THE DETERMINANTS OF TRANSPORT COSTS IN BRAZIL’S AGRIBUSINESS

Prof. Dr. José Vicente Caixeta Filho
“Luiz de Queiroz” Agricultural College (ESALQ)
Piracicaba, São Paulo
University of São Paulo (USP), BRAZIL
jvcaixet@esalq.usp.br

OUTLINE OF THIS PRESENTATION

- introducing the theme
- cargo transportation in Brazil
- main variables affecting agricultural road freights
- logistic expectations of the market
In Sapezal, West of Mato Grosso state, corn is planted immediately after the harvest of soybeans. In a typical day of work, each harvesting equipment takes 175 tonnes of soybeans. Altogether, tractors, seedling and harvesting machines that appear in this picture account for more than US$ 7 million. [Veja, 29/09/2004]
CARGO TRANSPORTATION IN BRAZIL

General cargo transported, in tons-kilometer, per transportation mode

Source: Brazilian Ministry for Transportation

* waterways = cabotage + river transportation
MAGNITUDE (KM) OF THE BRAZILIAN TRANSPORTATION SYSTEM, 2004

TRANSPORTATION DENSITIES IN SELECTED BRAZILIAN REGIONS, 2000

Sources: ANTT; Brazilian Ministry for Transportation; ANTAQ; Transpetro
Prof. Dr. José Vicente Caixeta Filho
BAD CONDITIONS...

EXAMPLES OF ROAD ROUTES TRAVELED IN BRAZIL, PER PRODUCT

<table>
<thead>
<tr>
<th>Product</th>
<th>Origin</th>
<th>Destination</th>
<th>Distance (km)</th>
</tr>
</thead>
<tbody>
<tr>
<td>soybean</td>
<td>Campo Novo (RS)</td>
<td>Porto Velho (RO)</td>
<td>3,283</td>
</tr>
<tr>
<td>corn</td>
<td>Nova Mutum (MT)</td>
<td>Maratú (RS)</td>
<td>2,037</td>
</tr>
<tr>
<td>sugar</td>
<td>Barra do Bugres (MT)</td>
<td>Santos (SP)</td>
<td>1,801</td>
</tr>
<tr>
<td>rice</td>
<td>Bagé (RS)</td>
<td>Ilhéus (BA)</td>
<td>3,017</td>
</tr>
<tr>
<td>beef</td>
<td>Itaporã (MS)</td>
<td>Recife (PE)</td>
<td>3,595</td>
</tr>
<tr>
<td>cotton</td>
<td>Diamantino (MT)</td>
<td>Natal (RN)</td>
<td>3,616</td>
</tr>
<tr>
<td>fertilizer</td>
<td>Paranaguá (PR)</td>
<td>Nova Olímpia (MT)</td>
<td>2,013</td>
</tr>
</tbody>
</table>

Source: CNT
TRAFFIC JAMS DURING SEASON TIMES...

Information System for Freights

(http://sifreca.esalq.usp.br)
PECULIARITIES OF AGRICULTURAL CARGOES

- perishability x high risks (due to biologic and weather conditions, for instance)
- seasonality of the production (and consumption, in some cases)
- long distances separating production and consumption sites
- low value added
- very high competitive markets
MAIN FACTORS INFLUENCING AGRICULTURAL ROAD FREIGHTS

- distance to be traveled
- type of cargo/load to be hauled
- seasonality of the demand for transportation
- regional peculiarities (at the origin and/or at the destination of the freight)
- possibility of back-hauling operation
- operational costs (e.g., type of vehicle to be utilized)
- competition and/or integration with other transportation modes
- quality of the pavement
- tolls and scales along the roads
- delivery time

Source: Correa Jr. and Caixeta Filho, 2003

FREIGHTS

\[ x \]

DISTANCES

Prof. Dr. José Vicente Caixeta Filho
MEAN VALUES OF ROAD FREIGHTS (US$/T) FOR SOYBEANS, APR-2008

MEAN VALUES OF ROAD FREIGHTS (US$/T.KM) FOR SOYBEANS, APR-2008
FREIGHTS

x

TYPE OF COMMODITY

Mean values of road freights (US$/t), Jun-2005 to May-2008

Source:

Prof. Dr. José Vicente Caixeta Filho
FREIGHTS $x$ DISTANCES and TYPE OF COMMODITY

Prof. Dr. José Vicente Caixeta Filho

MEAN VALUES OF ROAD FREIGHTS (US$/T) FOR BULK GRAINS, JUN-2005 TO MAY-2008

Source: Prof. Dr. José Vicente Caixeta Filho
FREIGHTS

\( \times \)

SEASONALITY OF THE DEMAND FOR TRANSPORTATION

INCREASING THE DEMAND FOR FREIGHT...

Freight rate ($/t)

SOYBEAN SEASON INCREASES DEMAND FOR FREIGHT

Initial equilibrium point

New equilibrium point

Supply

D_1

D_2

Quantity to be hauled (t)
DECREASING THE DEMAND FOR FREIGHT...

Freight rate ($/t)

PLAQUES OR DISEASES CAN AFFECT THE SOYBEAN SEASON, DECREASING THE DEMAND FOR FREIGHT

Initial equilibrium point

New equilibrium point

Supply

D1

D2

Quantity to be hauled (t)

FREIGHTS

\(\times\)

REGIONAL PECULIARITIES
SOYBEAN ROAD FREIGHTS FROM DIFFERENT ORIGINATIONS AT THE CENTER-WEST REGION, 1998-2002

Source: Prof. Dr. José Vicente Caixeta Filho

PATTERN OF HARVEST CALENDAR FOR SOYBEANS, PER BRAZILIAN STATE

Source: CONAB

Source: Prof. Dr. José Vicente Caixeta Filho

FREIGHTS x BACK-HAULING

Source: Prof. Dr. José Vicente Caixeta Filho
A chart showing the back-hauling operations involving fertilizers and soybeans is presented. The chart includes a map of Brazil with various symbols indicating blending factories, phosphate mines, existing silos, and new silos. "Soybean" is written with a red symbol and "Potential area" with a dark red symbol. "Fertilizer flow" is shown with an orange arrow, and "Soybean flow" with a blue arrow.

A graph titled "Mean values of road freight (R$/t.km), average distance of 1,500 km, Jan-2006 to May-2008" is also included. The x-axis represents the period from January 2006 to May 2008, and the y-axis represents the cost in Reais per kilometer. Two lines are plotted: one for main freight (soybeans from Mato Grosso State to the port of Paranaguá-PR), and another for back-hauling freight (fertilizers from the port of Paranaguá-PR to Mato Grosso State). The source of the data is cited as "Prof. Dr. José Vicente Caixeta Filho."
MEAN VALUES OF ROAD FREIGHTS (US$/T.KM) FOR FUELS BETWEEN PAULÍNIA (SP) AND CUIABÁ (MT), 1,508 KM, MAY TO DECEMBER 2007

Source: Prof. Dr. José Vicente Caixeta Filho

FREIGHTS

\[ x \]

TYPE OF VEHICLE

Source: Prof. Dr. José Vicente Caixeta Filho
**EVOLUTION OF THE TRANSPORTATION CAPACITIES FOR SUGAR-CANE TRUCKS**

![Graph showing the evolution of transportation capacities for sugar-cane trucks](image1)

*Source: Silva (2006)*

**EVOLUTION OF THE TRANSPORTATION CAPACITIES FOR ETHANOL TRUCKS**

![Graph showing the evolution of transportation capacities for ethanol trucks](image2)

*Source: Copersucar*
FREIGHTS
x
TRANSPORTATION MODE

Prof. Dr. José Vicente Caixeta Filho

WHICH IS THE MOST ADEQUATE TRANSPORTATION MODE?

Transportation Mode Competitiveness

Source: Figueiredo (2006)
MEAN VALUES OF FREIGHTS (US$/T) FOR SOYBEANS, 1,000-1,500 KM, JUN-2005 TO MAI-2008

Source: Prof. Dr. José Vicente Caixeta Filho
For the state of São Paulo, comprising sugar flows directed towards the port of Santos (road distances varying between 154 and 750 km), the mean road freight value obtained under the period for such analysis was **R$ 51.05/t**.

In the case of a series of railway projects were not concluded, an additional increase of **R$ 6.82/t** (13% in relative terms) would be expected in the corresponding road freights for sugar.
FREIGHTS

\[ x \]
DISTANCES and
TYPE OF COMMODITY and
PERIOD OF TIME and
CONDITION OF THE ROAD and
NUMBER OF TOLLS and BACK-
HAULING OPERATIONS etc.

\[ \text{FREIGHT}_{ij} = \beta_1 + \beta_2 \text{DISTANCE}_{ij} + \beta_3 \text{ROAD}_{ij} + \beta_4 \text{TOLL}_{ij} + \beta_5 \text{BACK}_{ij} + \epsilon \]

where:

\( \text{FREIGHT}_{ij} \) = freight rate, in R$/t, for the transportation of soybeans from \( i \) to \( j \);
\( \text{DISTANCE}_{ij} \) = distance in km between \( i \) and \( j \);
\( \text{ROAD}_{ij} \) = quality of the pavement between \( i \) and \( j \) (binary variable: 1 for good roads and zero for the others);
\( \text{TOLL}_{ij} \) = number of toll points between \( i \) and \( j \);
\( \text{BACK}_{ij} \) = possibility of getting a back-hauling operation at the destination \( j \) (binary variable: 1 for flows to the ports of Santos, Paranaguá and Guarujá and zero for the other destinations);
\( \beta_k \) = coefficients to be estimated, being \( k = 1, \ldots, 5 \);
\( \epsilon \) = error of the estimative.

Source: Correa Jr. and Caixeta Filho, 2003
Main results for the road freight of soybeans during season periods (January to May) of the years 1998 to 2000, originated in the states of Goiás (GO), Mato Grosso (MT) and Paraná (PR)

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>6.107 (9.80)*</td>
<td>5.908 (10.44)*</td>
<td>5.039 (10.39)*</td>
<td>4.332 (7.652)*</td>
<td>4.532 (7.661)*</td>
<td>4.332 (7.661)*</td>
<td>1.919 (2.952)*</td>
<td>3.629 (8.849)*</td>
<td></td>
</tr>
<tr>
<td>DISTANCE</td>
<td>0.040 (21.401)*</td>
<td>0.040 (22.724)*</td>
<td>0.035 (22.401)*</td>
<td>0.039 (22.401)*</td>
<td>0.034 (22.508)*</td>
<td>0.034 (22.508)*</td>
<td>0.034 (22.508)*</td>
<td>0.034 (22.508)*</td>
<td></td>
</tr>
<tr>
<td>ROAD</td>
<td>-3.068 (2.946)*</td>
<td>0.780 (0.663)</td>
<td>-1.529 (1.382)</td>
<td>-1.027 (1.379)</td>
<td>-0.258 (1.197)</td>
<td>2.377 (1.478)</td>
<td>4.882 (1.672)*</td>
<td>1.963 (1.672)*</td>
<td>2.547 (1.672)*</td>
</tr>
<tr>
<td>TOLL</td>
<td>1.038 (2.739)*</td>
<td>1.425 (2.805)*</td>
<td>1.166 (2.389)*</td>
<td>0.938 (2.349)*</td>
<td>0.876 (2.751)*</td>
<td>1.817 (2.398)*</td>
<td>-0.173 (6.049)*</td>
<td>-0.849 (6.049)*</td>
<td>-0.229 (6.049)*</td>
</tr>
<tr>
<td>BACK</td>
<td>-4.959 (1.842)</td>
<td>-4.312 (1.982)</td>
<td>-4.670 (1.924)</td>
<td>2.131 (0.539)</td>
<td>1.682 (0.548)</td>
<td>0.711 (0.125)</td>
<td>-0.602 (2.250)</td>
<td>2.847 (2.417)*</td>
<td>3.310 (2.417)*</td>
</tr>
<tr>
<td>F</td>
<td>656.6 467.1 283.5 413.589 473.0 312.5 342.7 628.1 243.0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>R²</td>
<td>0.9610 0.9125 0.8964 0.9008 0.9763 0.9144 0.9737 0.9824 0.9925</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Durbin-Watson</td>
<td>1.139 1.786 1.606 1.951 1.655 1.842 1.766 2.912 1.528</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nº obs.</td>
<td>105 184 106 187 272 122 42 50 110</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* level of significance = 1%
** level of significance = 5%

Source: Correa Jr. and Caixeta Filho, 2003

MAIN IMPACT TO BE EXPECTED FROM A "GOOD" LOGISTICS:

Prof. Dr. José Vicente Caixeta Filho
VERY COMMON STRATEGY ASSOCIATED TO A “GOOD” LOGISTICS:

dillution of the value of fixed costs...

“SHORCUTS” THAT CAN FACILITATE THE DILLUTION OF FIXED COSTS:

- economies of scale;
- efficiency of the process / low idleness;
- organization;
- integration among activities/players/stakeholders.

Source: Lean Institute Brasil

Prof. Dr. José Vicente Caixeta Filho
RECENT STRUCTURAL CHANGES

- privatization of a number of highways;
- concession of Federal Railway network;
- expansion of the navigability of several water basins;
- modernization of the national port system.
(1) Manaus (AM) - Santo Antônio do Içá (AM) - Puerto El Carmen del Putumayo (border Colombia – Ecuador) - Quito (Ecuador)
(2) Manaus (AM) - Benjamim Constant (border Brasil – Peru) – Iquitos (Peru) - Yurimaguas (border Peru – Ecuador)
(3) Porto Velho (RO) - Rio Branco (AC) - Astún Brasil (border Brasil – Peru) - Puerto Malandado (border Peru – Ecuador)
(4) Porto Velho (RO) - Rio Branco (AC) - Astún Brasil (border Brasil – Peru) - Yurimaguas (border Peru – Ecuador)
(5) Porto Velho (RO) - Rio Branco (AC) - Astún Brasil (border Brasil – Peru) - Ilo (border Peru – Chile)
(6) Rio Grande (RS) - Uruguaiana (border Brasil – Argentina) - Mendoza (Argentina) - Valparaíso (Chile)
(7) Santos (SP) - São Paulo (SP) - Paranaguá (PR) - Antofagasta (Chile)
(8) Santos (SP) - São Paulo (SP) - Paranaguá (PR) - Corrientes (Argentina) - Resistencia (Argentina) - Antofagasta (Chile)
(9) Santos (SP) - São Paulo (SP) - Paranaguá (PR) - Corrientes (Argentina) - Resistencia (Argentina) - Antofagasta (Chile)
(10) Santos (SP) - São Paulo (SP) - Paranaguá (PR) - Corrientes (Argentina) - Resistencia (Argentina) - Antofagasta (Chile)
(11) São Paulo - Este, p/ Botucatu - Espírito Santo do Turvo (SP) - Presidente Prudente (SP) - Presidente Epitácio (SP) - Campo Grande (MS) - Cuiabá (MT) - Coari (RO) - Porto Velho (RO) - Rio Branco (AC) - Cruz de la Palma (AC) - Tucumán (Argentina) - Presidente (Argentina) - Resistencia (Argentina) - Antofagasta (Chile)
(12) São Paulo - Este, p/ Botucatu - Espírito Santo do Turvo (SP) - Presidente Prudente (SP) - Presidente Epitácio (SP) - Campo Grande (MS) - Cuiabá (MT) - Coari (RO) - Porto Velho (RO) - Rio Branco (AC) - Cruz de la Palma (AC) - Tucumán (Argentina) - Presidente (Argentina) - Resistencia (Argentina) - Antofagasta (Chile)

ROUTES TO PACIFIC

Source: Brazilian Ministry for Transportation

Prof. Dr. José Vicente Caixeta Filho
**MAIN HIGHLIGHTS...**

- Cargo’s owner = logistics’ owner;
- Higher bargaining power of the shippers over the carriers;
- Greater frequency of back-hauling operations

**LOGISTIC EXPECTATIONS OF THE MARKET**

- Increase of the highway freight tariffs (and better level of service);
- Efficient strategies for a systematic maintenance of the highways (PPPs??);
- Decrease of the rail and waterway freight tariffs;
- Rescue of the credibility of railway networks (lost under the public management period);
- Expansion of coastal traffic (cabotage) and pipeline activities;
- Increase of the capacity and efficiency of the seaport terminals;
- Location of new industrial plants near to the main transportation corridors;
- Expansion of the storage system (especially on the farms);
- Active role of the transportation coordinating agent as a regulating policy maker;
- Consolidation of the intermodal model in remote areas (North and Center-West);
- Much greater importance of the evaluation of environmental effects to be resulted from logistic interventions.
References:
Silva, J.E.A.R. Desenvolvimento de um modelo de simulação para auxiliar o gerenciamento de sistemas de corte, carregamento e transporte de cana-de-açúcar. Dissertação de Mestrado, PPG em Engenharia de Produção/UFRJ, 2006.
Sources of data:
ANTAQ (www.antaq.gov.br)
ANTT (www.antt.gov.br)
BRAZILIAN MINISTRY FOR TRANSPORTATION (www.transportes.gov.br)
BUNGE (www.bunge.com.br)
CNT (www.cnt.org.br)
CONAB – Companhia Nacional de Abastecimento (conab.gov.br)
COPERSUCAR - Cooperação de Produtores de Cana-de-açúcar, Açúcar e Álcool do Estado de São Paulo (www.copersucar.com.br)
ESALQ-LOG = Grupo de Pesquisa e Extensão em Logística Agroindustrial (log.esalq.usp.br)
LEAN INSTITUTE BRASIL (lean.org.br)
SIFRECA – Sistema de Informações de Fretes (sifreca.esalq.usp.br)
TRANSPETRO (www.transpetro.com.br)

FURTHER CONTACTS
- Prof. Dr. José Vicente Caixeta-Filho
- Dept. of Economics, Management and Sociology - ESALQ/USP
- Av. Pádua Dias, 11
- 13418-900 – Piracicaba, SP - BRAZIL
- Tel: 55 19 3417 8736
- Fax: 55 19 3434 5186
- E-mail: jvcaixet@esalq.usp.br