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# Explaining German imports of Olive oil: evidence from a gravity model

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**Paper prepared for presentation at the 12th EAAE Congress**
**'People, Food and Environments: Global Trends and European Strategies',**
**Gent (Belgium), 26-29 August 2008**

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# Explaining German imports of olive oil: evidence from a gravity model

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*Abstract*— **In this study the case of olive oil imports of Germany is examined since olive oil is a traditional Mediterranean commodity and Germany is the biggest importer in the EU. A gravity model has been employed so as to analyse those factors that explain the German imports of olive oil that were identified in a preceding analysis of the German olive oil supply chain. The results of two random-effects models corrected for serial correlation and heteroskedasticity suggest that being a Mediterranean Partner country of the EU has the highest impact on trade flows to Germany, thus supporting further Euromediterranean trade integration. The level of trade to Germany is positively related to existence of direct marketing channels and to tourism implying that these factors should be explored more in the future by the Mediterranean countries so as to boost their exports.**

*Keywords*— **gravity model, olive oil, Germany.**

## I. INTRODUCTION

Olive oil is a typical Mediterranean commodity and considered as an important agricultural product of the countries surrounding the Mediterranean basin. In recent years due to campaigns for a healthier way of living the consumption has increased in non-traditional markets, providing space for the Mediterranean countries to expand their market shares in new destinations. The interest of the Mediterranean countries, especially of the non-EU Mediterranean countries, is to expand their EU market share as the relationships with the EU deepen along with the Barcelona Process and the updated discussions for the creation of a Mediterranean Union.

Germany with round 82 million inhabitants is the largest market in Europe and thus an attractive export destination of olive oil. Objective of this study is to analyse the factors that influence the German imports of olive oil and specifically to identify whether trade has been stimulated by the formation of the Barcelona Agreement by applying a gravity model, described in the second section of the paper. The findings of the study that follow on the third part could serve to form recommendations for the improvement of the trade policy of the Mediterranean countries, as discussed in the last section of the paper.

## II. THE GRAVITY MODEL

One of the most commonly used tools to examine and explain trade flows is the gravity equation. It is based on the idea that the traded volumes from origin i to destination j can be explained by the economic masses of the origin and of the destination country and any other forces, specific for the examined trade flow, that attract or not bilateral trade.

The gravity equation has been developed by Tinbergen (1962)[1] and Pöyhönen (1963)[2] and ever since applied by a number of authors. Anderson (1979)[3] attempted first to derive the gravity equation from a model assuming product differentiation and his attempt has been followed by further authors as for example by Bergstrand (1985 [4] and 1989 [5]), Deardorff (1998) [6] and Anderson and Wincoop (2003) [7]. In the studies of Mátyás (1997 [8]; 1998 [9]), Egger (2000 [10]; 2002 [11]) the econometric specification of the gravity equation has been improved and the advantages of the application of panel data methodology are drawn. Reviews of gravity models of regional trade agreements are given for example by Cardamone (2007) [12] and Greenaway and Milner (2002) [13].

In order to explain Germany's imports of olive oil, the gravity equation is specified in log-linear form:

$$lPX_{Gj} = \beta_0 + \beta_1 lY_G + \beta_2 lY_j + \beta_3 lYPC_G + \beta_4 lYPC_j + \beta_5 lDist_{Gj} + \beta_6 rer_{Gj} + \sum_h \gamma_h D_{Gjh} + e$$

where G=Germany, j=exporters and l denotes natural logs. PX is the value of trade flow, Y the nominal GDP, YPC the per capita GDP, Dist the distance between Germany and the exporter, rer the real exchange rate, e the error term. The dummy variables ΣγD, based mainly on the findings of the analysis of the German supply chain of olive oil that preceded this

study (Flatau et al., 2007 [14]) as well as on Vlontzos and Duquenne (2008) [15] and Garcia Álvarez-Coque and Martí Selva (2006) [16] are immigrants of the exporting countries in Germany, EU Membership, Mediterranean Partner Countries (MPCs), German tourists visiting exporting countries, German supermarket chains buy direct from producers-traders of the exporting countries, as the case of Lidl (Flatau, et al., 2007 [14]) and marketing of labelled and packaged olive oil.

Following Martinez-Zarzoso and Nowak-Lehman (2004) [17] as well as Nowak-Lehman et al. (2007) [18] the real exchange rate index has been calculated by multiplying the nominal exchange rate of the exporting country with the GDP deflator of the export country divided by the GDP deflator of Germany. The need to model trade barriers did not emerge, since no import tariffs have been applied and no non-tariff barriers have been reported for the examined time period (TRAINS database).

Data on the German imports of olive oil have been obtain from the EU's External Trade Statistics over the period 1995-2006 and after deleting zero bilateral trade flows they refer to 14 exporting countries. GDP and per capita GDP (based on Purchase Power Parity) are extracted from the World Economic Outlook database of the International Monetary Fund. Measures for distance are expressed as straight lines between main trade centres and Hamburg, because in Hamburg are located most of the importers of olive oil in Germany (Flatau et al., 2007 [14]).

For the estimation panel data methodology has been used as it allows accounting for individual heterogeneity across countries. As focus is given on time-constant variables, such as the Mediterranean Partnership, the random effects (RE) approach is considered as more appropriate instead of a fixed effects model. However, to ensure that the assumptions of the RE model hold (i.e. orthogonality of the individual effects and the regressors) a Hausman test is carried out, which fails to reject the null hypothesis of no correlation between the individual effects and the regressors (Greene, 2003 [19]; Johnston and DiNardo, 2007 [20]). To ensure that the estimates do not suffer from serial correlation or heteroskedasticity, the Durbin–Watson statistic modified by Bhargava et al. (1982) [21] and the Breusch-Pagan test adjusted to the panel data context are used, respectively. Both tests strongly indicate the presence of serial correlation and heterokedasticity. Based on the test results two RE models corrected for serial correlation and heteroskedasticity are calculated. For the latter, panel-corrected standard errors (PCSE) and Generalized Least Squares (GLS) are used.

## III. RESULTS

In general the statistical tests indicate that the gravity equation has a rather good explanatory power over the German imports of olive oil and almost all coefficients have the expected sign and are statistically significant. The differences among PCSE and GLS are only minimal. The detailed results are reported in Table 1.

The estimated GDP and GDP per capita coefficients of the exporters are statistically significant and have a positive sign implying that the exporting country's income has a positive impact on the trade flows of olive oil. The GDP coefficients are less than 1 indicating that trade increases less than proportionally with an increase of exporting country's economic size. Contrarily, the elasticities of Germany's GDP and GDP per capita have a negative sign, implying that olive oil is not considered as a luxury good (Martinez-Zarzoso and Nowak-Lehman, 2004 [17]).

The coefficient of the dummy variable Mediterranean Partnership indicates that the import share of MPCs is 6 % higher than their non-MPC counterpart. This suggests that there is potential for further trade creation between Germany and the MPCs. The coefficients of direct marketing and EU membership implies that the possibility of German super market chains to import directly from the exporters and to be EU member state creates trade by about 4 and 3 %, respectively. Labelling is the only dummy variable with a negative coefficient, implying that bulk olive oil has more potential to enter the German market than packaged and labelled, fact that should be attributed to the structure of the German supply chain of olive oil (Flatau et al., 2007 [14]). Moreover, German tourism has a positive effect on olive oil trade. This is certainly interesting for the Mediterranean Partner Countries, since it implies that

attracting German tourists can boost their exports to the German market.

Finally the parameter estimates of geographical distance and real exchange rate are negative but have only a minor impact on imports.

Table 1: Estimation results

| Variables | Random Effects (PCSE) | Random Effects (GLS) |
|---|---|---|
| GDP Germany | -0.764 | -1.191*** |
| | (0.397) | (0.328) |
| GDP per capita Germany | -3.042** | -3.188** |
| | (0.981) | (1.082) |
| GDP exporting country | 0.809*** | 0.867*** |
| | (0.152) | (0.152) |
| GDP per capita exporting country | 5.275*** | 5.711*** |
| | (0.786) | (0.818) |
| Distance | -0.0008*** | -0.0008*** |
| | (0.00004) | (0.0001) |
| Immigrants | 0.725* | 1.530*** |
| | (0.252) | (0.366) |
| EU-Membership | 3.005*** | 3.240*** |
| | (0.279) | (0.631) |
| Mediterranean Partnership | 5.060*** | 6.040*** |
| | (0.872) | (0.902) |
| German tourism | 2.831*** | 2.294*** |
| | (0.269) | (0.349) |
| Direct marketing | 3.845*** | 3.992*** |
| | (0.142) | (0.128) |
| Labelling | -3.067*** | -3.710*** |
| | (0.402) | (0.380) |
| Real Exchange Rate | -0.0527*** | -0.025 |
| | (0.014) | (0.019) |
| Constant | -10.845 | -11.014* |
| | (5.598) | (5.145) |
| $R^2$ | 0.80 | - |
| Log Likelihood | - | -154.77 |
| Observations | 158 | 158 |

Values in parenthesis are the standard errors of the regression coefficients, *** (**, *) statistically significant at the 99.9% (99%, 95%) level. Panel-corrected standard errors correct for heteroskedastic and contemporaneous correlated disturbances (Beck and Katz, 1995 [22])

## IV. SUMMARY AND MAIN CONCLUSIONS

In this study the case of olive oil imports into Germany is examined since olive oil is a traditional Mediterranean commodity and Germany is the largest market in the EU. A gravity model has been employed so as to stress those factors that can explain the German imports of olive oil that were identified in an analysis of the German olive oil supply chain (Flatau et al., 2007 [14]).

The results suggest that being a Partner Country with the EU appears to have a high impact on trade flows to Germany, fact that alone is promising for further trade creation with the deepening of the Barcelona Agreement. The level of olive oil imports into Germany is found to be positively related to direct marketing and to tourism meaning that creation of direct marketing channels with German super market chains as well as attracting German tourists seem to be important factors that could boost exports to Germany and should be explored more by the Mediterranean countries. Supposing that the German olive oil supply chain remains as such, then exporting packaged and labelled olive oil seems to enter the German market with much more difficulties than bulk. The negative

relation of trade flows to Germany's per capita income suggests that olive oil is not seen by the German consumers as a luxury good. By advertising the special characteristics of olive oil and the particular regional differences in the quality, consumers could start considering olive oil as a luxury good giving producers the opportunity to benefit from selling olive oil of higher quality and price in Germany.

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