David and Goliath: An Investigation Between Greece–Germany Bilateral Trade for Agricultural Products

Achilleas Kontogeorgos and Fotios Chatzitheodoridis

Abstract This paper investigates the factors that affect the bilateral trade between Greece and Germany for specific agricultural products (Meat and meat preparations, Dairy products and eggs, Fish and fish preparations, Cereals and cereal preparations and Fruit and vegetables). Data was collected through the COMTRADE database for the period 1992–2017. An analysis of the trade flows is made for the two countries. In addition, an augmented gravity model was used to estimate the factors that affect the bilateral trade. The analysis incorporates the cost of trade between the two countries instead of the geographic distance that is usually used in the gravity model. The results showed that the GDP of both countries has a positive effect on the trade flow. Trade costs appear to have a negative effect on trade flows in sectors where the country has a competitive advantage. The paper aims to quantify trade flows and facilitate this way researchers and policymakers to address practical issues and questions when analyzing trade policies between economic giants and smaller trade partners.

Keywords Greece · Germany · Bilateral trade · Agricultural products · Gravity model

JEL Classification F11 · F13 · F19

1 Introduction

This paper examines the bilateral trade flows between Germany, the largest economy in European Union, and Greece a small southern eastern Country with many economic problems during the financial Crisis (Kontogeorgos et al. 2017). Bearing

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in mind that exporting is a business that requires economies of scale, the comparative advantage of each country should by identified and studied. With this aim, this paper examines the Greek food and agriculture products exports in the German market during the past thirty years. Germany is, over time, the most important trading partner of Greece. Almost a third of the Greek exports to Germany are agriculture and food products. Thus, German market covers the export potential of a large number of Greek companies. However, the trade deficit skyrocketed in 2017 to a record level for the last five-year period ringing this way a bell for the Greek economy. Therefore, the bilateral trade between Greece and Germany should be further examined in order to identify the latent reasons for this increasing deficit.

Most of the Greek agri-food products trade is conducted within the EU region (about 75% of exports and 80% of imports) rather than with non- EU countries (Ghazalian 2015). There is also, a significant concentration of trade within specific countries, with the top 10 trade partners covering about 70% of both imports and exports (Magoulios and Athianos 2013; Konstantopoulou 2015). However, Greece imports more food and beverages than it exports. The leading agri-food suppliers to the Greek market are the Netherlands ($1.1B), Germany ($943 M), Italy ($751 M), Bulgaria ($688 M), and France ($643 M). The leading markets for Greece's exports are Italy ($1.3 B), Germany ($926 M), the United Kingdom ($447 M), the United States ($409 M) and Bulgaria ($346 M). Greece's top agri-food imports include cheese ($430 M), beef ($281 M), pork ($259 M), and food preparations ($198 M), whereas olive oil ($636 M), cheese (521 M), and olives (514 M) dominate Greece's agricultural exports, followed by cotton ($397 M), sea bream ($292 M), and canned peaches ($264 M) (Piraeus Bank 2015; ELSTAT 2017).

At this point, it must be noted that the most valuable export market for agricultural products is the Italian. However, Italy was not selected for the analysis because it belongs to the same southern European countries affected heavily by the economic crisis and even more Italy is a main destination for bulk Greek agricultural products such as olive oil.

The rest of the paper is organized as follows. Section 2 provides a short review on the Greek agricultural sector, it discusses Greece–Germany trade relationship and patterns then follows a very brief review of the gravity model. Section 3 presents the empirical evidence on Greece Germany trade flows and provides the results. Section 4 concludes on the findings and provides few points for discussion and policy making and highlights questions for future research.

2 Literature Review

2.1 Greek Agricultural Sector

Agriculture is a key sector for the Greek economy, comprising 4.1% of GDP and 14% of employment compared with an EU average of 1.6% and 4.7%, respectively

(ELSTAT 2017). Agriculture in Greece is characterized by small farms, elder farmers and low capital investment (Chatzitheodoridis et al. 2014). Greece's utilized agricultural area is close to 5 million hectares, 57% of which are in the plains and 43% are in mountainous or semi-mountainous areas (Chatzitheodoridis et al. 2016). Moreover, 76.7% of holdings have less than 5 ha and the average farm size of 6.8 ha, is smaller than the average EU-28 holding with a size of 16.1 ha. At the same time, only 5.2% of the Greek farmers are under 35 years old (EUROSTAT 2017). Thus, lower agricultural productivity in Greece, is correlated to the smaller average-size of holdings (Karanikolas and Martinos 2011). The economies of scale offered by modern farming practices have limited impact on the small plots of land typically used in Greece.

In addition, the lack of a clear agricultural strategy has led the sector since a long time ago, to rely heavily on European subsidies (Louloudis and Maraveyas 1997), incapable of exploiting the dynamics of the rapidly expanding international market. Subsidies amount to about 22% of the value of agricultural output in Greece, compared with 12%, on average, for Mediterranean countries. Greek agricultural production increased by less than 20% during the past 25 years (compared with 220% globally and 86% in Europe). In fact, Greek agricultural value added, excluding subsidies, dropped by 13% during the past 20 years, while other Mediterranean countries (Spain, Italy, France) managed to increase value added, excluding subsidies, by about 15% during the same period (Mylonas 2015). These structural deficiencies have undermined the sector's natural competitive advantages and have crippled its export capacity. A trade deficit of €1.2 bn, is observed in Greece compared with a cumulative surplus of €18 bn for other European Mediterranean countries (Mylonas 2015). Moreover, the food supply chain has a relatively small manufacturing component (adding just 40% to the agricultural production versus 70% in Western Europe), as most Greek agro-food products are consumed or exported in bulk form (Konstantopoulou 2015).

2.2 Greece–Germany Trade

It has been already mentioned that Germany is, over time, one of the most important trading partners of Greece. Figures 1, 2, 3 and 4 are revealing and indicative of this bilateral relationship. Greece imported products from Germany valued 5.3 billion euros in 2017, raising over € 3 billion the Greek trade deficit with the Germany. According to the latest aggregate data on bilateral trade relations between the two countries, Greece's imports from Germany in 2017 increased by 7.4% while Greece's exports increased by 4, 9% over € 2 billion. Thus, the volume of bilateral trade in 2017 grew by 6.7% to 7.3 billion euros against 6.9 billion in 2016 (see Figs. 1 and 2).

The imports by exports index in 2017 decreased slightly from 39.9 to 39%. Germany holds the largest share of the total volume of trade and imports of Greece, i.e. 9.3% and 10.5% respectively. As far as exports are concerned, Germany is ranked

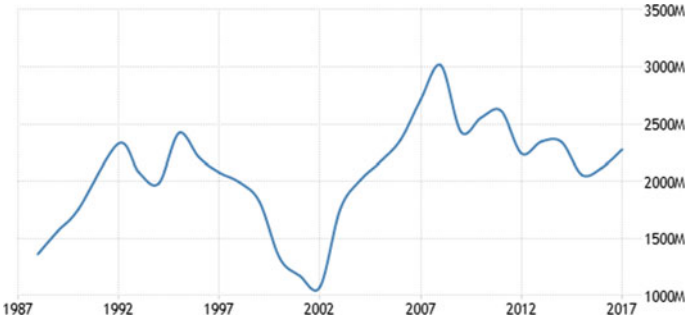

Fig. 1 Value of Greek exports to Germany. *Source* tradingeconomics.com

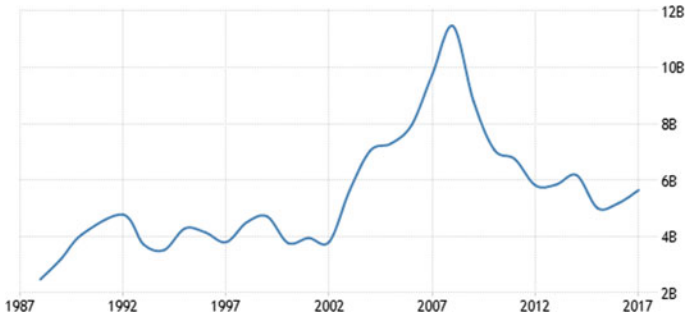

Fig. 2 Value of Greek imports from Germany. *Source* tradingeconomics.com

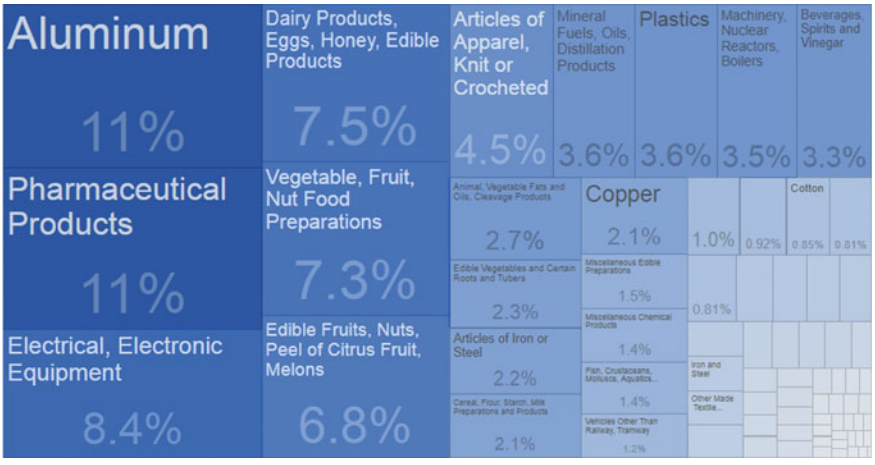

Fig. 3 Greek exports to Germany. *Source* tradingeconomics.com

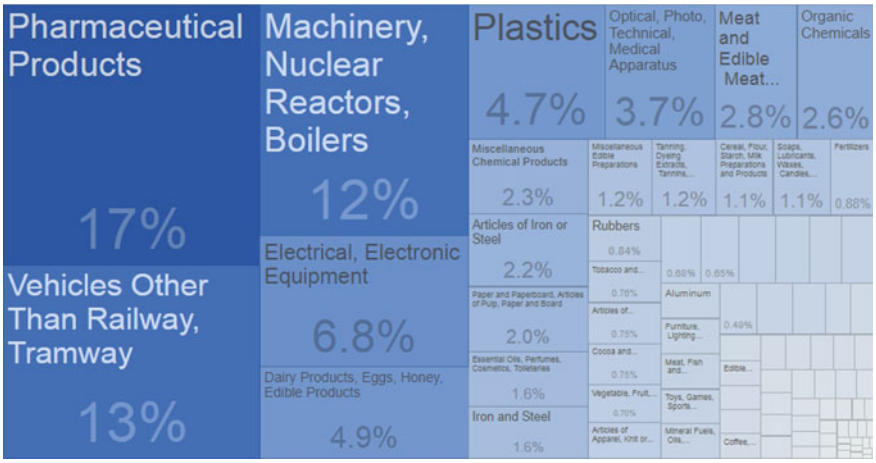

Fig. 4 Greek imports from Germany. *Source* tradingeconomics.com

second with a 7.1% share, after Italy, since Germany absorbs 10.6% of the Greek exports.

Greek exports to Germany include mainly food products, which in 2017 accounted for 32% of the total Greek exports. Aluminum products hold a share of 10.5%, followed by pharmaceuticals, with a share of 10.4%, machines and accessories (mainly wires), with a share of 8.3%, dairy products (7.4%), vegetable and fruit preparations (7.3%), fruit (6.8%) and apparel with a share of 4.5%, etc. On the other hand, the main imported products from Germany include medicines, passenger cars, mechanical equipment, plastics, dairy products, medical machinery and instruments, meats and sausages, cosmetics, organic chemicals, chemicals (see Figs. 3 and 4).

German Market is by far, the largest market in the European Union, with 83 million consumers, mostly of high incomes. The German market is a field of intense competition (due to its size, high per capita income and geographical location) and is considered particularly demanding. Germans consumers present a conscious behaviour using almost in total the price/quality ratio as a key element in their behaviour. Even more the development of consumer-friendly environmental standards (increasing consumption patterns in environmentally-friendly products—covering the entire spectrum of economic and commercial activity such as packaging, etc.), the public health sensitivity, the high propensity to consume organic products, etc., require serious and consistent business strategies to gain market access and retain significant market shares.

Therefore, Germany imports over $55 billion to meet a growing demand for food products. The demand for organic, healthy, innovative, welfare and luxury products are constantly increasing. However, Greece is ranked in a very low position among Germany's suppliers for most of the imported products. Greek exports to Germany are dominated by labor-intensive products and low-value industries, as opposed to the German exports to Greece that are mainly products of high value-added industries

(i.e. vehicles), which reflects this widening Greece's trade deficit mentioned before. What is more, labor-intensive products are subject to strong competition from similar products from EU and non-EU countries with low labour costs.

Even if, the intra-EU Community trade is free from import procedures, tariff and non-tariff barriers, this does not mean less effort to consolidate Greek presence and increase trading shares on the German market. The market shares of Greek products in the German market, particularly in the food and drink sector, show a significant mismatch with Greece's high degree of recognition in German society, which is further enhanced by the large number of almost 4 million Germans citizens visiting Greece for their vacation. The share of the Greek exports to Germany in 2017 remained at 0.2%. In 2017, Greece ranked 48th among the supplier countries of Germany, demonstrating the low utilization of the German market relative to the margins of bilateral trade development.

2.3 The Gravity Model

From the first conceptualisation of Tinbergen (1962) the gravity equation has been used again and again to empirically analyse trade between countries. There is great number of studies exploring the links in bilateral trade flows through the gravity model approach which is a distinguished contrivance to model international trade flows among nations, trading agreements and even between continents. The model has been defined as the workhorse of international trade and its ability to correctly approximate bilateral trade flows, makes it one of the most stable empirical relationships in economics (Leamer and Levinsohn 1995). In addition, the gravity model is the most popular and robust empirical relationship (Chen 2004) to estimate trade flows between two countries, usually indicating a positive effect from both countries' capital income and negative from the distance between them. Although not founded in economic theory, the model is particularly successful in representing trade flows, yielding in most cases a good fit, with R-squared in the order of 0.7 (Natale et al. 2015).

Nevertheless, there is a huge variety of trade transactions that cannot be explained. Most authors add other variables in order to create a model that describes better the trade flows. In literature there are plenty of studies that using gravity model attempt to identify how culture effects the trade flows between countries. Countries that speak the same language will exchange two to three times more than countries who do not share a common language. Indeed, the measures of colonial bonds are positively correlated with trade (Head and Mayer 2013). Another variable used by researchers is treaties and trade policy, since countries often sign agreements to facilitate bilateral trade. This variable is crucial for European trade as the European Union is an example of a trade agreement. One of the primary applications of the gravity model was the assessment of trade flows before and after the liberalization of trade. Many times, the conclusion of free trade agreements results in another trade agreement as a defense, thus leading to a proliferation of them (Baldwin and Jaimovich 2012).

There are researches that support the positive correlation between the existence of a free trade agreement between countries and their economic development. Dollar (1994) argued that a country's extroversion affects its economic growth positively as it allows the use of external capital to economy. The development of an economy is also positively related to the volume of trade in the country (Dollar and Kraay 2004). Overall, the gravity equation model helps to understand the value of trade between two countries and to discern the obstacles that continue to confine international trade even in today's globalized economy (Krugman and Obstfeld 2009).

3 Data and Methodology

The classic gravity model implies trade flow as the dependent variable and as independent variables countries' income and the geographical distance between the examined countries. In this approach distance is replaced by the trade cost between the two countries. This way the trade cost constitutes income restriction for trade between countries. Even more, all variables of the estimated equation have as measurement unit US dollar. Furthermore, this study attempts to answer if the trade comparative advantage for a country and a particular product is correlated with trade cost.

Trade data (imports/exports) of both countries were derived through the COMTRADE database for the period 1992–2017. The analysis focuses mainly on basic agricultural food products (Meat and Meat preparation, Dairy Products and Eggs, Fish and Fish preparation, Cereals and Cereals preparation and Fruits and Vegetables according to SITC ver.1). Tables 1 and 2 presents the descriptive for five

Table 1 Average Greek Imports from Germany for the period 1991 to 2017

Imports	Mean	Minimum	Maximum	Std. deviation
Meat and meat preparations	136,633,544.49	32,818,871.00	237,729,138.00	68,103,849.63
Dairy products and eggs	227,341,703.89	119,553,072.00	378,534,047.00	93,253,227.26
Fish and fish preparations	15,593,845.55	4,745,560.00	28,417,060.00	8,054,782.14
Cereals and cereal preparations	70,974,891.26	35,256,554.00	115,738,982.00	22,702,893.55
Fruit and vegetables Imports	53,183,083.37	12,590,823.00	122,084,323.00	31,631,671.60
Total	5,820,088,970.78	3,530,020,147.00	11,541,656,939.00	2,097,596,361.70

Source Survey Results, (prices in €)

Table 2 Average Greek Exports to Germany for the period 1991 to 2017

Exports	Mean	Minimum	Maximum	Std. deviation
Meat and meat preparations	3,060,061.04	833,075.00	9,115,692.00	1,826,472.26
Dairy products and eggs	80,697,626.12	31,260,942.00	161,008,892.00	43,745,174.52
Fish and fish preparations	17,852,339.41	4,020,985.00	33,773,952.00	10,074,228.62
Cereals and cereal preparations	30,192,370.82	3,317,500.00	58,476,844.00	16,785,696.53
Fruit and vegetables	352,296,149.81	207,910,805.00	533,593,397.00	86,242,230.15
Exports total	2,125,687,488.04	1,272,174,400.00	2,911,488,160.00	398,082,706.18

Source Survey Results (prices in €)

specific agricultural products (Meat and meat preparations, Dairy products and eggs, Fish and fish preparations, Cereals and cereal preparations and Fruit and vegetables) that participate in this study.

The globalization of the financial transactions between the countries has as a direct consequence the intense competition for the prevalence on the top of world trade. The theory of comparative advantage provides that trade flows arise as a result of relative cost differences between trading partners. It indicates that countries are competitive on goods and services in which they have a relative cost advantage (Bojnec and Fertő 2009).

Competition capacity in international and domestic markets depends on comparative advantages. Therefore, data was used to estimate the development of the comparative advantage by using trade competitiveness measures for the agri-food sector in the Greece–Germany bilateral trade. This research evaluates the trade competitiveness of the two countries in the agri-food sector using three representative indicators of trade competitiveness: import coverage index, Balassa index and intra-industry trade index.

Export Coverage Index: This indicator shows the share of exports absorbed by the value of imports. It is defined as the ratio of exports to imports.

$$\varepsilon_i = X_i/M_i$$

where X_i and M_i exports and imports of the sector i respectively.

Balassa Index: In order to estimate the degree of trade specialization of a country, Balassa (1965) proposed the following Revealed Comparative Advantage (RCA) indicator.

$$RCA_i = (X_i - M_i) / (X_i + M_i)$$

The index of the Revealed Competitive Advantage is essentially the share of exports of country for commodity i of total trade of country. Where, X and M is the exports and imports of product i correspondingly. When the index gets higher than a unit, then exports of i have a larger contribution to total trade of country. In this case, country displays a comparative on this product.

Grubel Lloyd Index: Grubel and Lloyd (1975) published the first empirical study on the importance of intra-industry trade and identified how to assess it. This index is also the most commonly used method of measuring the extent of intra-industry trade, also known as the intra-class commercial marker Grubel Lloyd. The Grubel Lloyd index is defined as:

$$GL_i = 1 - X_i - M_i / (X_i + M_i), \quad 0 \leq GL_i \leq 1$$

GL index values range from 0 to 1. As long as the GL_i tends to unit, it means that there is only intra-branch trade, and there is no inter-branch trade. On the other hand, if the GL_i tends to zero, it means that there is no intra-trade trade, so all trade is characterized as cross-trade, i.e. the country only exports or only imports the goods or services i.

In order to find the factors that explain best the trade flows between the countries was used two approximation of the gravity model: the restricted model and the augmented model. Wall (1999) developed the view of the exclusive relationship between the value of trade between two countries, the income of the two countries and the geographical distance between them. The Wall's view is the simplest and most basic form of the gravity equation of international trade and is defined as follows:

$$T_{ij} = A(Y_i,\ Y_j)/D_{ij}$$

where T_{ij} is the total value of transactions between countries i and j, $Y_i(j)$ is the nominal Gross Domestic Product (GDP) of country i(j), which represents domestic real income respectively, A is a constant and D_{ij} distance between countries i and j.

In the present study, the independent variable of distance between countries is defined as the trade cost that is required to export goods from one country to the other. The geographical distance that separates the two countries over time remains stable. By contrast, trade costs between the two countries are a dynamic variable that affects trade volume as it acts as an income restriction on trade flows.

At augmented model was added variables that can also affect trade flows between the two countries, such as the population and consumption. For the estimate of the gravity model of the bilateral trade the most appropriate method characterized the use of logarithm in such a way obtained the linear-by-parameter model as follows:

$$\log(T_{ij}) = \alpha + \beta \log(Yi) + \gamma \log(Y_j) + \delta \log(TC_{ij}) + \varepsilon_{ij} \quad (1)$$

Restricted Model

$$\log(T_{ij}) = \alpha + \beta \log(Y_i) + \gamma \log(Y_j) + \delta \log(TC_{ij}) + \zeta \log(C_i) + \eta \log(C_j) + \varepsilon_{ij} \quad (2)$$
Augmented Model

4 Empirical Results

The results of this survey identify the products that each country has a comparative advantage. The following tables present: (a) the Export Coverage Index (Table 3), (b) the Balassa index or Revealed Comparative Advantage - RCA (Table 4) and (c) the Grubel–Lloyd index (Table 5). Is obvious that Greece only presents a comparative advantage in the market of fruits and vegetables. Export Coverage Index of German Exports is higher than 1 for all variable except fruits and vegetable, the exactly opposite result observed on Greek Export Coverage Index. Furthermore, Balassa Index presents comparative advantage in exports of fruits and vegetables for Greece and in meat products for Germany. On the other hand, Germany has the comparative advantage on 3 product categories (Meat and Meat preparation, Dairy Products and Eggs and Cereals and Cereals preparation). In the Fish and Fish preparation category the analysis should be made only in specific fish categories since according to Grubel–Lloyd index an intra-industry trade is observed.

It should be noted that even if aquaculture is a relatively specialized sub-segment of food production, it is a rapidly growing sector of the Greek economy—and one where Greece can leverage its competitive advantages and already is a major international exporter. In Greece, approximately 90% of the sector's value is driven by two main fish products, seabass/seabream, in which Greece holds a dominant position in the global markets. In 2015, 110,000 tons of sea bream and sea bass were produced. These two species accounts for 98% of the harvest volume, while all the other Mediterranean species accounted for 2%. In 2015 Greece supplied 61% of the sea bass and sea bream sold in the EU and 31% worldwide. Greek aquaculture production is known for its product quality and has enormous further growth potential.

However, the intra-trade relationship with the Germany reveals a significant structural weakness of the sector. Fish feeds are the most important raw materials used in the production process and represent 57% - 59% of the production cost. The raw materials used in fish feed are fishmeal and fish oil, cereals, vegetable protein and oilseed products, which are imported to a large degree from northern Europe along with South America and Africa (FGM 2016) (Figs. 5, 6 and 7).

The next part of the analysis is the estimation of the gravity model that used to estimate the factors that determine the bilateral trade between Greece and Germany. The gravity model assumes that trade between any two countries is proportional, other things being equal, to the product of the two countries' GDPs, and diminishes with the distance between the two countries. Most gravity model studies introduce a large number of variables to distinguish cultural and geographic differences among nations (Tansey and Hanson 2013). The inclusion of distance in gravity equations generated

Table 3 Exports to imports index for Greek trade with Germany for the period 1991–2017

	Meat and meat preparation	Dairy products and eggs	Fish and fish preparation	Cereals and cereals preparation	Fruits and vegetables
1991	0.020	0.261	0.837	0.096	30.827
1992	0.020	0.245	1.048	0.173	26.753
1993	0.014	0.272	1.124	0.295	22.486
1994	0.022	0.341	1.326	0.235	18.547
1995	0.023	0.414	1.342	0.048	19.181
1996	0.035	0.347	1.488	0.050	14.583
1997	0.056	0.320	1.349	0.326	13.392
1998	0.046	0.332	1.175	0.431	11.918
1999	0.020	0.287	1.637	0.406	9.384
2000	0.014	0.274	0.957	0.290	8.239
2001	0.028	0.290	1.291	0.408	8.038
2002	0.020	0.292	0.669	0.551	5.773
2003	0.020	0.299	0.623	0.799	3.970
2004	0.016	0.303	0.837	0.635	3.719
2005	0.024	0.281	1.054	0.462	4.849
2006	0.015	0.287	1.028	0.462	4.998
2007	0.013	0.213	0.890	0.365	4.310
2008	0.012	0.284	0.891	0.488	4.371
2009	0.019	0.339	1.232	0.527	4.864
2010	0.020	0.312	1.178	0.511	5.391
2011	0.021	0.310	1.195	0.608	5.544
2012	0.018	0.378	1.521	0.433	5.895
2013	0.020	0.396	1.418	0.337	6.896
2014	0.024	0.438	1.065	0.400	6.547
2015	0.029	0.634	1.138	0.451	5.249
2016	0.035	0.642	1.217	0.556	5.013
2017	0.050	0.617	1.617	1.041	6.087

Source Survey Results

a large empirical literature. Disdier and Head (2006) examined 103 different papers in the literature using meta-analysis to confirm the relationship, concluding that on average, a 10% increase in distance lowers bilateral trade by about 9%.

However, in this case the distance between Greece and Germany is constant, therefore trade cost was preferred to incorporate the distance effect between the examined countries. Even more, no variable was used to distinguish cultural differences, since Greece and Germany are both members of the European Union and even more 500,000 Greeks are economic immigrants in Germany moreover 4 million Germans

Table 4 Balassa Index for Greek trade with Germany for the period 1991–2017

	Meat and meat preparation	Dairy products and eggs	Fish and fish preparation	Cereals and cereals preparation	Fruits and vegetables
1991	−0.961	−0.585	−0.089	−0.825	0.937
1992	−0.961	−0.606	0.023	−0.706	0.928
1993	−0.972	−0.572	0.058	−0.544	0.915
1994	−0.957	−0.491	0.140	−0.619	0.898
1995	−0.955	−0.415	0.146	−0.909	0.901
1996	−0.932	−0.484	0.196	−0.904	0.872
1997	−0.894	−0.516	0.148	−0.508	0.861
1998	−0.912	−0.502	0.080	−0.398	0.845
1999	−0.960	−0.554	0.242	−0.422	0.807
2000	−0.973	−0.570	−0.022	−0.550	0.784
2001	−0.946	−0.550	0.127	−0.420	0.779
2002	−0.960	−0.549	−0.198	−0.290	0.705
2003	−0.961	−0.540	−0.232	−0.112	0.598
2004	−0.968	-0.535	-0.089	-0.223	0.576
2005	-0.952	-0.561	0.026	−0.368	0.658
2006	−0.971	−0.555	0.014	−0.368	0.667
2007	−0.974	−0.649	−0.058	−0.465	0.623
2008	−0.975	−0.557	−0.057	−0.344	0.628
2009	−0.962	−0.494	0.104	−0.310	0.659
2010	−0.961	−0.525	0.082	−0.323	0.687
2011	−0.959	−0.527	0.089	−0.244	0.694
2012	−0.964	−0.451	0.207	−0.396	0.710
2013	−0.961	−0.433	0.173	−0.496	0.747
2014	−0.953	−0.391	0.031	−0.428	0.735
2015	−0.944	−0.224	0.065	−0.379	0.680
2016	−0.933	−0.218	0.098	−0.286	0.667
2017	−0.904	−0.237	0.236	0.020	0.718

Source Survey Results

visit Greece each year for their vacations. Assuming this way that both Greeks and Germans are familiar with the agricultural products of each other. The variables in the gravity model are described in Table 6.

Three gravity models where examined: one for the total trade, one only for the imports and a third for exports. The method of least squares (OLS) was used for the estimation. Table 7 presents the estimation of gravity model as specified in the previous section. According to Table 7, R^2 in the examined product categories are quite high meaning that the variables used explain the trade between Greece and

Table 5 Crubel Lloyd Index for Greek trade with Germany for the period 1991–2017

	Meat and meat preparation	Dairy products and eggs	Fish and fish preparation	Cereals and cereals preparation	Fruits and vegetables
1991	0.039	0.415	0.911	0.175	0.063
1992	0.039	0.394	0.977	0.294	0.072
1993	0.028	0.428	0.942	0.456	0.085
1994	0.043	0.509	0.860	0.381	0.102
1995	0.045	0.585	0.854	0.091	0.099
1996	0.068	0.516	0.804	0.096	0.128
1997	0.106	0.484	0.852	0.492	0.139
1998	0.088	0.498	0.920	0.602	0.155
1999	0.040	0.446	0.758	0.578	0.193
2000	0.027	0.430	0.978	0.450	0.216
2001	0.054	0.450	0.873	0.580	0.221
2002	0.040	0.451	0.802	0.710	0.295
2003	0.039	0.460	0.768	0.888	0.402
2004	0.032	0.465	0.911	0.777	0.424
2005	0.048	0.439	0.974	0.632	0.342
2006	0.029	0.445	0.986	0.632	0.333
2007	0.026	0.351	0.942	0.535	0.377
2008	0.025	0.443	0.943	0.656	0.372
2009	0.038	0.506	0.896	0.690	0.341
2010	0.039	0.475	0.918	0.677	0.313
2011	0.041	0.473	0.911	0.756	0.306
2012	0.036	0.549	0.793	0.604	0.290
2013	0.039	0.567	0.827	0.504	0.253
2014	0.047	0.609	0.969	0.572	0.265
2015	0.056	0.776	0.935	0.621	0.320
2016	0.067	0.782	0.902	0.714	0.333
2017	0.096	0.763	0.764	0.980	0.282

Source Survey Results

Germany. However, trade cost in not statistically significant for almost all product categories, while the same occurs for food consumption.

Table 8 presents the estimation results for the Greek imports from the Germany. The results are not statistically significant for the most product categories. On the other hand, when only the amount of the Greek exports to Germany is used to calculate the Gravity model (Table 9) the estimated results are statistically significant, and they can provide some useful observations. For example, trade cost can be used as an alternative variable to distance (all three variables of the simple gravity model, are

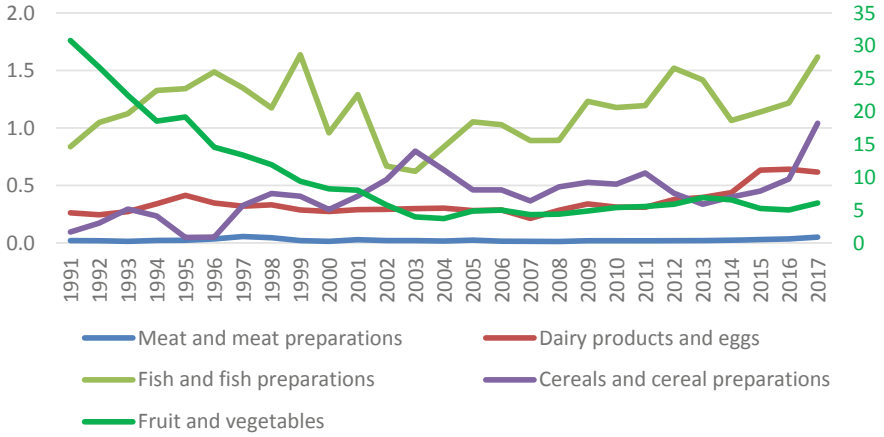

Fig. 5 Exports to Imports Index for Greek trade with Germany 1991–2017. *Note* exports to imports index for fruit and vegetables uses the secondary Y-axis scale (on the left of the graph)

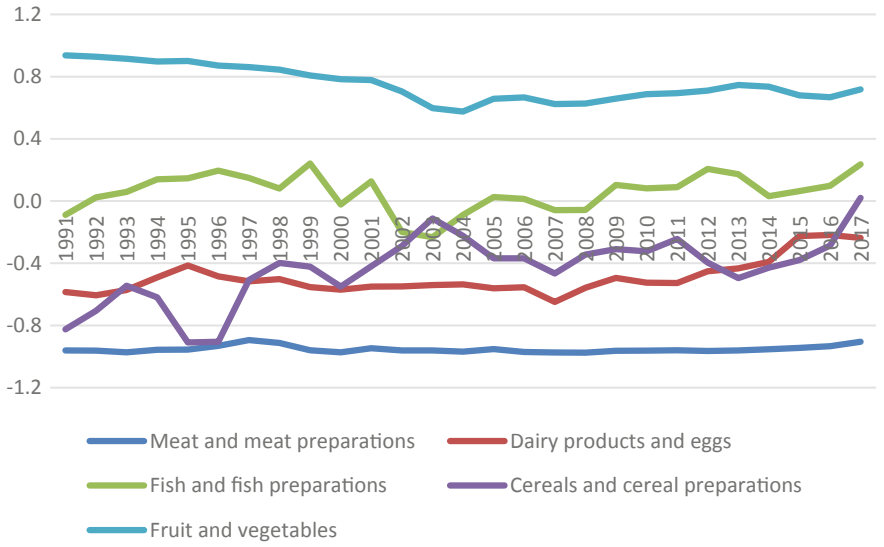

Fig. 6 Balassa Index for Greek trade with Germany for the period 1991–2017

proved to be valid in this case also). Greek/Germany GDP affects Greek/Germany trade as it was expected.

It is worth examining the effect of food consumption in Greek imports and exports. Food consumption in Greece seems to affect negatively Greek exports, meaning that companies are export oriented only, when they cannot sell their products in the domestic market. However, there is no clear conclusion of how food consumption in

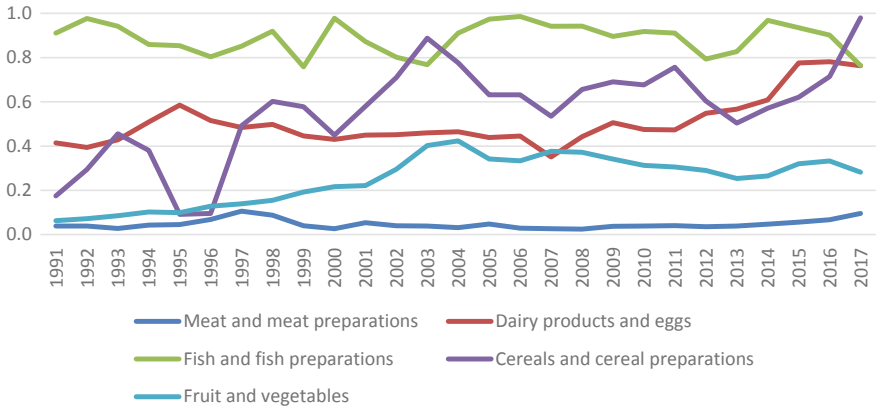

Fig. 7 Crubel Lloyd Index for Greek trade with Germany for the period 1991–2017

Table 6 Descriptive statistics for the variables in the Gravity model

	Mean	Min	Max	Std. dev
Per capita GDP for Germany (€)	33,412.65	21,710.52	48,942.91	8,881.91
Per capita GDP for Greece (€)	22,862.97	14266.07	30,855.94	5,449.62
Population for Germany (Millions)	81.73	80.25	82.50	0.722
Population for Greece (Millions)	10.92	10.37	11.19	0.248
Food Consumption for Greece (€)	13,821.4	12,249,5	16,7313	15,210.12
Food consumption for Germany (€)	19,097.2	10,959	25,632	5,172.30
Greece–Germany Trade cost (in € per tn)	111.52	102.95	124.36	6.802

Source Survey Results

Germany affects Greek Exports. Especially for the fruit and vegetable category, which means that a further investigation is needed to determine the fruit and vegetables market in Germany.

5 Conclusion—Discussion

According to the results, GDP of both countries, seems to have a positive effect on the exports of both countries. An increase on GDP of Greece or Germany can cause a growth on bilateral trade. However, according to the *t* statistic and the 10% level of significance, the GDP of Greece and Germany is statistically significant for the majority of food categories that was examined. On the contrary, Greek exports is statically significant, mainly due to Germany's GDP, which is justified because the German market absorbs an important part of the Greek exports.

Table 7 Greece–Germany Total Trade for the period 1992–2017

	Meat and meat preparation	Dairy products and eggs	Fish and fish preparation	Cereals and cereals preparation	Fruits and vegetables
Per Capita GDP for Greece	2.230 (1.093)	1.515 (1.569)	2.769 (3.113)***	2.887 (2.313)**	2.949 (2.900)**
Per Capita GDP for Germany	3.378 (1.639)	1.866 (1.915)*	3.693 (4.212)***	2.682 (2.218)*	2.218 (2.288)**
Trade Cost	0.789 (0.626)	−1.031 (−1.375)	−1.195 (−1.729)	−1.718 (−1.771)*	−1.099 (−1.391)
Food Consumption for Germany	−2.165 (−1.344)	−1.258 (−1.651)	2.019 (2.876)**	−1.606 (−1.630)	−2.207 (−2.750)**
Food Consumption for Greece	−0.926 (−0.163)	−0.360 (−0.134)	5.281 (2.131)*	−6.583 (−1.893)*	−4.077 (−1.439)
R^2	0.825	0.905	0.948	0.793	0.789
R^2adj	0.763	0.871	0.929	0.720	0.714
F test (Sig)	13.219 (0.00)	26.666 (0.00)	50.959 (0.00)	10.757 (0.00)	10.942 (0.00)
DW test	0.766	1.302	1.962	1.664	1.687

Estimation Results for the examined Gravity Model
Source Survey Results
Notes All numbers are logarithmic, OLS estimation
(t-statistic) "***" denoting statistical significance at 1%, level "**" at 5% level, "*" at 10% level

Trade cost appears also, to have a significant correlation with the export flow in the sectors that the country has a competitive advantage over the other. Moreover, trade cost in this case are statistically significant using the *t* statistic and a 10% significance level. The positive correlation between the cost of trade and the level of exports also appears in the estimation of the model. On the contrary, in sectors where the country does not have an advantage, the impact of trade cost on exports seems to be insignificant. The interpretation for the positive correlation between trade cost and exports in sectors that the country has a competitive advantage is that the country, due to its competitive advantage, manages to export efficiently by achieving economies of scale and reducing this way the cost of trade for each additional export unit. Thus, the country has an incentive to increase its exports even if trade cost increases. This is the case for Greece's food and beverage companies that have created a large sales and distribution network in Southeast Europe, a strength that is reinforced by the dynamism of the Greek enterprises operating in the region.

Overall, agricultural production has been a major export sector for Greece in the past, with Greek fruit and vegetables being consumed in Germany and several other international markets. Despite the small lot size, the Greek agriculture sector has

Table 8 Greek Imports from Germany for the period 1992–2017. Estimation Results for the examined Gravity Model

	Meat and Meat preparation	Dairy Products and eggs	Fish and fish preparation	Cereals and cereals preparation	Fruits and vegetables
Per capita GDP for Greece	2.191 (1.056)	1.490 (1.500)	2.499 (2.125)*	3.539 (2.884)**	3.070 (2.568)**
Per capita GDP for Germany	3.332 (1.590)	1.615 (1.611)	2.747 (2.313)**	2.452 (1.979)*	1.392 (1.979)
Trade cost	0.884 (0.592)	−0.951 (−1.233)	−0.565 (−0.618)	−2.314 (−2.427)**	−0.094 (−0.101)
Food consumption for Germany	−2.135 (−1.304)	−1.060 (−1.353)	−1.210 (−1.304)	−2.454 (−2.534)	−0.573 (−0.608)
Food consumption for Greece	−0.690 (−0.119)	−0.134 (−0.049)	−4.069 (−1.242)	−5.796 (−1.695)	−3.178 (−0.954)
R^2	0.823	0.900	0.917	0.740	0.943
R^2adj	0.760	0.864	0.887	0.647	0.923
F test (Sig)	13.035 (0.00)	25.121 (0.00)	30.891 (0.00)	7.968 (0.00)	46.601 (0.00)
DW test	0.769	1.290	1.751	1.770	1.590

Estimation Results for the examined Gravity Model
Source Survey Results
Notes All numbers are logarithmic, OLS estimation
(t-statistic) "***" denoting statistical significance at 1%, level "**" at 5% level, "*" at 10% level

maintained a positive trade gap in a wide range of agricultural products. There are several specific sectors that show potential for increased returns in terms of production capacity. Most notably, there are several types of crops which are considered "export engines" (e.g. grapes, oranges, peaches, nectarines, kiwis) and which can all meet European and global demand with the appropriate standardization and quality control.

In this direction, Greek specialty foods that include a variety of products, ranging from high-value niche products (Chios Masticha, Kalamata olives, Aegina pistachios) to widely available categories which are endemic to the Greek diet (e.g. Greek yoghurt, olive oil, honey) to Protected Designation of Origin Status (PDO) products only found in Greece. These products have significant export potential and higher value added in the international markets. These products should be examined more and promoted with domestic and regional policies, providing capital subsidies, and developing export enhancing infrastructure. In addition, Fish farming is a sector that should be examined more, as it can obtain a leading position in Greece's Food industry and it is a top industry sector in the EU characterized by strong market consolidation. Investing in the consolidation and expansion of aquaculture facilities and the improvement of competitiveness, operating efficiency and market access can

Table 9 Greek Exports to Germany for the period 1992−2017. Estimation Results for the examined Gravity Model

	Meat and meat preparation	Dairy products and eggs	Fish and fish preparation	Cereals and cereals preparation	Fruits and vegetables
Per capita GDP for Greece	6.231 (3.724)***	2.708 (2.515)**	4.508 (4.484)***	1.584 (0.498)	2.311 (2.314)**
Per capita GDP for Germany	3.614 (2,181)**	1.498 (1.405)	3.059 (3.072)***	−0.959 (−0.303)	2.851 (2.985)***
Trade cost	−1,67 (−1.297)	−1,286 (−1.552)	−1,941 (−2.509)**	−0.361 (−0.147)	−1.312 (−1708)
Food consumption for Germany	11.460 (2.482)**	−1.268 (−0.427)	6.262 (2.257)**	−4.126 (−0.468)	4.233 (1.357)
Food consumption for Greece	−3.66 (−2.719)**	−1.802 (−2.141)*	−2.781 (−3.539)***	3.098 (1.242)	−2.347 (−3.009)***
R^2	0.801	0.892	0.938	0.750	0.758
R^2adj	0.730	0.853	0.915	0.660	0.672
F test (Sig)	11.289 (0.00)	23.134 (0.00)	42.005 (0.00)	8.387 (0.00)	8.783 (0.00)
DW test	1.878	1.604	2.045	1.668	1.785

Estimation Results for the examined Gravity Model
Source Survey Results
Notes All numbers are logarithmic, OLS estimation
(t-statistic) "***" denoting statistical significance at 1%, level "**" at 5% level, "*" at 10% level

yield significant returns for this sector based on its growth potential and existing market positioning.

Nevertheless, food and agriculture sector in Greece is expected to maintain, over the next years, its significant contribution to GDP growth. There is abundant opportunity to create value added in many product categories, especially as the global interest in healthful foods, snack foods, and convenience foods continues to expand. The prevalence of the Mediterranean Diet, as a premier paradigm of healthy, natural eating diet that affect consumer preferences in developed economies could be a significant opportunity for the Greek food producers. They have to take advantage of their smaller scale, access to high-quality inputs and traditional Mediterranean positioning to differentiate from the global food manufacturers and gain market share value-added product segments and higher price points.

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