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Analysing the EU Canola Oil Trade with Developing Countries: A Gravity Model Approach

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Introduction

The international biodiesel production increased steadily and exponentially from 2000 to 2007 (WBGU, 2008). More than half of this increase can be attributed to biodiesel production in the European Union (EU). The production of biodiesel in Europe depends mostly on canola oil (e.g. Ho, 2006). As a result, Europe naturally had an increase in the demand for canola oil. In fact, the increase in world canola oil imports is even almost only due to the increase in European canola oil imports (FAOSTAT, 2001). Accordingly, our analysis of canola oil trade focuses on European import and its drivers. Two main influences on the European import pull are taken into account: Firstly, the trade integration. It is by definition set up to increase trade among member states. So, the question is whether the integration in the EU promotes trade among EU member countries. Secondly, we include green policy measures of the EU in our analysis. Here the question arises, whether and to what extent green policies like quotas and subsidies foster import of canola oil into the EU.

Method and Data

The underlying model for our analysis is based on the Newtonian gravity model for the calculation of gravitational pull between two bodies. Tinbergen (1962) was the first economist who used this as analogy for trade. Our basic gravity model looks as follows:

$$X_{ij} = A \frac{M_i \cdot M_j}{D_{ij}} \qquad (1)$$

X_{ij} represents the bilateral trade between origin i and destination j. The trade is positively related to the economic size of both countries which is traditionally represented by the gross domestic

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product (GDP). In contrast, the trade value is negatively related to the distance between them. Distance is generally understood as a proxy for transaction costs. To be able to estimate the gravity model, the parameters have to be log-transformed in order to linearize the model.

$$\ln X_{ij} = \beta_0 + \beta_1 \ln M_i + \beta_2 \ln M_j + \beta_3 \ln D_{ij} + u_{ij} \qquad (2)$$

The trade data used in the econometric estimation are the following: The independent variable is canola oil for non-food use (TARIC 15141110) in the year 2006 (EU Export Helpdesk, 2009). More precisely, it is the import into EU countries including intraregional trade. The data set comprises 39 countries including 23 EU countries and 16 non-EU countries. From 1,300 potential pairs of trading partners only 107 country-pairs actually trade.

Due to the special characteristics of the underlying data set, the following calibrations were needed to adapt the model. First, due the fact that more than 90 percent of the country pairs do not trade, the data set was characterized by a huge zero-inflation. This problem is tended to by the two-stage Heckman solution, which corrects for the selection bias problem (Heckman, 1979; Martin and Pham, 2008). The first stage consists of a probit model with a dependent variable of x=1 if the observed pair trades and 0 otherwise. Based on the linear predictors of the probit model, the inverse Mill's ratio (IMR) is calculated correcting for omitted variable bias otherwise included in the second stage of the Heckman model. In this second stage the determinants for the amount of trade are estimated. Further, the so-called multilateral resistance terms recommended by Anderson and Van Wincoop (2003) are taken into account by introducing country fixed effects in the first stage of the Heckman solution. They correct for possibly underestimated spill-over effects. Apart from that, the problem of spatial autocorrelation has been considered by including spatial weight in the second stage of the Heckman model (Anselin et al., 2004; Behrens et al., 2007).

Results

Four consecutive gravity models have been estimated using this approach. The results of the second step of the gravity equation are shown in table 1. The dependent variable is the log-transformed trade volume valued in Euro. The first model is the traditional gravity model including GDP and distance. Only the distance as a measure for transaction costs has a significant impact on trade and it exhibits a negative coefficient, as was expected. The GDP of both countries is insignificant. This is not surprising since they are very broad indicators for the economic size included in an analysis for a very specific sector. The Moran's I statistic as a measure for spatial autocorrelation shows negative spatial correlation. To correct for the spatial autocorrelation, the variable Value Weighted Distance has been included in the model being a distance related weight imposed on the trade value. As indicated by a significant coefficient, zero-inflation caused omitted variable bias and was countered by the IMR. It also carries the country fixed effects from the first step into the second step regression.

Table 1: Determinants of Canola Import to the European Union

Variables	Traditional Gravity Model	+Trade Integration Effect	+ Biofuel Policy Effects	+ Value Chain Effects
Dependent Variable	Log Import Value	Log Import Value	Log Import Value	Log Import Value
Intercept	17.4 30 ***	19.270 ***	18.040 ***	18.040 ***
Log GDP Importer$_i$	0.124	0. 198	0.067	0. 130
Log GDP Exporter$_j$	- 0.065	0.008	-0.070	-0.177
Log Distance$_{ij}$	- 0.698 ***	-0.975 ***	-1.065 ***	-1.045 ***
Dummy Both EU$_{ij}$		-1.015 *	-1.194 **	-1.067 **
Biofuel Quota$_i$			1.011 ***	0. 913 ***
Subsidy Dummy$_i$			1.328 **	1.202 *
Log Production Costs Ratio$_{ij}$				-0.758
Canola Seed Production$_i$				-3.401 x 10^{-7} *
Canola Seed Production$_j$				1.312 x 10^{-7}
Biofuel Consumption Transport$_i$				6.302 x 10^{-4} **
Biofuel Consumption Transport$_j$				7.502 x 10^{-5}
Value Weighted Distance$_{ij}$	3.633 x 10^{-5} ***	3.442 x 10^{-5} ***	3.090 x 10^{-5} ***	2.844 x 10^{-5} ***
Inverse Mill's Ratio$_{ij}$	- 0.786 ***	-0.789 ***	-0.572 ***	-0.538 ***
Country Fixed Effects	Yes	Yes	Yes	Yes
Adj. R^2	0.19	0.20	0.31	0.34
AIC	329.59	328.35	290.60	287.97
Breusch-Pagan test (p-value)	0.63	0.69	0.14	0.39
Global Moran's I test		-0.2837		
N	88	88	88	88

In the second model, a dummy variable for EU trade integration is added which is equal to one if both trading partners are members of the EU. Surprisingly, we see a negative significant coefficient indicating that the trade volume is higher if the exporter is a non-EU country.

In the third model, we introduce biofuel quotas and a dummy for the existence of subsidizing the green industry to gauge the effect of political measures. Both variables have positive and significant coefficients, as expected.

Lastly, we wanted to control for up- and downstreamed value chain stages of the biodiesel chain. To avoid multicollinearity between the value chain variables and endogeneity with the dependent variable, we introduced only the two opposite ends of the biodiesel chain instead of the whole chain: canola oil production on the one hand and liquid biofuel consumption for transport on the other.

Here, only the coefficients for the importer countries are significant and have the expected sign. This indicates that the importer biodiesel chain constrains or affects the trade of biodiesel imports.

Conclusions

The main objective of this analysis was to identify the effect of major drivers of the canola import of the European Union. The regression results showed significant and positive coefficients for mandatory biofuel quotas and the subsidy dummy. With respect to both political measures we can conclude that they effectively increased trade. The surprisingly negative value of the coefficient indicates that even though the monetary union has been set up to foster trade among members, members do rather import from outside of the union. This could possibly be explained by the import pull caused by exhausted input production. This is supported by the significant value chain stages of the importer. Further research questions are whether the policy and border effects are the same for other countries and trade agreements.

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