Available online at www.centmapress.org

INTERNATIONAL JOURNAL ON FOOD SYSTEM DYNAMICS

Int. J. Food System Dynamics 11 (5), 2020, 451-467

DOI: http://dx.doi.org/10.18461/ijfsd.v11i5.67

The "Sophistication" of Agri-food International Trade: Switching the Concept to Imports

Anna Carbone[1], Federica Demaria[2] and Roberto Henke[2]

[1]*Department for Innovation in Biological, Agro-Food and Forest Systems (DIBAF), University of Tuscia, Italy*
[2]*Council for Agricultural Research and Economics – Research Centre for Agricultural Policies and Bioeconomy, Italy*
acarbone@unitus.it; federica.demaria@crea.gov.it; roberto.henke@crea.gov.it

Received April 2020, accepted October 2020, available online November 2020

ABSTRACT

The aim of the paper is twofold. First, it introduces a new index (called Consy) for measuring the sophistication of traded goods looking at the importers' side. The index is defined and then its sophistication content is assessed based on a simple regression model. Second, an empirical exercise is carried out focused on agri-food imports for a set of 46 selected items. This empirical analysis brings evidences on the kind of outcome provided by the index, but it also sheds light on recent trends in agri-food trade where demand of food imports in emerging countries is enlarging and it is more quality-oriented. Results can help stakeholders in better defining and implementing their exporting strategies, especially orienting business towards promising markets and enhancing the quality features for their exports to be delivered to more demanding consumers. Policymakers and sector analysts may also be interested in acknowledging how agri-food international trade is re-shaping in recent years in order to be able to govern the related processes.

The Consy values of agrifood products indicate that rich countries are major world importers. Furthermore, the Consy ranking shows that higher value-added and more complex items are imported mainly by richer countries. The time trend of the Consy index is also studied and results show that, in the studied period, the was an increase of import shares of food items for final consumption of higher quality from poorer countries.

Keywords*: agri-food trade; import sophistication; international competition.*

JEL *Classification codes: Q130; Q170*

1 Introduction

In trade literature the "sophistication" concept is increasingly used to refer to all the quality features that add value to products, such as the technological content, branding, style, packaging, the sensory attributes, and so forth (Lall et al., 2006; Rodrick, 2006). Such characteristics have increased their role in the international arena, becoming keys for non-price competition that is gaining momentum in almost all sectors. Producers and exporters increasingly focus on product differentiation and quality in order to meet demand trends (Krugman, 1980; Helpmann, 1981; Schott, 2004; Sarker and Surry, 2006; Fabrizio et al., 2007). Some authors have shown that quality is a major export driver also in the agri-food sector (Gehlhar and Pick, 2002; Hallak, 2006; Sarker and Surry, 2006; Fischer, 2010).

So far, the measure of trade sophistication has been focused on export flows, while in this paper the concept of sophistication is applied to imports. Looking at the sophistication of imports implies to switch the attention to the demand in destination markets, rather than looking at the kind of competitors who populate the global arena. As a matter of fact, the two views seem to be complementary and together can contribute to get a more complete picture about the kind of forces that are driving competition in international markets. More in details, while focusing on the export side highlights the competitors and the kind of competition they exert, looking at the sophistication level of destination markets adds information on the kind of clients to be met and on the potential profitability for an export flow. In other words, the focus on demand can contribute to highlight features that may be crucial for gaining market shares and getting higher returns. The index synthetizes a large amount of information and its time trend provides insights on the market trajectory of change for each traded product.

The goal of this paper is twofold. First, we define a new index and assess to what extent it can be regarded as a good comprehensive measure for trade sophistication. Second, we test how the index works for a selection of agri-food traded items. International trade is relevant in the food sector and involves both commodities and differentiated products for final consumption where quality plays a major role, thus providing a solid ground for a first application of the import sophistication measure. Results can help stakeholders in better defining and implementing their exporting strategies, especially in terms of orienting business towards promising markets and to enhance the quality features for their exports to be delivered to more demanding consumers. Sector policymakers and analysts may also be interested in acknowledging how agri-food international trade is re-shaping in recent years in order to be able to govern the related processes.

The paper is organized as follows: Section 2 summarizes the main features of the literature on trade sophistication and presents the overall logic of the approach proposed. Section 3 introduces the index. In Section 4 we build a model that relates the sophistication measure to some sophistication attributes of the traded goods; then we present the results of a regression analysis based on agri-food trade data, for the period 2005/06-2015/16, applied to our simple model. Based on the encouraging results of the estimated model, Section 5 presents and discusses the import sophistication index to a selection of agri-food traded items, both for the static ranking and for the index dynamic. Last, Section 6 provides some concluding remarks.

2 Pushing forward the literature on trade sophistication

2.1 From export sophistication…

In recent trade literature, the concept of sophistication has been referred to the level of prosperity of exporting Countries as measured by their level of per capita Gross Domestic product, hereafter GDP pc. The sophistication index of exports was first introduced by Lall *et al.* (2006) and by Hausmann *et al*. (2007) in two distinct but almost contemporary works.

This index, referred to as "export sophistication" and called Prody, is defined for a given exported item as the average of the GDPpc of the countries exporting that item, each of them weighted with the share of total world trade represented by each country for the exports of that item[1]:

$$Prody_i = \Sigma_j GDPpc_j * s_{ij} \quad (1)$$

$$s_{ij} = X_{i,j} / X_{iw} \quad (2)$$

where $X_{i,j}$ is the amount of the agri-food product *i* exported by the country *j* and X_{iw} is the world agri-food export of product *i*.

[1] Alternative weights have also been used such as the revealed comparative advantage in slightly different forms.

The underlying hypothesis is that, other things being equal, richer countries have better endowments in terms of resources that are required for producing high quality sophisticated goods and, hence, are more likely to do so (Lall et al., 2006; Hausmann et al., 2007, Marvasi, 2012). The relation works also the other way around: the more a country is specialised in producing and exporting high value products, the higher is the remuneration of inputs and, consequently, the higher the level of its GDP. Based on the Chinese experience, Rodrick suggests the idea that exporting sophisticated goods is a powerful driver of economic growth via positive spill-overs that allow for the socialisation of benefits generated by discovery costs sustained by firms that are pioneers in external markets (Rodrick, 2006).

The sophistication indices have been used for comprehensive studies analysing the entire set of exports and a wide range of competing countries as well as for trade analysis of specific countries and/or sectors (Rodrick, 2006: Minondo 2008; Di Maio and Tamagni, 2008). A stream of more recent literature has shown that the measure of export sophistication works well also when applied to the agri-food sector, despite the role that factors such as climate, natural resources, conjunct productions, as well as sectoral policies, might play in production localisation and, hence, in influencing the export patterns, especially for the agricultural commodities (Carbone and Henke, 2012; Carbone et al., 2015).

2.2 …To import sophistication

It is well acknowledged that factors influencing trade flows are diverse and complex, especially in more recent times. The core idea at the basis of reversing the sophistication concept to imports is that demand drive trade flows. More specifically, product characteristics drive demand and this relationship increases with income. Hence, quality is an important export driver as assessed in different bodies of trade literature (Hallak, 2006; Fajgelbaum et al., 2011; Krishna and Maloney, 2011). This is also in line with Porter's view of the competitive advantages of locations and with the empirical literature that directly or indirectly stemmed out from his seminal work (Porter, 1985 and 1986; Ketels, 2006; Sterns and Spreen, 2010).

Economic literature provides wide theoretical rationale for a positive relationship between per capita GDP and the demand for diversification and quality, both in domestic markets and in trade flows. It is worth to recall Linder's seminal work on how quality acts as a determinant of the direction of trade and how richer countries tend to spend their income on higher quality goods (Linder, 1961). Linder also noticed that firms develop first in domestic markets and only afterwards start to export. In his view, this implies that, broadly speaking, cultural proximity to demand is a source of comparative advantage and, thus, provides rich producers with a comparative advantage in exporting high quality goods. It is clear that supply and demand deeply influence each other.

Following Linder's view, Hallak (2006) explored the role of quality in bilateral trade flows and his estimations confirmed that rich countries tend to import higher quality goods from richer exporters. In particular, he proved that Linder's hypothesis holds when trade is considered at a sector level (Hallak, 2010). Furthermore, looking at destination markets, rather than at markets of origin, reduces the influence of localization factors other than GDP pc on export patterns. Particularly in the agri-food sector, the localisation of production and, thus, export specialization, is largely influenced by such factors. However, especially for processed food, the relationship still stands and works quite well, providing valuable results (Carbone and Henke, 2012; Carbone et al., 2015; Ferto and Bojnec, 2015).

Following the above considerations, we propose to switch the sophistication concept to imports, hence, attaching the measure to the income of importing countries. The import sophistication measure here introduced is called Consy and it is based on the income levels of importing countries. (details about the formula of the proposed index are provided in section 3). The interest here is to underline that complex competitive strategies are required in destination markets with higher sophistication levels and that in such cases higher returns are expected.

The index basically allows to: i) rank and compare imported products according to the kind of destination market; ii) understand basic time trends of international import markets in terms of sophistication and perspective remuneration levels to be expected; iii) disentangle different drivers/components of import sophistication dynamic

Figure 1 describes the overall logical framework on which the paper is based, together with the steps of the empirical analysis performed.

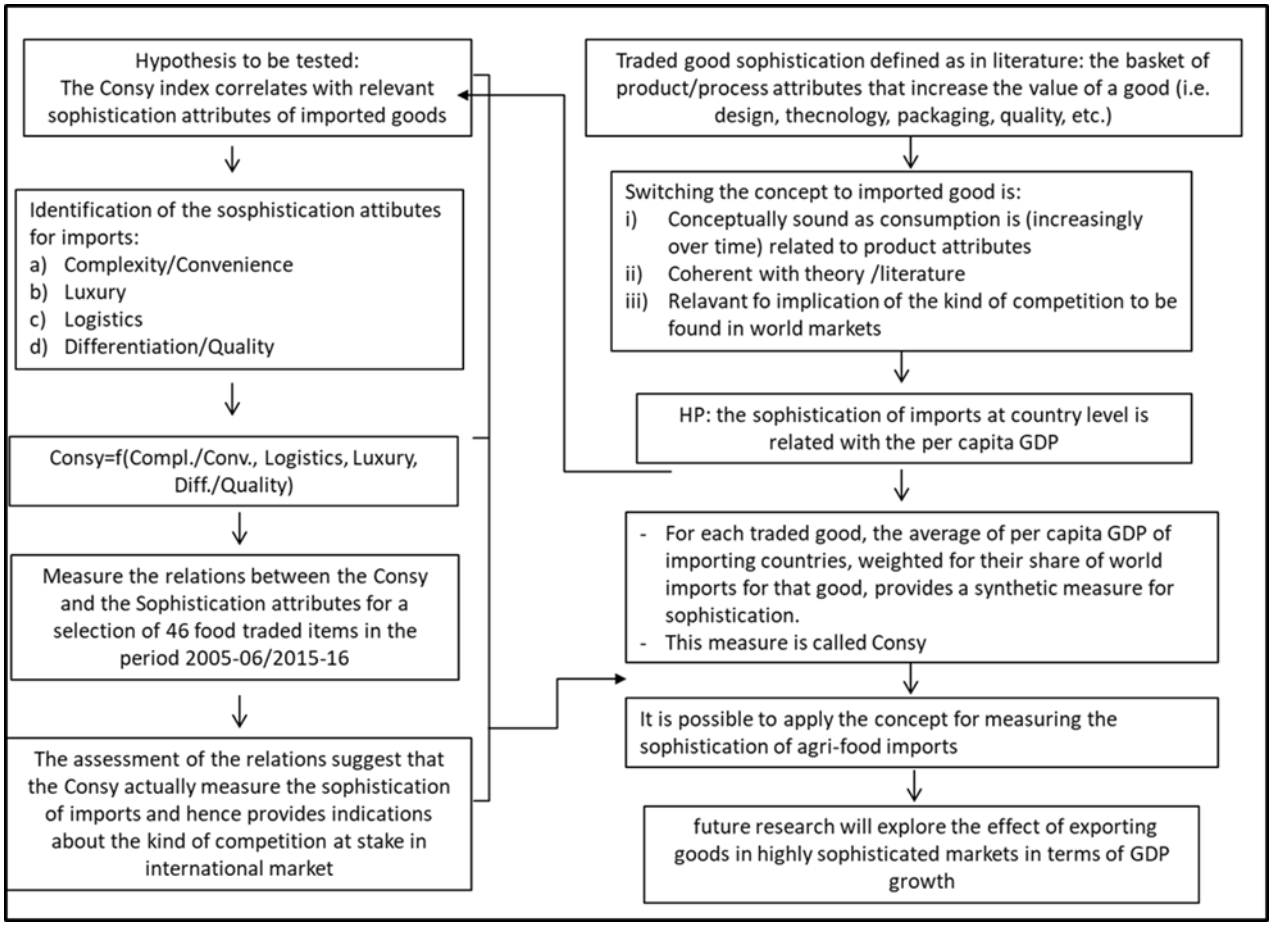

Figure 1. The logical framework for import sophistication

3 The Index for import sophistication

The sophistication index we propose is called Consy and, for each imported good *i*, it is defined as follows:

$$Consy_i = \Sigma_j GDPpc_j * c_{ij} \quad (3)$$

where $GDPpc_j$ is the per capita income of importing country *j* and c_{ij} is the share of total world imports of item *i* imported by country *j*:

$$c_{ij=} M_{i,j} / M_{iw} \quad (4)$$

where $M_{i,j}$ is the amount of the agri-food product *i* imported by the country *j* and M_{iw} is the world agri-food import of product *i*.

The higher is the role of high-income countries in the imports of a good, the higher is the $Consy_i$ and the more sophisticated is the product (i.e. the more sophisticated is the demand for that product). In other words, we posit that the income level of the destination markets for a product indicates the kind of demand that the product would likely meet. The ranking based on the index values allows for comparing the sophistication level of these goods.

Other interesting information provided by the index include their time trends as the dynamic of the index provides insights on the direction of change in the market for each good. We point out different components of the time variation of the index in order to get further insights on time trends. Particularly, it is possible to measure the impact on the sophistication measure of: i) changes in the geographical patterns of trade; ii) the dynamic of the per capita GDP of importing countries. In fact, the index varies following GDP pc variations (i.e. whether the wealth of the importing countries changes) and/or subject to variations of the geography of trade (i.e. whether there are changes in the set of clients' countries and/or their import shares).

In symbols it is:

$$VarConsy_i = LnConsy^2{}_i - LnConsy^1{}_i \quad (5)$$

Where:

$Consy^2{}_i$ = is the Consy measured at time 2
$Consy^1{}_i$ = is the Consy measured at time 1

and Ln indicates the natural Logarithm and their differences approximates the percentage variation and allows for summing the different components of the variation itself. These two components are defined as follows:

$$VarConsy_i = GDPpcE + GEOE \quad (6)$$

Where the first is called GDPpc effect and it is obtained as shown below:

$$GDPpcE = LnConsy^2{}_i - LnConsyK^2{}_i \quad (7)$$

Where $ConsyK^2{}_i$ is the Consy at time 2 but measured with constant GDP per capita (i.e. GDP at time 1).

Finally, changes in the geography of trade (hereafter called the GEO effect - GEOE) are disentangled and captured by:

$$GEOE = LnConsyK^2{}_i - LnConsy^1{}_i \quad (8)$$

Where, having kept the GDP pc invariant, the difference is totally due to changes in the set of importing countries and to variations in their share of imports.

As in other applications of the trade sophistication indices, also Consy can be applied to any traded good. Considering that one of the most meaningful outcomes of this kind of analysis is the ranking of the goods in terms of sophistication, usually wide sets of goods are analysed. However, as also the index dynamic over time provides interesting insights, the index may be useful also in more focused analysis that seek at assessing time changes in single product sophistication level.

4 The sophistication content of the consy index

In order to test the validity of our hypothesis on the existence of a relation between the Consy index (CI) - based, on importers' income - and sophistication features of imported products, we built a simple model where the index values are explained by a set of product attributes. The product attributes are here synthetized by four variables that are defined as follows:

- *Complexity/convenience*: it is based on the technological content of goods and/or on the number of ingredients.
- *Luxury: identifies* goods with hedonic contents and/or with status symbol implications.
- *Logistics:* this variable accounts for product perishability, transport costs, overall complexity of the logistics.
- *Quality/differentiation:* it measures the degree of product differentiation and hence the role of quality attributes that segment demand/market.

variables	Complexity/Convenience	Logistics	Luxury/Hedonic	Quality/Differentiation	Varsum
number of levels	3	3	3	3	12
critiria description	number of ingredients and/or technological content	perishability, transport costs, complexity of logistics	goods whose consumption is elastic to income	the degree of product differentiation and hence the role of quality attributes that segment demand	is the sum of the previous 4 variables
classification rules	qualitatively done by a food technology expert	qualitatively done by a food technology expert	percentage variation of world imports over percentage variation of world GDPpc (classes are: Er<=1; 1-1.4; >=1.5)	For each traded item the Average Unitary Value (AUV) of imports for each importing country has been calculated, then the Variation Coefficient (VC) for all import flows for each product has been calculated (classes are: VC=<0.6; 0.7-1.0; >1.0	each score value correspond to one class
drawbacks and interpretation cautions	complexity/technology may be not homogeneous within trade flows as defined in the trade dataset	logistics may be not homogeneous within trade flows as defined in the trade dataset	The variable accounts only for average values of import and GDPpc variations; the variability among countries is cancealed	1) the AUV hides the variability within flows; 2)here this drawback is even more serious as in the trade dataset the different items are not homogeneously defined (e.g. Pasta vs bakery, fresh veggies vs grape)	provides an aggregate measure that takes into account with one unique classification all the 4 previous criteria

Figure 2. Overview of the sophistication attributes

A detailed description of each variable is provided in Figure 2. The variables are ordinal, all defined on three levels (scores) from 1 to 3. Only the variable *Varsum*, obatained by summing the scores of the other variables, spans from a minimum of 4 scores to a maximum level of 12. Figure 2 summarizes the basic information about the way the variables have been built and about their main drawbacks together with the cautions to be kept in mind for their interpretation.

Clearly, these four variables do not capture entirely the sophistication content of goods. However, we posit that they represent a large spectrum of relevant attributes comprised in the import sophistication concept. The model has been estimated with reference to 46 selected agri-food items mainly for final consumption. Products' scores according to these variables are shown in the annex. For each traded item the value of the CI has also been calculated[2].

Results provide a measure of the impact of each variable on the CI values. We expect that products with higher values of the variables have higher CI values. For this purpose, the empirical model is written as follows:

$$LnConsy_k = a + b_1\ Convenience_k + b_2\ Logistics_k + b_3\ Luxury_k + b_4\ Quality_k + e_k \quad (9)$$

where the dependent variable $LnConsy_k$ is the natural logarithm of the sophistication index measured as the average value of the CI in 2005/2006 and 2015/2016. The model considers a simple linear relation between the CI and the four product attributes. Furthermore, an additional equation relates the CI and the *Varsum* variable, defined as the sum of the four individual variables (see Annex).

$$LnConsy_k = a + b_1\ Varsum_k + e_k \quad (10)$$

Table 1 shows the descriptive statistic of our variables of interest. The dependent variable, $LnConsy_k$, shows a moderate variability ranging from 21,761 to 42,296 US dollars.

[2] The application of the model and the subsequent trade analysis is based on the import flows of 130 countries, for 46 food items for final consumption, in 2005/06 and 2015/16. These items result from the aggregation of more detailed trade lines selected from the United Nations ComTrade databank, HS 1996 version, at 6-digit level of specification that includes 700 items for the agri-food sector. Trade data, in current US dollars (USD), are referred to years 2005-06 and 2015-16 where the average is calculated for each biennium. Imports of 130 countries are included that represent around 90% of worldwide agri-food trade exchanges. For each country the GDP pc is measured in International Dollars at 2011 PPP (Purchasing Power Parity), values as released by the World Bank (WDI-World Development Indicators).

Table 1.
Descriptive statistics

Variables	Obs	Mean	Std. Dev.	Min	Max
Convenience$_k$	46	2.022	0.745	1	3
Logistics$_k$	46	1.979	0.774	1	3
Luxury$_k$	46	2.043	0.698	1	3
Quality$_k$	46	2.392	0.614	1	3
Varsum	46	8.435	2.018	4	12
Consy2005/06	46	35333.3	4155.2	20422	41166
Consy2015/16	46	36114.78	4687.87	23100	43787
ConsyAV	46	35724.04	4323.62	21761	42296

Table 2 reports the correlation matrix. All four attributes are positively correlated with the level of the CI; however, only the correlations with *Luxury, Quality and Varsum* are statistically significant. Besides, it is also worth to pinpoint that these three variables are positively correlated with logistics and convenience whose correlation with *LnConsy* is not statistically significant. Conversely, these last two variables are not correlated with each other and the absence of correlation could be due to overlapping effects as the negative sign of the coefficient suggests.

Table 2.
Correlation Matrix

	LogConsy	Convenience	Logistics	Luxury	Quality	Varsum
LnConsy	1					
Convenience	0.0067	1				
Logistics	0.2309	-0.0762	1			
Luxury	0.4803*	0.4256*	0.3719*	1		
Quality	0.3696*	0.5155*	0.3456*	0.5819*	1	
Varsum	0.3646*	0.6438*	0.5892*	0.8225*	0.8282*	1

Considering the exploratory nature of the exercise, we built 4 different equations: model A includes all the 4 variables; model B excludes *Convenience*; model C includes only *Luxury and Quality;* while model D considers *Varsum* (see eq. 2). Table 3 shows results of Ordinary Least Square (OLS) estimations.

Table 3.
OLS results*

	A	B	C	D
Convenience (2)	-0.0956			
	(0.0706)			
Convenience (3)	-0.1178			
	(0.0642)			
Logistics (2)	-0.0154	0.0092		
	(0.0387)	(0.033)		
Logistics (3)	-0.0621	-0.0139		
	(0.0653)	(0.048)		
Luxury (2)	0.1353*	0.0687	0.0585	
	(0.0618)	(0.0455)	(0.0508)	
Luxury (3)	0.1964**	0.1326**	0.1218*	
	(0.0676)	(0.0489)	(0.0504)	
Quality (2)	0.2408*	0.2734*	0.2799*	
	(0.1034)	(0.1143)	(0.112)	
Quality (3)	0.2446*	0.2422	0.2527*	
	(0.1068)	(0.1221)	(0.1168)	
Varsum (5)				-0.2338*
				(0.1095)
Varsum (6)				0.0556
				(0.0471)
Varsum (7)				0.1427***
				(0.0145)
Varsum (8)				0.1025**
				(0.0333)
Varsum (9)				0.102
				(0.0509)
Varsum (10)				0.1298***
				(0.0222)
Varsum (11)				0.0405
				(0.0247)
Varsum (12)				0.1321***
				(0.0072)
_cons	10.2275***	10.1638***	10.1638***	10.3966
	(0.1039)	(0.1076)	(0.1049)	(0.1059)
N	46	46	46	46
r2	0.5132	0.4589	0.4545	0.4516
F	4.1937	3.1738	4.7551	61.2303
ll	44.2646	41.8336	41.645	41.5218
BIC	-54.0715	-56.8668	-64.1469	-52.4145
Reset: Prob > F	0.0070	0.1893	0.9410	0.0391

*The dependent variable is $LogCons_{AV}$. Standard errors are in parentheses.
Significance level * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

The R2 ranges from 0.45 to 0.51, indicating that the variables have a good explanatory and predictive ability. These results confirm a linear and positive relationship, between the CI and the independent variables, overall considered.

The model is not affected by multicollinearity problems as the values of the standard errors are of a lower magnitude order compared to their coefficients. The Variance Inflation Factor (VIF) test confirms this outcome.

Furthermore, we use the Reset test in order to verify misspecification of the relationship between the dependent and the independent variables. Results of the Reset test suggest that model B and C are correctly specified.

Still, in order to evaluate the better fitted model, the Bayesian Information Criterion (BIC) has been considered, under the assumption that the models have the same log likelihood. Results suggest that model C is to be preferred as it has the smaller BIC[3].

Indeed, most of the estimated coefficients of *Luxury* and *Quality* are positive and statistically significant in the regression models A, B, and C. In the regression model C (as well as in model B) Luxury is only significant at level 3, while level 2 has no significant impact on the CI. As for the impact of *Quality*, this is greater than that of *Luxury*. In regression models C (as well as in model B) *Quality* is significant both at level 2 and 3.

As expected, the coefficients for *Logistic* and *Convenience* are not significant (negative), thus, these variables seem to have no impact on the CI values. One possible reason could be their partial overlapping with the *Luxury* and *Quality* variables.

Looking at the variable *Varsum* (model D) we can observe that in this case most of the beta coefficients are positive and statistically significant. These results suggest that changes in the overall values of the product features do affect their CI value.

All in all, results allow to conclude that the CI can be used as a measure of sophistication of imported goods, at least in the case of agri-food items for final consumption.

5 The sophistication of imported food products

Before analysing the CI values for the 46 selected items, it is worth to give an overall look at their shares of world imports. Two of the items have considerably higher shares compared to all the other products: *vegetable oils oth.* (including all vegetable oils except olive oil) and *sauces soups and condiments*, respectively, account for about 8-12% of the overall imports for the 46 items. Moreover, the shares of these two products increase significantly in the decade. For all the remaining products, the shares are significantly lower than 6% and for many of them they remain below 2%. As for the variations, some shares slightly increase but for about three quarters of the items the shares decrease along the period.

Moving to the analysis of the CI for this selection of products, Table 4 offers an overview showing that values span from slightly more than 23,000 US dollars, for *processed rice*, up to over 43,000 US dollars in the case of *red berries*. In table 4 the mean and the median values are reported too. The median is well above the mean, showing a concentration of products in the higher part of the ranking. All in all, these data indicate that rich countries dominate the import markets of agri-food products for final consumption. The major role of rich countries in international trade is quite well known in the case of non-food products, however this outcome in the case of agri-food products is less trivial and, hence, it is worth to be underlined. Furthermore, the relatively low figures of the standard deviation and of the coefficient of variation in table 4 show that CI values are distributed quite regularly and with low variability. The distribution is less smooth only at the bottom of the ranking.

Table 4.
Descriptive statistics for the CI values

	Consy 2015/2016	Consy 2005/2006
min	23100	20422
max	43787	41166
mean	36115	35333
median	37030	36139
standard dev.	4637	4110
Variation coef.	0.13	0.12

Source: Our elaborations on UN-Comtrade and WB-WDI data.

Figure 3 and Table A.2 (in the appendix) show the ranking provided by the CI. Furthermore, in Figure 3 groups of products belonging to the same category are identified by the same colours. This reveals that items within the same family of products (i.e. fish, cheese, fruit, cereals and others) -but with different contents in terms of

[3] To double-check robustness, we also: i) regressed the four attributes by considering separately the values of Consy in 2005/2006 and in 2015/2016 and also in these cases the signs and the significance of the betas are confirmed; ii) performed a Probit regression model where the median is the threshold value for cutting the distribution of the Consy and, once again, results are confirmed; however, due to the limited size of sample, results of the Probit model could not add much and are not presented.

quality attributes- span all along the ranking showing different levels of sophistication. Looking at these groups, it is quite evident that higher value added and/or more complex items (i.e. more sophisticated goods) within each family/chain are ranked higher according to the CI values. On the contrary, low-value, less processed and/or less complex goods (i.e. less sophisticated goods) are located at the other end of the ranking. For example, in the case of cereals and cereal-based products, rice - quite a simple product, whose consumption is mainly based in low-middle income countries - is at the bottom of the ranking; pasta is n. 32, *fresh pasta* – a more complex, more perishable, higher value added product, which includes also stuffed pasta- is n. 19, and last, *bakery* products – a highly differentiated group of items where brand and packaging are very relevant- is ranked n. 11.

A similar positioning can be observed for oils. *Virgin olive oil* that has a very high average unitary value compared to substitutes, is increasingly demanded for its healthy contents and is also increasingly regarded as a hedonic good (Anania and Pupo D'Andrea, 2007; Mili, 2004; LMC, 2015), is ranked n. 24. Differently, imports of *vegetable oils oth.*, that include fats largely used in low-middle income countries and whose consumption is very much elastic to their income growth , appear at the very bottom of the ranking.

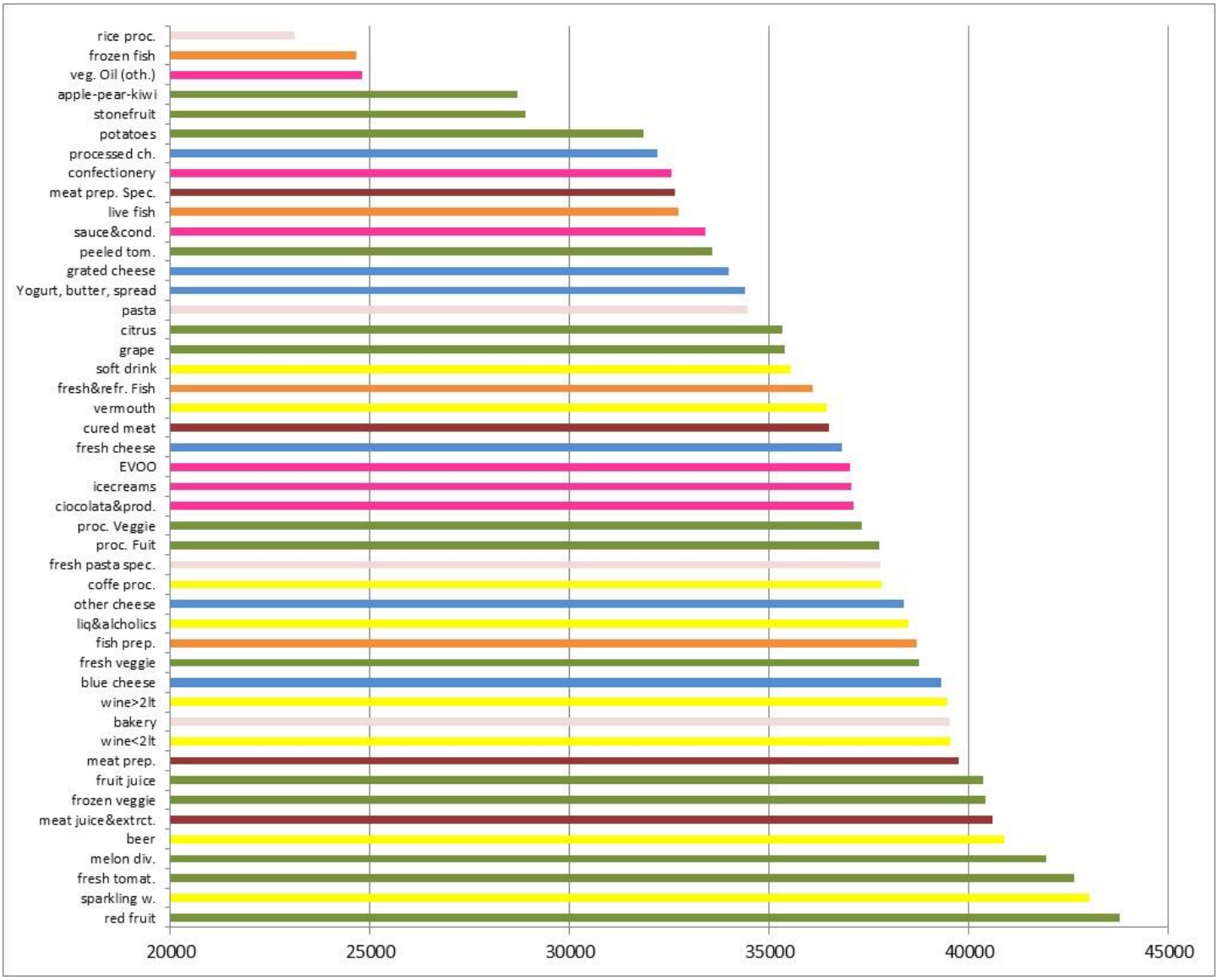

Figure 3. The CI values at 2015/16 by groups of items (The same colour indicates the same group of goods).

Coming to analyse the time trend of the CI (Table A2 and Figure 4 4), we see that during the decade 2005/06-2015/16 the CI values have changed significantly. Most products traced here show an overall positive variation, even though to different extent. For example, the CI associated to *red fruits*, *special meat preparations (*i.e. basically infant food) and *meat extracts* sharply increases like that of *vermouths* and *liquors and spirits*. Differently, for a small number of goods, the sophistication level reduces; among these the larger reductions are for *stone fruits*, *apples pears and kiwis* and for *frozen fish*. Smaller reductions are observed for *potatoes* and *grapes*, *grated* and *processed cheese* together with *pasta*.

In addition to the total variation of the CI, the values of the two components (GDP effect and GEO effect) of the overall change are calculated and reported in the annex (Table A2).

The GDP effect is always positive, while, on the contrary, the GEO effect is always negative, with only three exceptions (Figure 5). As the total CI variations are mostly positive, this means that the GDP effect generally more than counterbalances the negative sign of the GEO effect.

The generalised negative GEO effect indicates that agri-food imports are increasingly located in countries whose income is below the average/median while richer countries are losing quotas of world imports for those food products.

It is worth to point out that the larger (negative) GEO effects are associated to items that appear in the lower part of the ranking, while in the upper part of the distribution changes in the location of imports are less important. This means that poorer countries are especially increasing their role as importers of relatively less sophisticated food items, while for the more sophisticated ones they are gaining momentum at a slower pace. This is also the case when one looks within product groups; for example, *wines in larger bottles (>2lt.)* show a larger negative GEO effect than *wines in smaller bottles (< 2lt.)*; the same also holds for fishery products where less sophisticated items are associated with larger negative GEO effects than more sophisticated fish items.

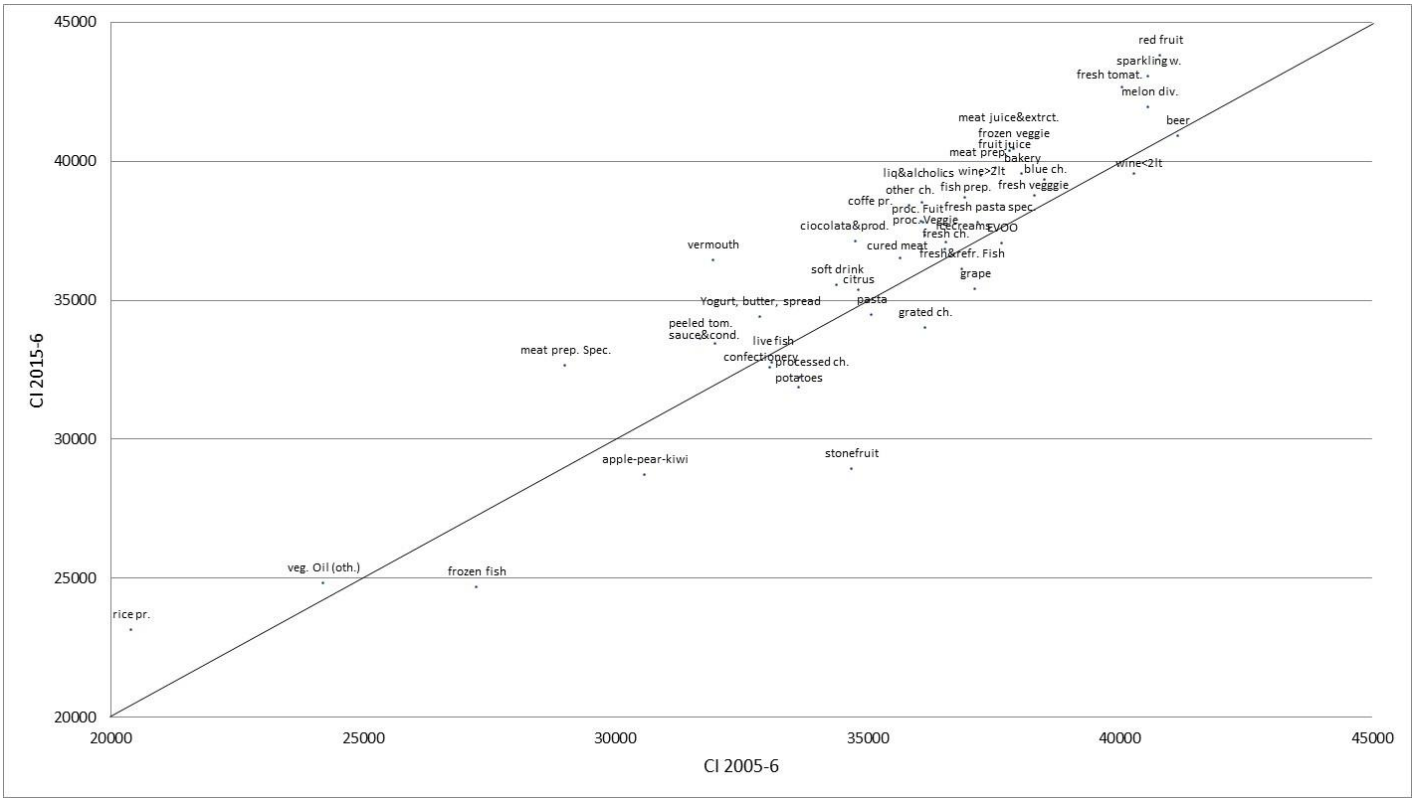

Figure 4. CI – 2005/06 and 2015/16 values*

*Only some items have been fully labelled in the figure in order to assure its readability.

Such dynamics are well explained by data presented in table 5 where it is shown how agri-food imports of countries below the median value of the per-capita annual income are more than tripled while imports of richer countries increased by 65.9%. Consequently, the share of world imports of the former has grown from 10% to 17%. The opposite signs of the two effects indicate that with a general growth of GDP, especially in low-medium income countries, food consumption is elastic and increases particularly for higher value added, complex goods that include convenience and other quality attributes embraced in the sophistication concept.

Red berries, *vermouths* and *special meat preparations* are the only items with a positive GEO effect; for them the role of rich countries as clients is increasing and, thus, the kind of competition that exporters shall expect to meet in international markets is more based on quality features.

It is also interesting to go back to the example of the oil products (*virgin olive oil* and *vegetable oils oth.).* Even if the two components of the total CI variation have the same signs for these two items, their overall dynamic is opposite, with the CI for *virgin olive oil* that slightly reduces (-1.75%) while the CI for *other vegetable oils* increases by 2.41%. Besides, the dynamics are much stronger for *other vegetable oils* than for *virgin olive oils*. The strong negative GEO effect for *other vegetable oils* (-10.8%) reflects the rise of the import quota (from 6.6% to 12.8%) of India, a country with an income well below the median, as well as the shrink of the import quota of

one of the richest countries in the world: Germany (whose import quota reduced from 6.7% to 3.3%). The GEO effect for *virgin olive oil* has also been negative, though at a more limited rate (-4.2%), because of a number of opposite changes in the geography of imports. More specifically, traditionally important consumer (and importer) countries such as Italy, France and Portugal (with high income levels, well above the world median) have reduced their import quotas, thus affecting negatively the GEO effect. China - a country with an income level below the median - also had a negative impact on the GEO effect due to its increased import quota for this product. On the contrary, USA, Japan and Brazil increased their quotas and had a positive influence on the GEO effect. However, these positive impacts could not offset the (larger) negative ones.

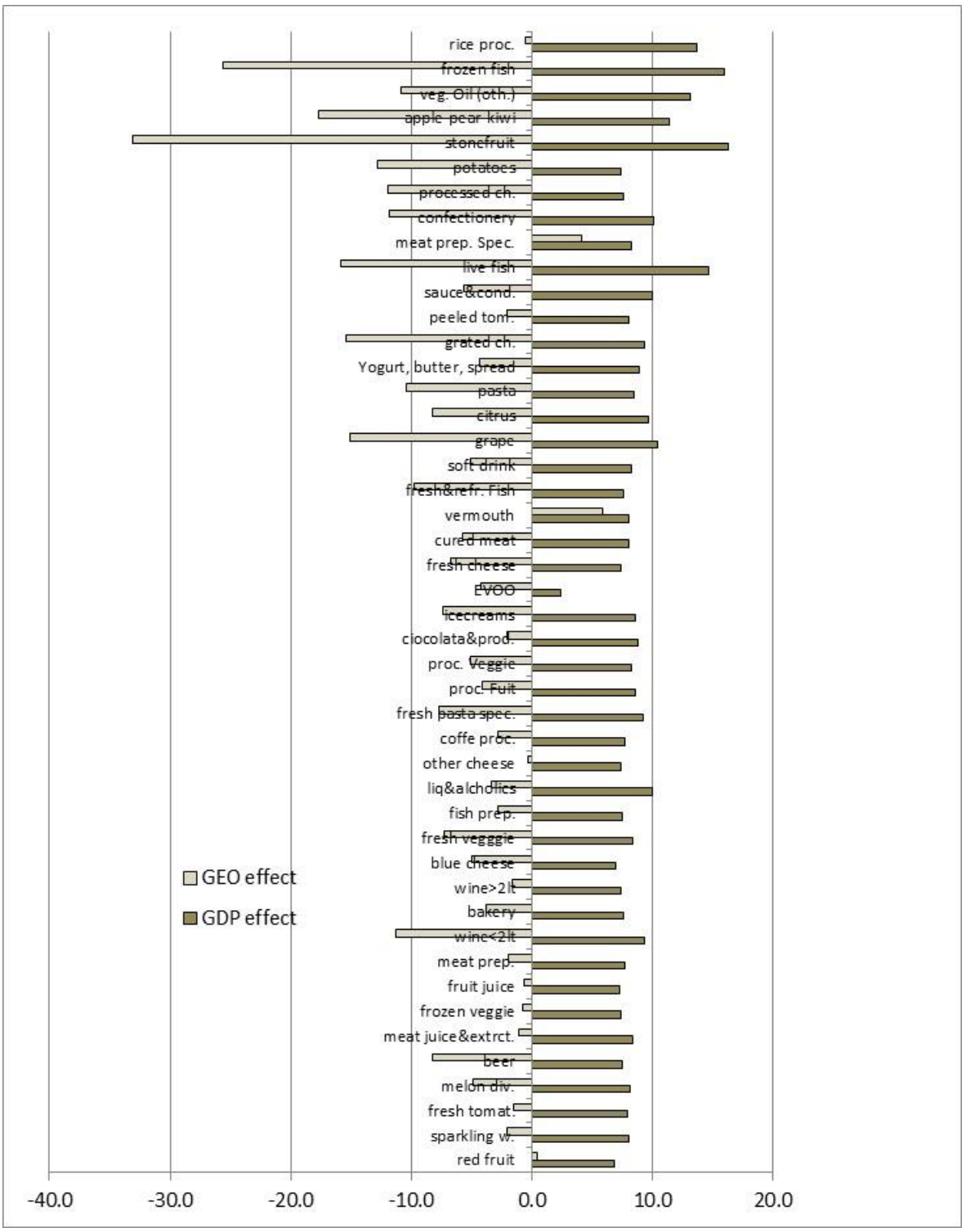

Figure 5. Income (GDP) and geographic (GEO) effects of the CI variation (2005/06-2015/16)

Table 5.
Share of imports of countries above/below the world median value of the per-capita GDP

values in billions current US $	IMP 2005-6 values	IMP 2015-6 values	%variation	IMP 2005-6 quotas	IMP 2015-6 quotas
total 130 countries	283.4	510.1	80.0	100.0	100.0
total poor countries (below GDP median)	27.5	85.6	210.8	9.7	16.8
total rich countries above GDP median)	255.9	424.5	65.9	90.3	83.2

Source: elaborations on UN-Comtrade and WB-WDI data.

6 Concluding remarks

This paper adds to the literature on trade sophistication by looking at import flows. First, it introduces a new index (called Consy), for measuring the sophistication of imports. The index is based on importers' GDP. The agri-food sector has been chosen for a first application of the CI thanks to: i) its relevant role in international trade; ii) the increasing worldwide attention on food quality and safety and, consequently, the growing role of product attributes in featuring international competition.

Second, with the aim of testing whether the CI can be regarded as an appropriate and effective measure of the sophistication level of imported items in the agri-food sector, we built and estimated a simple model where Consy is explained by some product characteristics. Results of the regressions were encouraging so that we proceeded to analyze trade data using the CI.

Overall, the ranking of the selected 46 food products shows the major role played by richer countries as importers of agri-food items for final consumption. Furthermore, this ranking follows a quite regular path with higher value added and/or more complex items that are ranked higher; while low-value, less processed more simple goods that are located at the bottom of the ranking.

The dynamics of the CI along the decade 2005-06/2015-16 indicates that some relevant changes occurred. A generalised upward shift in the CI measure shows that sophistication is increasing in agri-food markets. The way this change occurred is not trivial: while rich countries generally dominate agri-food imports - and this is especially true for some goods - poorer countries are gaining import shares, thus determining a reshaping of the geographical patterns of agri-food trade and pushing for a reduction of the level of sophistication for several traded goods. However, at the same time, per capita GDP of many of these countries increased pushing up the sophistication level of their demand of imports, with this second effect that prevails on the first. In other words, our results confirm the increasing role as importers of emerging countries but, at the same time, the analysis indicates that the kind of competition is changing in these markets and globally.

Changes in the CI values and rankings indicate the direction of markets evolution. The kind of evidences provided by our analysis can help stakeholders along the chain - and especially exporters - in defining their marketing strategies and, particularly, in selecting the markets that better fit their products and that seem more promising and potentially rewarding. As suggested by the increasing sophistication of many agri-food products for final consumption, quality competition is becoming progressively more important also in emerging markets. In these markets the share of better-off population and with higher education is increasing and this is driving demand towards higher quality and, overall, sophistication features. Consumers in these countries are also pushing for more rigorous set of rules and policies for assuring food quality and safety. As a consequence, exporters from richer countries - that usually adopt more stringent norms - may enjoy a competitive advantage as they have a longer and wider experience in delivering quality and matching quality standards. Policy makers in less rich countries should be committed in setting legal frameworks able to encourage firms in reaching higher quality and safety levels.

Further methodological contributions may seek at combining the use of sophistication indices, on both the supply and on the demand side. These may help in providing a more complete and sounder analysis aimed at exploring the articulation and geography of global value chains, where each country enters at the same time as an importer and as an exporter of goods at different processing levels.

References

Anania, G., Pupo D'Andrea, M.R. (2007). The Global Market for Olive Oil: Actors, Trends, Policies, Prospects and Research Needs. Working Paper 08/2, TRADEAG - Specific Targeted Research Project, VI Framework Programme, European Commission, http://www.tradeag.eu.

Carbone, A., Henke, R., (2012). Sophistication and Performance of Italian Agri-food Exports. *Journal of Food System Dynamics*, **3**: 22-34.

Carbone, A., Henke, R., and Pozzolo, A.F. (2015). Italian agri-food exports in the international arena. *Bio-based and Applied Economics*, **4**: 55-75.

Di Maio, M., Tamagni, F. (2008). The evolution of world export sophistication and the Italian trade anomaly.*Rivista di Politica Economica*, **98**(1): 135-174.

Fabrizio, S., Igan, D., and Mody, A. (2007). The dynamics of product quality and international competitiveness. IMF Working Papers. 1-33.

Fajgelbaum, P., Grossman, G. M., and Helpman, E. (2011). Income Distribution, Product Quality, and International Trade. *Journal of Political Economy*, **119**: 721-765.

Ferto I., Bojnec S. (2015). Quality upgrading in the European-Union agri-food exports. Paper presented at the 87th Annual Conference of the Agricultural Economic Society, 8-10 April 2015, University of Warwick, United Kingdom

Fisher, C. (2010). Food Quality and Product Export Performance: An Empirical investigation of the EU Situation. *Journal of Food and Agribusiness Marketing*, **22** (3): 210-233.

Gehlhar, M.J., Pick, D-H. (2002). Food Trade Balances and Unit Values: What Can They Reveal About Price Competition?. *Agribusiness*, **18**(1): 61-79.

Hallak, J.C. (2006). Product quality and the direction of trade. *Journal of international Economics*, **68**(1): 238-265.

Hallak, J.C. (2010). A product-quality view of the Linder hypothesis.*The Review of Economics and Statistics*, **92**(3): 453-466.

Hausmann, R., Hwang J., and Rodrik D.,(2007). What You Export Matters. *Journal of Economic Growth*, **12**: 1-25.

Helpman, E. (1981). International trade in the presence of product differentiation, economies of scale and monopolistic competition: A Chamberlin-Heckscher-Ohlin approach. *Journal of international economics*, **11**: 305-340.

Kamakura, M. (2007). What's so special about China's exports? A comment. *China and World Economy*, **15**(5): 18-37.

Ketels, H.M. (2006). Michael Porter's comtetitivenes framework: recent learning and new research priorities. *Journal of Industry Competition and Trade*, **6**(2): 115-136.

Krishna P., Maloney W.F. (2011). Export Quality Dynamics. Policy Research Working Paper 5701, The World Bank, Washington D.C.

Krugman, P. (1980). Scale Economies, Product Differentiation, and the Pattern of Trade. *American Economic Review*, **70**: 950-959.

Lall, S., Weiss, J., and e Zhang, J. (2006). The "sophistication" of exports: a new trade measure. *World development*, **34**: 222-237.

Linder, S. (1961). *An Essay on Trade and Transformation*. Almqvist & Wiksell, Stockholm.

LMC. (2015). Oilseed and oils report, LMC International, www.lmc.co.uk

Marvasi, E. (2012). China's Exports Sophistication, Imports and Intermediate Products, in G. Gomel, D. Marconi, I. Musu and B. Quintieri (eds.), *The Chinese Economy*. Springer, Berlin and Heidelberg.

Mili, S. (2004). Prospects for Olive Oil Marketing in Non-Traditional Markets, AIEA2 International Conference "Sustainable Development and Globalisation of Agri-Food Markets", Laval University, Québec, Canada, August 23-24-

Minondo, A. (2008). The Sophistication of Basque Exports. Orkestra Working Paper Series in Territorial Competitiveness, n. 2008/03.

Porter, M. (1985). *Competitive advantage: creating and sustaining superior performance*. NewYork FreePress, NewYork (NYC-USA).

Porter, M. (1986). Competition in global industries: A conceptual framework.In M. Porter (ed.) *Competition in global industries*, Harvard Business School Press, Boston (MA-USA).

Rodrick D. (2006). *What's so special about China's exports? China and World Economy*, **14**(5): 1-19.

Sarker, R. Surry, Y. (2006). Product differentiation and trade in agri-food products: Taking stock and looking forward. *Journal of International Agricultural Trade and Development*, **2**(1): 39-78.

Schott, P.K., (2004). Across-Product Versus Within-Product Specialization in International Trade. *Quarterly Journal of Economics*, **119**: 647-678.

Stern, J.A., Spreen, T.H. (2010). Evaluating sustainable competitive advantages in Brazilian and U.S. processed citrus supply chains: an application of Porter's diamond framework. *International Journal of Food System Dynamics*, **1**: 167-175.

Appendix

Table A.1.
Classification of the 46 traded items according to sophistication attributes

list of items	Complexity/ Convenience	Logistics	Luxury	differentiation /Quality	Version
live fish	1	3	2	2	8
fresh fish	1	3	3	3	10
frozen fish	2	3	2	2	9
yogurth, butter and spread	3	3	2	3	11
fresh cheeses	2	3	2	3	9
grated cheeses	3	2	2	3	9
processed cheeses	2	2	2	3	9
blue cheese	2	2	2	3	8
other cheeses	2	2	2	3	8
potatoes	1	1	1	1	4
fresh tomatoes	1	3	2	2	8
fresh vegetables	1	3	2	2	8
frozen vegetables	2	3	2	2	9
citrus	1	1	1	2	5
grape	1	2	1	2	6
melon and oth.	1	2	1	2	6
apples, pears and kiwis	1	1	1	2	5
stronefruits	1	2	1	2	6
red fruits	1	3	3	2	10
processed coffee	3	1	2	3	8
processed rice	2	1	1	1	4
extra-virgin olive oil	2	1	2	2	6
vegetable oils oth.	2	1	1	1	4
cured meat	3	2	2	3	9
meat preparations spec.	3	1	2	3	9
meat preparations	3	2	2	3	10
meat juice and extracts	2	1	3	2	8
fish preprations	3	2	3	3	11
chocolate and choc. products	3	2	2	3	10
fresh pasta	3	2	3	3	11
pasta	2	1	1	2	5
confectionary and pastry	3	2	3	3	11
bakery	3	1	2	3	9
peeled tomatoes	2	1	1	2	5
processed vegetables	2	1	2	2	7
processed fruits	2	1	2	2	6
fruit juices	3	1	2	2	7
sauces soups and condiments	3	1	2	2	8
icecreams	3	3	3	3	12
soft drinks	2	1	2	2	7
beer	2	1	3	2	8
sparkling wine	2	2	3	3	9
wine < 2 lts	2	1	3	3	8
wine > 2 lts	2	1	2	2	6
vermouth	2	1	3	3	8
liqueurs and spirits	2	1	3	3	9

Table A.2.
Values of the Consy indices and their variations

item	CONSY 2015/2016	CONSY 2005/2006	% variation	GDP effect	GEO effect
red fruit	43787	40805	7.31	6.8	0.5
sparkling w.	43021	40577	6.02	8.0	-2.0
fresh tomat.	42645	40070	6.42	7.9	-1.5
melon div.	41931	40586	3.32	8.1	-4.8
beer	40888	41166	-0.67	7.5	-8.2
meat juice&extrct.	40586	37832	7.28	8.3	-1.1
frozen veggie	40415	37917	6.59	7.4	-0.8
fruit juice	40366	37842	6.67	7.3	-0.7
meat prep.	39745	37556	5.83	7.7	-1.9
wine<2lt	39538	40305	-1.90	9.4	-11.3
bakery	39516	38068	3.80	7.6	-3.8
wine>2lt	39442	37262	5.85	7.4	-1.6
blue cheese	39304	38524	2.02	7.0	-5.0
fresh vegggie	38745	38328	1.09	8.4	-7.3
fish prep.	38684	36939	4.72	7.5	-2.8
liq&alcholics	38495	36096	6.65	10.0	-3.4
other cheese	38380	35845	7.07	7.4	-0.3
coffe proc.	37822	36076	4.84	7.7	-2.8
fresh pasta spec.	37779	37210	1.53	9.2	-7.7
proc. Fuit	37762	36118	4.55	8.6	-4.1
proc. Veggie	37310	36162	3.17	8.2	-5.1
ciocolata&prod.	37101	34769	6.71	8.8	-2.1
icecreams	37048	36576	1.29	8.6	-7.3
EVOO	37012	37673	-1.75	2.5	-4.2
fresh cheese	36807	36548	0.71	7.4	-6.7
cured meat	36488	35675	2.28	8.0	-5.8
vermouth	36432	31955	14.01	8.1	5.9
fresh&refr. Fish	36091	36891	-2.17	7.6	-9.8
soft drink	35526	34403	3.26	8.3	-5.0
grape	35394	37146	-4.71	10.4	-15.1
citrus	35336	34833	1.44	9.7	-8.3
pasta	34442	35099	-1.87	8.5	-10.4
Yogurt, butter, spread	34385	32880	4.58	8.9	-4.3
grated ch.	33975	36160	-6.04	9.4	-15.4
peeled tom.	33585	31694	5.97	8.0	-2.0
sauce&cond.	33398	31989	4.40	10.0	-5.6
live fish	32728	33119	-1.18	14.7	-15.9
meat prep. Spec.	32627	29017	12.44	8.3	4.1
confectionery	32547	33078	-1.60	10.2	-11.8
processed ch.	32194	33676	-4.40	7.6	-12.0
potatoes	31849	33644	-5.33	7.4	-12.8
stonefruit	28897	34707	-16.74	16.3	-33.1
apple-pear-kiwi	28702	30604	-6.21	11.4	-17.6
veg. Oil (oth.)	24808	24225	2.41	13.2	-10.8
frozen fish	24647	27265	-9.60	16.0	-25.6
rice proc.	23100	20422	13.12	13.7	-0.6

Source: elaborations on UN-Comtrade e WB-WDI data.