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Abstract

Over the last 15 years, the global trade of virgin olive oil (VOO) seems to face a stringent regulatory regime, mainly through the imposition of TBT and SPS measures. Such a development should have adversely impacted global levels of VOO trade. However, evidence shows that the world's imports of VOO have more than quadrupled in value since 2000. Alongside this trend, the share of VOO imports gradually shifts from traditional sources (mainly EU) to New World producing countries, such as Argentina, Australia, the USA, and Chile. By extracting data from hundreds of NTM regulations, as well as all possible registered bilateral trade flows between 2002 to 2014, this paper aims to empirically explore to what extent particular NTMs impact imports of VOO. The results indicate that while tariffs remain a stringent barrier, most NTMs have a positive impact on imports, rather than enhancing restrictiveness. The paper asserts that the majority of NTMs respond to consumers' demand for higher food safety standards and protection of human health, while increasing available information and transparency. That, in turn, leads to an expansion in the magnitude of imports of VOO products.

JEL Classifications: F13, F14, Q17, Q18
Keywords: Non-Tariff Measures, Technical Barriers to Trade, Sanitary and Phytosanitary, Virgin Olive Oil.

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1 Introduction

The agreements on Sanitary and Phytosanitary (SPS) and Technical Barriers to Trade (TBT) of the World Trade Organization (WTO) were designed to provide the member countries with the freedom to choose a particular measure that allows them to achieve legitimate policy objectives, such as the protection of human health and the environment. However, these instruments should be levied only to the extent necessary to achieve the desired purpose while the prohibitive effects on trade are kept to a minimum. Meanwhile, over the past two decades, the Dispute Settlement Body of the WTO reports a growing number of trade disputes, related either to SPS or TBT measures which created unnecessary trade barriers (WTO, 2012).

The influence of SPS and TBT measures on international market access are more complicated than those of traditional trade barriers, such as tariffs and countervailing duties. The pivotal role of SPS and TBT measures ranges from alleviating asymmetric information in the marketplace (i.e. labelling requirements) to mitigating risk in the consumption of particular products and enhancing the sustainability of the eco-system. Accordingly, SPS measures and TBTs are likely to impact both consumers' and producers preferences and modify their decisions. Consequently, while NTMs may create unnecessary trade barriers and significantly impede market access for agricultural products from particular sources, it may also enhance consumers demand via risk mitigation or quality assurance, and possibly serve as trade catalysts.

The paper aims to provide an empirical framework for examining the inclusive effects of a variety of SPS and TBT measures, collectively organized into seven subgroups, on the imports of a particular sector. To achieve this objective, the olive oil sector has been chosen as a case study. Notably, the paper refers to the subcategory of virgin olive oil (VOO), which despite being the highest quality of olive oil, accounts for over 85% of the total olive oil exports. This sector is of particular interest given the intensified regulation environment it operates in, as well as the dynamic developments that have occurred during the last three decades against the background of the surge in global consumption. Moreover, a special interest is attributed to the shift in the variety of production sources, after hundreds of years of absolute dominance of the Mediterranean basin countries (predominantly Spain, Italy, and Greece).

The significant growing demand for VOO, highlights the increasing popularity of the Mediterranean diet, for its highly beneficial nutritional and culinary properties due to its unique composition in containing fatty acids and antioxidants. Accumulated evidence demonstrate that demand for VOO has more than quadrupled since the new millennium, primarily in countries outside the EU. Furthermore, the consumption of VOO is expected to further increase significantly in near future. Additional notable trend is the shift of imports of VOO, from the traditional exporting countries to the New World producing countries, such as Argentina, Australia, the USA, and Chile. This development which is clearly generated by the growing demand for affordable products, as well as the consumers interest in diversified supply sources, creates another challenge for VOO producers.

The novelty of this paper arises from the detailed analysis of trade regulations and their impact on global trade flows of VOO. This type of analysis is especially useful for identifying which regulations (most) efficiently achieve a magnifying effect, in contrast to those which pose a restrictive barrier to trade. Moreover, it also allows to determine the extent to which these measures can serve as trade catalysts for the relevant stakeholders.

The main contribution of the paper is the empirical validation it provides to the trade-enhancing impact of a wide range of regulatory measures on VOO imports. It does so by building a panel data which consists of thousands of possible NTMs, affecting all possible bilateral trade flows between the years 2002 to 2014. The estimation results reveal that while tariffs remain a stringent barrier, most TBT and SPS measures are associated with a positive impact on imports rather than increasing restrictiveness. The paper asserts that while aiming to achieve better food safety, human and animal health, and protection of the environment, the majority of NTMs generate additional economic benefits. Through risk mitigation, quality assurance and increased traceability, as well as information and transparency, numerous regulatory measures virtually enhance consumer demand, resulting in an expansion in the demand for VOO imports.

The paper is comprised of five sections. Following the introduction, the second section portrays the characterization of the VOO sector and the policy measures which affect its trade across countries. The third section outlines the relevant literature review, which examine the relations between tariffs, NTMs, and olive oil trade. The fourth section presents the econometric methodology which was chosen to conduct the analysis, accompanied by a discussion of the results of the estimations, and a comparison of the exports by EU producing countries to non-EU producing countries. The last section underlines the key findings which can be drawn from the research.

2 The Global Trade of Virgin Olive Oil

2.1 Background and Characteristics

Edible olive seems to have co-existed with humans for millennia, with its origins traced along the eastern Mediterranean coast, which is nowadays Turkey, Syria, Lebanon, Palestine, and Israel. After their introduction to Greece, Egypt, and western Turkey, olives continued to move westward into Italy, France, Spain, Portugal, Algeria, Tunisia, and Morocco. Since then, through the days of the Roman Empire, olive planting and oil processing facilities have spread around the Mediterranean basin, which remain up to recent years, the main region of olive oil production and largest market of consumption.

The dominant producing countries of olive oil (OO) nowadays are Spain, Italy, and Greece, which account for more than half of the global production. Spain is also the leading exporter of VOO, with a share of 52% of the world's exports, followed by Italy, Portugal, and Greece. Spains significant growth in production is a result of the vast plantations and investments made during the 1980s, thanks to the incentives for production, export, and storage provided within the EU Common Agricultural Policy. Trailing behind the EU are Tunisia, Turkey, Syria and Morocco, countries that gradually gain a grip of the worlds production of OO. Table 1 shows the gradual shift in output share from the EU to non-EU producing countries, which currently account for about 42% of the global volume produced.

Table 1
EU vs. Non-EU countries, Olive Oil Statistics

		2000		***2008***		***2015***	
		Volume	***Share***	***Volume***	***Share***	***Volume***	***Share***
EU	*Production (1,000 tonnes)*	*1,879*	*79.1%*	*1,939*	*72.6%*	*1,435*	*58.4%*
	Consumption (1,000 tonnes)	*1,728*	*70.7%*	*1,866*	*67.7%*	*1,605*	*55%*
	Exports, Virgin Olive Oil ($ Mil.)	*1,293*	*84.8%*	*3,884*	*81.5%*	*4,730*	*78.6%*
	Imports, Virgin Olive Oil ($ Mil.)	*1,112*	*71.8%*	*3,284*	*66.3%*	*3,979*	*63.5%*
	Per Capita Consumption (kg)			*3.74*		*3.21*	
Non-EU	*Production (1,000 tonnes)*	*496*	*20.9%*	*730.5*	*27.4%*	*1,024*	*41.6%*
	Consumption (1,000 tonnes)	*714*	*29.3%*	*887*	*32.2%*	*1,312*	*45%*
	Exports, Virgin Olive Oil ($ Mil.)	*232*	*15.2%*	*884*	*18.5%*	*1,286*	*21.4%*
	Imports, Virgin Olive Oil ($ Mil.)	*436*	*28.2%*	*1,667*	*33.7%*	*2,286*	*36.5%*
	Per Capita Consumption (kg)			*0.15*		*0.21*	

Source: WITS and the International Olive Council, Nov. 2016

In the last 20 years, several notable developments were associated with olive oil. The most significant development is the growing popularity of the Mediterranean diet, mainly due to its

Table 2
Imports of Virgin Olive Oil by Main Importing Countries

		2002		*2008*		*2015*		*MFN Applied*
		$ Mil.	***Share***	***$ Mil.***	***Share***	***$ Mil.***	***Share***	***Tariff Rates***
	Italy	*928*	*46.4%*	*1,659*	*33.5%*	*1,876*	*29.9%*	
	Spain	*15*	*0.8%*	*194*	*3.9%*	*603*	*9.6%*	
	France	*194*	*9.7%*	*435*	*8.8%*	*448*	*7.1%*	
	Germany	*108*	*5.4%*	*272*	*5.5%*	*278*	*4.4%*	
EU	*Portugal*	*67*	*3.4%*	*174*	*3.5%*	*245*	*3.9%*	
	United Kingdom	*63*	*3.2%*	*201*	*4.1%*	*181*	*2.9%*	
	Belgium	*31*	*1.6%*	*71*	*1.4%*	*58*	*0.9%*	
	Netherlands	*16*	*0.8%*	*52*	*1.1%*	*54*	*0.9%*	
	Total EU	***1,484***	***74.2%***	***3,284***	***66.3%***	***3,979***	***63.5%***	***40%****
	USA	*263*	*13.1%*	*760*	*15.4%*	*926*	*14.8%*	*1.3%**
	Japan	*60*	*3%*	*116*	*2.4%*	*236*	*3.8%*	*0%*
	Brazil	*17*	*0.9%*	*152*	*3.1%*	*224*	*3.6%*	*10%*
	China	*0*	*0%*	*41*	*0.8%*	*145*	*2.3%*	*10%*
Non-EU	*Canada*	*37*	*1.8%*	*107*	*2.2%*	*133*	*2.1%*	*0%*
	Russia	*3*	*0.2%*	*44*	*0.9%*	*40*	*0.6%*	*5%*
	Switzerland	*30*	*1.5%*	*78*	*1.6%*	*79*	*1.3%*	*0%*
	Australia	*25*	*1.2%*	*55*	*1.1%*	*47*	*0.7%*	*0%*
	S. Korea	*4.5*	*0.2%*	*45*	*0.9%*	*48*	*0.8%*	*5%*
	Total Non-EU	***515.7***	***25.8%***	***1,667.2***	***33.7%***	***2,286***	***36.5%***	

Source: UN Comtrade Dataset & World Integrated Trade Solution (WITS).
** Converted to tariff ad-valorem equivalents, using 2015 imports.*

acknowledged nutritional properties, but also as a response to the growing threat caused by global obesity (also known as the silent killer). Notably, the most valuable benefits are attributed to the quality of VOO. Coupled with improvements in cultivation and the use of oil-mill technologies, this has generated a substitution drift from generic olive oil towards VOO.

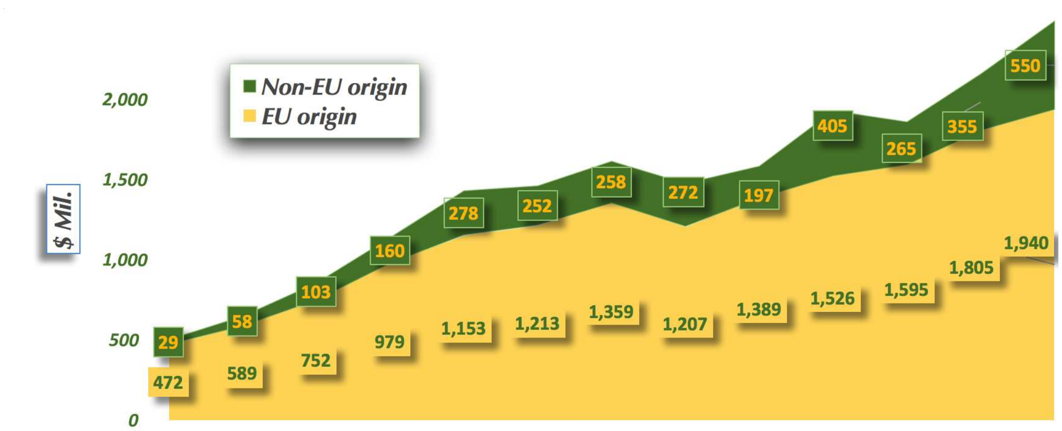
After thousands of years of pure dominance, the world is experiencing a remarkable growing demand for VOO, which is spreading beyond the Mediterranean region to non-traditional markets. In particular, countries such as the USA, Brazil, Japan, Canada, China have extensively increased their VOO consumption. Since the beginning of the millennium, while the total consumption of olive oil has increased up to 1.8-fold, the share of consumption of olive oil by non-EU countries has soared 4-fold to 45% of the worlds consumption (IOC, 2016). The highest growth rate in consumption is recorded in Japan (1400%), and the biggest in terms of volume is the USA, which jumped from 88 to 308 thousand metric tons.

Obviously, the increase in demand for VOO is accompanied by a rise in imports to supply this consumption. The global imports of VOO, as reported in Table 2 account for USD 6.3 billion (2015). Excluding intra-EU trade, the rest of the worlds imports of VOO accounts for 36.5%

of the total imports. That represents a dramatic surge of over 500% since the beginning of the millennium. In 2015, the largest EU importers of VOO were Italy, Spain, France, and Germany, while outside the EU, the biggest importers are the USA with 14% of the global imports, followed by Japan, Brazil, China and Canada. Interestingly, the annual growth of VOO imports, in the non-EU countries, since the year 2000, is over 10%, with Brazil demonstrating the fastest annual growth rate of 22.9%, followed by Japan with 11.9%.

An additional trend is the gradual shift of VOO imports from traditional sources in the EU to New World producing countries. Among these countries, the most noteworthy sources of VOO are Tunisia, Morocco, Syria, Turkey, and Algeria. Yet, growing demand is emerging from developed countries such as Argentina, Chile, USA, Australia, and others. By 2015, non-EU countries are responsible for approximately 40% of the world OO production. Moreover, the evidence presented in Figure 1 shows that between the years 2002 and 2014, excluding intra-EU trade, imports arriving from Non-EU exporters more than tripled their share in the global imports of VOO. Figure 1 displays the growth in the share of imports from non-EU sources in particular to countries such as the USA, Brazil, Japan, Canada and China. With the rise in the presence of non-EU producers on the international arena, these countries are beginning to exercise a more significant influence on designing trade policies.

Figure 1
World imports of Virgin Olive Oil, By Origin, (Excl. Intra-EU Trade)



Importer	Origin	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
USA	Non-EU	5.3%	8.6%	13.9%	17%	17%	17.9%	16.7%	19.6%	15.6%	19.6%	18%	23.2%	13.1%
	EU	94.7%	91.4%	86.1%	83%	83%	82.1%	83.3%	80.4%	84.4%	80.4%	82%	76.8%	86.9%
BRAZIL	Non-EU	12.6%	23.8%	22.6%	18.7%	26.5%	22.5%	19.6%	19.2%	14.1%	12.4%	11%	11.8%	13.6%
	EU	87.4%	76.2%	77.4%	81.3%	73.5%	77.5%	80.4%	80.8%	85.9%	87.6%	89%	88.2%	86.4%
JAPAN	Non-EU	1.1%	1.5%	1.4%	3.5%	3.7%	6.7%	7.2%	6.7%	7%	6%	6%	7.4%	11.7%
	EU	98.9%	98.5%	98.6%	96.5%	96.3%	93.3%	92.8%	93.3%	93%	94%	94%	92.6%	88.3%
CANADA	Non-EU	3.9%	7.8%	13.1%	17.6%	15.5%	17.6%	11%	10.6%	10.7%	10.1%	12.8%	16%	20.1%
	EU	96.1%	92.2%	86.9%	82.4%	84.5%	82.4%	89%	89.4%	89.3%	89.9%	87.2%	84%	79.9%
CHINA	Non-EU	5%	1.1%	0.4%	3.1%	5.6%	10.3%	13.4%	17.2%	11.1%	10.4%	11%	10.2%	14.2%
	EU	95%	98.9%	99.6%	96.9%	94.4%	89.7%	86.6%	82.8%	88.9%	89.6%	89%	89.8%	85.8%

Source: authors calculations based on TRAINS

2.2 Policy Measures Affecting the Trade of Virgin Olive Oil

With the exception of the EU, the global applied tariff rates on VOO are relatively low and range between 0 and 10%. Tariff rates of zero are applied on VOO imports entering Japan, Australia, Canada, Switzerland and others. While the USA imposes ad-valorem tariffs equivalent of 1.3%, the EU charge an equivalent tariff of approximately 40% (2015). Yet, only a negligible share of EUs imports is subject to full MFN rates, as the majority benefit from preferential trade agreements. Statistical evidence validates that while the average MFN tariff rates on VOO have declined from 9% in 2002 to 5.5% in 2015, the use of TBT and SPS measures affecting the VOO appear to be on the rise (Figure 2).

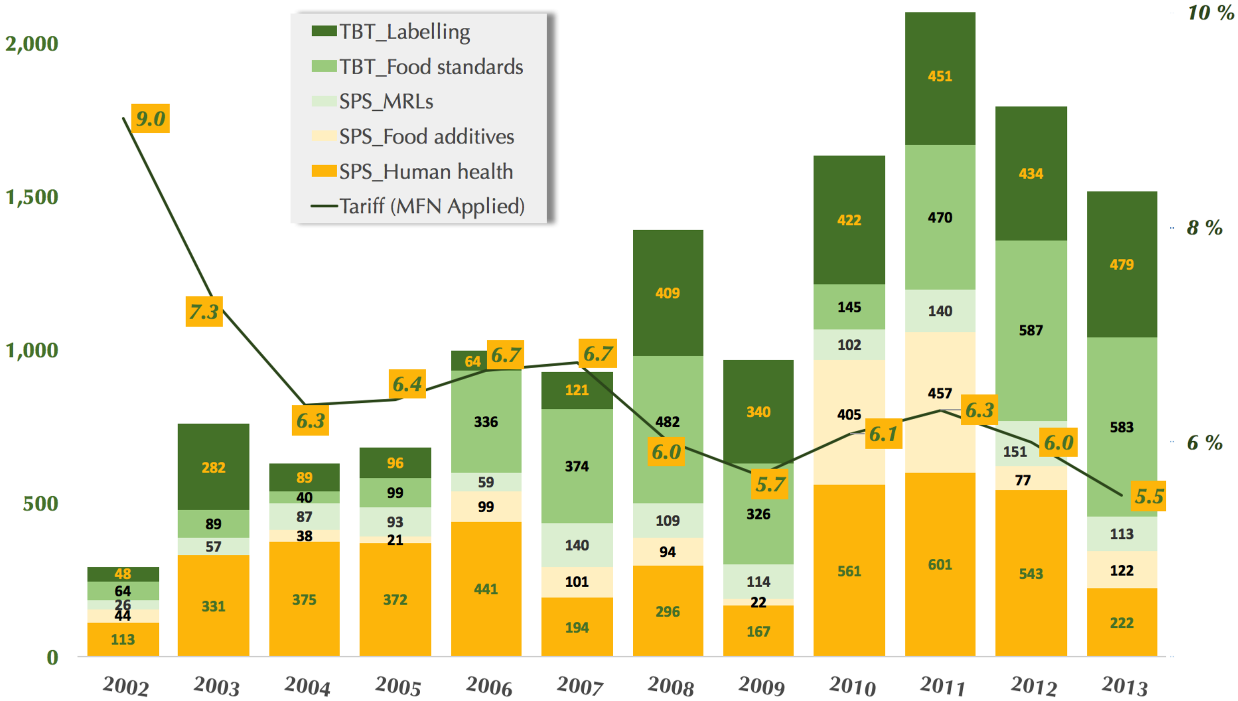
The regulatory landscape is filled with wide range of NTMs, which partly serve to protect domestic producers against foreign competition, but undeniably also act to improve the quality of VOO products entering local markets. Such measures are designed to protect human health, increase consumers welfare, afford adequate information and increase risk assurance for consumers, as well as provide protection from counterfeit. Numerous examples of illegal products confiscated, after failing to follow national standards, were reported in recent years. To combat such endeavours, countries apply a broad range of regulations and procedures, among which labelling requirements, standards and marketing order, as well as food safety regulation. While often these policy measures are grouped as SPS or TBT measures, the proposed research allows to differentiate between subgroups of NTMs in order to examine the effective impact of each individual measure on VOO imports.

The global minimum requirements for olive oil are covered by the Codex Alimentarius Standard for Olive Oils and Olive Pomace Oils. Also known as the Food Code, it aims to develop science-based harmonized international food standards, to protect consumer health and promote fair practices, in the least trade-distorting manner. The Food Code covers composition and quality factors for various types of olive oil, including food additives, contaminants, labelling requirements, physical features and methods of analysis and sampling. Evidence show that not only that food safety standards imposed by developed countries are stringent compared to the Food Code, but also, these standards have become increasingly stricter over time.

For example, Maximum Residue Limits (MRLs) were introduced to control harmful damage caused due to the widespread dissemination of pesticides for improving agricultural productivity. In general, MRLs are determined by national regulatory agencies, whether on their own or based on the Food Code. The European Regulation from 1991 and its amendments from 2015 classifies eight quality categories of olive oil to define which may be granted access to the EU market. Similarly, Australia and Japan have MRLs which are more stringent than the Codex MRLs, whereas other countries set their standards near or follow the exact Codex wordings.

Another example of a NTMs may be the labelling requirements, which were originally intended to provide better traceability information, but also inform more knowledgeable consumers regarding their preferences. Along with labelling requirements, there is a growing importance of organic and fair trade schemes, which resulted in the demand for such products to follow organic certification requirements. For instance, for the olive oil to be marketed as organic-certified in the EU, it must contain the EUs organic logo, after complying with the EU regulation for organic farming and marketing.

Figure 2
Evolution of NTMs & MFN Applied Tariffs on Virgin Olive Oil



Source: authors calculations based on data of the World Bank and WTO I-TIP.

3 Literature Review

An extensive literature on the effects of NTMs on import flows has evolved in the last two decades, primarily due to the proliferation in the use of trade-related regulatory measures. Supplementary conceivable explanations involve the global reduction of tariffs; the growing demand for transparency and reporting requirements on the application of NTMs by WTO; and the harmonization of regulations, as a result of PTAs signed and implemented by various countries. Lastly, the valuable advancement in estimation methodologies allow the quantification of trade impact of NTMs and provide a strong base for comparison across countries or within sectors.

The economic literature, however, provides an indecisive response regarding how and to what extent these policy regulations, affect trade in the myriad of agriculture or food products. Particularly, it is often uncertain whether these regulatory measures necessarily hamper trade, mainly through the associated compliance costs of stringent regulations. Alternatively, these measures may raise consumers confidence in the safety associated with the product, while creating a positive feedback which. This may result in the expansion of imports of a particular product which has initially been subject to a stringent measure.

The ambiguous trade effect of NTMs evidently differs across sectors, and varies among countries, depending on the economic development level. Disdier et al. (2008), examine the impact of SPS and TBT on 30 disaggregated Agri-food products imported to OECD members and find a significantly adverse effect on 10 industries. Yet, SPS and TBTs can have no impact (as found in 12 industries) or even a positive effect, as these measures carry information and provide confidence in the imported products. While OECD exporters are not significantly affected by SPS and TBTs in their exports to other OECD countries, developing and least developed countries exports are negatively and significantly affected. Furthermore, EU imports seem to be more negatively influenced by tariffs and SPS and TBTs than imports of other OECD countries.

In the large share of surveyed literature, a trade-reducing impact of food safety standards on Agri-food products is observed. In particular, the heterogeneity of standards is associated with an adverse effect on trade. Winchester et al. (2012) validate the significant trade-restrictive effect of stringent MRLs for plant products in importing countries compared to exporting countries. Further, Chen et al. (2006) determine that in developing countries, the testing procedures and lengthy inspection times significantly reduce firms propensity to export to developed countries, predominantly in agricultural firms. Moreover, the compliance costs associated with SPS measures tend to create a comparative disadvantage for the small and medium-sized firms. Fontagne et al. (2013) show that SPS compliance costs create market entry prohibition and increase the probability to exit the restricted market by 2%.

By contrast, several scholars acknowledge the trade-enhancing effects of NTMs due to their beneficial impact on public health, well-being, animal welfare, food safety and sustainable environment. Josling et al.(2004) find that in nations where consumer awareness to such features is valued, demand is stimulated for products under such policies. Another key channel through which NTMs may positively affect trade flows is the correction of market imperfections (Thilmany and Barrett, 1997). Moreover, as countries differ in their capacity to meet with foreign standards, some countries may enjoy a competitive advantage. Henson and Jaffee, (2008) show that exporters facing stricter food safety standards incur compliance costs which may be offset by benefits from the enhancement of food management capacity. Supplementing this, Swinnen and Vandemoortele (2011) acknowledge the trade-augmenting role of food standards, and Chevassus-Lozza et al. (2008), report positive trade effects of sanitary measures, despite some negative or insignificant impacts of phytosanitary and quality measures.

Xiong and Beghin (2014) highlight the gradually challenged standards-as-barriers perception, by the two faces of standards approach. Consequently, even if there is a cost involved in complying with standards, the trade-enhancing effects may be larger. The effects of MRLs regulations imposed by high-income OECD countries jointly enhance the import demand and hinder foreign exporters supply. Although the net effect is positive for most countries, it is smaller for developing countries. This implies that exporters from developing countries face greater difficulty than their competitors from developed countries when food safety standards exist in export markets.

In his review of the economic literature and surveys on the trade effects of international and national standards as well as regulations of various products, across countries, Swann (2010) provides valuable insights. First, compared to national standards and regulations, which tend to negatively impact imports, in most of the economic literature, international standards and regulations are found to have a positive effect on imports. With respect to data based on surveys, the effects of national standards on imports can be either positive or negative. Nevertheless, the effects of national regulations on domestic imports are mostly found to be negative.

Michalek et al. (2005) analyse the effects of three EU approaches for dealing with TBTs for the new member states (CEEC) and the Mediterranean countries. Their results suggest that the Harmonization Approach and the New Approach are likely to increase trade, while the Mutual Recognition approach (MR) tends to reduce trade. The effect of MR may seem surprising, since supportive studies find it the most efficient method to overcome TBTs. Their interpretation highlights the reverse direction of causation connection, i.e. that MR may be introduced in sectors when trade flows are relatively low but there are few TBTs, meaning little to be gained from a policy other than MR.

As increased cooperation among countries reduces regulation heterogeneity, importers may gain market share at the expense of domestic producers. Liu and Yue (2012) argue that the EUs adoption of the Hazard Analysis Critical Control Point (HACCP) standard was a catalyst for orange juice imports. It resulted in increased imports, reduced sales of domestic producers, and improved consumer welfare. By contrast, Anders and Caswell (2009) find a negative effect of a HACCP food safety standard on the overall seafood imports. However, a differentiation by exporting country shows negative effects for developing countries, but positive effects for developed countries.

Drogu and Federica (2012) finds that reducing the heterogeneity between MRLs has a trade-enhancing impact on apples and pears, however, the impact differs depending on the exporter. Nevertheless, regulatory harmonization where previously a country did not have a standard may imply new or higher costs for existing producers and an increase in the stringency. This was the case with the harmonization of MRLs for aflatoxin in the EU in 2002, which meant that aflatoxin standards became more stringent in most countries (Xiong and Beghin 2012; Otsuki et al. 2001). According to the latter, the new EU regulation on aflatoxins will reduce trade flows by 63% compared to when the Food Code standards are followed.

In recent years, several attempts have been undertaken to study the effects of various regulatory policies on consumers willingness to pay (WTP) for OO across and within countries. Labelling and Geographical Origin Certification seem to affect consumers' purchasing decisions. Menapace et al. (2011) underline that EU consumers have a greater WTP for Geographical Indication (GI) than non-GI labelled products. Dekhili et al. (2011) assert that official cues are more important for consumers of non-producing countries, whereas consumers from producing countries choose OO based on origin and sensory cues (e.g., colour and appearance). The Origin information and traceability as reported on the label is important as consumers are increasingly concerned about food safety (Krystallis and Ness, 2005). Higher value is also placed on quality assurances, such as MRLs, and Protected Designation of Origin labels, which improve the signalling of credence to consumers (Combris et al.,2010).

Sandalidou et al. (2002) find that the Organic certification of OO in Greece is positively perceived by consumers, irrespective of the continued unsatisfactory level of information. Gil and Sofer (2006) observed that information about the conventional product (reference price) increased the perceived value of the Organic OO for Spanish consumers. Cicia et al. (2005) valued at one euro per bottle the attribute of Italian product origin (COOL) ascribed by Italian consumers. Dekhili and dHauteville (2009) highlight consumers preference for traditionally known brands and private labels. By contrast, Kavallari et al. (2011) find that bulk olive oil is more likely to enter the German and the UK markets compared to similar packaged and branded products.

As seen in the review, the extensive and divergent studies which were reviewed reinforce the assertion that some regulatory measures are not necessarily protectionist, and at times actually boost imports. Yet, empirical validation regarding the impact of a wide range of regulatory measures on a particular agriculture sector is rare. The current research attempts to fill this gap by empirically studying the influence of various subgroups of SPS and food related TBT measures on the virgin olive oil sector. In particular, it encompasses a large dataset of national regulations in order to underpin further their trade-enhancing impact on imports of VOO during the years 2002-2014.

4 Econometric Methodology and Data

In the empirical econometric analysis, the determinants of imports of VOO are examined with respect to various explanatory variables. Among these variables, some are directly related to the olive oil sector, such as production, tariffs and NTMs which fall under the broad umbrella of the TBT and SPS practices, while others variables are standard in gravity modelling. The size of the sample which was developed for this purpose is comprised of approximately 2,600 observations, encompassing imports panel data of 160 importing countries, during the years 2002 to 2014.
The econometric methodology applied in this analysis is the following:

$$
\begin{aligned}
&ln\,,\mathtt{IMPORTS}_{ijt} = \alpha^1_{i,n}\,ln\,,\mathtt{GDP}_{it} + \alpha^2_{i,n}\,ln\,,\mathtt{PROD}_{jt} + \alpha^3_{i,n}\,ln\,,\mathtt{GDPpc}_{it} + \alpha^4_{i,n}\,ln\,,\mathtt{TARIFF}_{it} \\
&+ \alpha^5_{i,n}\,ln\,,\mathtt{DIST}_{ijt} + \alpha^6_{i,n}\,ln\,,\mathtt{POP}_{ijt} + \alpha^7_{i,n}\,,\mathtt{Comlang}_{ijt} + \alpha^8_{i,n}\,,\mathtt{Contig}_{ijt} + \alpha^9_{i,n}\,,\mathtt{Comcur}_{ijt} \\
&+ \alpha^{10}_{i,n}\,,\mathtt{RTA}_{ijt} + \alpha^{11}_{i,n}\,,\mathtt{NTM}_{xijt} + \varepsilon_{i,n}
\end{aligned}
\tag{1}
$$

For the purpose of this study, a log-linear transformation of the ordinary least squares (OLS) model has been employed. The dependent variable in all the specifications is $ln\ \mathtt{IMPORTS}_{ijt}$, which is the natural logarithm transformation of the imports of VOO to country i from country j in a particular year t. From an empirical perspective, both the presence of zero flows and heteroskedasticity in the idiosyncratic error term are matters to take into consideration due to their possible effect on gravity-type estimations (Silva and Tenreyro, 2006). The solution to that has been to add an additional estimation using a Tobit model to correct for the presence of zero trade flows bias (Martin and Pham, 2008). Moreover, the paper assumes an additive error in specification and estimates the model using the Poisson pseudo-maximum likelihood estimator (PPML).

The econometric analysis is comprised of a vector of variables, which may account for control variables explaining the imports of VOO. The first control variable in the analysis is denoted as $ln\,\mathtt{GDP}_{it}$, which is the natural logarithm transformation of the the gross domestic product (GDP) of the importing country i in a particular year t. As the theory predicts, the correlation between imports of VOO and the variable is expected to be positive and significant, in line with the view that larger markets foster higher volumes of trade. The second major control variable is Production (denoted $ln\,\mathtt{PROD}_{jt}$), which represents the olive oil output in exporting country j in year t, which represents the output of VOO, allowing to capture the exporting countrys supply capacity. A positive coefficient for production of is expected, in line with the view that larger producers export higher volumes of VOO. The variable $ln\,\mathtt{GDPpc}_{it}$, represents the GDP per capita in the importing country i, and is likely to be positive since increasing income lead to higher demand for VOO.

The fourth control variable is denoted as $ln\mathtt{TARIFF}_{i,n}$, which is a vector of the Most Favoured Nations (MFN) applied tariffs on VOO. Specifically, it provides the tariff rates on the 6-digit HS classification 150910. Data is provided for each of the importing country, depending on the source of import (i.e. a particular importing country may have dissimilar applied tariff rates to two exporting countries, depending on benefits granted by different trade agreements). As the theory predicts, the correlation between imports and tariffs is expected to be negative and significant, since the higher a tariff rate (i.e. higher costs on imports), the smaller the demand for VOO.

Several additional gravity variables were extracted from the CEPII database (Mayer and Zignano, 2011). Distance is measured in km between the sample countries economic centres. Common language, currency and contiguous are dummy variables that take the value 1 when two countries share the same language, currency or are contiguous, correspondingly, and zero otherwise. In all cases, proximity among countries contributes to decreasing transaction costs and enhances imports. An additional dummy variable RTA takes the value 1 if a regional trade agreement exists between the importing and the exporting countries, to reflect the positive influence on imports of the recent proliferation of trade agreements in the last three decades.

Therefore, except for distance, the coefficient signs are expected to be positive and significant. As mentioned, the most significant set of variables is the NTMs, which were obtained following a careful analysis of hundreds of relevant regulations, extracted from I-TIP. The entire database provides information on over 25,000 measures, which were screened in order to identify only the particular regulations containing SPS and food related TBTs that affect trade in VOO. The regulations were allocated to four subgroups which fall under the scope of the TBT measures, and three subgroups which fall under SPS measures. Each dummy variable takes the value 1 if a particular policy measure imposed by an importing country i affects the exports of VOO from country j. It is important to note that these dummy variables indicate the mere existence of particular regulatory measures, over time, regardless the stringency level or (dis)similarity of these regulations among countries.

5 Estimation Results

5.1 Regression Results: Virgin Olive Oil

The results of the regression analysis for the entire sample of countries are presented in Table 3. The first two columns report OLS estimates in log form; however, the second column adds a list of dummy variables, which represent the impact of NTMs on the imports. The third column presents Tobit estimates, and the fourth column reports PPML estimates. Lastly, year fixed effects were added to all the specifications, to control for considerable seasonal fluctuations and climate sensitivity on olive cultivation, which may potentially bias the results. While the estimated coefficients from the OLS and the Tobit models are relatively similar, most coefficients obtained from the PPML model differ from those obtained with the other model. The substantial advantage of the PPML model is that it allows us to deal with sample selection bias that may result from excluding zero observations. Although selection bias rarely affects the sign of the variable, it often influences the magnitude, statistical significance and economic interpretation of the marginal effects (Haq et al., 2013). In the rest of this subsection, unless specified otherwise, the results refer to the estimates from the PPML model. Notably, once the NTMs are introduced, the goodness-of-fit as measured by R-squared increase by a supplementary of 18% and 7.7% in the OLS and PPML specifications, respectively.

The estimation coefficients of TARIFF are found to be negative and economically significant, however, the magnitude varies according to the specifications. While a relatively small impact of 1.6% is found in the basic OLS, adding the impact of NTMs increases its negative elasticity to 6.4% to 6.8% (OLS and the Tobit specification, respectively). Parameter estimates of GDP are statistically significant and have the expected positive sign. The results concerning VOO supply as captured by Prod underline the substantial and positive contribution of olive oil production at the exporting country on imports of VOO. The estimates are statistically significant and range between 96% and 97% in the first two specifications, and 8% at the PPML model.

With respect to the gravity variables, the estimates are in line with previous studies (Disdier, et al., 2008 and Grant and Boys, 2012). The role of geographical distance is inversely related to imports of VOO; however, significantly larger when using OLS and Tobit estimators. The estimated elasticity is approx. between 0.77-0.79, whereas the PPML estimate is much lower (0.067). As seen in most of the literature, socio-economic variables such as GDP per capita are main determinants of consumers willingness to pay a premium for healthier olive oil (Gil and Soler, 2006). The difference in the size of the population between the importing country and the exporting country of VOO is found to influence positively and statistically significant. Lastly, the variables Comlang and Contig are statistically significant, at the 1% level, and positively impact imports of VOO as expected. Surprisingly, Comcur is likely to negatively affect imports of VOO, and RTA does not meaningfully affect such imports.

As the hypothesis suggests, the estimated coefficients of the Sanitary and Phytosanitary measures, if statistically significant, are found to be positive. The most predominant sub-category of NTM is the MRLs requirements with estimated coefficients which are statistically significant and positive. Generally, MRLs enhance the import demand by reducing the potential risks caused by pests, and ensuring higher food safety, but it also expected to reduce export supply by imposing additional controlling costs. The net effect of MRLs as expected is stronger for the former. The effect of Human health is found to be positive and statistically significant at 10% level of statistical significance, however, it affects VOO imports to a lesser extent compared to MRLs. Analysing the trade effects of TBTs reveals that food standards' is the only sub-category that has a statistically significance and positive effect in all specifications. Interestingly, TBT measures that focus on labelling requirements were found insignificant in all the models.

Finally, it should be expressed that the estimations are to be interpreted with some caution, given that they reflect the underlying assumptions of the models, databases and the particular policy specifications which have been modelled, as detailed in the paper.

Table 3
Regression Results

	OLS (NO NTMs)	OLS (3)	Tobit (4)	PPML (2)
ln GDP	0.179***	0.177***	0.167***	0.017***
	(3.95)	(3.99)	(3.93)	(4.12)
ln PROD	0.789***	0.969***	0.957***	0.080***
	(36.75)	(49.83)	(51.15)	(47.86)
ln GDPpc	0.683***	0.726***	0.744***	0.055***
	(11.91)	(11.13)	(11.88)	(9.16)
ln TARIFF	-0.016***	-0.068***	-0.064***	-0.006***
	(-6.08)	(-10.31)	(-9.98)	(-8.15)
ln DIST	-0.481***	-0.792***	-0.768***	-0.067***
	(-6.88)	(-14.82)	(-14.97)	(-13.83)
ln POP	0.506***	0.701***	0.700***	0.054***
	(12.27)	(17.80)	(18.53)	(14.02)
Comlang	1.696***	1.147***	1.149***	0.097***
	(16.11)	(10.27)	(10.70)	(8.54)
Contig	1.076***	1.511***	1.525***	0.105***
	(4.12)	(8.20)	(8.69)	(7.89)
Comcur	-0.260*	-0.253*	-0.233*	-0.018
	(-2.07)	(-2.15)	(-2.06)	(-1.67)
RTA	-0.136	0.051	0.020	0.007
	(-1.09)	(0.40)	(0.16)	(0.59)
SPS_MRLs		0.390**	0.374**	0.040***
		(3.08)	(3.09)	(3.69)
SPS_Human Health		0.293**	0.270*	0.023*
		(2.61)	(2.51)	(2.55)
SPS_Food Additives		-0.172	-0.160	-0.009
		(-1.65)	(-1.61)	(-1.01)
TBT_Food Standards		0.305***	0.313***	0.022**
		(3.41)	(3.65)	(3.02)
TBT_Conformity Ass.		-0.210	-0.276	-0.010
		(-0.43)	(-0.59)	(-0.24)
TBT_Consumer Info.		0.150	0.148	0.021
		(0.61)	(0.63)	(1.01)
TBT_Label		0.005	0.007	-0.003
		(0.06)	(0.09)	(-0.45)
R^2	0.453	0.633		0.639
N	2,601	2,601	2,601	2,601

note: t statistics in parentheses.
p-value (* p<0.05, ** p<0.01, *** p<0.001)

5.2 Regression Results: Virgin Olive Oil, EU vs. Non-EU

This part of the paper disentangles the impact of various NTMs on imports of VOO, according to the major import sources. The two clusters are the EU exporting countries of VOO to Non-EU markets and other VOO manufacturers who export to EU markets. This exercise aims to examine whether a retaliation effect exist, that is to say, non-EU exporters may face tougher import regulation compared to the regulatory requirements imposed on EU exporters due to the growing presence of the former in VOO arena. Notice that the sample used for EU exporters excludes internal EU trade flows, to avoid the positive effect associated with regulatory homogeneity in the EU single market.

The results of the comparison are presented in Table 4. The estimations which proxy the supply side of the equation, are relatively similar in terms of magnitude and direction to the EU exporters, which is not surprising given that most VOO exporters are Europeans. The estimated coefficients of GDP were significantly trade-enhancing for non-EU exporters, yet meaningless for EU exporters. Nevertheless, the level of income per capita of the importing country is positive and likely to affect more significantly the EU exporters, compared to non-EU exporters. Concerning the geographical and supplementary gravity variables, the impact is fairly similar to the previous findings.

The results of the analysis, seem to reject the retaliation effect proposition, since both groups of exporters face a relatively similar adverse effect of tariff barriers. The coefficients found in the OLS model and the Tobit specification imply that a 1% tariff reduction is associated with 6-7% higher VOO imports. In terms of economic magnitudes, it means that an increase in tariffs from 1% to their mean level of 6.5% (a 550% increase) decreases VOO imports by 37%, which is a considerable impact.

More importantly, the coefficients of NTMs, despite the asymmetrically impact on exporters according their source, are found to effect VOO imports positively. In particular, EU exporters enjoy a significantly positive effect of MRLs requirements; mainly due to their capacity to meet stricter requirements in their neighbour EU markets. Similarly, SPS measures dealing with food additives are found to affect EU exporters positively, yet when imposed by the European Commission, they adversely affect non-EU exporters. TBT measures in the form of food standards are associated with 3.1% higher imports of VOO, yet insignificantly affect imports from EU producing countries.

Table 4
Regression Results, EU vs. Non-EU Exporters

	EU Exporters			Non-EU Exporters		
	OLS	Tobit	PPML	OLS	Tobit	PPML
	(19)	(20)	(21)	(16)	(17)	(18)
ln GDP	0.027	0.058	0.008	0.337***	0.314***	0.033***
	(0.26)	(0.62)	(0.92)	(4.64)	(4.52)	(4.73)
ln PROD	0.953***	0.927***	0.077***	0.683***	0.679***	0.065***
	(26.98)	(27.77)	(23.19)	(13.58)	(14.09)	(13.94)
ln GDPpc	1.148***	1.119***	0.080***	0.233*	0.261*	0.020
	(9.57)	(10.00)	(7.17)	(2.11)	(2.46)	(1.89)
ln TARIFF	-0.067***	-0.061***	-0.006***	-0.067***	-0.064***	-0.007***
	(-8.02)	(-7.68)	(-6.05)	(-5.45)	(-5.44)	(-4.58)
ln DIST	-0.621***	-0.592***	-0.046***	-0.495***	-0.463***	-0.050***
	(-5.40)	(-5.51)	(-4.64)	(-4.78)	(-4.65)	(-4.89)
ln POP	0.837***	0.794***	0.057***	0.423***	0.436***	0.039***
	(8.84)	(8.98)	(6.16)	(7.03)	(7.57)	(6.93)
Comlang	1.555***	1.494***	0.118***	1.169***	1.176***	0.112***
	(7.37)	(7.61)	(5.93)	(6.81)	(7.13)	(6.65)
Contig	1.076*	1.061*	0.086**	1.480***	1.527***	0.117**
	(2.08)	(2.21)	(2.71)	(3.74)	(4.05)	(2.90)
Comcur	-0.100	-0.099	-0.007	-0.394	-0.331	-0.036
	(-0.47)	(-0.50)	(-0.38)	(-1.83)	(-1.60)	(-1.62)
RTA	0.373	0.374	0.032	0.220	0.160	0.023
	(1.73)	(1.87)	(1.53)	(1.00)	(0.77)	(1.19)
SPS_MRLs	0.688***	0.653***	0.048***	0.336	0.335	0.030
	(3.51)	(3.58)	(3.41)	(1.71)	(1.79)	(1.80)
SPS_Food Additives	0.348	0.338	0.029	-0.525**	-0.483*	-0.042*
	(1.88)	(1.95)	(1.84)	(-2.68)	(-2.58)	(-2.39)
SPS_Human Health	0.292	0.287	0.023	0.592**	0.510*	0.054*
	(1.55)	(1.63)	(1.49)	(2.66)	(2.39)	(2.44)
TBT_Food Standards	0.005	0.028	-0.003	0.420*	0.433**	0.035*
	(0.03)	(0.20)	(-0.24)	(2.57)	(2.78)	(2.48)
TBT_Consumer Info.	-0.153	-0.065	-0.013	0.526	0.419	0.059*
	(-0.45)	(-0.21)	(-0.40)	(1.34)	(1.12)	(1.97)
TBT_Conformity Ass.	-0.505	-0.646	-0.028	0.035	0.020	0.013
	(-0.81)	(-1.11)	(-0.49)	(0.04)	(0.03)	(0.23)
TBT_Label	-0.054	-0.012	-0.012	0.023	0.046	-0.005
	(-0.36)	(-0.09)	(-0.97)	(0.14)	(0.29)	(-0.33)
R^2	0.722		0.694	0.403		0.417
N	669	669	669	976	976	976

note: t statistics in parentheses.
p-value (* p<0.05, ** p<0.01, *** p<0.001)

6 Conclusions

The paper aims to examine, whether, and to what extent, NTMs can serve as trade boosters rather than create unnecessary trade barriers. To perform such analysis, the paper provides an empirical framework which incorporates all bilateral imports of virgin olive oil (VOO) during the period of 2002-2014. It examines a spectrum of possible determinants, which can explain the trade flows of VOO, while further investigating beyond the realm of the traditional trade policies. Predominantly, it focuses on the actual impact of a wide range of regulatory measures on the imports flow. This dataset of NTMs was extracted following a detailed screening process of all potential regulations affecting VOO. This provides an opportunity to identify which type of regulatory measure affects the level of bilateral trade the most. Moreover, it allows to differentiate which regulatory instruments could be associated with trade-enhancement, and which policy measures impede trade.

At the outset, the analysis highlights the restrictive role of tariffs on VOO imports. Further, it validates the positive impact of most of the gravity explanatory variables. As The results of this study validate the hypothesis of this paper, that while serving legitimate public policy objectives, the majority of NTMs actually do not necessarily impose restrictiveness on imports. The results highlight the statistically and economically significant support for the demand-enhancing effect of regulatory measures, and in particular of MRL requirements. Likewise, a significant positive contribution is associated with human health regulations and food standards. Furthermore, a differentiation by source of VOO exporters, uncovers the asymmetrical yet, positive impact of NTMs on VOO imports. EU countries are affected mainly by MRL regulations, while New World producing countries are positively affected by human health requirements and adversely affected by the EU's food additives regulations.

These findings have two policy implications. First, despite the extensive heterogeneity among countries regarding the implementation of various regulatory measures, in fact, the mere existence of regulations does not necessarily impedes international trade in their cumulative effects. Second, the implementation of measures related to food safety, human health, information and transparency, may, in turn, actually expand the magnitude of trade amid countries.

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Appendix

Table 5
Variables and Sources

Variable	Definition	Source
IMPORTS	Bilateral Imports of Virgin Olive Oil ($), HS classification 150910	The World Integrated Trade Solution (WITS), The World Bank
TARIFF	MFN applied tariffs, of Virgin Olive Oil, HS classification 150910	The World Integrated Trade Solution (WITS), The World Bank
NTMs	TBT / SPS Measures, By Subgroups, Dummy Variable	The Integrated Trade Intelligence Portal (I-TIP) World Trade Organization
PROD	Production of Virgin Olive Oil, Crops processed (1,000 tonnes)	Food and Agriculture Organization (FAOSTAT)
CONS	Consumption of Olive Oil	International Olive Council (IOC)
GDP	Gross Domestic Product, Current prices (Bil. $)	International Monetary Fund (IMF)
GDPpc	Gross Domestic Product per capita, in current prices ($)	International Monetary Fund (IMF)
DIST. POP. Comlang Contig Comcur RTA	Distance between capitals (km). Population (mil.) Common Language, dummy. Countries are Contiguous, dummy. Common Currency, dummy. Regional Trade Agreement, dummy.	Centre d'Etudes Prospectives et d'Informations Internationales (CEPII)
D_EU	Dummy Variable 0=Non EU Member States. 1=EU Member States	The European Commission
Year FE	Fixed effects of years	
Exporter FE	Fixed effects of exporters	

Table 6
Statistical Description

Variables	Mean	Std. Dev.	Min	Max	Observations
IMPORTS	3,594	33,266	0	1,118,144	12,100
TARIFF	6.54	12.9	0	261	9,006
GDP	104,994	2,595,613	184	16,700,000	11,849
PRODUCTION	166	337.3	0	1,615	1,977
GDPpc	28,291	17,056	223.6	114,665	11,923
CONSUMPTION	251	261.3	0	848	7,722
SPS_MRLs	0.1909	0.393	0	1	6,238
SPS_Food Additives	0.2373	0.425	0	1	6,238
SPS_Human Health	0.6759	0.468	0	1	6,238
TBT_Food Standards	0.5763	0.494	0	1	6,238
TBT_Consumer Info.	0.0348	0.183	0	1	6,238
TBT_Conformity Ass.	0.0053	0.073	0	1	6,238
TBT_Label	0.5186	0.450	0	1	6,238

Figure 3
Evolution of the Worlds Exports/Consumption of Olive Oil (%)

Source: authors calculations, based on International Olive Council, Nov. 2016