Sub-Saharan Africa's role in International Biofuel Trade

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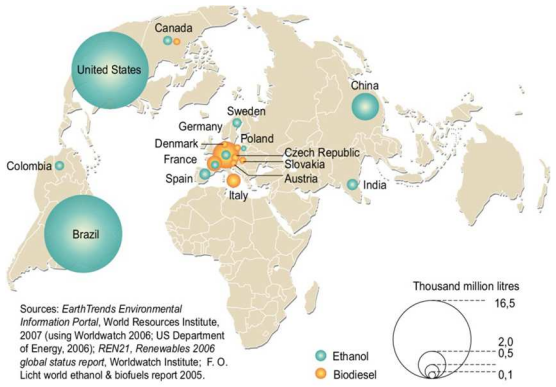
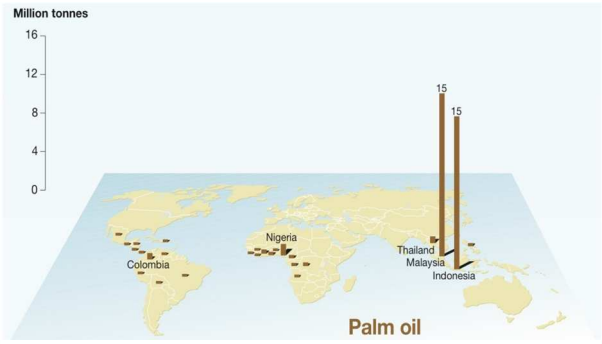
Motivation and Objective

- Producing and exporting raw material for biodiesel like canola oil, palm oil or others, is an opportunity for many agriculturally dependent developing countries. Although they should have a comparative advantage in these goods, they do not export as much as would be expected.
- Especially sub-Saharan countries claim to be disadvantaged in the international trade of biofuels in terms of exporting raw products and the final biofuel to developed countries.
- Palm oil is the most important pre-product for biodiesel in Europe next to canola oil.
- This paper analyzes the role of tariffs and other barriers in explaining trade patterns of palm oil for biodiesel use generally and the lack of trade in certain goods in particular.

Palm Oil Market

- Most countries producing biofuels are industrialized OECD countries.
- Though Africa produces little biodiesel itself, it produces palm oil which is one basis for biodiesel production in industrialized countries.





http://maps.grida.no/go/graphic/major-producers-of-palm-oil-and-beef

The Gravity Model

- For analyzing international trade flows of biofuels, one can use the gravity model which is derived from Newton's gravitational concept in mechanics.
- It describes the amount of trade between two countries as directly related to the size of the countries and inversely related to the distance between them:

$$X_{ij} = A\frac{M_i M_j}{D_{ij}}$$

- X_{ij} represents the value of trade between country i and country j, M_i is country i's GDP, M_j is country j's GDP. D_{ij} represents the distance as a proxy for transaction costs and transportation costs which results in lower trade volume between the countries. A is a constant.
- The linear equation of the gravity model looks as follows:

$$\ln X_{ij} = \alpha_0 + \alpha_1 \ln M_i + \alpha_2 \ln M_j + \alpha_3 \ln D_{ij} + u_{ij}$$

- The gravity model is applied to analyze the determinants of international trade of palm oil for non-food use (X_{ij}).

Methodology and Data

- Heckman (1976, 1979) has proposed a simple practical two step method which treats the selection problem as an omitted variable problem.
- The Heckman two-step method or the limited information maximum likelihood (LIML) method calculates a selection equation in its first step.
- The predicted values of the selection equation are then used to calculate the Inverse Mill's ratio (IMR) by a Probit model (1=trade, 0=no trade of palm oil). IMR is the ratio of the probability density function to the cumulative distribution function (Greene, 1990).
- The IMR can now be included in the outcome equation, that determines the influence on the amount of trade, to counter the bias caused by the zero-inflation. If this ratio is significant, it can be interpreted as an account for the assumed selection bias (Puhani, 2000).
- Data sources are:
  - European Export Helpdesk: Trade data for palm oil for non-food use
  - CIA Factbook and Worldbank
  - Renewable Energy Policy Network for the 21st Century (REN21) database

Results

Table 1: Selection Equation: determinants of Palm Oil Trade (1=yes)

Variables	Basic Gravity Model	+ Policy Effects	+ Transaction Costs
Dependent Variable	Existence of Palm Oil Trade for Non-Food-Use		
Intercept	-8.70***	-13.45***	-13.56***
Log GDP_j	0.24***	0.23***	0.24***
Log GDP_j	0.15***	0.30***	0.30***
Log $Distance_{ij}$	-0.38***	-0.33***	-0.35***
$Asia_j$	0.17**	0.07	0.17*
$North\ America_j$	-0.50***	-0.90***	-0.94***
$South\ America_j$	0.10	-0.09	-0.02
EU_j	-0.26***	0.03***	0.02***
Other EU_j	-0.92***	-0.62***	-0.32**
Lambda (IMR)	-3.58***	-3.96***	-6,55***

i=importer, j=exporter — Level of significance: a =0.1*, a =0.05**, a =0.01***

Continent variables like Asia, North and South America as well as the EU and other European countries as exporter were constituted. They determine the amount of palm oil traded by each of these continents in the relation to Sub-Saharan Africa.

Table 2: Outcome Equation: determinants of Intensity of Trade

Variables	Basic Gravity Model	+ Policy Effects	+ Transaction Costs
Dependent variable	Log Import Value Palm Oil for Non-Food-Use		
Intercept	3.61	13.57	16.91*
Log agric. GDP_j	0.04**	0.03	0.14
Log agric. GDP_i	0.09***	0.04	0.20
Log $Distance_{ij}$	1.08***	1.75***	2.82***
Biofuel $Quota_i$		0.00	-0.94
Subsidy $Dummy_i$		-0.05	-0.71
$Landlocked_j$			0.23
$Landlocked_i$			-1.81***
$Area_j$			$2.00*10^{07}$
$Area_i$			$-2.40*10^{07}$
$Internet_j$			0.03**
$Internet_i$			0.04***
$Population_j$			$5.83*10^{09***}$
$Population_i$			$1.98*10^{09}$
$Contiguity_{ij}$			1.42*
$Common\ Language_{ij}$			0.38
Wald Chi^2	50.75***	31.20***	116.33***
LR test	13.13***	8.41***	19.33***
N	30564	30343	30341

i=importer, j=exporter — Level of significance: a =0.1*, a =0.05**, a =0.01***

Conclusion

- The estimation results show, that the more similar the GDPs of the trading country pairs are and the lower the distance between them is, the higher is the probability to trade.
- However, the trade volume itself is only partially affected by the GDP of the importer whereas the percentage of the agricultural GDP of both the exporter and importer has a positive effect.
- Surprisingly and in contrast to the probability to trade at all, the amount of palm oil traded is higher, the larger the distance between the county pairs is.
- No tariffs for palm oil for non-food use are requested by the EU.

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