Intra-industry trade for agri-food products in the enlarged European Union

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Abstract

International trade theory suggests that advanced trade integration may lead to higher level of IIT. The enlargement of the European Union during last decade is as a good example to analyse the IIT in agri-food products. The aim of the paper is to analyse the pattern and drivers of IIT within European Union between 1999 and 2010. Previous empirical studies fail to provide an exact link between the theory and the data. Thus, we employ a new empirical strategy developed to test the predictions of Helpman and Krugman (1985) model. At the country level, Belgium, France, Netherlands and Germany report the highest level of IIT within the EU. Our calculations mainly support the Cieslik's (2005) proposal to find the missing link between empirics and theory of IIT. In addition, our results are robust to various IIT indices and subsamples.

Keywords intra-industry trade, agri-food products, EU

JEL codes Empirical Studies of Trade: F14
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1. Introduction

Last decades the intra-industry trade (IIT) became widespread phenomena with growing role in international trade providing strong incentives for theoretical and empirical research. New trade theory offers several models to explain IIT based on different assumption on product differentiation. In the case of horizontal product differentiation the usual conclusions are about the role of factor endowments and scale economies that stem from the framework of monopolistic competition. This framework, summarised in Helpman and Krugman (1985), and often referred to as the Chamberlin-Heckscher-Ohlin (C-H-O) model, allows for inter-industry specialisation in homogeneous goods and intra-industry trade in horizontally differentiated goods. This model suggests a negative relationship between differences in relative factor endowment, proxied usually by GDP per capita, and the share of IIT. Alternatively, the vertical IIT models developed by Falvey (1981), Falvey and Kierzkowski (1987) and Flam and Helpman (1987) predict a positive relationship between IIT and differences in relative factor endowment. The available empirical evidence provides rather puzzling evidence on the impact of relative factor endowments on the IIT. One of possible explanation of diverging results is that majority of empirical studies fail to provide exact link between theory and data. Empirical studies on IIT usually employ rather eclectic approach using simply the most common explanatory variables to test hypotheses based on different theoretical frameworks.

The formation of stronger economic ties between European countries due to the creation and expansion of the EU contributed to an increase in intra-industry trade among European countries. There is a wealth of literature on the IIT between a particular EU country and its partner (see for recent examples Jensen and Lüthje 2010, Milgram-Baleix and Moro-Egido 2010). However significant part of the studies still has focused on industrial products. Although the importance of IIT is already well documented in agri-food sectors in the late nineties (Fertő, 2005), last decade research remained still limited on the determinants of agri-food IIT. The main reason is probably that agricultural markets are still usually assumed by perfect competition. But, recent studies support the view that agricultural markets can be characterised by imperfect competition (Sexton, 2013) and IIT has increasing role in agricultural trade for both developed and developing countries (e.g. Leitao and Faustino 2008, Leitao 2011, Rasekhi and Shojaee 2012, Wang 2009, Varma 2012). The enlargement of the European Union during last decade is as a good example to analyse the IIT in agri-food products. The aim of the paper is to analyse the pattern and drivers of IIT within European

Union between 1999 and 2010. This paper is the first attempt to analyse agri-food trade within EU.

More specifically, following Helpman (1987) and Hummels and Levinsohn (1995) we focus on the theoretical relationships between factor proportions and intra-industry trade within original Helpman-Krugman framework. Moreover, we control the impact of the sums of capital-labour rations as proposed by Cieslik (2005). Our additional contributions are following. We employ multilateral dataset instead of bilateral framework still predominating recent empirical research. This approach raises an additional issue, namely the accuracy of trade data. In the bilateral approach studies use data only from exporter point of view. However it is well-known, although less investigated that trade data are very rarely symmetric. Thus, we pay special attention to analyse the possible bias due to asymmetric nature of trade data. Research using panel data in the empirical IIT literature should face some additional issues coming from recent developments of panel data econometrics which are not always tackled carefully. Consequently, our analysis moves beyond to simple pooled OLS and standard static panel models. Finally, although Helpman-Krugman model based on horizontal product differentiation, empirical tests of their model are usually neglect the distinction between horizontal and vertical IIT, when they measure the IIT. Thus we check the robustness of our results using total and horizontal IIT indices.

The next section presents the theoretical foundation of the empirical model. Section 3 outlines briefly the standard measurement of IIT, and these approaches are applied to our data set in section 5. The theoretical basis for investigation of the country-specific determinants of IIT is outlined in section 6, and the results of the regression analysis are presented in section 7. Section 7 contains a summary and some conclusions.

2. Theoretical framework

The traditional IIT model, often referred to as the Chamberlin-Heckscher-Ohlin (C-H-O) model, assumes that goods are horizontally differentiated. In these models (Krugman, 1979; Lancaster 1980; Helpman 1981), IIT opens up in monopolistically competitive markets, with increasing returns to scale on the supply side and diverse consumer preferences on the demand side. Helpman and Krugman (1985) add factor endowment differences to a model that explains the co-existence of intra- and inter-industry trade. Consider two countries (A and B), two factors (labour and capital) and two goods: a homogeneous commodity which is relatively labour intensive and a differentiated product which is relatively capital intensive. If country A is relatively labour-abundant and country B is relatively capital abundant, Helpman and Krugman (1985) show how country A tends to export homogeneous product and both country import the differentiated good. This model predicts that IIT will decrease as countries' factor endowments diverge. Moreover, Bergstrand (1990) expanded earlier theoretical works by proposing a new framework, using gravity-like equation that explains the relationship between share of IIT in total trade and factor endowments as well as income. Important determinants of the share of IIT in total bilateral trade in the Bergstrand model are differences in income, average income, and average capital-labour ratios as well as differences therein.

However Cieslik (2005) points out that previous empirical studies fail to provide an exact link between the theory and the data. He shows that Helpman-Krugman (1985) model does not predict unique theoretical relationship between IIT and relative country size if we keep differences in capital to labour ratios unchanged. Thus Cieslik (2005) develop a formal model to eliminate this shortcoming providing two complementary propositions. First, the share of IIT between two countries is larger the sum of their capital-labour ratios, given the fixed difference in their capital labour proportions. Second, the share of IIT between two countries is larger the smaller the difference in their capital-labour ratios given the constant sum of their capital labour ratios. His results imply the theory finds support in the data when we control for the sum of capital–labor ratios in the estimating equations instead of relative country-size variables.

3. Measuring intra-industry trade

The basis for the various measures of IIT used in the present study is the Grubel–Lloyd (GL) index (Grubel and Lloyd, 1975), which is expressed formally as follows:

$$GL_i = 1 - \frac{|X_i - M_i|}{(X_i + M_i)} \qquad (1)$$

where X_i and M_i are the value of exports and imports of product category i in a particular country. The GL index varies between 0 (complete inter-industry trade) and 1 (complete intra-industry trade) and can be aggregated to level of countries and industries as follows:

$$GL = \sum_{i=1}^{n} GL_i w_i \text{ where } w_i = \frac{(X_i + M_i)}{\sum_{i=1}^{n}(X_i + M_i)} \qquad (2)$$

where w_i denotes the share of industry i in total trade.

Literature suggests several options to disentangle the horizontal and vertical IIT. *Greenaway et al.* (1995) developed the following approach, a product is horizontally differentiated if the unit value of export compared to the unit value of import lies within a 15% range, and otherwise they define vertically differentiated products. Formally, this is expressed for bilateral trade of horizontally differentiated products as follows:

$$1-\alpha \leq \frac{UV_i^X}{UV_i^M} \leq 1+\alpha \qquad (3)$$

where UV means unit values, X and M means exports and imports for goods i and ά=0.15. The choice of 15 per cent range is rather arbitrarily, thus already Greenaway et al. (1994) proposed to widen the spread to 25 per cent. Interestingly, the papers checking the possible impact of various thresholds on results confirm that results coming from the selection of the 15% range do not change significantly when the spread is widened to 25% (Jensen and Lüthje 2009). Based on the logic above, the GHM index comes formally as follows:

$$GHM_k^p = \frac{\sum_j \left[\left(X_{j,k}^p + M_{j,k}^p\right) - \left|X_{j,k}^p - M_{j,k}^p\right|\right]}{\sum_j \left(X_{j,k} + M_{j,k}\right)} \qquad (4)$$

where X and M denote export and import, respectively, while p distinguishes horizontal or vertical intra-industry trade, j is for the number of product groups and k is for the number of trading partners (j, k = 1, ... n).

We employ trade data from the Eurostat COMEXT database using the HS6 system (six digit level). Agri-food trade is defined as trade in product groups HS 1-24, resulting in 964 products using the six digit breakdown. Our analysis focuses on the period 1999-2010. In this context, the EU is defined as the member states of the EU27.

4. Econometric specifications

We use three different specifications to test theoretical propositions of Helpman-Krugman model and modified versions developed by Cieslik (2005). Early tests of Helpman-Krugman based on following specifications introduced by Helpman (1987).

$lnIIT_{ijt}$=α_0+$\alpha_1$$lnDGDPC_{ijt}$+$\alpha_2$min($lnGDP_{it}$, $lnGDP_{jt}$)+$\alpha_3$max($lnGDP_{it}$, $lnGDP_{jt}$)+$_{ij}$+ε_{ij} (5),

where IIT is the bilateral GL index.

To separate the effect of absolute country size from impact of relative country size Helpman (1987) suggests the following modification:

$lnIIT_{ijt}$=α_0+$\alpha_1$$lnDGDPC_{ijt}$+$\alpha_2$sum($lnGDP_{it}$, $lnGDP_{jt}$)+$\alpha_3$$lndispersion_{ijt}$+$_{ij}$+$\varepsilon_{ij}$ (6),

where dispersion is can expressed is following:

$$dispersion = ln\left[1-\left(\frac{GDP_i}{GDP_i+GDP_j}\right)^2-\left(\frac{GDP_j}{GDP_i+GDP_j}\right)^2\right] \quad (7).$$

To test two propositions by Cieslik (2005) we estimate following model:

$lnIIT_{ijt}$= α_0+ $\alpha_1$$lnDCAPLAB_{ijt}$ + $\alpha_2$$lnsumCAPLAB_{ijt}$ + v_{ij} + ε_{ij} (8)

From capital-labour ratios the physical capital was estimated by perpetual inventory method. Table 1 provides an overview of the description of variables and related hypotheses.

Table 1: Description of independent variables

Variable	Variable description	Data source	Sign
lnDGDPC	The logarithm of per capita GDP absolute difference between trading partners measured in PPP in current international USD	WDI	-
lnGDPmin	The logarithm of minimum GDP measured in PPP in current international USD	WDI	+
lnGDPmax	The logarithm of maximum GDP measured in PPP in current international USD	WDI	-
lnGDPsum	The logarithm of average GDP absolute difference between trading partners measured in PPP in current international USD	WDI	+
lndispersion	The logarithm of absolute difference between trading partners capital city measured in kilometres	WDI	+
lnDCaPLab	The logarithm of absolute difference of capital labour ratios between trading partners	Penn World Tables	-
LnsumCapLab	The logarithm of sum of capital labour ratios between trading partners	Penn World Tables I	+
lnDIST	The logarithm of absolute difference between trading partners capital city measured in kilometres	CEPII	-

Source: Own composition

5. The nature of intra-industry trade

One well-known problem in any research in empirical trade analysis including IIT is that of the accuracy of the data used. Most researchers study IIT bilaterally, that is one country's trade with several others, using the data of the former one. Mostly it is a member of the OECD, with good reputation of reporting accuracy. Consequently an IIT index measuring intra-industry trade between two countries should remain invariant if it is calculated from trade data reported by a certain country or by data reported from its trade partner due to the symmetry of the formulas. This is so obvious that articles often do not even mention the issue. However, investigation of multilateral trade between different combinations of OECD and non-OECD countries reveals serious inconsistency in the accuracy of trade data (Fertő and Soós, 2009). Jensen and Lüthje(2009) provide some evidence that data accuracy is less severe for the trade within Europe. To see whether this is the case, correlations between IIT indices based on trade data reported by a country and data reported by its partner are presented in Table 2.

Table 2: Correlation of indices based on a report and partner counttries as report country

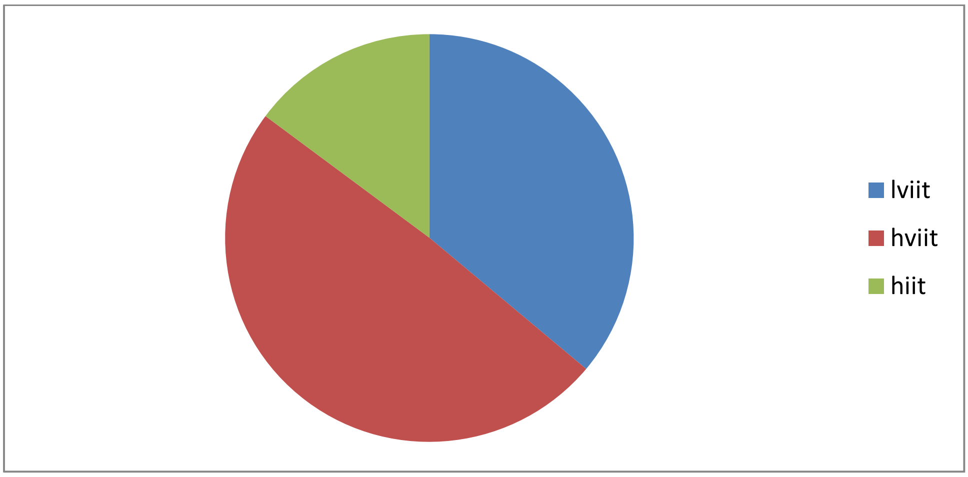
	HIIT	IIT
Austria	0.594	0.797
Belgium	0.882	0.963
Bulgaria	0.746	0.840
Cyprus	0.024	0.347
Czech Republic	0.543	0.765
Denmark	0.688	0.810
Estonia	0.763	0.887
Finland	0.748	0.906
France	0.872	0.944
Germany	0.852	0.934
Greece	0.242	0.643
Hungary	0.586	0.730
Ireland	0.204	0.445
Italy	0.813	0.939

Latvia	0.869	0.921
Lithuania	0.837	0.901
Luxemburg	0.046	0.184
Malta	0.189	0.267
Netherlands	0.805	0.945
Poland	0.636	0.770
Portugal	0.744	0.878
Romania	0.797	0.868
Slovakia	0.654	0.768
Slovenia	0.459	0.585
Spain	0.796	0.931
Sweden	0.575	0.847
UK	0.236	0.419
EU27	0.544	0.858

Source: Own calculations based on the Eurostat database

First striking findings that correlation indices are ranging significantly accross countries from 0.05 to 0.95. Second, correlation indices are consistently higher for IIT comparing to HIIT numbers. Third, the economic development is not necessary implies higher accuracy of trade data, see example of Luxembourg, UK. In short, in line with Fertő and Soós (2009) our preliminary analysis cast some doubt on trade data accuracy.

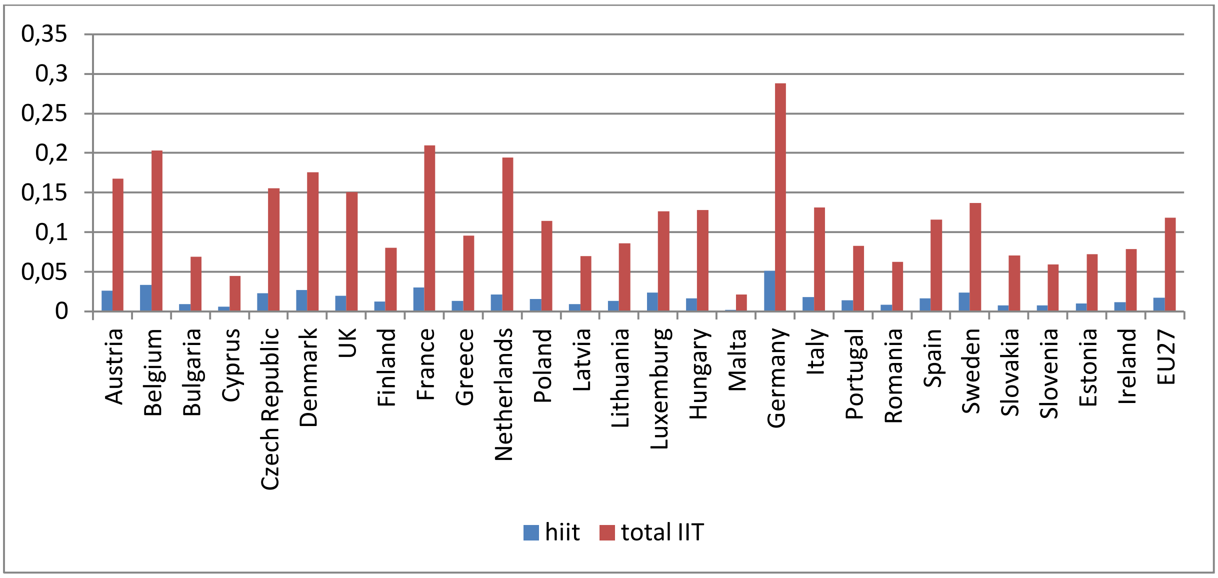
Figure 1: Types of IIT



Source: Own calculations based on the Eurostat database

There is evidence of IIT, mainly of a vertical nature, suggesting the exchange of products of different quality (Figure 1). High vertical IIT plays dominant role implying that IIT based on higher quality segment within the EU. The dominance of vertical over horizontal type trade accords with the general findings of recent empirical literature.

Figure 2: Agri-food IIT in EU-27 by countries



Source: Own calculations based on the Eurostat database

The level of IIT is rather low in agri-food trade in the EU (Figure 1). However, one may observe considerable difference by countries. Germany Belgium, France and Netherlands, Austria and Denmark show the highest value of IIT indices.

6. Regression results

Before estimating the panel regression models, the main model variables are pre-tested for unit root tests. A number of panel unit root tests are available. Considering the well known low power properties of unit root tests, in this paper we employ a battery of unit root tests: Levin, Lin and Chu (2002) method (common unit root process), Im, Pesaran and Shin (2003) method (assuming individual unit root processes), ADF-Chi square, and PP-Chi square. Table 2 presents the results of four different panel unit root tests (Levin, Lin and Chu; Im, Pesaran and Shin; ADF-Fisher Chi square, PP-Fisher Chi square), with different deterministic specifications (with constant, and with constant and trend). Mixed results were obtained. The most important model variables such as the IIT and HIIT do not have unit roots, i.e. are stationary, with individual effects and individual trend specifications. GDP related variables such as lnGDPC, lnGDPmin and lnGDPmax are more ambiguous in terms of unit root in a panel context. Five of nine panel unit root tests reject the panel unit root null hypothesis for lnGDPC, while five of nine panel unit root tests support the existence for lnGDPmin and lnGDPmax. We may conclude we do not have definite conclusion for reject/accept the panel unit root. Capital-labour ratios variables show clearer picture, majority of test reject the existence of panel unit root.

Table 2: Panel unit root tests

	IIT	HIIT	lndgdpc	lngdpmin	lngdpmax	lncaplabdif	lncaplabsum
Levin, Lin & Chu t*	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Im, Pesaran and Shin W-stat	0.000	0.000	0.214	0.991	1.000	0.000	0.000
ADF - Fisher Chi-square	0.000	0.000	0.007	1.000	1.000	0.000	0.000
PP - Fisher Chi-square	0.000	0.000	0.000	1.000	1.000	0.1538	1.000
with trend							
Levin, Lin & Chu t*	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Breitung t-stat	0.000	0.000	1.000	1.000	1.000	0.0387	0.568
Im, Pesaran and Shin W-stat	0.000	0.000	0.621	0.000	0.000	0.000	0.000
ADF - Fisher Chi-square	0.000	0.000	0.000	0.000	0.000	0.000	0.000
PP - Fisher Chi-square	0.000	0.000	1.000	1.000	1.000	1.000	1.000

Source: Own estimations

To ensure that both variables are stationary I(0) and not integrated of a higher order, we apply unit root tests on first differences of all variables. All tests (not shown here) reject the unit root null hypothesis for the first differences. In sum, we may conclude that panel is likely stationary.

We apply several estimation techniques to equation (5-6, 8) in order to ensure the robustness of the results. Preliminary Hausman tests favour to use of fixed effect panel models for majority of models. However, there are some additional issues that we have to be addressed when are estimated such panel models. First, heteroskedasticity may occur because trade between two smaller countries or between a smaller and larger country is probably more volatile than trade between two larger countries. The panel dataset is also subject to the existence of autocorrelation. Contemporaneous correlation across panels may occur because exporting to one country can take place as an alternative to exporting to another country. Similarly, adjacent exporter(s)'/importer(s)' time specific shocks result in larger correlated error terms of their trade with their partners. Preliminary analysis (likelihood ratio tests, Wooldridge test for autocorrelations and Pesaran tests) confirms the presence of heteroscedasticity, autocorrelation and cross-sectional dependence. Because our analysed period is shorter than cross sectional unit, to deal with issues of contemporaneous correlation the panel corrected standard error model (PCSE) is applied which controls for heteroskedasticity and the AR(1) type of autocorrelation and contemporaneous correlation across panels (Beck and Katz, 1995, 1996).

To check the robustness our results on possible bias due to trade data inaccuracy we estimate three different models for each cases using total, reporter and partner based samples.

6.1. Baseline models

Table 3 shows results on the benchmark Helpman model (equation 5). Estimations highlight that relative factor endowments proxied by difference in GDP per capita do not have significant impact on both total and horizontal IIT for all specifications except Partner HIIT model. Country size effects are strongly significant, however lngdpmax variables has unexpected signs. In general, results are fairly robust to different measures of IIT and subsamples.

Table 3: Baseline Helpman model 1.

	Total		Reporter		Partner	
	IIT	HIIT	IIT	HIIT	IIT	HIIT
lndgdpcap	0.0003	0.0004	-0.0003	-0.0001	0.0010	0.0010**
lngdpmin	0.0484***	0.0082***	0.0508***	0.0085***	0.0460***	0.0078***
lngdpmax	0.0114***	0.0015***	0.0086***	0.0007*	0.0142***	0.0023***
constant	-1.3560***	-0.2193***	-1.3415***	-0.2073***	-1.3720***	-0.2326***
N	7722	7722	3861	3861	3861	3861
R^2	0.1092	0.0471	0.1154	0.0473	0.1031	0.0474

Source: Own estimations

Note: N: number of observations. ***/**/*: statistically significant, respectively at the 1%, 5%, and 10% levels.

Next step we consider the alternative specification of benchmark model to separate the effect of absolute country size from impact of relative country size. Our results are rather mixed. Similarly to previous model, difference in GDP capita does not influence significantly the total or horizontal IIT except last specification. However, our estimations support positive effect of relative and absolute country size on both types IIT. Again, our estimations are robust to various IIT indices and subsamples.

Table 3: Baseline Helpman model 2.

	Total		Reporter		Partner	
	IIT	HIIT	IIT	HIIT	IIT	HIIT
lndgdpcap	0.0003	0.0004	-0.0001	-0.0001	0.0008	0.0010**
lngdpsum	0.0299***	0.0048***	0.0298***	0.0046***	0.0301***	0.0051***
dispersion	0.1523***	0.0277***	0.1707***	0.0316***	0.1334***	0.0234**
constant	-1.4339***	-0.2334***	-1.4294***	-0.2233***	-1.4390***	-0.2443***
N	7722	7722	3861	3861	3861	3861
R^2	0.1075	0.0466	0.1124	0.0466	0.1029	0.0473

Source: Own estimations

Note: N: number of observations. ***/**/*: statistically significant, respectively at the 1%, 5%, and 10% levels.

6.2. New evidence

It is well known that the use of per capita GDP as a proxy for relative factor endowments is problematic. Linder (1961) already noted that inequality per capita income may serve as a proxy for differences in preferences as suggested. In addition, Hummels and Levinsohn (1995) argued that this proxy is appropriate only when the number of factors is limited to two and all goods are traded, thus they proposed income per worker as a measure of differences in factor composition and also using actual factor data on capital–labour and land–labour ratios. Interestingly, despite of these limitations of use of the GDP per capita, it became a popular and dominating proxy for factor endowments in empirical literature.

In the first step we present results focusing on the relationships between the IIT and differences in capital-labour ratios with control for the variation in the sum of capital-labour proportions predicted by Cieslik (2005). The estimated coefficients are highly significant and consistent with the theoretical predictions (Table 4) irrespective to alternative specifications. The absolute value of differences in capital labour ratios is negatively, whilst the sum of these ratios are positively influences the IIT.

Table 4: Cieslik model

	Total		Reporter		Partner	
	IIT	HIIT	IIT	HIIT	IIT	HIIT
lncaplabdif	-0.0222***	-0.0052***	-0.0212***	-0.0054***	-0.0232***	-0.0049***
lncaplabsum	0.0648***	0.0125***	0.0628***	0.0123***	0.0668***	0.0128***
constant	-1.0204***	-0.1810***	-0.9918***	-0.1676***	-1.0501***	-0.1942***
N	7722	7722	3861	3861	3861	3861
R^2	0.0571	0.0300	0.0551	0.0282	0.0594	0.0325

Note: N: number of observations. ***/**/*: statistically significant, respectively at the 1%, 5%, and 10% levels.

Source: Own estimations

6.3. Sensitivity analysis

To check the robustness of our results we perform several alternative specifications including common control variables offered by empirical literature. First, we add two Helpman (1987) control variables including lnGDPmin and lnGDPmax. LnGDPmin variables are significantly positive as in Table 3 regardless of alternative specifications, whilst lnGDPmax variables has positive and significant impacts for three of six models. More importantly, capital-labour variable are loosing their significance.

Table 5: Sensitivity analysis 1.

	Total		Reporter		Partner	
	IIT	HIIT	IIT	HIIT	IIT	HIIT
lncaplabdif	-0.0028	-0.0010	-0.0008	-0.0009	-0.0049	-0.0012
lncaplabsum	-0.0087	0.0013	-0.0108	0.0011	-0.0068	0.0015
lngdpmin	0.0492***	0.0077***	0.0524***	0.0081***	0.0459***	0.0073***
lngdpmax	0.0208***	0.0017	0.0173***	0.0010	0.0243***	0.0024
constant	-1.3179***	-0.2204***	-1.3021***	-0.2078***	-1.3327***	-0.2329***
N	7722	7722	3861	3861	3861	3861
R^2	0.1100	0.0472	0.1163	0.0475	0.1049	0.0475

Source: Own estimations

Note: N: number of observations. ***/**/*: statistically significant, respectively at the 1%, 5%, and 10% levels.

Second, we extend our models with relative and absolute country size variables. In all cases capital-labour variables became insignficant, whilst relative and absolute country size has strong positive impacts on the IIT at 1 per cent level.

Table 6: Sensitivity analysis 2.

	Total		Reporter		Partner	
	IIT	HIIT	IIT	HIIT	IIT	HIIT
lncaplabdif	-0.0018	-0.0008	0.0004	-0.0007	-0.0039	-0.0009
lncaplabsum	-0.0127	0.0003	-0.0159*	-0.0001	-0.0096	0.0008
lngdpsum	0.0363***	0.0050***	0.0367***	0.0049***	0.0360***	0.0051***
lndispersion	0.1146***	0.0239***	0.1383***	0.0274***	0.0905**	0.0202*
constant	-1.3657***	-0.2300***	-1.3589***	-0.2185***	-1.3712***	-0.2412***
N	7722	7722	3861	3861	3861	3861
R^2	0.1099	0.0469	0.1155	0.0469	0.1054	0.0475

Source: Own estimations

Note: N: number of observations. ***/**/*: statistically significant, respectively at the 1%, 5%, and 10% levels.

Bergstrand (1990) suggests to distinguish the demand and supply side for explanation of the IIT. He argues that since the inequality in per capita incomes between countries seems to influence the share of intraindustry trade via two channels both of them should be taken into account in econometric analysis.

Table 7: Sensitivity analysis 3.

	Total		Reporter		Partner	
	IIT	HIIT	IIT	HIIT	IIT	HIIT
lncaplabdif	-0.0197***	-0.0044***	-0.0190***	-0.0046***	-0.0203***	-0.0041***
lncaplabsum	0.0506***	0.0097***	0.0488***	0.0096***	0.0523***	0.0098***
lndgdpcap	-0.0382***	-0.0081***	-0.0387***	-0.0083***	-0.0378***	-0.0079***
lnsumgdpcap	0.0341***	0.0060***	0.0341***	0.0056***	0.0342***	0.0064***
constant	-1.0097***	-0.1660***	-0.9761***	-0.1478***	-1.0441***	-0.1839***
N	7722	7722	3861	3861	3861	3861
R^2	0.1223	0.0739	0.1199	0.0715	0.1247	0.0772

Source: Own estimations

Note: N: number of observations. ***/**/*: statistically significant, respectively at the 1%, 5%, and 10% levels.

Cieslik (2005) proposes two different tests for Bergstrand's considerations. First step we add the logs of absolute value of difference in GDP per capita and logs of sum of GDP per capita of trading partners to control for divergence in tastes and the average level of development. Estimations shows that capital-labour variables are significant and they are in line with theoretical expectations. Both GDP per capita variables are siginficantly influences the IIT for all specifications.

Table 8: Sensitivity analysis 4.

	Total		Reporter		Partner	
	IIT	HIIT	IIT	HIIT	IIT	HIIT
lncaplabdif	-0.0061*	-0.0021**	-0.0039	-0.0020**	-0.0083**	-0.0022**
lncaplabsum	-0.0037	0.0026	-0.0068	0.0020	-0.0005	0.0031
lngdpsum	0.0287***	0.0034***	0.0293***	0.0035***	0.0281***	0.0032***
lndispersion	0.0518**	0.0086	0.0767***	0.0117*	0.0273	0.0054
lndgdpcap	-0.0334***	-0.0074***	-0.0332***	-0.0075***	-0.0337***	-0.0073***
lnsumgdpcap	0.0193***	0.0042***	0.0185**	0.0037**	0.0201***	0.0047***
constant	-1.1559***	-0.1824***	-1.1498***	-0.1671***	-1.1628***	-0.1975***
N	7722	7722	3861	3861	3861	3861
R^2	0.1469	0.0784	0.1478	0.0777	0.1467	0.0802

Source: Own estimations

Note: N: number of observations. ***/**/*: statistically significant, respectively at the 1%, 5%, and 10% levels.

Alternatively, we extend our previous model with absolute and relative country size variables. Results are less unambigous. The coefficients of difference in capital-labour ratios are significantly and negatively influences the IIT confirming theoretical predictions. However, the sum of capital-labour ratios became insignificant. Estimations on country size variables support a priori expectations. GDP per capita variables have also strong impacts on the IIT.

Finally, we investigate the role of distance in explanation of the IIT. Bergstrand (1990) provided a formal justification for the relationship between horizontal IIT and transport costs. Our results support the traditional concerns, namely distance is signifcantly and negatively related to the IIT in all specifications. At the same time, the estimates of the coefficients on differences and sums of capital–labour ratios have predicted signs and remain statistically significant at the 1 percent level.

Table 9: Sensitivity analysis 5.

	Total		Reporter		Partner	
	IIT	HIIT	IIT	HIIT	IIT	HIIT
lncaplabdif	-0.0203***	-0.0046***	-0.0199***	-0.0049***	-0.0207***	-0.0044***
lncaplabsum	0.0605***	0.0116***	0.0590***	0.0113***	0.0621***	0.0119***
distance	-0.0001***	-0.0000***	-0.0001***	-0.0000***	-0.0001***	-0.0000***
constant	-0.8642***	-0.1533***	-0.8298***	-0.1387***	-0.8985***	-0.1677***
N	7722	7722	3861	3861	3861	3861
R^2	0.1132	0.0563	0.1143	0.0561	0.1123	0.0571

Source: Own estimations

Note: N: number of observations. ***/**/*: statistically significant, respectively at the 1%, 5%, and 10% levels.

7. Summary and conclusions

The aim of the paper is to analyse the pattern and driving forces of the IIT and relative factor endowments using the integrated Helpman and Krugman model. This framework predicts a negative relationship between differences in capital–labour ratios and the IIT. However, there exists rather puzzled evidence to support this theory. Previous empirical studies fail to provide an exact link between the theory and the data. Thus, we employ a new empirical strategy developed by Cieslik (2005) to test the predictions of Helpman and Krugman (1985) model.

Our results confirm the increasing role of IIT within enlarged EU for agri-food products during analysed period. Estimations support the dominance of vertical over horizontal type trade accords with the general findings of recent empirical literature. At the country level, Belgium, France, Netherlands and Germany report the highest level of IIT within the EU.

Our empirical evidence suggests that the standard IIT theory finds some support in the data when we control for the sum of capital–labor ratios in the estimating equations instead of relative country-size variables. Although empirical research based on CHO framework usually neglects the distinction of horizontal and vertical IIT, our results are fairly robust to total and horizontal IIT. Since preliminary analysis reveals a considerable extent of trade data accuracy, our estimations are robust various sample.

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