soybean case study (Sorriso to Shanghai) is 72.88 percent (1.4932*1.1578-1=0.7288).

The tax equivalent of soybean transportation costs from the north of Mato Grosso to Shanghai was estimated at 85 percent, according to USDA data for the first quarter of 2006. This compares to 35 and 33 percent tax equivalent from Minneapolis or Davenport, respectively. Therefore, the tax equivalent export transportation cost of the largest producing area in Brazil is more than twice the same tax cost in the largest producing area in the United States.

Most of this tax differential refers to the domestic transportation cost. The tax equivalent of this cost in Brazil (north of Mato Grosso) was 54 percent compared to 15-17 percent in the United States, while the tax equivalent of the ocean freight was 20 percent in Brazil compared to 15 percent in the Unites States.

Therefore, soybean is a clear example of a Brazilian export product for which non-policy trade costs are much more relevant than policy costs. As a result, much larger cost reductions can be achieved through investment policies designed to improve the domestic transportation infrastructure than through trade policy negotiations.

In the specific case of soybean, this means to improve the existent waterways of the Madeira and Tiete Rivers, modernize the railway lines to the ports in Sao Paulo, Rio Grande do Sul, and Parana, and allow larger ships into Brazilian ports through harbor dredging. For the soybean of the north of Mato Grosso, although the highways from Cuiaba to Porto Velho and to Santarem ought to be paved, trucks are clearly inadequate for long distance transportation of large volumes of grains.

The projected[17] 206 km extension of the Ferronorte railway, connecting Alto Araguaia to Rondonopolis, should cut transportation costs from the West to the ports in the Southeast and South. But transporting grains from the Center-West of Brazil to the ports of the Amazon River seems to make more sense than adding more traffic to the transport and port systems of the Southeast and South of Brazil. Though not contemplated in the present government plans, the Tapajos-Teles Pires Waterways seems to be the best route to export soybean from the

[17] PAC- Programa de Aceleração do Crescimento- Infra-estrutura Logistica.

north of Mato Grosso. It connects the north of Mato Grosso to Santarem. The project requires some investment in canal locks, but the costs are reasonable[18], and trucks would be used just on local roads and for short distances.

The ad-valorem tax equivalent of non-policy trade costs of Brazilian sprayers ranges from 7.0 percent for backpacker sprayers to Buenos Aires by truck via Foz de Iguacu to 23.8 percent for self-propelled sprayers to Russia. Transportation costs tax equivalent accounts for most of the total tax: 6.1 percent for backpack sprayers to Buenos Aires in Argentina and 17.7 percent for self-propelled sprayers to Russia. Brazilian sprayers are free of import tariffs in Argentina and Mexico, but self-propelled sprayer pays 10 percent of import tariff in Russia. Therefore, non-policy trade costs also are more relevant than policy trade costs for sprayers.

Domestic transportation costs raise the plant price of backpack sprayers by 3.1 percent both to Foz do Iguacu and to Santos, while increasing the plant price of self-propelled sprayers by 3.3 percent, when going to Foz de Iguacu, and 4.3 percent, when going to Santos. The tax equivalent of international freight costs from Foz do Iguacu to Buenos Aires by truck is 2.3 percent for self-propelled sprayers and 2.9 percent for backpack sprayers.

However, the tax equivalent of international freight costs from Santos to Mexico is 7.7 percent for backpack sprayers and 12.8 percent to Russia for self-propelled sprayers. These rates are not as dramatic as in the case of soybean, but the evidence from CIF and FOB prices from developed countries to the U.S. suggests that ocean freight rates for Brazilian goods can be significantly lowered.

Moreover, the tax equivalent of customs costs (storing, unloading, loading, legal, and tax costs) of over 5 percent for self-propelled sprayers to both Argentina and Russia seems quite high. In fact, it was not possible to estimate time, information, and some legal and regulatory costs. Just as an example of these costs, it takes approximately three days to go through the border, though trucks take sixteen hours from the factory to Foz de Iguacu and eight hours from the factory to the port of Santos. Jacto's export department employs ten people and two work full time on required Mercosur certificates of origin. Jacto exports about five thousand sprayer parts and these certificates are issued for each part and are valid for six months only.

[18] For more information on the costs and feasibility of this Project see Administraçao das Hidrovias da Amazonia Oriental, AHIMOR-Ministerio dos Transportes: http://www.ahimor.gov.br/tapajos/index.htm.

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