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# Trade and transport mode, share model analysis

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Commodities are delivered using different transport modes, according to the product and the trading partner characteristics (Hummels-2007 and Harrigan-2010). Less is known about the determinants of the allocation of transport modes shares. We propose, in the case of Europe in 2003, to highlight these determinants considering three transport modes (sea, road and air).

Our objective is to better estimate the impact of liberalization on transport modes allocation in order, for instance, to correctly evaluate the increase of greenhouse gas emissions due to higher trade flows as mentioned in Hummels(2009).

## Estimating shares, what method?

### Multivariate Fractional Logit (Sivakumar and Bhat-2002; Mullahy-2010)

-Let  $s_{jkm}$  be the share of product  $k$  exported to country  $j$  by the transport mode  $m$ , with  $m=1,2,3$  and  $s_{jkm} \in [0; 1]$

-We have  $\sum_{m=1}^3 s_{jkm} = 1$

- $E[s_{jkm}|z_{jk}] = G_m(z_{jk}B) = \frac{\exp(z_{jk}\beta_m)}{\sum_{l=1}^3 \exp(z_{jk}\beta_l)}$ , with identification constraint  $\beta_3=0$

-a multinomial quasi-likelihood function is defined:  $Q(\beta) = \prod_{j=1}^J \prod_{k=1}^K \prod_{m=1}^M G_m(z_{jk}B)^{s_{jkm}}$

## Descriptive statistics

### Database

⇒ **French Custom** database (2003)

⇒ It describes the **volume** and **value** of French exports of agricultural and food processed products, which are described at an **8-digit** level, the **destination** country and the **transport mode** used (maritime, road or air).

⇒ Only European countries for which the three modes are available, meaning neither islands nor landlocked countries, were taken into account.

| Transport mode | mean distance | mean unit value |
|----------------|---------------|-----------------|
| Sea            | 1693.341      | 12.83053        |
| Road           | 1019.811      | 20.84792        |
| Air            | 1765.63       | 238.5184        |

Mean value of distance and unit value by transport modes

### Descriptive statistics

In Europe road represents the main transport mode used for the exports of French agricultural and food processed products, with more than 80% of exports in value on average. Nevertheless according to the product or the country this share can vary.

Products transported by **air** are **highly valuable**, whereas the products transported by boat have a substantial lower value.

**Distance** seems also to play a major role in the choice of the transport mode, **boat and plane are preferred for remote destination** countries.

Thus, the split between transport modes for exporting agricultural and food products may be partly determined by the value of these products and the remoteness of the partner country.

## First results

Source: French Custom -2003

| share road          |         |
|---------------------|---------|
| Log of distance     | -0.0691 |
| Log of Unit Value   | 0.0202  |
| Log of total export | -0.0167 |
| UE*                 | 0.1336  |
| share sea           |         |
| Log of distance     | 0.0577  |
| Log of Unit Value   | -0.03   |
| Log of total export | 0.0188  |
| UE*                 | -0.1252 |
| share air           |         |
| Log of distance     | 0.0114  |
| Log of Unit Value   | 0.0098  |
| Log of total export | -0.0021 |
| UE*                 | -0.0083 |

Marginal effects of explanatory variables at the mean point and UE=0

\*variable changes from 0 to 1

We study the impact of four variables on the share of each transport modes:

-**distance** and **EU** a dummy variable indicating if the specified country belonged to the European Union in 2003.

-average **unit value** (i.e. value/quantity)

- **the total export value** of a given product to this country

As expected **distance has a positive impact** on the percentage of product which are transported by ship or by plane. An increase of distance leads to a reallocation of shares, mainly between road and maritime transport.

Besides, the more valuable a product is, the more it will be transported by plane.

Finally, in 2003, belonging to the European Union have a **highly positive impact** on the share of **road** transport.

Adding GDP as explanatory variable, shows that when GDP increases, share of exports by road increases.

Source: French Custom -2003

|                     | Share sea | Share air |
|---------------------|-----------|-----------|
| Log of distance     | 0.451***  | 1.061***  |
|                     | (0.0608)  | (0.168)   |
| Log of Unit Value   | -0.215*** | 0.815***  |
|                     | (0.0259)  | (0.0360)  |
| UE                  | -1.743*** | -1.410*** |
|                     | (0.0664)  | (0.150)   |
| Log of total export | 0.140***  | -0.157*** |
|                     | (0.0117)  | (0.0313)  |
| Constant            | -4.994*** | -12.10*** |
|                     | (0.462)   | (1.286)   |
| Observations        | 16,897    | 16,897    |
| ll                  | -4625     | -4625     |

\*\*\* p<0.01, \*\* p<0.05, \* p<0.1

Results of the fractional multinomial Logit

## Conclusion:

The method of estimation we used predicts an increase in the proportion of product exported by road when a country integrate the European Union. Thus, the liberalization leads to a reallocation in transport shares, mainly between road and maritime transport in our case. This conclusion can be confirmed with an analysis of data, between 2000 and 2006, road transport share in the countries, which integrate EU in 2004 **increased by 11%**.

This methodology would extend Hummels(2009) in estimating the impact of **trade liberalization** on **greenhouse gases emission** in the European context (European Union enlargement or new trade agreements) .

Further works are needed to better understand at **the firm level**, the drivers explaining the choice of transport mode (given especially its location and its productivity).



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