

# Intra-Industry Trade in Agricultural and Food Products: The Case of Greece prior and during the Debt Crisis

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## Abstract

*This article examines the evolution of Greek Intra-Industry Trade (IIT) in agri-food products during the period 2002-2016, concentrating on evident changes in IIT shares after the onset of the 2009 Greek debt crisis. The severity of the Greek crisis, which affected the main determinants of IIT, presents a unique opportunity to study producers' reaction and infer on policy targets to assist trade during economic downturns. I concentrate on agricultural and food products, as they have received less attention in the IIT literature and examine IIT through the Grubel-Lloyd index and by separating IIT into Horizontal IIT (HIIT), and high and low-quality Vertical IIT (HVIIT and LVIIT). Results indicate the post-2009 growth of high-quality VIIT exports in products that require a high degree of processing. Panel VAR analysis indicates that negative shocks to GDP have a significant and persistent negative impact on VIIT and HVIIT.*

## Key Words

*intra-industry trade; Horizontal IIT; Vertical IIT; HVIIT; LVIIT; agriculture Grubel-Lloyd Index; marginal intra-industry trade*

## 1 Introduction

Trade can be either Inter-Industry (INT), commonly referred to as one-way trade, or Intra-Industry (IIT), also referred to as two-way trade. Inter-industry trade consists of the international trade of products in different categories and it comprises the majority of total worldwide trade. It reflects the traditional definition of trade explained by the models of Ricardo and Heckscher-Ohlin, where flows are based on comparative advantage and differences in technology. IIT, on the other hand, is defined as the simultaneous import and export of products that belong to the same industry category, whether finished, semi-finished, parts or components. It can take the form of Horizontal IIT (HIIT), reflecting products of the same price and quality, mainly observed within countries with similar

factor endowments, or Vertical IIT (VIIT) which refers to products of different price and quality that can also be the result of back and forth trade of fragmented production across countries and within the same industry at different stages of production.

Since the early 60's, IIT has been growing together with consumer demand for differentiated products. BRÜLHART (2009) reports 44% of total worldwide trade for the year 2006 was IIT (measured at the 3-digit level). The unweighted overall country average IIT, estimated over a total of 217 countries included in the study, was 14%. For agri-food products, BOJNEC and FERTŐ (2016) report that, while INT is still more important than IIT for most EU-27 member states, IIT and agri-food IIT shares have been increasing. JAMBOR (2014) and FERTŐ (2015) also find evidence of increasing EU agri-food IIT shares while JENSEN and LÜTHJE (2009) report increasing shares in the manufacturing sector.

The increasing importance of IIT worldwide, can be seen in the growing interest of the empirical literature. The literature has examined numerous aspects of IIT, including the impact that EU accession has had on shares of IIT trade, the impact of intervention, trade liberalization, Free Trade Agreements and economic development. Despite the rich and growing literature, there is no reference to date that examines how IIT shares are affected when all of the main determinants of IIT are simultaneously shocked. Such is the case when a country enters a severe recessionary period. The question we seek to explore is related to producers' response during an economic crisis. Do producers respond by seeking new opportunities, shifting resources towards more productive uses, thus affecting only the composition of INT, or do differentiation and value added activities provide an outlet for producers, leading towards an increase in IIT shares?

The Greek crisis presents such an opportunity. The 2009 downturn of the Greek economy had a substantial negative impact on the country's welfare, its finances and its prospects. From 2008 to 2016, GDP and GDP per capita both decreased by approximately 25%, while unemployment increased from 8% to

25%<sup>1</sup>. The effects of the slowdown were reflected in all parts of the economy including the level of trade and the competitiveness of Greek products in the international markets. The value of total exports of goods and services dropped by 27.2% and the value of total imports by 42.6%<sup>2</sup>, reflecting both competitive losses for producers as well as losses in consumer purchasing power. The slowdown of the Greek economy manifested on the structure and the factors of production, on the use/availability of technology, the competitiveness, the size and number of the firms as well as the ability to take advantage of economies of scale. It is, therefore, of special interest to examine how IIT shares changed during this period of structural changes, where the main drivers of IIT, as discussed in the literature, were themselves affected by the economic crisis. Inferences with respect to Greek producers' reaction during this period, will allow us to discuss potential outlets for producers in cases of severe negative shocks to an economy as well as policy formation to assist production and exports.

I concentrate on agri-food IIT. The interest in the primary sector stems from two main factors. The first factor relates to the limited attention the agricultural sector has received so far in the IIT literature, despite the fact that IIT's role in agri-food trade has increased (FERTŐ, 2005, 2015; JAMBOR, 2014; RASEKHI and SHOJAEE, 2012; JAMBOR, 2016). The second factor relates to the rapid growth of agricultural IIT through value-added agricultural activities over the last decades. While differentiation is more common and likely to be observed in the manufacturing sector, we observe IIT in products from the primary sector as well. The growth of value-added agriculture in recent years, resulted in the appearance of new differentiated products, targeting niche segments of the market that have added to the growth of agri-food IIT. Together with the effect from industrialization, economic integration and globalization of the markets, the constant restructuring of the global international markets promises further growth of IIT in agri-food products, which emphasizes the need for research.

The most common measures of IIT by GRUBEL and LLOYD (1975), BRÜLHART (1994), ABD-ELRAHMAN (1991) and GREENAWAY et al. (1995) are employed, in order to examine IIT, Horizontal IIT (HIIT), Vertical IIT (VIIT) as well as high-quality and

low-quality VIIT (HVIIT and LVIIT, respectively). 15 years of data in the study cover the period immediately after Greece's adoption of the Euro (2002) until 2016. The analysis concentrates on evidence suggesting dynamic changes in the patterns/structure of IIT trade after the 2009 slowdown. Granger-causality tests and Panel VAR are employed to examine whether GDP changes are associated to changes in IIT shares and to examine the persistence of shocks to GDP on IIT.

The next section presents a literature review that will allow us to understand the evolution of the theory and the empirical measures for IIT as well as the way the empirical literature has utilized these measures in the past to discuss the trends and/or the determinants. Section 3 present the methodology, where the measures that are employed to address the changes in the trend of all types of IIT are thoroughly presented. Section 4 presents the results and section 5 presents the conclusions together with extensions to this research.

## 2 Literature Review

IIT was first noticed when researchers observed the simultaneous import and export of same category products, differentiated enough, however, to satisfy niche segments of market demand. It mainly involved the trade between developed countries of similar level of industrialization, similar factor endowments and capital-labor ratios. The appearance of IIT was attributed, amongst others, to a rising demand for differentiated varieties of goods and economies of scale which allow industry specialization within a country.

The theory to examine this type of trade was developed by BALASSA (1966), who employed the differentiation of production as an explanation of IIT and who was also the first one to propose an index to measure the extend of trade overlap that defined IIT. GRUBEL and LLOYD (1975) formalized the method with the well-known Grubel-Lloyd (GL) index, after adjusting the measure presented by BALASSA (1966). Theoretical foundations were added, amongst others, by KRUGMAN (1979), LANCASTER (1980), HELPMAN (1981) and HELPMAN and KRUGMAN (1985).

IIT gradually took up a significant portion of total trade. Together with the rising demand for differentiated products, the growth in IIT can be partially attributed to technological progress and structural transformation of worldwide production and consumption (LAPINSKA, 2014). Industrialization and the

<sup>1</sup> Calculations based on World Development Indicators. For GDP constant 2010 values were used.

<sup>2</sup> Calculations based on UN Comtrade data and constant 2010 values.

vertical fragmentation of production also had a positive impact while worldwide trade liberalization and economic integration further enhanced IIT's role in the international markets. The effects of economic integration on the level of IIT can be demonstrated through the example of Europe, where IIT expanded substantially, especially after the monetary unification and EU-expansion. Numerous articles have examined the country-level effects of accession to the EU on IIT (see ATURUPANE et al., 1999; BOTRIC, 2013; KANG, 2010; CAETANO and GALEGO, 2007; DAUTOVIC et al., 2014; LAPINSKA, 2014). Amongst them, BOJNEC and FERTŐ (2015), discuss IIT for Old Member States (OMS) vs. New Member States (NMS) in the EU and find that, after the enlargement of the EU, the NMS have increased Intra EU-27 agri-food exports, HIIT and HVIIT. Within the confounds of integration and EU accession, higher levels of IIT carry lower costs of adjustment than INT (smooth adjustment hypothesis). The process of integration leads to adjustments in production and trade, hence, shifting of factors of production from contracting to expanding sectors. With IIT, factor requirements in the expanding and contracting sectors will be similar, transfer of factors will be easier and can thus be achieved at lower costs. On the other hand, when INT is high, adjustments will require shifting of resources from contracting to expanding industries with significant costs associated to it (i.e. retraining). Therefore, IIT carries low costs of factor market adjustment (AZHAR and ELLIOT, 2008; BRÜLHART, 2009).

IIT can be separated into VIIT and HIIT. The literature emphasizes the importance of separating these two concepts as they differ both in terms of theory as well as in terms of their determinants (TURKCAN and ATES, 2011). HIIT refers to the trade of same quality/price products (homogeneous quality) whereas VIIT refers the trade of products of different quality and price (heterogeneous quality). HIIT is associated with similar factor endowment, developed economies, whereas VIIT is associated to countries with different levels of income and different factor endowments (FALVEY and KIERZKOWSKI, 1987).

The growth of the literature on HIIT can be attributed to DIXIT and STIGLITZ (1977), KRUGMAN (1979, 1980, 1981), LANCASTER (1980), HELPMAN (1981) and HELPMAN and KRUGMAN (1985). KRUGMAN (1979) first discussed horizontal differentiation using monopolistic competition. HELPMAN and KRUGMAN (1985) provided the main contributions to the theoretical model using a Chamberlin-Heckscher-Ohlin

framework employing monopolistic competition, factor endowments with increasing returns to scale, horizontal product differentiation and a demand for variety. HIIT is large within-EU countries' trade as they are similar in industrial structure, income and growth (ITO and OKUBO, 2012). Within the context of an FTA or deeper integration agreements, such as the EU, the level of HIIT as well as its trend, also serve as an indicator of similarity of products for member countries which can be considered as a measure of the ability to converge and for trade creation (SEMOS, 2006). The low costs of adjustment related to the smooth adjustment hypothesis, are further emphasized with HIIT, where similar quality products are likely to demonstrate more similarities between contracting and expanding sectors, thus allowing for a more smooth transition between firms in the same industry as opposed to different quality products (vertically differentiated) where i.e. labor requirements may be significantly different (AZHAR and ELLIOT, 2008, 2011).

Vertical IIT, on the other hand, refers to the trade of similar products with different price and quality. The modelling was first started by CAVES (1981) and the theory was developed by FALVEY (1981), FALVEY and KIERZKOWSKI (1987) and FLAM and HELPMAN (1987). FALVEY (1981) suggested that VIIT will increase as differences in factor endowments increase. Countries with higher levels of income that are capital-abundant will export high-quality goods, while countries with lower levels of income that are labor-abundant will export low-quality goods. High disparities in the factor-endowments therefore will lead to high IIT. FALVEY and KIERZKOWSKI (1987) also added a demand side to the model using consumers with similar preferences. Consumers, depending on their income, demand only one type of a differentiated product, from either the low-quality, labor-abundant country that produces lower-priced, labor-intensive products or the high-quality, capital-abundant country that produces higher-priced, capital-intensive products. Income differences within each country will lead to a demand for both products and consumption of both goods in both countries. Higher levels of income disparities between countries will reflect larger differences in factor endowments, leading to higher levels of VIIT. VIIT is, therefore, more likely to be observed between economies with different levels of income and different factor endowments and technologies. FLAM and HELPMAN (1987) further presented how firms produce products of different quality even when increasing returns to scale are not present.

The rapid growth of IIT in worldwide markets has resulted in a growing part of empirical literature that has examined the trends as well as the determinants of IIT in either a country or an industry setting. The initial post-1966 empirical literature examined the trends of trade, both IIT and INT, but later on, a lot of work concentrated on explaining the determinants of IIT. The increased interest nowadays, is not only related to the theoretical conclusion about the changing patterns of trade, which classical/neo-classical theories cannot explain, but also to the availability of trade data at higher levels of product classification.

A large portion of the empirical literature concentrates on the manufacturing sector, firstly, because differentiation of production is easier, thus allowing the satisfaction of niche preferences and secondly because manufactured goods exhibit greater scale economies and technological factors in the production (MENON, 1996). Moreover, with manufacturing goods it is easier to globally fragment production. LUKA and LEVKOVICH (2004), who studied the Ukrainian agri-food sector for the years 1996-2002, support this conclusion. IIT for food products (21.78%) was higher than IIT for agricultural products (8.43%) verifying that IIT is more in sectors with significant product differentiation. LEITÃO and FAUSTINO (2008), who examined the food processing sector in Portugal, using panel models and 6<sup>th</sup> level HS (Harmonized Commodity Description and Coding System) classification from 1995 to 2003, found that IIT in the food processing sector was lower than total industry IIT. While IIT in the total industry sector increased from 1995 to 2003 from 49.1% to 59.6%, IIT in the food processing sector remained constant. AMBROZIAK (2016) presents the case of the automotive industry where production division among different countries and plants creates IIT trade between plants producing parts and plants producing components, between plants for semi-finished products and the car assembly plants as well as assembly and outlets.

The concentration of IIT research in the agricultural sector, on the other hand, is more limited despite the recent growth of agricultural IIT in both developed and developing countries (LEITÃO, 2011; RASEKHI and SHOJAEI, 2012; VARMA, 2012). The limited amount of research is related to a large extent to agricultural markets being usually assumed to be perfectly competitive which contradicts the main hypothesis of IIT (FERTÖ and JAMBOR, 2015; JAMBOR 2015). However, research suggests that agricultural markets are largely oligopolistic (SHELDON and SPERLING, 2003).

The presence and the growth of agri-food IIT in itself, might provide indications of market imperfections and profit persistence. The growth of agri-food IIT can also be studied in light of the growth of value-added agriculture. While in the past, agricultural products used to be characterized by trade in bulk commodities, the emphasis that has been placed over the last decades in value-added agricultural activities, due to higher profit margins, as well as in consumer preferences, has preempted the growth of differentiated products (CHAKRABORTY, 2017). New markets for high-margin, value-added products in agri-food trade have surfaced, emphasizing the need for more research oriented in IIT towards the growing agri-food sector.

In one of the few IIT studies for the Greek agricultural sector, SEMOS (2006) examined three exportable Greek products for the period 1987-2000: tobacco, cotton and fruits-vegetables. For tobacco he found that over the period of study, trade turned from INT to being characterized mainly as IIT. For cotton, he found decreasing levels of IIT reaching a low of 16% of total trade in the year 2000, and for fruits and vegetables he found that the pattern of trade leaned towards INT in the early 90's but reached 55% by the year 2000, suggesting the majority of trade being IIT. VOGIATZOGLU (2004) examined the period 1981 to 2002 for Greece and found that IIT in food and animals (SITC 0) and in animals, vegetable oils, fats and waxes (SITC 4) showed a substantial increase between 1988 and 2002, both in the intra-EU and the extra-EU context. On the other hand, IIT in tobacco and beverages (SITC 1) increased in the extra-EU context but decreased within the EU. In all three categories, (SITC 0,1,4) the proportion of new trade which was due to IIT within the EU was declining. KARELAKIS et al. (2016) concentrated on the Greek fisheries sector, stressing the importance of the aquaculture industry, where Greece is one of the largest producers of sea bream and sea bass. For the period 2003-2012, they estimated an average contribution of IIT equal to 88%. CAETANO and GALEGO (2007), who examined EU-25 countries for the period 1993-2001, found that the value of Greek IIT was less than 20% of total trade, almost all of it being VIIT, and that, from 1993 to 2001, the percentage of IIT in total trade increased from 12.9% to 16.3%. IIT for Greece, as for most of the EU-25 countries, was mostly vertical in nature.

Despite the limited availability of articles for Greek IIT, there is an increasing number of articles for

agricultural and food IIT for Europe and the rest of the world, that discuss the role of IIT in the international markets. LAPINSKA (2014) examined IIT in agricultural and food products between Poland and the EU and found that Poland's IIT with the EU increased after EU membership and that it is taking up an increasingly important role. LUKA and LEVKOVICH (2004) used the GL index in the Ukrainian agri-food sector for the years 1996-2002 and found relatively low and declining shares of IIT, equal to an average of 13.7% for the period of study. They also found large variability present in the values of IIT with respect to HS categories as well as partner country. LEITÃO and FAUSTINO (2008) examined the food processing sector in Portugal during the period 1995 to 2003, using 6<sup>th</sup> level HS classification and found that IIT between Portugal and the EU (15) was about 40% but it was still lower than the IIT in the industry.

<sup>3</sup>Numerous studies have gone one step further, separating IIT into VIIT and HIIT. Over the last years, there is growing evidence suggesting that VIIT is increasing its share in total IIT (FONTAGNE et al., 1997; ATURUPANE et al., 1999; FONTAGNE et al., 2006; FERTŐ, 2007; CAETANO and GALEGO, 2007; JENSEN and LÜTHJE, 2009). Past studies have indicated that VIIT dominates HIIT particularly in Europe (ATURUPANE et al., 1999). JAMBOR (2014) found that that agri-food trade is mainly vertical in New Member States (NMS) and EU-27, with NMS exporting mainly low quality products. BOTRIC (2013) examined the Western Balkans and the EU-15 and found most of IIT being related to VIIT while HIIT was negligible, suggesting increased costs of integration. ITO and OKUBO (2012) suggested that, after the 2004 expansion to the emerging economies of Eastern Europe, there was an increase in lower-priced inferior technology products to the EU-15, which resulted in a substantial increase of VIIT. FERTŐ (2007) found that Hungarian agri-food IIT with the EU is equal to 38%, with VIIT dominating (31%) over HIIT (7%). As Hungary was a candidate for full EU accession at the time, he adds that "the prevalence of vertical IIT suggests that any economic adjustment cost to the Hungarian economy is likely to be higher than in the case where trade is predominantly of a horizontal nature".

<sup>3</sup> In most of the references that follow the researchers went one step further than the simple presentation of the trends in IIT, HIIT and VIIT estimating the determinants for each type of trade. In this article I limit the discussion to the trends these researchers found on IIT, HIIT and VIIT proportions.

JAMBOR (2015) examined the Visegrad countries (Czech Republic, Hungary, Poland, Slovak Republic) for the period 1999-2013 and looked at both country and industry specific determinants of HIIT and VIIT in agri-food trade with the EU. He found that most of IIT was VIIT with exports being mainly of low quality and IIT increasing significantly since the 2004 EU enlargement. LEITÃO and FAUSTINO (2008) examined the food processing sector in Portugal and found that VIIT gained ground from 1995 to 2003, growing from 26.7% (out of 49.1%) to 37.7% (out of 59.6%) suggesting that IIT was related mostly to products differentiated by quality. ATURUPANE (1999) suggests that VIIT comprises 80-90% of total IIT between the CEEC countries and the EU.

Further decomposition in low-quality VIIT and high-quality VIIT allows insight into the quality composition of exports and imports. One of the articles that decompose agricultural IIT into LVIIT and HVIIT include BOJNEC and FERTŐ (2016) who examine the drivers for agri-food IIT for the EU-27. They found that EU-27 agri-food IIT share has been increasing, consistent with EU enlargement expectations. HIIT was the most important component of IIT structure, followed by HVIIT, suggesting that countries exported mostly similar quality products and high quality products. They also found that low-quality VIIT decreased, suggesting an increase in the quality of agri-food exports and that high quality VIIT increased for most of the EU-27 countries. This suggests a quality advantage, as EU countries are exporting more high-quality than they are importing low-quality. BOJNEC and FERTŐ (2015) further find that NMS have caught up with OMS, especially in VIIT, in both EU-27 markets as well as global markets. HIIT took up the largest proportion, followed by HVIIT and LVIIT.

The articles reviewed, indicate the presence of high variability in IIT both in terms of partner country as well as by category of products examined. The general pattern verifies the theoretical conclusion that large and more developed economies tend to have higher levels of IIT, whereas smaller and less developed countries exhibit lower values of Intra-Industry Trade. Moreover, the trends suggest that VIIT in the EU dominates HIIT and that high-quality exports dominate low-quality exports.

A number of alternative measures for IIT have been proposed in the past that overcome some of the shortcomings of the measures discussed. Some of those measures include FONTAGNE and FREUDENBERN (1997), MENON and DIXON (1997), NILSSON (1997),

BRÜLHART (1994) and AZHAR and ELLIOT (2003, 2008, 2011; AZHAR et al., 2012). These are briefly summarized in the next section, as they are not employed in this research, to allow comparability of our results with articles in the literature.

### 3 Methodology

GRUBEL and LLOYD (1975) were the first to quantify the level of IIT based on the theory proposed by BALASSA (1966), by introducing the well-known Grubel-Lloyd index (GL) that has since found a wide range of applications in the literature. The simple GL index employs imports ( $M_k$ ) and exports ( $X_k$ ) of industry  $k$  to estimate

$$GL_{ikt} = 1 - \frac{|X_{ikt} - M_{ikt}|}{(X_{ikt} + M_{ikt})}, \text{ where } i \text{ represents the country of origin and } t \text{ represents time}^4.$$

When the level of exports is equal to the level of imports, the GL index takes its highest value of 1 indicating exclusively IIT flows. The index takes the value of zero when either exports or imports of the product category are equal to zero, suggesting one-way trade (INT) in the specific product category. When the GL index is above 0.5, trade is generally considered to be in its majority IIT.

We can aggregate the index at the national level, for  $k$  industries, using the following formula:

$$GL_{it} = 1 - \frac{\sum_k |X_{ikt} - M_{ikt}|}{\sum_k (X_{ikt} + M_{ikt})} = \sum_k GL_{ikt} w_{ikt}$$

where  $w_{ikt} = \frac{(X_{ikt} + M_{ikt})}{\sum_k (X_{ikt} + M_{ikt})}$ . (1)

The aggregate measure indicates the proportion of IIT in the total trade of the country with the rest of the world.

The GL index has received numerous criticisms. One of the problems pointed out by GREENAWAY et al. (1986) and QASMI and FAUSTI (2001) is that it fails

<sup>4</sup> The GL index is based on the Balassa Index

$$\left( B_k = \frac{|X_k - M_k|}{X_k + M_k} \right)$$

which shows a negative correlation with IIT however fails to explain aggregate trade imbalances and also assigns equal weights to all industries (GRUBEL and LLOYD, 1975).

to take into account trade imbalances, resulting in underestimation of the index when countries have large imbalances, whether deficits or surpluses. Grubel and Lloyd had recognized that their measure was biased downwards as it exhibited a negative correlation with the trade imbalance and suggested an adjustment. However, the literature provides support for the use of the unadjusted measure of the GL index as it generates more plausible values for IIT (VONA, 1991)<sup>5</sup>.

A second problem, called the geographical bias, appears when destination countries are grouped together and we examine trade flows from a country of origin to a group of countries (such as the EU). To avoid geographical bias we can avoid country-groupings or we can adjust the index to account for bilateral trade flows between two countries, the country of origin ( $i$ ) and the destination country ( $j$ ) where the industry-aggregate GL index over  $k$  industries is now estimated as:

$$GL_{ijt} = 1 - \frac{\sum_{k=1}^K |X_{ijkt} - M_{ijkt}|}{\sum_{k=1}^K (X_{ijkt} + M_{ijkt})} \quad (2)$$

A third problem is related to estimates of Intra-Industry Trade based on high levels of aggregation that can result in an upward bias of the GL index – sectoral bias (GULLSTRAND, 2002). In simple words, with high aggregation (i.e. per country estimation of the GL index) there will always be some products for which there will be imports and exports such that the GL index will depend on the balance of trade in the category<sup>6</sup>. This can be dealt with by analyzing the data at a more disaggregated level.

Last but not least, the GL index presents a static measure for the pattern of trade, measuring the composition of trade overlap at a specific point in time

<sup>5</sup> The adjusted measure is equal to

$$GLA_j = \frac{\sum (X_i + M_i) - \sum |X_i - M_i|}{\sum (X_i + M_i) - |\sum X_i - \sum M_i|}$$

See VONA (1991) for more support to the unadjusted measure.

<sup>6</sup> One of the early criticisms of IIT measures from LIPSEY (1976) who thought of IIT even as a “statistical phenomenon” was that at the 3-digit SITC level, canoes and 200,000 tone tankers were considered to be in the same industry. Similarly for table radios and airport flight control equipment which fell under the telecommunications apparatus industry (also see ANDRESEN, 2003)

(HAMILTON and KNIEST, 1991; GREENAWAY et al., 1994; BRÜLHART, 1994). It cannot capture changes in IIT, as trade flow adjustments imply that both Inter-Industry as well as Intra-Industry trade adjusts (see HAMILTON and KNIEST, 1991). When the GL index increases from one year to the next and if the adjustments in imports and exports lead to a reduction in the trade imbalance, the resulting increase in the GL index may actually represent an increase in Inter-Industry Trade. To compare the country GL index through different points in time we need to adjust our measure. BRÜLHART (1994) presents the A-index which is a measure of Marginal IIT (MIIT).

$$MIIT_{ikt} = 1 - \frac{|\Delta X_{ikt} - \Delta M_{ikt}|}{|\Delta X_{ikt}| + |\Delta M_{ikt}|}$$

$$= 1 - \frac{|(X_{ikt} - X_{ik,t-1}) - (M_{ikt} - M_{ik,t-n})|}{|(X_{ikt} - X_{ik,t-n})| + |(M_{ikt} - M_{ik,t-n})|}$$

Where values closer to 1 indicate moves towards IIT. The equivalent aggregated measure for the country is equal to

$$MIIT_{it} = 1 - \frac{|\Delta X_{ikt}| + |\Delta M_{ikt}|}{\sum_k (|\Delta X_{ikt}| + |\Delta M_{ikt}|)} = \sum_k MIIT_{ikt} w_{ikt}$$

$$w_{ikt} = \frac{|\Delta X_{ikt}| + |\Delta M_{ikt}|}{\sum_k (|\Delta X_{ikt}| + |\Delta M_{ikt}|)} \tag{3}$$

Complementary use of the GL index with a rising Brühlhart-A index can now indicate increasing levels of IIT<sup>7</sup>. FERTŐ (2009) suggests that the exclusive reliance on the A-index to measure dynamic changes in IIT maybe misplaced, as they fail to find support for the SAH using the A-index. An alternative measure is presented by AZHAR and ELLIOT (2003; 2008; 2011) who propose a three step approach to measuring quality changes. In the first step the s-index is employed to measure adjustments in the volume of trade

$$s = \frac{\Delta X - \Delta M}{2(\max\{|\Delta X|, |\Delta M|\})}$$

measuring sectoral trade balances and taking negative values when the balance deteriorates and positive when it improves. Industries that show large changes in matched trade are carried to the second stage where trade is separated into horizontal and vertical (PQV index). Stage three estimates a marginal quality index

$$MQ_t = \frac{(\Delta UV^x - \Delta UV^m)_t}{2(\max\{|\Delta UV^x|, |\Delta UV^m|\})}$$

to study trade induced adjustment effects and representing changes in product quality in MIIT. By comparing the PQV, S and MQ indexes for each product we can better understand the adjustment of volume and quality changes. They suggest that governments can examine cases with large negative S values and large negative MQ values, which would suggest that exports have decreased and quality has fallen. AZHAR and ELLIOT (2011), further discuss how to combine the indexes into a single dynamic quality adjusted measure to obtain a quality adjusted volume index ( $VQ_H = S + MQ$ ).

To separate IIT into its components of Vertical and Horizontal IIT, the most commonly employed method in the literature is presented by ABD-EL RAHMAN (1991) and GREENAWAY et al. (1995). They decomposed IIT into the shares of VIIT and HIIT employing unit price differentials of exports and imports in cross-country data. Decomposition starts by estimating the ratio of export to import unit-values that fall between the threshold  $1 + \alpha$  and  $\frac{1}{1 + \alpha}$  such that:

$$\frac{1}{1 + \alpha} \leq \frac{P_{ijkt}^x}{P_{ijkt}^m} \leq 1 + \alpha \tag{4}$$

where  $a$  is a scalar between 0.15 and 0.25. The traded products whose values fall within these limits are classified as HIIT. The lower limit was initially proposed as  $1 - a$  by GREENAWAY (1995) but was later corrected by FONTAGNE and FREUDENBERN (1997) to  $\frac{1}{1 + \alpha}$ . For example, using an  $\alpha$ -threshold value of 0.15, traded products, where the unit price differential falls within 0.87 and 1.25, are categorized as Horizontal IIT. HIIT, therefore, reflects IIT of products without a substantial unit price im-

<sup>7</sup> BRÜLHART (1994) also proposed the B-index and the C-index. The B-index can be employed for measuring industry performance which, however, cannot be aggregated across industries. The C-index provides an unscaled measure of matched trade through a transformation of the A index.

port/export gap. Values that fall outside this limit  $\left( \frac{P_{ijkt}^X}{P_{ijkt}^M} < \frac{1}{1 + \alpha} \text{ and } \frac{P_{ijkt}^X}{P_{ijkt}^M} > 1 + \alpha \right)$  are classified as

Vertical IIT.

GREENAWAY et al. (1995) uses  $\alpha=15\%$  and  $25\%$ , which are nowadays standard in the literature, despite the fact that there is no theoretical reason for the adoption of these threshold values. FUKAO et al. (2003) increased the level of the  $\alpha$ -threshold to (an arbitrary)  $35\%$  in order to take into account fluctuations in the exchange rate. ITO and OKUBO (2012) also examined the effect of employing different levels of  $\alpha$  by using a  $5\%$  interval up to reaching an  $\alpha$  of  $50\%$  but found that, while the growth rate of HIIT depends on the threshold value, the overall trend is not affected by the choice of  $\alpha$ . Similar results were found by JENSEN and LÜTHJE (2009) who concluded that results do not change significantly when  $\alpha$  ranges between  $15\%$  and  $25\%$ . ANDRESEN (2003) suggests the use of  $15\%$  when prices reflect only quality differences and there is perfect information, whereas  $25\%$  when there is imperfect information. Following the literature, in this article, I employ  $\alpha = 25\%$ .

Once the goods that satisfy the limits of the unit values are identified, the GHM index is estimated as

$$GHM_{itk}^p = \frac{\sum_j \left[ \left( X_{ijkt}^p + M_{ijkt}^p \right) - \left| X_{ijkt}^p - M_{ijkt}^p \right| \right]}{\sum_j \left( X_{ijkt}^p + M_{ijkt}^p \right)} \quad (5)$$

Where  $p$  reflects either HIIT or VIIT. The GL index is equal to the sum of VIIT and HIIT.

Assuming perfect information, the unit values of the products are an indicator of quality. Low unit price

differentials  $\left( \frac{P_{ijkt}^X}{P_{ijkt}^M} \right)$  within the same product category

(HIIT), indicate that exports and imports are of similar price, therefore, they must also be of similar quality. Since they are of similar quality, they must differ in terms of other characteristics. On the other hand, products where the unit price differentials are above or below the threshold are classified as VIIT. Exceeding the threshold values implies that VIIT reflects the trade of products with a substantial unit price import/export gap. The differences in these unit prices, of otherwise similar products, is attributed to differences in the quality of the product. When we further examine the two sides of the inequality separately, we

see that when the unit-value is below the lower boundary (low-quality VIIT - LVIIT), then the unit-value of exports is relatively lower than the unit-value of imports and the goods from the home market are cheaper and of lesser quality. On the other hand, when the unit-value is above the high boundary (high-quality VIIT- HVIIT), the unit-value of exports is relatively high as compared to the unit-value of imports and the goods from the trading partner are cheaper and of lesser quality (also see AMBROSIK, 2016)<sup>8</sup>. ITO and OKUBO (2012) disaggregate in their analysis of Vertical IIT the effects on the upper limit VIIT and lower limit VIIT and find that there are important asymmetries, so they propose the need for those two concepts to be discussed separately.

One of the limitations presented by this analysis is the availability of trade quantity data. Missing unit values can well take more than  $30\%$  of the trade data. Because information on trade quantity is not available for all HS codes that comprise our trade data at the HS6 level, and because the unit prices are necessary to determine whether trade should be classified as HIIT or VIIT, when this data is unavailable, products are classified as unidentified (see FONTAGNE et al., 2006, and ANDO, 2006). Those products that are considered as non-classified IIT are, however, still included in the estimation of the GL index to avoid underestimating the share of IIT, especially for those countries where a large number of products do not contain unit values (also see ANDO, 2006; FONTAGNE et al., 2006; TURKCAN and ATES, 2011). ITO and OKUBO (2012) further note that during the classification of products into LVIIT and HVIIT, a number of errors may appear. These errors can be due to different units presented in the data across partner countries or even over time for the same product category but also when export unit prices versus import unit prices differ by a factor of  $100$ . The authors handle those errors by deleting the observations.

Other measures available in the literature to separate vertical and horizontal IIT include FONTAGNE and FREUDENBERG (1997) and FONTAGNE et al. (2006). The estimation of the FF-index starts with a ratio and a cutoff level of  $10\%$  to classify products

<sup>8</sup> While the unit value approach employed in this research is widely used in the literature it has been criticized because consumers may buy expensive products for reasons other than quality and because differences in the product mix of bundles in terms of high vs. low quality share may affect the value of the bundle itself (see CRESPO and FONTOURA, 2004).



into IIT or INT:

$$\frac{\text{Min}(X_i, M_i)}{\text{Max}(X_i, M_i)} \geq 10\% .$$

When this value is below 10% trade is classified as INT. When it is more than 10% then the FF-index takes the following form:

$$FF_k^p = \frac{\sum_j (X_{j,k}^p + M_{j,k}^p)}{\sum_j (X_{j,k} + M_{j,k})}$$

Unit values are still needed to disaggregate horizontal from vertical IIT. The FF index provides higher values of IIT than both the GL index and the GHM index.

NILSSON (1997) proposed the N indicator that divides the GHM measure by the number of traded products to obtain an average level of IIT per product (see FERTŐ and JAMBOR; 2015; FERTŐ, 2005):

$$N_k^p = \frac{\sum_{i=1}^n (X_{ijkt} + M_{ijkt}) - \sum_{i=1}^n |X_{ijkt} - M_{ijkt}|}{n^p}$$

FERTŐ and JAMBOR (2015) use all three indices for their analysis of the Hungarian agri-food sector (GHM, FF, N). In this study I limit the discussion using the measures of GL, MIIT, HIIT, VIIT, HVIIT and LVIIT, as they are the most common measures found in the literature and allow for points of comparison between articles.

## 4 Results and Discussion

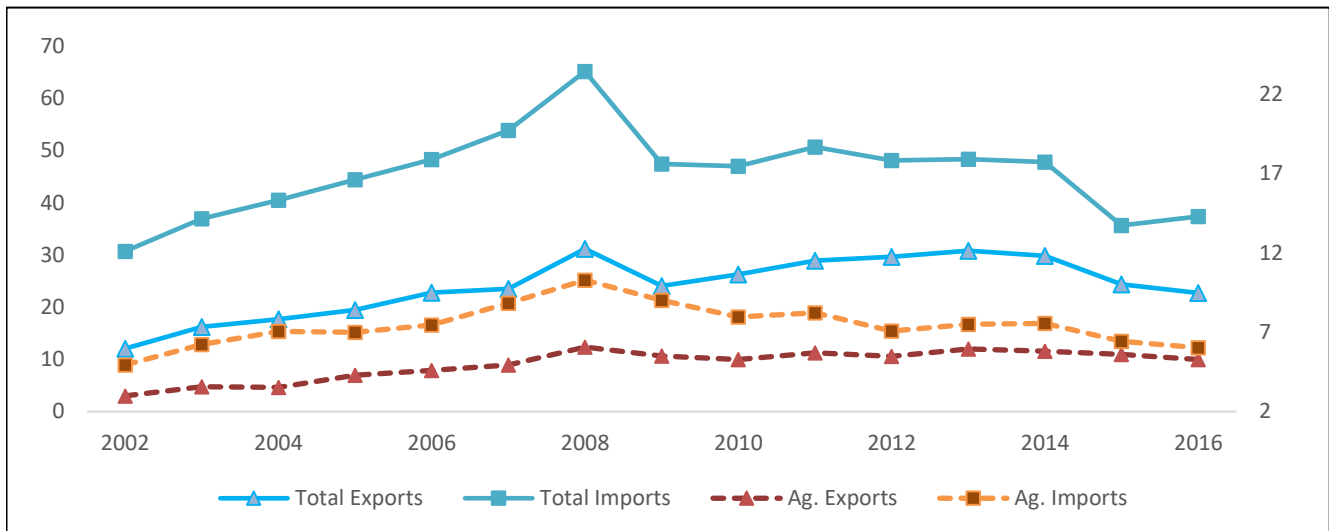
To examine the changes in the trade structure of IIT and INT, we start after Greece adopted the Euro in 2002, when prospects for the Greek economy were promising. GDP was showing signs of steady increase and unemployment was set at relatively low levels exhibiting signs of contraction. Borrowing costs were at an all-time low, following the European Central Bank (ECB) rules and the 1997 Stability Pact, designed to provide credibility and help weak economies such as Greece limit deficits and debt. However, concerns over a widening current account deficit were mounting and worries about its external sustainability were high. The trade balance deficit, throughout the period 2000-2008, was increasing and government debt gradually climbed from approximately 70% of

GDP in the 1990's to 110% by the year 2000 and to 115% by the year 2006. When we examine trade with the Euro area, the period 2000-2007 marked an increase of both exports (>1/3) and imports (>2/5) (MAGOULIOS and ATHIANOS, 2013). The trade balance mounted to a negative cumulative of 118.7 billion Euros while the trade deficit with Euro Zone countries, during the period 2000-2007, rose by 42.49%. MAGOULIOS and ATHIANOS (2013) further note that the competitiveness of Greek products deteriorated and Greece's position in the international markets weakened. In addition, consumption-based growth of the Greek economy together with a decreasing savings ratio and rising expenses gradually brought forth the inherent problems which left Greece with consecutive breaches of the Stability Pact criteria. By 2009, the external debt was not sustainable and unemployment started to rise while GDP drastically dropped. Since 2008, the aforementioned drop in GDP and the rise in unemployment was escorted by a public debt growth to about 185% of GDP.

The effects of the crisis were immediately reflected on the value of total imports and exports of goods and services which dropped in 2009<sup>9</sup> (Figure 1). The consequent loss of purchasing power combined with decreased production and sales that domestic producers had to face, was complemented with rising costs for producers, further affecting exports through a deterioration of competitiveness in the international markets. Agri-food trade was not immune from the slowdown<sup>10</sup>. A similar drop can be observed when we

<sup>9</sup> Greece's main exports consist of refined petroleum, packaged medicaments, olive oil, aluminum plating and non-fillet fresh fish. Main export destinations are Italy, Germany, Turkey, Cyprus and Bulgaria. It's main imports consist of crude and refined petroleum, packaged medicaments, packages and cargo ships and cars. Main imports originate from Germany, Italy, Russia, Iraq and China (OECD).

<sup>10</sup> Greece's largest 25 export partners in Agricultural Products in 2016 (all of HS commodities 1-24) were Italy, Germany, USA, Bulgaria, Cyprus, UK, Spain, Netherlands, France and Romania. Italy and Germany have been throughout the period of study the top two export destinations of agricultural products for Greece. USA and Bulgaria have recently risen from lower export destinations to taking up 3<sup>rd</sup> and 4<sup>th</sup> place. In terms of imports the largest trading partners were the Netherlands, Germany, Italy, France, Bulgaria, Belgium, Denmark, Poland Spain and Romania. The change in rankings of countries for both imports and exports of Agricultural products from 2002 to 2016 can be seen in the Appendix A

**Figure 1. Value of total exports and total imports**

Units: Billions of Constant 2010 Euros, HS classification codes 1-99 for total trade (left hand axis) and codes 1-24 for agricultural trade (right axis)

Source: UN Comtrade

examine agricultural and food product trade (HS categories 1-24, Figure 1 – right hand side axis). While the value of exports and imports was rising until 2008, immediately after, we observe a negative trend which, by 2016, led to a 41% decrease in imports and a 13% decrease in exports.

The economic crisis affected the structure of agri-food imports and exports as well as the percentage shares of IIT and INT.<sup>11</sup> Table 1 allows us to see the percentage that imports and exports of category-aggregated 2<sup>nd</sup> level HS categories 1 through 24 of agricultural and food products, took up in the total value of imports/exports of Greece, for indicative years 2008 and 2016. The percentage of animal and

animal product exports (cat. 1-5) in total agri-food exports rose from 20.11% to 23.13% (respectively, as a percentage of total exports, we observe a rise from 3.9% to 5.37%), vegetable products including fats and oils from vegetables and animals (cat. 6-15) rose from 36.9% to 39.76% (7.16% to 9.22%), while foodstuffs (16-24), lost ground dropping from 43% to 37.11% (8.35% to 8.61%). The total value of all agri-food exports as a percentage of total country exports also gained ground rising from 19.41% to 23.2% of total exports (while imports were marginally affected growing from 15.78% to 16.11%). The change in the composition of exports shows shifting of resources between sectors of the economy and adjustment of

**Table 1. Agricultural exports/imports as a percentage of total**

		Ag. exports as a % of total Ag. exports		Ag. exports as a % of total exports		Ag. imports as a % of total Ag. imports		Ag. imports as a % of total imports	
		2008	2016	2008	2016	2008	2016	2008	2016
1-5	Animal products	20.11%	23.13%	3.90%	5.37%	36.28%	36.56%	5.72%	5.89%
6-15	Vegetable products (and animal and vegetable fats)	36.90%	39.76%	7.16%	9.22%	25.30%	25.97%	3.99%	4.18%
16-24	Foodstuffs	42.99%	37.11%	8.35%	8.61%	38.42%	37.47%	6.06%	6.04%
<b>Total</b>				<b>19.41%</b>	<b>23.20%</b>			<b>15.78%</b>	<b>16.11%</b>

Note: subtotal HS categories 1-5 represent animals and animal products, 6-15 vegetable products and 16-24 foodstuffs. See Appendix B for HS level 2 definitions.

Source: author's estimations using UN Comtrade Data

<sup>11</sup> Trade value data for categories 1 through 24 for agricultural and food products was downloaded for the years 2002 to 2016 from the UN Comtrade Database. The definition of the categories as well as the total number of disaggregated 6-digit HS products in each one of the 24 product categories can be found in appendix (B) of this article.

domestic production/export practices towards products that compete more effectively in the international markets.

Basic economic indicators, total trade flows and trade flows from agri-food categories allow us to get an initial picture of an economy restructuring production to new mid-crisis standards. The decrease in

GDP, the increase in unemployment, the level decrease of total exports and imports as well as the change in the structure of production, suggest economic agents that are exploring new strategies to deal with the consequences of the crisis. The question that arises is how the change in the composition of imports and exports imprinted on IIT vs. INT shares. Did producers try to find outlets by shifting resources towards more productive uses, thus only affecting the distribution of INT between sectors, or did they also differentiate production and participate in value-added activities leading to increases in IIT shares? To further examine the adjustments in the structure of trade we need to shift to changes in IIT type measures.

The first part of the answer lays with Table 2, where we see IIT shares for agricultural and food products (HS 1-24) and the respective annual MIIT values. From 2003 to 2016 the total share of agri-food IIT, albeit low, showed a mild increasing trend, uninterrupted by the onset of the crisis. Over the years, IIT ranged from 8% to 13%, indicating that 92% to 87% of trade consisted of Inter-Industry Trade. The rising trend may indicate producers increasingly differentiat-

ing production as means of competing in the international markets. Rising agri-food IIT shares may be due to the rise of value-added agriculture that preempted the growth of differentiated products. While producers kept the momentum from pre-crisis levels with increasing IIT shares, the MIIT measure for agri-food products indicated only a very small percentage of new trade, on an annual basis, due to IIT (11%). Despite the low levels of IIT and MIIT, when we consider the post-2009 lack of available funding for the development of new differentiated products, the increased costs, the drop in demand etc., that might have set IIT back, the rising trend retained from the pre-crisis period provides us with evidence of producers realizing that differentiation of production should persist, as it could be the key towards competing in the international markets.

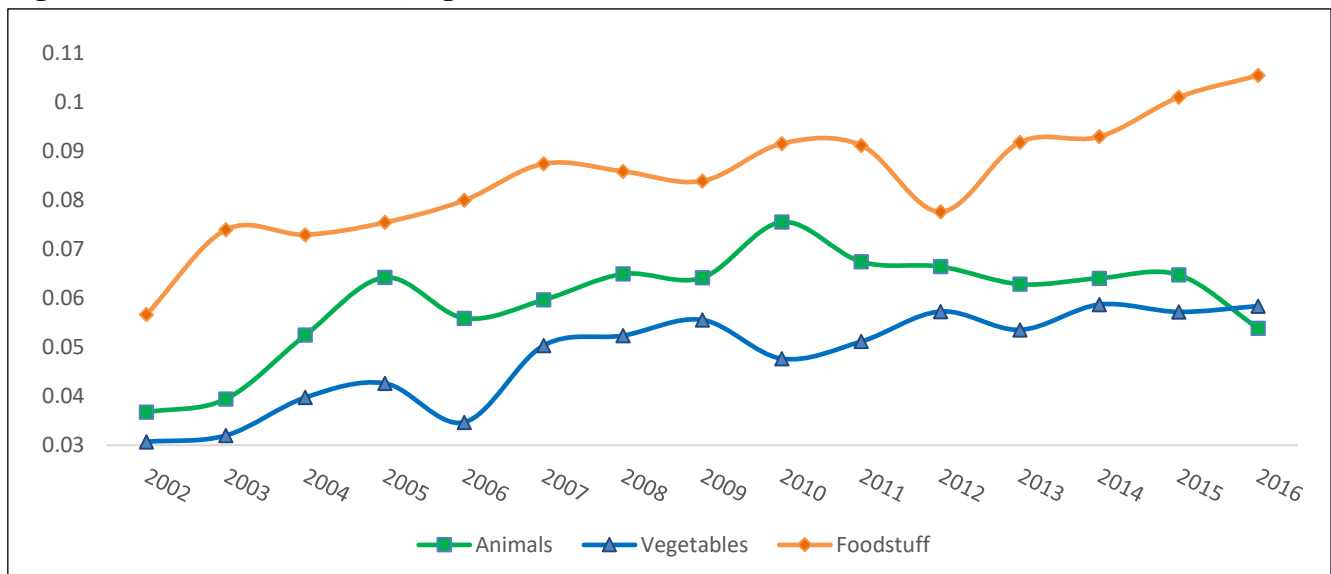
To better understand producers' reaction towards new economic conditions we need to look deeper into product subcategories where differentiation is more likely to occur. The proposition that producers took advantage of opportunities to differentiate production in order to compete in the international markets, be-

**Table 2. GL-index and MIIT for Greece 2003-2016**

Year	2003	2004	2005	2006	2007	2008	2009
GL	8.14%	8.67%	9.20%	8.63%	9.63%	10.03%	10.89%
MIIT	11.59%	10.82%	10.96%	10.60%	10.91%	10.84%	10.36%
Year	2010	2011	2012	2013	2014	2015	2016
GL	10.56%	11.03%	11.27%	11.52%	12.32%	11.77%	12.69%
MIIT	11.32%	11.90%	12.01%	11.18%	11.90%	10.85%	11.83%

Source: author's estimations

**Figure 2. IIT for animals (1-5), vegetables (6-15) and foodstuff (16-24)**



Note: author's estimations

comes more evident when we separate the GL index into 2-digit categories. Agri-food IIT was separated into aggregated categories for animals and animal products (HS categories 1-5), vegetable products (including animal and vegetable fats and oils) (HS categories 6-15) and foodstuffs (HS categories 16-24) (Figure 2). The start of the crisis marked a period of increased variability for all types of IIT shares. Foodstuff products were the ones with the highest level of IIT proportion, as expected, since they are easier to differentiate, as opposed to vegetable and animal products. These results are similar to past research that found IIT being higher for product categories that require a higher degree of processing (QASMI and FAUSTI, 2001). Both vegetable and foodstuff IIT shares showed increasing trends, retaining the momentum from pre-crisis levels, while animal product's IIT leveled initially and then dropped in 2016.

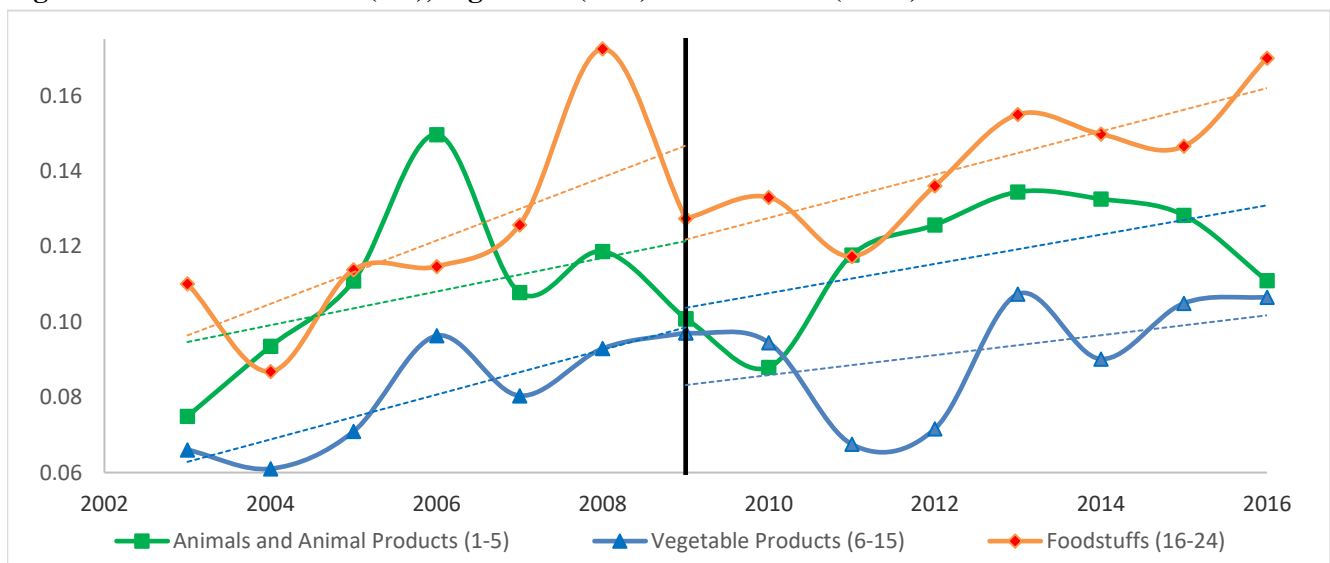
The respective MIIT values in Figure 3, show a low but rising percentage of new trade going towards IIT for all three types of products depicted. The post-2009 percentage increase in the composition of exports of animal products (cat. 1-5) (see Table 1), the relatively constant proportion of IIT (Figure 2) and the low level of MIIT (Figure 3) suggest gains in trade in the animal products categories were distributed mainly towards INT. Similar conclusions can be reached for vegetable products including fats and oils (6-15), where the percentage of vegetable product exports in total trade and agricultural trade increased while imports remained relatively constant. Both IIT and MIIT showed a slight increase, however MIIT was very low suggesting again gains for INT. For foodstuff products

(16-24), rising IIT and MIIT values of Figures 2 and 3 suggest that IIT gained some ground against INT.

Gains in IIT are mainly noted in product categories that require a higher degree of processing where product differentiation is possible. By comparing the agri-food GL index with the respective HIIT and VIIT, LVIIT and HVIIT values we can further examine what type of IIT benefited. Figure 4 allows us to see that, throughout the period of study, VIIT was higher than HIIT, similar to the results found by other researchers for most of the EU countries (BOTRIC, 2013; FERTŐ, 2007; CAETANO and GALEGO, 2007; ITO and OKUBO, 2012; JAMBOR, 2015). In other words, unit-price differentials for the traded commodities indicated that, for the majority of two-sided trade, there was a persistent difference in quality. VIIT exhibited an increasing trend which was retained after 2009, whereas HIIT shares leveled. Hence, the rise in Greek IIT, as it is presented by the GL index, is mainly due to VIIT, that is, mainly due to products of different quality.

When we further separate VIIT into LVIIT and HVIIT we observe that, after 2005, HVIIT has been dominant. Greece's IIT has been driven mainly by high quality exports and low quality imports. Moreover, it is HVIIT that exhibits an increasing trend rather than LVIIT, which remained relatively constant. Therefore, the sluggish growth in IIT shares in Greece is mainly due to VIIT which dominates HIIT but, more so, it is from high quality VIIT, where the unit value of exports is substantially higher than the unit value of imports, or, export prices are higher than import prices. In other words, Greece exports high-

**Figure 3. MIIT for animals (1-5), vegetables (6-15) and foodstuff (16-24)**



Note: author's estimations

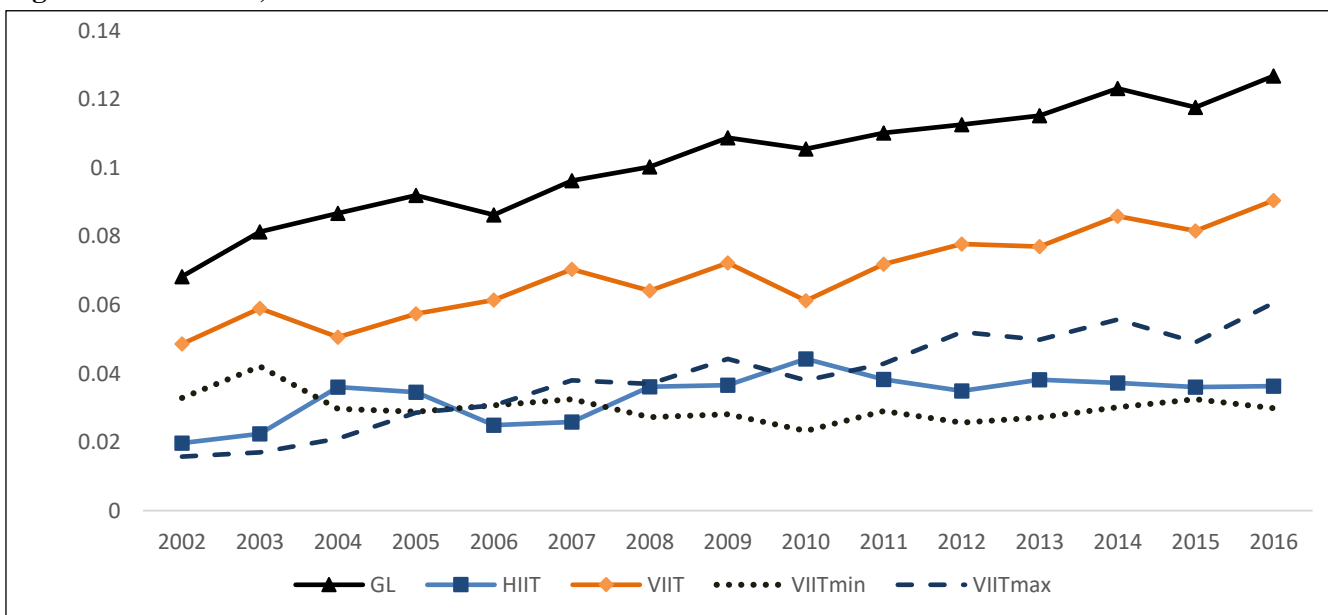
quality products and imports low quality products. LVIIT can be seen as being less desirable in terms of agri-food quality exports (BOJNEC and FERTŐ, 2015). A reduction in LVIIT and an improvement in HVIIT suggests improvements in the quality of agri-food exports as opposed to agri-food imports of similar products. Moreover, LVIIT can be considered as less desirable than HVIIT because low quality products are more likely to quickly find substitutes and competition. With HVIIT, on the other hand, costs, technology, resources etc., may render a product more difficult to replicate, thus partially shielding the product from competition<sup>12</sup>. Hence, exporting high-quality differentiated products in the international markets is exactly what a country in crisis would require. Producers realized their disadvantage in low-quality (LVIIT) differentiated products against lower cost countries, and specialized in value-added, high-quality exports of differentiated products. We can contrast these results with BOJNEC and FERTŐ (2015) for the EU-27 who find that HIIT is more important than the share of HVIIT which is more important than LVIIT. The Greek experience differs, as early as 2002, when VIIT was more dominant than HIIT.

The experience from Greece allows us to draw inferences for countries facing similar problems with respect to producers' reaction and policy implementation. The 2009 beginning of the recession, found producers trying to stay viable in receding markets, by retaining and expanding value-added, product-differentiating activities, where possible. The increas-

ing trends in IIT shares, non-interrupted by the economic crisis, suggests that efforts were placed towards types of activities that allowed producers to effectively continue to compete in the international markets. These activities are found in product categories with high degree of processing, such as foodstuff categories (16-24), and through the production and export of unit-price differentiated products that are of high quality. Policy related to the support of high-quality, differentiated/value-added processes, seems to be paramount to the viability of producers. Assistance can take the form of retraining, incentivizing diversification and value-added activities in sectors that require a high degree of processing.

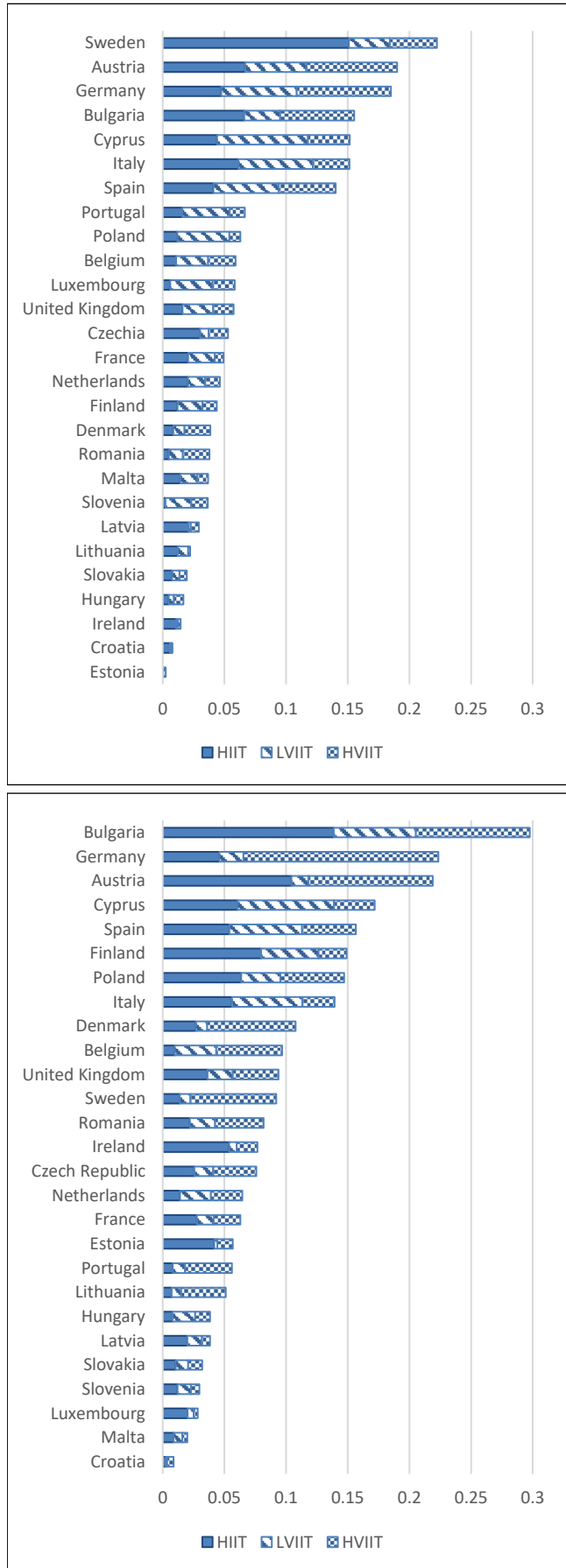
In order, to better understand and construct policy targets, however, we need to further examine bilateral measures of IIT using pre-crisis and post-crisis IIT differentials. I limit the discussion to the European continent as I examine the IIT indexes using arithmetic averages for the pre-2009 and the post-2009 period. Figure 5 allows us to see the GL index, the HIIT index and the components of VIIT for trade with EU28 countries. The upper panel presents averages for the 2002-2009 period and the lower panel presents averages for the post-2009 period. The first thing to note is that, on a bilateral level, the shares of IIT both in the pre-2009 as well as the post-2009 period are higher than aggregate shares presented earlier. While the country aggregate for the GL index reached a maximum of 13%, shares with some partner-countries such as Sweden, Italy, Bulgaria, Germany, Cyprus,

**Figure 4. GL Index, HIIT and VIIT for Greece**



Source: author's estimations

**Figure 5. Pre- and post-crisis HIIT, LVIIIT and HVIIT for EU-28**



Source: author's estimations

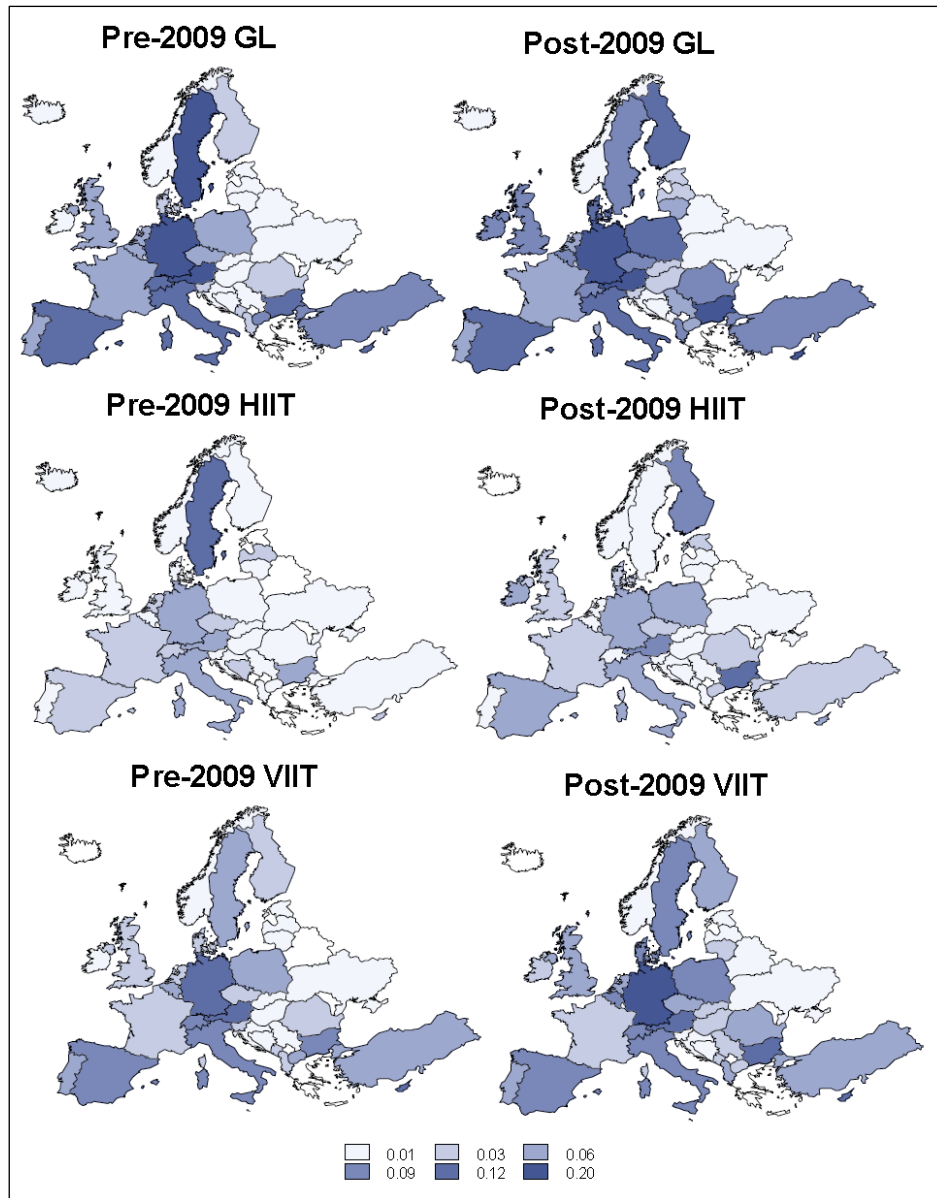
Austria, both before as well as after 2009, were near 30%. Intra-industry trade, therefore, despite showing low sizes for the aggregate country values, is relatively high with specific partner countries, related to proximity, development and similarity of market demand. Identification of countries that possess those characteristics, allows producers to better target niche market segments with similar demand structures in order to assist exports. Second, the earlier observation related to the increasing levels of IIT, can be extended to the country level for most EU28 countries. Third, VIIT and HVIIT have increased in shares with most of the countries. The increase in HVIIT suggests quality improvements in agri-food exports as opposed to agri-food imports for most destination countries.

However, we must take special note on the rise of IIT shares with some destination countries such as Bulgaria, Germany, Austria, etc. as well as the drop in IIT shares with others such as Sweden, which shows a redistribution of destinations in IIT shares. Figures 6 and 7 allow us to better understand the shifting of IIT share destinations. They plot the averaged 6-digit bilateral GL indexes on GIS maps for Europe, separating them in the pre-2009 and post-2009 period.

For example, for the GL index, we observe that bilateral agri-food IIT as a proportion of total reached 20% with specific partner countries both in the pre-2009 as well as post-2009 period. More importantly, however, we observe that for all types of IIT, there are no substantial changes on the shares of IIT in the pre- to post-2009 periods. For HIIT we observe a rise mainly with Bulgaria, Austria, Finland and Poland. For VIIT we observe a rise with Bulgaria, Romania, Serbia and Slovenia. When we examine LVIIIT (Figure 7) we see minor shifts in low quality export shares but also lower overall shares. Exception to this rule seems to be HVIIT, where we see increases in the IIT shares with many destination countries mapping new trade routes for high quality products.

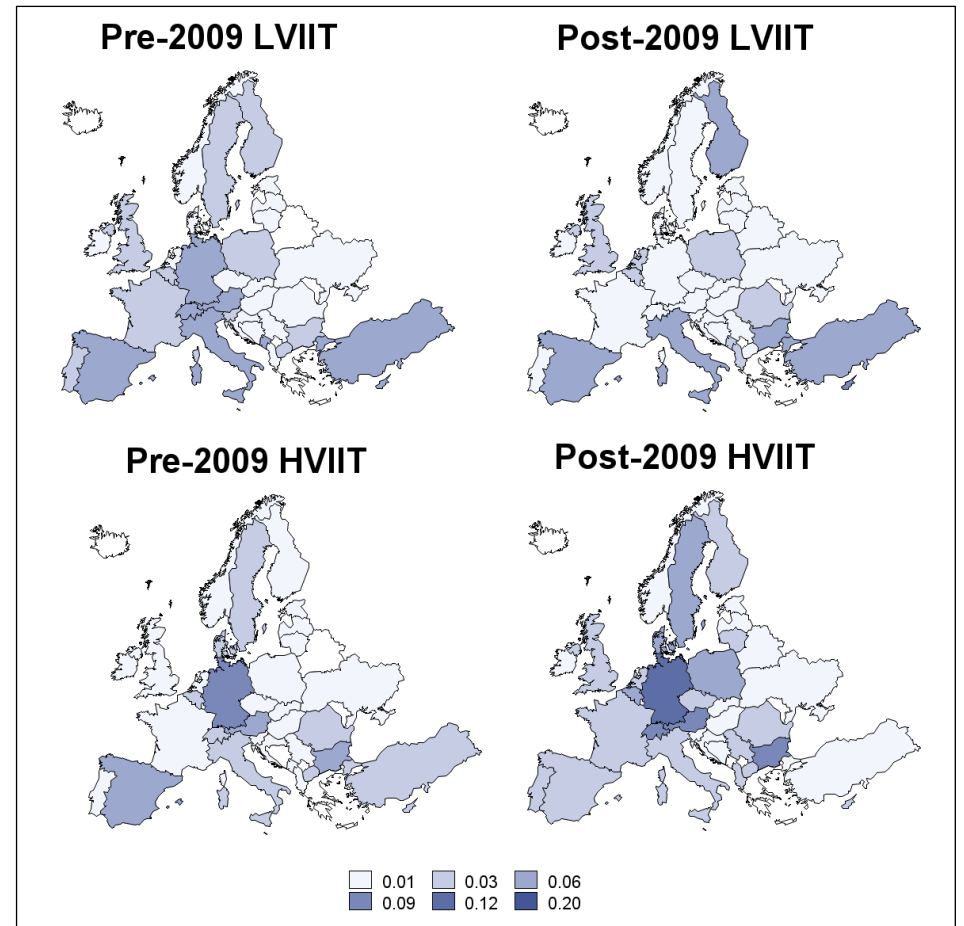
The economic crisis did not seem to uniformly affect destinations for all types of IIT. It did seem to have, however, an impact on the destinations of HVIIT. In terms of policy this would suggest the need for support towards entry to new markets whether that is done through management, advertisement, market research for the demand structures in each country to identify similarities and differences that would support the development of new products and the proper targeting of destination markets.

Figure 6. Pre- and post-crisis GL, HIIT and VIIT



Source: author's estimations

Figure 7. Pre- and post-crisis LVIIT HVIIT



Source: author's estimations

Finally, to better understand the timing of policy, we need to understand the dynamic response of IIT shares to shocks in GDP. Panel VAR analysis was conducted on all types of IIT indices and Impulse Response Functions (IRF) were obtained. Panel stationarity tests confirmed the series examined were I(0). The MBIC, MAIC and MQIC criteria were employed to select the lag length prior to conducting the Granger-Causality tests and obtaining the IRF. Granger-causality runs only one way from GDP to Intra-Industry Trade shares (Table 3) and it suggests that the recessionary drop in GDP is associated only with VIIT and HVIIT. GDP changes granger-cause VIIT and HVIIT, however, we do not find evidence of granger-causality from GDP to the GL index, HIIT, or LVIIT.

**Table 3. Granger causality tests**

	GL	HIIT	VIIT	LVIIT	HVIIT
GDP Gr. causes → IIT (.)	3.45	1.04	8.14**	3.60	10.53***
GDP ← Gr. caused by IIT(.)	0.08	0.88	0.27	1.72	2.59

Note: chi-square values presented, \*\*significant at  $\alpha=0.05$ , \*\*\*significant at  $\alpha=0.001$

Source: author estimations

Figure 8 plots the impact of a positive one-standard deviation shock to GDP on all types of IIT. Most of the results show an insignificant impact of GDP to IIT, other than for VIIT and HVIIT. The positive values for the IRF, indicate that the recession (drop in GDP) had a negative impact on IIT shares, both VIIT and HVIIT. More specifically, a negative one-deviation shock to GDP has a negative but not very persistent effect on VIIT. The GDP decrease, results in VIIT shares decreasing by 0.15 in the first period but the effect fades 4 years after the shock. The effect on HVIIT is more persistent, suggesting that a negative shock to GDP, decreases HVIIT shares by 0.2 in the first period. The effect fades after 7 years when the response becomes statistically insignificant.

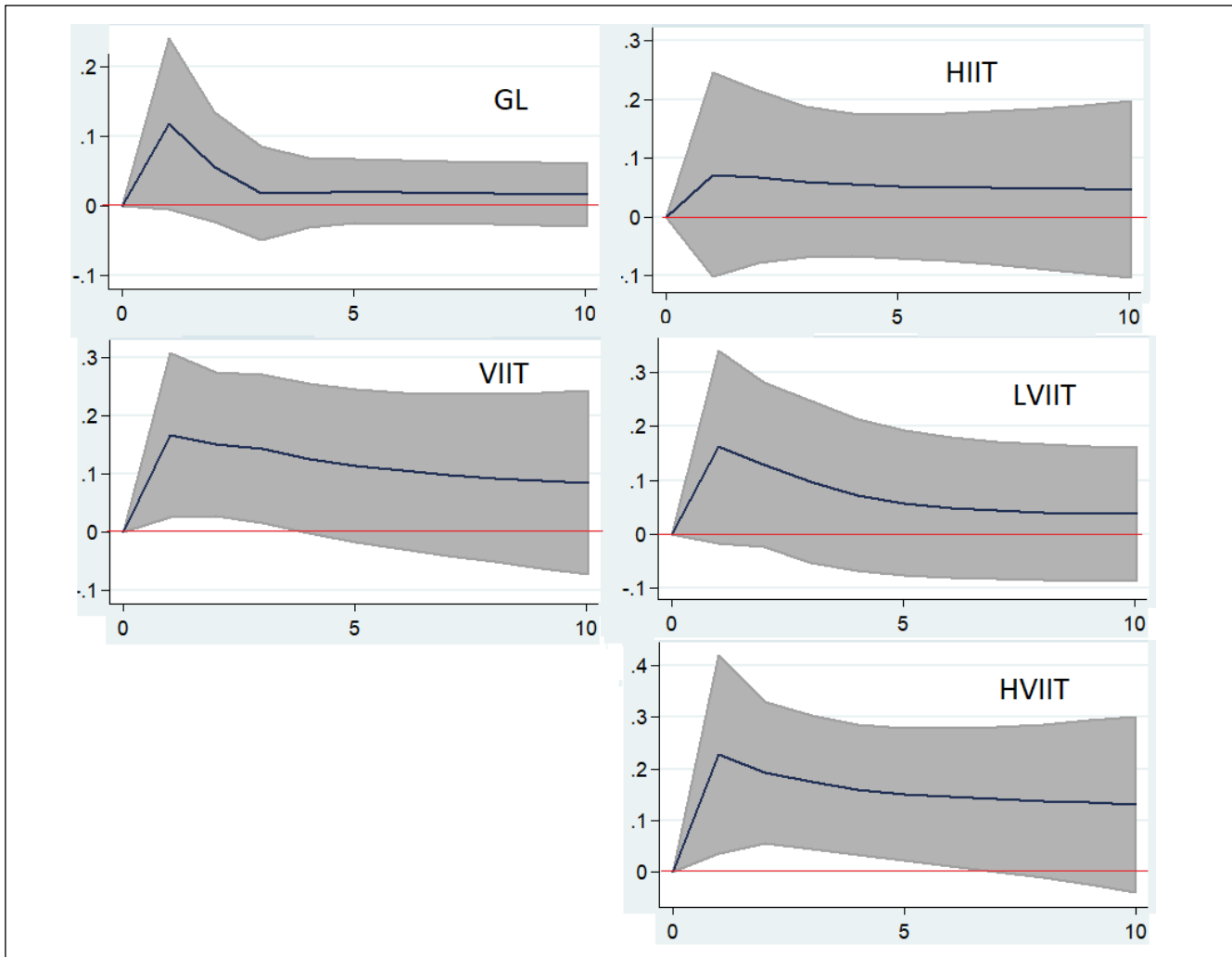
The negative trend on VIIT and HVIIT immediately after 2009, observed with the help of Figure 4, is consistent with these results. While the PVAR analysis indicates that effects are not permanent, it signifies the need for policy timing and assistance to producers immediately after a negative shock, such as the one observed during a recessionary period. VIIT and HVIIT may provide a viable alternative during recessionary times, as differentiation and market targeting through high quality products, can assist domestic products effectively reaching international markets.

Although HVIIT can, partially, overcome competition, thus driving the growth in IIT, it is not immune from the effects of the crisis. During the first 4-7 years after a shock, producers still need assistance to overcome contracting markets.

Overall, the results suggest that producers of agri-food products, and especially those producers in sectors where higher levels of processing are required, such as the foodstuff sector, confronted the challenges of a severe recessionary period by continuing to differentiate production, establishing value-added activities to provide high-quality exports of differentiated products and seeking new markets with similar demand structure. In light of competitive pressures felt on INT trade, competition from low-cost producers and rising domestic costs, HVIIT can assist producers with the negative effects of a recession. Establishing HVIIT in today's highly competitive international markets, where low-cost countries have a cost-advantage in HIIT and low-quality VIIT can thus be a viable outlet for producers. The main idea here being that: while INT trade, HIIT and LVIIT may not be immune to international competition or to the effects of a recession, HVIIT is, at least partially, immune to international competition, given that high-quality VIIT is not as easy to replicate and compete against.

While HVIIT can overcome some of the problems of international competition, it is not immune to the effects of an economic crisis. Results suggest that policy should be timed with negative shocks to GDP. The persistence of the impact of a shock to GDP for 4 through 7 years, emphasizes the need for early assistance. Assistance to producers in the beginning of a crisis, can help retain rising shares of HVIIT, assist in the continuous improvement/creation of new value-added, high-quality differentiated products, diversified agri-food product exports and development of new varieties that can compete in the international markets. Assistance should be targeted mainly towards HVIIT and towards sectors that require a higher degree of processing, where product differentiation and niche market targeting will be more effective. Assistance can take the form of incentivizing value-added, production/differentiation activities to lead to viable production structures. Identification of target markets/destinations, where similarities in market demand allow the growth of IIT trade can assist producers to expand production and exports, gradually take



**Figure 8. Impulse Response Functions for Positive Shocks to GDP**

Source: authors' estimations

advantage of economies of scale, reduce costs and advance one step ahead in the international markets. This can be achieved through management, advertisement, market research for the demand structures in each country to identify similarities and differences. Trade liberalization, openness, reducing barriers and costs, can together assist in the improvement of quality. Furthermore, providing funds for the training/retraining of employees moving from contracting to expanding sectors during an economic recession can also assist the growth of HVIIT.

## 5 Conclusions

This article examined the trends of Greek agri-food IIT before and after the 2009 debt-crisis. The discussion concentrated on IIT trends and on producers' reaction in order to identify possible outlets for

producers and make inferences on effective ways to deal with a downturn of an economy.

The share of Intra-Industry Trade in Greece has been low throughout the period of study with IIT showing signs of a slow increase. The economic crisis did not seem to hamper the growth of IIT which continued to rise even after 2009, mainly due to HVIIT. Producers dealt with the economic crisis by taking advantage of the benefits of an integrated Europe and the access to developed markets for differentiated products it offers. They tried to "crawl" back into the highly competitive international markets with high quality VIIT in sectors that require a high degree of processing and by expanding HVIIT to new markets. Access to funding for the development of new differentiated products, identification of target markets, of similar demand structures in destination countries, incentivizing the growth of production and the capture of economies of scale and product differentiation are

necessary during an economic crisis, especially at the onset of a downturn, to permit producers to compete more effectively against countries that have the cost-advantage.

The momentum in IIT trade in Greece is likely to prevail in the near future, as producers will keep searching for new opportunities and value-added activities to differentiate production, penetrate foreign markets and deal with international competition.

Interpretation of the results cannot associate *ce-teris paribus* effects of the economic crisis on the level of IIT. To discuss the effect of the crisis, a thorough econometric analysis of IIT for Greek agri-food products is necessary to better understand/expose how the recession affected the shares but also the determinants of Greek agri-food IIT. An examination of specific sectors following AZHAR and ELLIOT (2008; 2011; 2012) can further allow us to study the reasons for quality shifts, the long-term health of the sector and the adjustment costs.

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## Appendix

### Appendix A. Changing ranking of selected countries with highest levels of exports/imports

Partner	Exports				Imports			
	2004	2008	2012	2016	2004	2008	2012	2016
Albania	9	13	14	12				
Argentina					9	14	12	12
Australia	16	21	18	17				
Austria	17	19	23	15	17	17	17	15
Belgium	11	14	12	13	7	6	6	6
Brazil					10	9	13	13
Bulgaria	10	3	3	4	13	8	5	5
Canada	21	22		20	24			
China					23	23	22	20
Cyprus	6	5	5	5	25	21	23	18
Czechia	24	17	21	21				
Denmark				22	8	10	9	7
Ecuador							19	
Egypt			20	23	22			
France	7	9	9	9	3	3	3	4
Germany	1	2	2	2	2	1	2	2
Hungary					15	19	24	22
India					20	16	16	17
Indonesia						20		21
Ireland					16	22		23
Italy	2	1	1	1	4	4	4	3
Libya			17	14				
Malaysia							21	
Mauritania	18							
Netherlands	8	6	6	8	1	2	1	1
Paraguay							18	
Poland	13	12	13	11		15	11	8
Portugal	19	20	25	19				
Rep. of Korea	25							
Romania	15	8	11	10	14	18	10	10
Russian Fed.	12	11	8					24
Saudi Arabia			24	25				
Serbia		25				24	20	25
Serbia Mont.	20				19			
Spain	5	10	10	7	5	5	7	9
Sweden	22	18	16	16	18			
Switzerland		23						
TFYR of Mac.	14	16	19	24		25		
Tunisia		24						
Turkey	23	15	15	18	11	12	14	16
USA	4	7	7	3	12	13	25	19
Ukraine			22		21	11	15	14
United Kingdom	3	4	4	6	6	7	8	11

Source: author's estimations using UN Comtrade data

**Appendix B. 2<sup>nd</sup> level HS classification**

HS 2 <sup>nd</sup> level cat.	Number of 6 digit products within category	Description
01	23	Live animals
02	57	Meat and edible meat offal
03	91	Fish, crustaceans, molluscs, aquatic invertebrates nes
04	27	Dairy products, eggs, honey, edible animal product nes
05	8	Products of animal origin, nes
06	11	Live trees, plants, bulbs, roots, cut flowers etc
07	60	Edible vegetables and certain roots and tubers
08	54	Edible fruit, nuts, peel of citrus fruit, melons
09	29	Coffee, tea, mate and spices
10	15	Cereals
11	29	Milling products, malt, starches, inulin, wheat gluten
12	41	Oil seed, oleagic fruits, grain, seed, fruit, etc, nes
13	12	Lac, gums, resins, vegetable saps and extracts nes
14	8	Vegetable plaiting materials, vegetable products nes
15	44	Animal, vegetable fats and oils, cleavage products, etc
16	25	Meat, fish and seafood food preparations nes
17	16	Sugars and sugar confectionery
18	11	Cocoa and cocoa preparations
19	18	Cereal, flour, starch, milk preparations and products
20	49	Vegetable, fruit, nut, etc food preparations
21	14	Miscellaneous edible preparations
22	18	Beverages, spirits and vinegar
23	23	Residues, wastes of food industry, animal fodder
24	9	Tobacco and manufactured tobacco substitutes

Source: author's estimations using UN Comtrade data