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PATTERNS AND DETERMINANTS OF HORIZONTAL AND VERTICAL IIT OF REGIONS: PANEL ANALYSIS FOR SPAIN & POLAND

TOMASZ BRODZICKI

TOMASZ JURKIEWICZ

LAURA MARQUEZ-RAMOS

STANISŁAW UMIŃSKI

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ul. J. Czyżewskiego 6/1

PL 81-706 Sopot, Poland

e-mail: office@instytut-rozwoju.org

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Instytut Rozwoju
ul. J. Czyżewskiego 6/1
PL 81-706 Sopot
e-mail: office@instytut-rozwoju.org

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Patterns and determinants of horizontal and vertical IIT of regions: Panel analysis for Spain & Poland

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Tomasz Brodzicki [a]
Tomasz Jurkiewicz [b]
Laura Marquez-Ramos [c]
Stanisław Umiński [a]

Abstract

Most of the empirical studies in the literature on intra-industry trade and on the factors affecting trade are performed on the country level. Countries, however, differ in terms of granularity and internal heterogeneity at the regional level. This internal differentiation in terms of intra industry (IIT) patterns, which could affect countries' overall trade pattern, is thus not typically taken into account. In contrast, in the present study – using a unique dataset – we conduct an analysis at the level of NUTS2 regions of two large EU Member States (Poland and Spain) of similar size, level of development, a number of regions and the extent of international regional diversity. This allows drawing more thorough and robust conclusions, as regards the nature of IIT and its determinants. IIT is measured at the 4-digit level of products CN classification. We first describe the overall pattern of IIT for regions, and then empirically identify the determinants of overall IIT as well as its horizontal and vertical components in trade the Spanish and Polish NUTS-2 regions with all existing trade partners on bilateral basis over the period 2005-2014. In order to obtain unbiased results, we utilise a novel empirical approach - a semi-mixed effect model, estimated with the Poisson Pseudo Maximum Likelihood estimator.

We estimate the models jointly for all Spanish and Polish regions and then disjointly in a comparative manner – in order to identify incongruities of reaction to various factors investigated. These include both traditional factors, postulated by the standard theoretical models, as well as a number of factors related to the regional dimension of our analysis such as regional path dependence, quality of regional institutions or the core or peripheral nature of reporting region. The study contributes significantly to the analysis of determinants of IIT. We go beyond the traditional approach to IIT analysis (focused on countries). By treating regions as small open economies, participating in international trade, we are able to show new, interesting aspects of IIT and its determinants.

JEL Classification: *F12, F14, R11, C23*

Keywords: *intra-industry trade; horizontal & vertical IIT; semi-mixed effects model; PPML; Poland; Spain*

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[a] Institute for Development & University of Gdansk, Faculty of Economics
[b] University of Gdansk, Faculty of Management
[c] Institute for International Trade, University of Adelaide

1. Introduction

Traditionally, it is a country level for which international trade analysis has been performed. International trade theories were formulated for countries. However, the empirical research on the international trade assessed at the regional level has proliferated. Regions' economies have become more dependent on global markets. For many regions, exports have become an important growth factor as well as a determinant of labour market situation. The increased openness of the region's economy brings positive and negative consequences. On the one hand, high openness indicates high competitiveness, on the other hand, openness can bring instability and volatility. For a long time, regional and international economics have been evolving separately. The assessment of IIT at regional level bridges this gap and enables to formulate interesting observations regarding the nature of IIT and its determinants that so far have been neglected (i.e. metropolises or path dependency).

The heterogeneity of regions (their lumpiness) in terms of i.a. localisation, production factors' abundance (K/L ratio, human capital availability), investment attractiveness (inflow of FDI, institutional quality) and metropolitan status – has encouraged us to appraise IIT for regions, which have been treated as small open economies. We are fully conscious, that such an approach to international trade can be regarded as controversial and probably will be subject to critique. An orthodox economist would judge that IIT theory was formulated for countries and therefore IIT shall be inquired for countries. However, countries are lumpy. Regions differ, economic activity is concentrated in a few regions, so are foreign trade flows. These are firms from concrete localisation that participate in foreign trade. The character of this trade matters – international economics provides a thorough explanation of the consequences of IIT vs. inter-industry one, such as smooth adjustments hypothesis, synchronisation of business cycles or inclusion in the production fragmentation.

The paper contributes to the existing literature in several ways. Firstly, it is an empirical attempt to bridge a gap between international and regional economics. Secondly, a new dimension of regional differences is depicted - namely overall IIT intensity and its decomposition into horizontal and vertical components in the region-country framework. Thirdly, additional regional determinants of IIT have been identified.

We utilize data from a number of sources: DataComex Español and Polish Customs Chamber (Izba Celna), the Quality of Government EU Regional Dataset (Charron et al., 2016) and from Polska Agencja Informacji i Inwestycji Zagranicznych (PAIiIZ) as well as the Spanish Ministry of Economy and Competitiveness for Spain. We also utilize Penn World Tables PWT 9.0. (Feenstra, Inklaar, & Timmer, 2015).

The remainder of the paper is structured as follows. Section 2 reviews theoretical and empirical analyses on the discussed manner. Section 3 is an attempt to "regionalise" the concept of IIT and its determinants; in that section, the hypotheses are formulated. Section 4 embraces calculation and decompositions of IIT for regions. Section 5 presents the dataset, reviews the data sources and presents our empirical strategy and methods of econometric estimation. Section 6 presents the results and provides discussion. The last section concludes.

2. Intra-industry trade theories – a brief overview

The analysis of foreign trade and the type of specialisation that the trading partners are engaged in the global economy constitutes an important aspect of a scientific research in theoretical, empirical and trade policy framework. International economics offers a variety of theories that can be considered, ranging from classical to the neoclassical, new and new-new theory of trade. Moreover, if a foreign trade inquiry is done form the regional perspective, a whole gamut of regional economics concepts, including the localisation theories, can also be referred to.

Several reasons can be given, why the study of the nature and determinants of IIT deserves attention. A higher intensity of IIT indicates stronger economic integration with the trading partners, diversification and development of the economy from the supply (economies of scale and specialisation) and demand sides (love for variety), as well as the participation in the global value chains (fragmentation of production through FDI). An intensive IIT, particularly with the highly developed trading partners, is a result of higher development. Thus, it signals a country or a region "maturity", as regards the participation in the world economy. Moreover, there are important adjustment implications of trade expansion through IIT, formulated as the smooth adjustment hypothesis. The adjustment costs, proxied by unemployment, are lower if trade expansion is of IIT character, compared to inter-industry expansion. However, as the theoretical and empirical research on IIT evolved into the split into its horizontal and vertical components, the nexus between IIT and smooth adjustments has become complicated (Brülhart & Elliott, 1998; Kawecka-Wyrzykowska, Ambroziak, Molendowski, Polan, & Sielski, 2017; Lloyd & Lee, 2002). Last but not least, IIT contributes to the synchronisation of business cycles and therefore reduces the asymmetric shocks between the trading partners.

In the traditional approach to IIT determinants, much attention was put on the convergence between countries in terms of per capita incomes, that resulted in the overlapping imports and exports in heterogenous products, perceived by the customers as close substitutes (Czarny, 2002; Finger, 1975; Zielińska-Głębocka, 1996). In such an approach, IIT resulted from the customers' love for variety. On the other hand, the supply side of the IIT determinants was emphasised, meaning that the products which exports and imports overlap in IIT are similar in terms of factors inputs or production function (Bhagwati & Davis, 1994). According to the empirical research, in the long run, predominantly among the similar countries, participating in the integration processes (the EU being a good example) the IIT increasing share has been observed, which reflects the shrinking importance of the inter-industry trade. There is, however, some theoretical, interesting question to be asked, that stems from the comparison of the IIT literature and the New Economic Geography (NEG) predictions. As has been already said, IIT intensity is growing between the similar, integrating countries, being in the close geographical distance (which reduces trade costs). On a contrary, NEG predicts that falling trade costs contribute to the agglomeration of industrial activity, therefore bringing specialisation and reducing the IIT intensity. This issue undoubtedly will be subject to further inquiry[1]. It draws attention to the spatial aspects of economic activity, and the core-periphery debates as well as to the fragmentation of production, strongly affected by the activity of FDI (Cieślik, 2008). Defragmentation means decomposition of production, that was integrated, into stages located at a distance from one another. This process brings important consequences for regions' economies and their participation in international trade. As regional economies have become more open and therefore vulnerable to the external shocks and long-run economic changes (liberalisation of world trade, decreasing trade costs, establishment of value-added global chains), the inquiry into the nature of their trading relations and the role and character of IIT (and its split into HIIT and VIIT) is an important part of the overall assessment of the economic situation.

The overview of determinants of IIT was presented by Brodzicki (2016b), Clark, Sawyer, & Sprinkle, 2005; Sawyer, Sprinkle, and Tochkov (2010) and Zielińska-Głębocka (1996). If, however determinants of IIT are searched for regions, the regional perspective should also be applied, which makes the assessment more interesting, broaden by the regional economics related factors. The intensity and character of IIT for regions is determined by factors generally attributed for development ITT (for countries), such as: increasing products' heterogeneity, love for variety, trade liberalisation, falling transport costs, economies of scale, gradual factors' price equalisation and club convergence as regards the development of homogenous groups of countries (Brodzicki, 2016b). If the regional perspective is applied, the spectrum of IIT determinants broadens, however the "purely regional" determinants of IIT remain unclear. A solution seems to be treating the regions as small open economies, that increase their role in the international economy. Such an approach draws attention to the experience of the Asian economies, for which Sawyer et al. (2010) have identified the following determinants of IIT: high level of development (high income), R&D expenditures, openness, a high share of manufacturing exports and trade agreements. On the other hand, geographical distance and dissimilarities in economic size had a negative effect on IIT.

[1]The „confrontation" of NEG with traditional IIT theory predictions could be an interesting research task per se. It should be recalled that as early as in the 1960s and 1970s the findings of Balassa (1965, 1966), Grubel and Lloyd (1975) and Grubel (1967) showed the increasing role of the IIT in the European Economic Community, which was contrary to the predictions of the comparative advantages concept, that predicted the inter-industry specialisation. Thus, basically what NEG stipulates, is contrary to IIT, and rather in line with comparative advantages idea.

The determinants of the intra-industry type of trade were developed in a detailed way in the so-called new trade theory in the 1980s (Helpman, 1981; Krugman, 1979; Krugman, 1980; Lancaster, 1980) (Falvey & Kierzkowski, 1987). Brander and Krugman (1983) formulated the alternative IIT model, related to the reciprocal dumping. The new trade theory was based on monopolistic competition concept, increasing returns to scale, vertically and horizontally diversified products in terms of quality. The consumer demands a variety of products (love for variety) that can be supplied by firms that are subject to increasing returns to scale. The key model for the emergence of new trade theory was presented by Dixit and Stiglitz (1977). It incorporated the love for variety, in the monopolistic competition market framework, in which in long-run equilibrium the size of the output of every firm is the same (is not dependent on the market size). It is, however, the size of the market that determines the number of firms. Thus, if the two symmetrical economies are integrated, the number of the diversified goods available for customers (demanding variety) increases. The Dixit-Stiglitz model of international trade was furtherly extended by Krugman (1979; 1980) who added the second symmetrical market. Another approach to IIT was presented by Bernhofen (1999), who derives IIT from the strategic interactions between and among firms, thus referring to the game theory. In line with the Cournot's duopoly, firms compete by the products quantity. Davis (1995) has derived IIT from a Heckscher-Ohlin-Ricardo approach, based on comparative advantages, in which increasing returns are not a necessary condition for IIT.

Summing up, the high intensity of IIT is positively linked to product heterogeneity, increasing returns to scale, the similarity between and among trading partners which are highly developed and show small differences in the relative factors endowment. Geographical proximity exerts a positive effect on IIT, as it positively contributes to other "proximities", such as institutional, societal and cultural ones.

IIT theory and empirical research have developed, as a result, its two components are distinguished: horizontal and vertical (respectively HIIT and VIIT). This decomposition reflects the way in which products are differentiated in two-way trade. HIIT is the mutual exchange of products' variants, representing the similar quality, manufactured with the use of similar technology and at the similar costs, however different in terms of characteristics or attributes. A consumer, having diverse preferences, therefore has access to products' variants, which contributes to the manufacturing of heterogeneous products (which is contrary to the basic H-O trade model, in which each product is homogenous). This type of trade occurs between similar countries in terms of factors' endowment and level of development and industrialisation (Dixit & Stiglitz, 1977; Helpman, 1981, 1987; Krugman, 1979; Lancaster, 1980). VIIT represents the exchange of products' variants, differentiated in terms of technology, costs of production, quality and prices (Falvey & Kierzkowski, 1987; Flam & Helpman, 1987; Helpman, 1987). The higher is the difference between countries in terms of their technological capabilities and factors' endowment, the higher the intensity of VIIT. This kind of observation remains contrary to the initial, basic IIT theory, that did not envisage the IIT to occur between dissimilar countries. Furtherly, VIIT is split into down-market or up-market specialisation. Down-market specialisation reflects the situation in which a country exports lower quality variant of a particular product and imports its higher quality variant. In up-market specialisation, higher quality variants are exported, while the lower quality ones are imported.

3. "Regionalisation" of IIT determinants

The theory of IIT was formulated for countries. Its application to regional analysis – even if regions are treated as small, open economies – needs some conceptual work. IIT is determined both, by country-related and region-related factors. For instance, membership in a certain trade agreement is a country-related factor, while the GDP per capita of a region is a region-related one. One has to admit however that the distinction of the country- and regional-related factors is difficult, the latter also being impacted by country characteristics.

The literature overview has shown both, demand related (love for variety) factors and supply related ones (economies of scale and fragmentation of production) that determine IIT. If IIT is assessed for regions, it is highly probable that it is fragmentation of production analysed, rather than "love for variety" (Yoshida, 2008). Regional perspective brings an important consequence, which is the IIT lower intensity, if assessed for regions of a particular country, that for the country itself. It was explained by Yoshida (2008) and Umiński (2014) on the example: if an importer of a particular product (or its variant) is located in region A of a certain country, and an exporter in region B, from a country perspective there is IIT registered (imports and exports overlap), however for regions A and B – there is only one-way trade observed. The above example shows that the way the country is divided into regions can impact the IIT assessment results. Thus, it is recommended to perform IIT analysis at the regional level for similar countries, as regards their size and the character of the division into regions. Krugman and Venables (1995) have also shown that the nature of administrative division into regions may not reflect the optimal one, that could have evolved in so-called seamless world circumstances. It can also bias IIT intensity analysed for regions.

No matter if IIT is assessed at the country or regional level, the G-L index itself is problematic. The definition of the "industry" has been seen as causing difficulties, which has been addressed in the literature. Kawecka-Wyrzykowska et al. (2017) identify three main potential problems that affect the IIT calculations' results: (i) geographical bias, (ii) trade imbalance and (iii) sectoral bias and the level disaggregation of statistical data. These are the well-known issues that have been addressed in the literature (Greenaway & Milner, 1981, 2003), (Aquino, 1978; Brülhart, 2002; Czarny, 2003; Fontagne & Freudenberg, 1997; Lipsey, 1976; Mayer & Ottaviano, 2007), however the application of IIT concept to regions makes them even more severe. The geographical bias has its additional regional dimension, stemming from the fact that some regions perform an intermediary function for exporters from other parts of a country. The bias can also be the result of an already mentioned seamless world issue. Trade imbalance also has its regional dimension, as importers tend to agglomerate in the capital region of a country, or at least in several most important regions, being the most active in foreign trade. Also, aggregation of statistical data matters for the results of IIT calculations. If data aggregated at the less detailed level is used, it ends in higher IIT intensity. On the other hand, the excessive disaggregation per se may lead to the situation in which the similar products are classified within different groups, which lowers the intensity of IIT and accounts for inter-industry trade. The proper level of data disaggregation seems to be an even more problematic question for regional IIT analysis because if too disaggregated data are used, very low indices of IIT would be obtained. According to Kawecka-Wyrzykowska et al. (2017), there are no unified rules as regards the definition of “industry” for the purpose of IIT analysis for countries. For regional analysis, this issue is even more arbitrary, which makes the comparability of the obtained results with other research a serious problem.

As the empirical literature on IIT for regions is scarce, there is some hesitation about the character of hypotheses to be formulated: should they relate to the standard questions asked in the research on IIT (i.e. the size of trading partners economies or dissimilarity in GDP per capita), or rather the questions ought to be more related to the regions’ features, therefore depicting the regional characteristics. Although it apparently seems that the nature of IIT for regions is the same as for countries, which implies that standard IIT hypotheses verification would bring mediocre research value added – as it has not been verified for regions, the empirical research may result in interesting conclusions, bringing the novel inquiry into IIT. Decomposition of IIT into its horizontal and vertical components makes the research even more interesting.

On the basis of the theoretical and empirical literature overview, several hypotheses have been formulated, related to the region-country framework. They are subject to empirical verification, with the use of econometric models. The hypotheses are tested for the overall IIT as well as its horizontal and vertical components.

Hypothesis 1: Bigger market size of trading partners – in a region-country framework – positively determines the intensity of overall IT, however, the direction of its impact on the HIIT and VIT is ambiguous

The above hypothesis is derived from the role of the increasing returns to scale as a driver of IIT, however, a large home market may also have an adverse effect on the IIT intensity. The consequence of low openness – which is an attribute of bigger economies – can be a smaller number of products and their variants traded, which can reduce the probability of trade overlap, especially in the region-country framework.

Hypothesis 2: The smaller the distance between the trading partners, the more intensive IIT is expected. Moreover, adjacency additionally stimulates the intensity of IIT.

We derive this hypothesis indirectly from the gravity law, applicable to the analysis of trade relations (Brodzicki & Umiński, 2017). The expected positive role of distance can also be justified on the grounds of consumption patterns similarity and their dissemination (positively affected by small distance). The similarity of consumption patterns increases love for variety, which positively impacts IIT. Moreover, if IIT is inquired from the supply side, FDI is expected to have a positive effect on IIT. FDI is also prone to gravity rule. Distance also translates into the time of delivery, which is important for IIT, especially if it represents the fragmentation of production.

Hypothesis 3: The presence of FDI in a region affects IIT intensity

Hypothesis 3A: The above impact, however, can be ambiguous on HIIT and VIIT, depending on the character of FDI

As already mentioned, there is a prerequisite that IIT assessed at a regional level to large extent refers to fragmentation of production, in which foreign-owned enterprises (FOEs) are key players (Forsgren, 2008), performing the coordination role in the global value chains. However, relations between FDI and IIT are sophisticated, much depends on the character of FDI (vertical vs. horizontal). FOEs' sales can be directed towards the host region (or country) market or can be exported (FDI as an export platform), an FOE may import components and export final goods, which makes the unit prices to differ. Moreover – imports and exports are thus classified into different categories. In a nutshell, vertical FDI translates into vertical IIT, and horizontal FDI into horizontal IIT. The character of a region, in which FDI is located, also matters. A region's central vs. peripheral location, proximity to the border and its character (with the EU countries vs. non-EU ones), its investment attractiveness for particular types of FDI (i.e. services, vs. manufacturing) impact the impact of FDI on IIT and its decomposition into HIIT and VIIT. The incoming FDI changes the K/L ratio in a region, which affects the IIT. The convergence in terms of K/L in trading partners is expected to exert a positive impact on overall IIT, on its horizontal component and the negative one on the vertical one.

Hypothesis 4: The greater the difference in K/L ratio, the lower the intensity of IIT

K/L ratio difference is the basis for the trade of H-O type. As this difference becomes smaller, the basis for H-O type of trade fades out and IIT becomes more intensive, at the expense of the inter-industry trade. This observation rather leaves no doubts in trade between countries, however, it deserves to be verified for the region-country framework. Its positive verification can shed light on the justification of treatment regions as small, open economies, for which international economics theorems can be applied.

Hypothesis 5: The intensity of IIT of a particular region is positively affected by its institutional quality

IIT represents an advanced form of international trade relations (compared to inter-industry one). The regional export base for IIT can be of a path-dependent nature or may stem from the external resources re-location to it. In the open, global economic context, in both situations the regional institutional capacity matters. Regions are competing for the best performing (the most competitive) companies, of which many are exporters and FOEs. Therefore, a region's attractiveness is crucial, institutional quality being its component. If the region already is a competitive exporter the regional institutional capacity also matters, for instance, to make firms reinvest their profits and to stimulate spillovers to other firms. Effective institutions play a role in facilitating cooperation with other firms and in improving the business environment.

Hypothesis 6: Historical factors (path dependence) exert a long-term, persistent effect on trade relations and their character, thus influencing the IIT intensity

Past history raises the probability of structural similarity and thus significantly increases the intensity of IIT. IIT compared to inter-industry trade, requires similarity in terms of technological capacity, effective exchange of knowledge (incl. tacit knowledge) and coordination, for instance in the sphere of logistics).

Hypothesis 7: Metropolitan status of regions should positively contribute to overall IIT intensity and in particular its horizontal component

Metropolises are nodes of globalisation and "islands" of high GDP per capita, which positively contributes to love for variety. They are attractive for FDI, which contribute to production fragmentation. Metropolises are relatively well endowed with human capital which is positively correlated with exports (exporting requires profound knowledge) (Chuang, 2000; Levin & Raut, 1997). Metropolitan regions are bigger and more densely populated and thus have more diversified economic structures, which increases the intensity of IIT.

4. Intra-industry trade intensity – calculation and decomposition

The analysis in the present article is primarily based on the Grubel-Lloyd (G-L) index, which is the most frequently used tool in empirical studies to measure the intensity of IIT.

It is given by the following formula:

$$IIT_{R,P,j,t} = 1 - \frac{\sum_R \sum_P \sum_{i \in j} |X_{RPit} - M_{RPit}|}{\sum_R \sum_P \sum_{i \in j} (X_{RPit} + M_{RPit})} \qquad [1]$$

where:

$IIT_{R,P,j,t}$– IIT ratio of region *R* to country *P* for product *i* in section *j* and year *t,*

X_{RPit}– exports from region *R* to country *P* of product *i* in year *t*,

M_{RPit}– imports of region *R* to country *P* of product *i* in year *t*.

The G-L index may assume values from 0 to 1. If it equals 1, exports equal imports within a given industry and the whole trade is within one industry (IIT). On the other hand, if within a given industry, a country only imports or exports a product, the value of the index is 0 – we then deal with inter-industry trade.

The method of decomposition of IIT into vertical and horizontal components was developed by Greenaway, Hine, and Milner (1995). They assumed that the differences in the quality of varieties of products are reflected in price differentials, which roughly represents the value of the units of goods under analysis. With perfect information availability, a variety of a commodity sold at a higher price is more worthy, and therefore must be of a higher quality than the cheaper varieties. Greenaway et al. (1995) utilized the concept of the so-called unit values (UV) for exports and imports, measured e.g. in EUR/kg. In our case this applies:

$$UVx_{RPit} = \frac{X_{RPit}}{QX_{RPit}} \qquad [2]$$

$$UVm_{RPit} = \frac{M_{RPit}}{QM_{RPit}} \qquad [3]$$

where:

UVx_{RPit}– unit value for product i exported from region R to country Pin year t,

UVm_{RPit}– unit value for product i imported to region R from country P in year t,

X_{RPit}– exports from region R to country P of product i in year t,

M_{RPit}– imports of region R to country P of product i in year t,

QX_{RPit} *i* QM_{RPit} – quantities of exports and imports of product *i.*

In this study, the unit value was calculated separately for exports and imports, as the ratio of the value of trade in EUR to the trade quantity in kg. The values approximated the average price in exports and import of a given product group. Then, the relative unit value (RUV), as the ratio of UVx to UVm, was calculated for individual product categories.

Following Fontagne and Freudenberg (1997), HIIT and VIIT measures can be used that allow classifying trade in a given product as HIIT or VIIT. For a product to be recognised as horizontally differentiated, the similarity criterion needs to be obeyed, whereby the difference between unit values of exports and imports is small. The similarity criterion is expressed as:

$$\frac{1}{1+\alpha} \leq \frac{UVx_i}{UVm_i} \leq 1+\alpha \quad [4]$$

where the dispersion factor α is typically 15% or 25%. In the present analysis, we utilized its value equal to 15%.

When the conditions listed below are fulfilled, we can speak of, respectively, horizontally differentiated IIT and vertically differentiated IIT in low-quality products (*down-market specialisation*) and in high-quality products (*up-market specialisation*). The conditions in question may be expressed in the form of the following formulas:

- horizontal IIT

$$\frac{1}{1+\alpha} \leq \frac{UVx_{RPit}}{UVm_{RPit}} \leq 1+\alpha \qquad [5]$$

- vertical IIT (low quality)

$$\frac{1}{1+\alpha} > \frac{UVx_{RPit}}{UVm_{RPit}} \qquad [6]$$

- vertical IIT (high quality)

$$\frac{UVx_{RPit}}{UVm_{RPit}} > 1+\alpha \qquad [7]$$

Therefore, for RUV in the range 0.85 – 1.15 two-way trade is classified as horizontal, and for values under 0.85 or above of 1.15 – as vertical, owing to considerable UV differences recorded in exports and imports. On this basis, specific IIT categories may be calculated as:

$$IIT_{R,P,j,t} = IIT^{H}_{R,P,j,t} + IIT^{WL}_{R,P,j,t} + IIT^{WH}_{R,P,j,t} \quad [8]$$

$$IIT^{H}_{R,P,j,t} = \frac{\sum_R \sum_P \sum_{i\in j} \sum_{z\in H}(X^{z}_{RPit} + M^{z}_{RPit}) - \sum_R \sum_P \sum_{i\in j} \sum_{z\in H}|X^{z}_{RPit} - M^{z}_{RPit}|}{\sum_R \sum_P \sum_{i\in j} \sum_{z}(X^{z}_{RPit} + M^{z}_{RPit})}$$

$$IIT_{R,P,j,t}^{WL} = \frac{\sum_R \sum_P \sum_{i\in j} \sum_{z\in WL}(X_{RPit}^z + M_{RPit}^z) - \sum_R \sum_P \sum_{i\in j} \sum_{z\in WL}|X_{RPit}^z - M_{RPit}^z|}{\sum_R \sum_P \sum_{i\in j} \sum_z (X_{RPit}^z + M_{RPit}^z)}$$

$$IIT_{R,P,j,t}^{WH} = \frac{\sum_R \sum_P \sum_{i\in j} \sum_{z\in WH}(X_{RPit}^z + M_{RPit}^z) - \sum_R \sum_P \sum_{i\in j} \sum_{z\in WH}|X_{RPit}^z - M_{RPit}^z|}{\sum_R \sum_P \sum_{i\in j} \sum_z (X_{RPit}^z + M_{RPit}^z)}$$

where:

z – is one of three categories depending on a given type of trade,

H – two-way trade in horizontally differentiated products,

WL – two-way trade in vertically differentiated low-quality products,

WH – two-way trade in vertically differentiated high-quality products.

The data on exports for Polish and Spanish regions have been obtained from the Polish Customs Chamber (Izba Celna) and DataComex Español database (http://datacomex.comercio.es) at the 4-digit level of the combined nomenclature CN. IIT indices (IIT, HIIT and VIIT) have been calculated at this level for every single region-country-year pair for every 4-digit CN and then averaged for every single region-country-year using the weight, giving the share of a given product group in the value of total trade (imports and exports) between a given region and a given trade partner in a given year. These are our dependent variables in the models.

5. The data, data sources and our methodology and the empirical strategy

The data panel that we use has been constructed for the trade of 16 NUTS-2 level regions of Poland (voivodships) and 19 NUTS-2 level regions of Spain (17 autonomous communities and 2 autonomous cities) observed over the period of 11 years 2005-2014 vis-à-vis all possible trade partners. This gives a total of 8330 region-country pairs and 91630 observations in total. The panel is however unbalanced – IIT and its components are not available for every region-country-year triplet. Furthermore, the use of different datasets and variables excludes some observations. Therefore, due to missing data in some of the specifications considered the number of observations falls considerably.

The data have been acquired from a number of sources. The data on exports and imports for Polish and Spanish regions as already have been stressed were obtained from the Polish Customs Chamber (Izba Celna) and DataComex Español database (http://datacomex.comercio.es). The values of IIT, HIIT and VIIT between a given region and a given trade partner in a given year calculated above our dependent variables.

The data for regions have been predominantly acquired from the Quality of Government EU Regional Dataset Charron et al. (2016). The data on FDI inflows by trade partner into regions have been obtained for Poland from PAIH (Polska Agencja Inwestycji i Handlu) and from http://datainvex.comercio.es as well as from the Spanish Ministry of Economy and Competitiveness for Spain. The World Bank's Governance Matters dataset was used to measure the quality of institutions of country trade-partners (for its description see: Kaufmann, Kraay, and Mastruzzi (2011)).

The data on regional total factor productivity (TFP) has been obtained the following way. We have utilized the Penn World Tables PWT 9.0. (Feenstra et al., 2015) country-level TFP yearly estimates for Poland and Spain and then we have approximated the regional TFP, using the ratio of regional real GDP per capita to the national mean.

As the observed variation in income per capita is mostly driven by differences in TFP Easterly and Levine (2001) and thus TFP is generally considered the prime determinant of regional real GDP per capita. TFP differences are large between regions from different countries as well as between regions within countries and to large extent can be attributed to discrepancies in economic geography and historical development paths (Beugelsdijk, Klasing, & Milionis, 2017). The estimation of TFP at regional or sub-regional levels encounters a number of problems (Ciołek & Brodzicki, 2016). The method applied, despite a potential bias, allows us to be coherent with the TFP estimates at the level of countries.

In order to obtain values of K for regions corresponding to national values from PWT 9.0, we have assumed that they can be approximated by the share of a given region in the gross domestic product times the value of the national stock of K from the database. This seems to us to be the most intuitive and least biased approach.

The dummy variables for border region, access to sea or capital region are the result of own elaboration. In order to account for metropolitan status of a region we took the ESPON study (Dühr, 2005) on metropolitan areas in the European Union and constructed a dummy variable for metropolitan regions (metro) and in addition we took into account the MEGA classification thus creating dummy variables for MEGA 1, 2, 3 & 4 regions (mega1, mega2, mega3 & mega4). In the case of Spanish or Polish regions, MEGA 2 does not occur.

The descriptive statistics of the utilized variables, their definitions and data sources are given in Table 1.

We started with the pooled model estimated with OLS using robust standard errors. Acknowledging the variation along three major dimensions (region, partner and year) we immediately shift to panel data analysis. First of all, we have identified that time effects are statistically significant and should be included in the specification. The value of Breusch and Pagan LM test for random effects points to their significance. The Hausman test points to the choice of fixed effect model over the random effect model, however, it would point to exclusion of time-invariant determinants constant for region-country pairs.

The results of a modified Wald statistic for groupwise heteroskedasticity in the residuals of a fixed effect regression model points to the presence of heteroskedasticity in our panel. The value of a test for serial correlation in the idiosyncratic errors of a linear panel-data model points on the other hand to the problem of the first-order autocorrelation.

Santos Silva and Tenreyro (2006) proposed the use of Poisson pseudo-maximum-likelihood (PPML) estimator to gravity-like models. However, the time effects and region-country-pair specific effects are then estimated as fixed effects which cause that some of the time-invariant effects cannot be estimated. Savasci (2011) proposed the estimation with the aid of a mixed effect PPML, where the pair effects are random effects to control for unobserved cross-section heterogeneity. The obvious problem is to prevent misspecification due to the independence assumption for the random effects. Lombardía and Sperlich (2012), however, introduced a new class of semi-mixed effects models where an extra fixed clustering variable is introduced. In our case it is eu28, which has an extra sense – the trade with partners from EU28 happens within the broad context of EU internal market with a common set of regulations and no borders). The use of it should allow us to obtain unbiased results and include all the required variables in order to test the set of our hypotheses. In line with the suggestions of Silva every specification of the models considered includes fixed temporal effects.

The aggregate intra-industry trade index (IIT), the vertical intra-industry trade index (VIIT) or the horizontal intra-industry trade index (HIIT) will be our explained variables.

The analysed empirical model has the following, general formula:

$$iit_{R,P,t} = exp\left[ln\alpha_0 + \beta_1 lnV_{R,t} + \beta_2 lnZ_{P,t} + \beta_3 lnZ_{P,R} + \vartheta_t + \mu_{PR}\right]\varepsilon_{P,R,t} \quad [9]$$

The empirical strategy in the present article is the following. We construct a basic specification of the IIT model and then extend it to test a number of hypotheses from section 3. The analysis is conducted jointly for a sample of Polish and Spanish NUTS-2 regions. We have checked the robustness of the results by splitting the sample of the regions into two national subsamples – it does not affect the key results (available upon request).

Furthermore, due to the nature of the research question, 3 groups of models with different explained variables will be estimated separately; these will be, respectively, the G-L index for IIT, and its constituents of HIIT and VIIT. Our approach is justified, as the review of the theoretical literature demonstrated that some of the determinants have a concordant effect on VIIT and HIIT, whereas some may have a divergent effect.

6. Econometric results and discussion

The results of the estimation of the baseline and extended model specifications are presented in Tables 2-7.

As the general structure of the specified models is the same in accordance with our empirical strategy, the estimations' results can be simultaneously discussed. With the numbers of observations about 25k for HIIT and VIIT and about 40k for IIT, the coefficient of determination R2 varies and goes up to 0,35, however, its values are low for models devoted to HIIT.

The base specification of the model (Table 1, M1) includes the size of the economies of a country and a region (*ln_y_c* and *ln_y_r*), the distance between them (*ln_distance*) and the clustering variable, which is *eu28*. The size of the regional economy and of the trading partner (country) has a positive and statistically significant impact on IIT, the country size having a stronger magnitude. The results are in line with the expectations, thus H1 has been confirmed for IIT.

As regards the decomposition of the IIT into horizontal and vertical components, the obtained results differ. The region size has the negative effect on HIIT, which is in contrast to the standard expectations. Size is expected to positively contribute to the economies of scale and therefore to the possibility of the regional economy to "generate diversity", as regards the variants of the products offered for exports. The question of trading partners' economies size – in the model for HIIT – seems not to be consistent; in the alternative specification (T3, models 2-10) the usage of population as a proxy of size brings different results: a positive impact of the region's size and a negative of the country – has been observed. As regards VIIT, definitely more consistent results have been obtained. The usage of both measures of the trading partners' economies size (GDP and population, T5, models 1-10) clearly shows, that size exerts positive, statistically significant impact on the VIIT intensity. Regarding the trading partners size in HIIT and VIIT, the literature provides similar conclusions. For instance (Brodzicki, Ciołek, & Śledziewska, 2016) in an inquiry of IIT and its decompositions, conclude that both, Poland and the trading-partner size (proxied by GDP) positively impacts IIT and VIIT. However, for HIIT, in case of a partner's economy size, generally there is no statistically significant impact registered. In the case of Poland's GDP size, the results in most specifications of the model show the positive and statistically significant impact. The obtained results regarding the determinants of VIIT and HIIT prove that both the structure and the directions of IIT and its decompositions are hard to be predicted, especially if the model is estimated in the region-country framework. The negative impact of the region's size on HIIT obtained in most of the estimations may also stem from the home market effect, interpreted as a tendency to trade within a region, which reduces the probability of trade overlap, as a smaller number of products' variants are traded. It can also reflect the border effect, or region market bias. According to Coughlin and Novy (2013), most of the trade is of the intra-region nature. This effect would require further research and more detailed data availability, having in mind that for Poland data on intra-regional trade is not available.

Size similarity of trading partners (region and country) is another factor that has been tested. Its impact on the intensity of IIT is positive and significant. This is an interesting conclusion, showing that symmetry matters, regarding the size of trading partners, even if the region-country framework has been applied. This constatation shows that treating regions as small, open economies is justified. The obtained results, regarding the size similarity of trading partners, are in line with Helpman (1981), who showed that countries of different size do not trade as intensively, as the countries of similar size. Intensive trade links per se, increase the probability of exports and imports overlap.

The confirmed size similarity impact, draws out attention to other aspects of similarity, strongly underlined by the IIT theory. Similarly, the differences in GDP per capita and in TFP (log of the absolute difference) have statistically significant and adverse impact on IIT (Table 2, models 8 - 9). The above conclusion on the difference's consequence in GDP also holds for HIIT and VIIT. The greater the similarity of trading partners in terms of the level of development (as proxied by real GDP per capita) the more intense IIT. This is in line with the Linder hypothesis, focusing on the similarity of consumer preferences. The difference in TFP focuses on the other hand on technology or general productivity and thus has a supply-side nature. The difference in TFP in the region-country framework, however, does not exert a statistically significant impact on HIIT and VIIT.

If the gap in TFP between trading partners is large, it reduces the possibility of effective communication and thus of technological transfer, which is crucial for the establishment of cooperative links and the production fragmentation. The hindering role of the gap increases if we allow for skill-biased technological change.

Another aspect of similarity relates to the difference in K/L ratios. The difference in capital and labour endowments constitute the basis for H-O type trade. The potential equalisation of K/L ratios or due to factor price equalization (FPE) could make the H-O theorem useless, thus making the IIT the main theory for the assessment of trade relations between similar partners.

At first, the K/L ratios for a given region and a country are introduced (Table 2, model 10). We expected K/L to positively impact IIT. This has been positively verified for IIT and VIIT, albeit with a low magnitude of the impact. In the case of HIIT, the regional K/L ratio impact is negative, however, with a very low magnitude. In the second step (Table 2, models 11-12), we account for the difference in K/L. Contrary to our expectations, K/L difference has a positive, significant impact on IIT, HIIT and VIIT. The inclusion of the control for the difference in the level of economic development (*diff_y*) does not change the results.

The obtained results are in line with the empirical results of Brodzicki (2016a), who have identified the positive impact of the difference in K/L for Poland's IIT and with Brodzicki et al.

(2016) who showed the positive impact on VIIT. We have to stress, however, that some studies on determinants of IIT do not include the K/L ratios (Thorpe & Zhang, 2005).

In line with expectations, in all model specifications for IIT, HIIT and VIIT the adverse impact of (geographical) distance on intra-industry trade has been identified, which confirms our H2. The smaller the distance, the greater the intensity of IIT and its components: HIIT and VIIT.

It reflects consumption patterns similarity. Close distance is also a significant factor in the establishment of cooperative links, also in the context of the production fragmentation through FDI. Reduced distance lowers trade costs, enables just-in-time deliveries and facilitates business contacts.

Moreover, in most of the model specifications, also the adjacency (*adj*) has a positive impact on IIT, HIIT and VIIT. Adjacency turns out to be statistically insignificant only if the variable representing the difference in the institutional quality is introduced and has an adverse impact on IIT if we control for a cumulated number of foreign investments. In the case of HIIT, the introduction of this variable makes adjacency statistically insignificant.

In all model specifications for IIT, HIIT and VIIT the positive and statistically significant impact of border-character of a given region is detected. Thus, it is not only adjacency but also the status of the border region matters. Border status, ceteris paribus, facilitates international trade in general and IIT in particular.

EU is the main trade partner for both Poland and Spain, however for firms from particular regions its importance strongly varies. As regards the membership in the EU, *eu28*, its effect ceteris paribus is significant and positive in the case of IIT and VIIT. In HIIT the results are mixed, in some specifications of the model if additional variables are introduced, *eu28* is not significant or its magnitude changes from positive to negative. In the basic specification, the *eu28* exerts a positive and significant impact on HIIT, however controlling for a country and a region's landlockedness and institutional quality, as well as the difference in institutional quality, makes *eu28* dummy insignificant, so does the introduction of variables related to FDI.

In specification 5, we replace eu28 with *euroz* – membership of the trade partner in the eurozone. In accordance with our expectations, the impact of it is positive and statistically significant. The version of the Rose effect could be at work, increasing the overall intensity of IIT.

The inclusion of landlockedness of a region and a country redirects our discussion to issues of geography even more. Geography determines the economic processes, but the verification of this impact is difficult. As has been already shown, the status of the border region has a positive impact on IIT.

The inclusion of a landlockedness variable for a region shows another aspect of "bordering", which is the access to the sea and port infrastructure. In gravity models, landlockedness is a component of multilateral resistance (Anderson & Yotov, 2010). Countries and regions that are not landlocked, benefit from lower transport costs. As it was stated by Bertho, Borchert, and Mattoo (2016, p. 232), "*for trade with developed economies, maritime transport costs today matter more than tariffs*". According to Rodrik, Subramanian, and Trebbi (2004), geography impacts the way in which an economy integrates with the world markets. Remoteness and landlockedness increase the trade costs and adversely affect this integration. We contribute to this discussion, by showing consequences of landlockedness for the intensity of IIT. Landlockedness of both the region and the trade partner generally lowers IIT intensity (please refer to Table 3, M1; Table 5 M1, Table 7 M1) with landlockedness of the region having a positive impact on VIIT only. Further research, however, is recommended in this respect by taking into account the transport modality.

Benedictis and Pinna (2015) state that "bad geography" features, including landlockedness, can be reversed by effective institutions".

Superior institutional quality of a trade partner positively affects IIT, HIIT and VIIT (please refer to Table 3, M2; Table 5 M2 & Table 7 M2). This is not the case with the region's institutional quality, which means that H5 should surprisingly be rejected. It could be related to a specific sample of regions of Poland and Spain. Further analysis of other countries is required to draw more general conclusions. As could be expected to take the above results, the impact of the difference in institutional quality (log of absolute difference), contrary to our expectations, seems to have a positive impact on IIT, HIIT and VIIT in our sample of region-country pairs (please refer to Table 3, M3; Table 5 M3 & Table 7 M3).

The impact of common historical ties is statistically insignificant in the case of IIT in general (please refer to Table 3 M4). Even more surprisingly, the impact of it is adverse both for HIIT (Table 5 M4) and VIIT (Table 7 M4). This could be due to the specific nature of historical ties that differ for Poland and Spain. For Spain, we took into account colonial ties. The impact of it is negative for IIT general and VIIT, and insignificant for HIIT (not shown here, results available upon request). For Poland, we took into account the impact of former partitions. The impact of it in general (common partition) is positive and statistically significant for IIT, HIIT and VIIT. If we go into more details we find that the result is mostly due to the impact of Prussian partition (always positive). The impact of location in Russian partition is always negative. The Austro-Hungarian partition has a statistically significant and adverse impact only on IIT. The initial results need further explanation. The path dependence has overall been proven however the direction of the impact varies between countries. In the joint sample, the overall impact is negative.

Our observations related to the impact of geography on trade are in line with the constitutions of Brülhart (2011, p.59), who stated that the available evidence confirms that ceteris paribus, "*regions with inherently less costly access to foreign markets, such as border or port regions, stand to reap the largest gains from trade liberalisation*". Liberalisation of trade facilitates IIT. IIT – compared to inter-industry trade – brings benefits in the form of smoother adjustments, the greater participation in production fragmentation (global value chains) and therefore in technology transfer. Better access to world markets is to a large extent dependent on geographical determinants.

According to the World Bank (2009, p. 12), "*not all parts of a country are suited for accessing world markets and coastal and economically dense places do better*". Metropolitan regions definitely represent dense places. We expected the metropolitan status of a given region to matter (please refer to M8-9 in Tables 3, 5 & 7). The results for IIT, HIIT and VIIT prove our hypothesis H7. As expected, the magnitude of the impact for metropolitan dummies is higher in case of HIIT, in comparison with VIIT. The concentration of "economic mass" World Bank (2009, p. 50) – or in other words agglomeration – is not only important for international trade but as we have shown – also for IIT. The literature that explains why exporters agglomerate indicates the role of sharing, matching and learning (Duranton & Puga, 2004). For instance, through learning the exporting firm acquires access to knowledge on export markets, which reduces the entry costs. Positive export spillovers from agglomeration processes have been shown by Koenig (2009), Cassey, Schmeiser, and Waldkirch (2016) and Koenig, Mayneris, and Poncet (2010), however, there is also empirical evidence on the negative effects of over-agglomeration (Bao, Shao, & Song, 2014; Elliott & Zhou, 2015). Our contribution to the existing literature is the provision of empirical evidence of a positive impact of agglomeration of the economic activity within a specific region on IIT. Furthermore, the magnitude of the impact increases in the significance of the metropolitan area from an international perspective (the impact is higher for MEGA 1 than for MEGA3, and this, in turn, is higher than in the case of MEGA 4).

In line with our expectations, FDI seems to have a positive impact on IIT, which proves our hypothesis H3. Three different measures have been used, incl. zero adjustments and relativizing the number of investors per square kilometre (please refer to M5-M7 Tables 3, 5 & 7). As mentioned, data on FDI relates to bilateral, cumulated number of FOEs from a particular country that invested in a given region of Poland or Spain. Therefore, it is not an impact of FDI per se but we analyse the impact of FDI from a given trade partner on IIT. The obtained results shed important light on the role of FDI in facilitating IIT. We, therefore, confirm the constatation of Yoshida (2008), that if IIT is analysed at the regional level, FOEs positively contribute to the production fragmentation, which constitutes the basis for IIT. The same results have been obtained for HIIT, which we regard as an important contribution to the literature on the nature of the nexus between FDI and international trade. The relation is however difficult to be predicted, given the different types of FDI (horizontal versus vertical FDI for instance), varied motivations that make firms' invest abroad and different role performed by the subsidiaries within MNEs (Estrin, Meyer, Wright, & Foliano, 2008).

As already has been mentioned, we expect that IIT assessed at a regional level to large extent refers to fragmentation of production, in which foreign-owned enterprises (FOEs) are key players (Forsgren, 2008), performing mostly the coordinating role within the global value chains. However, relations between FDI and IIT are complex and to a large extent dependent on the character of FDI (vertical vs. horizontal).

FOEs' sales can be directed towards the host region (or country) market or can be exported (FDI as an export platform), an FOE may import components and export final goods, which makes the unit prices to differ. Moreover – imports and exports are thus classified into different categories. In a nutshell, vertical FDI translates into vertical IIT, and horizontal FDI into horizontal IIT. The character of a region, in which FDI is located, also matters. A region's central vs. peripheral location, proximity to the border and its character (with the EU countries vs. non-EU ones), its investment attractiveness for particular types of FDI (i.e. services, vs. manufacturing) impact the impact of FDI on IIT and its decomposition into HIIT and VIIT. The incoming FDI changes the K/L ratio in a region, which affects the IIT. The convergence of trading partners' K/L, is expected to exert a positive impact on overall IIT, on its horizontal component and the negative one on the vertical one.

We would like to stress that the direction of the impact is the same for Polish and Spanish regions taken independently (not shown here, results available upon request). The magnitude of the impact is higher for Spanish regions. In addition, for Spanish regions only we were able to control for the log of the value of foreign FDI by Spanish NUTS2 regions in trade partners. Their impact is statistically significant and positive for IIT and its components.

In the last specifications, we control for infrastructure endowment of a region. First of all the presence of seaports (proxied by access to the sea), road infrastructure (as proxied by motorways relative to land area) and railway infrastructure (total railways relative to land area). The overall impact is positive on IIT. For instance, a seaport can facilitate foreign trade, as was shown by Ciżkowicz, Rzońca, and Umiński (2013) and by Brodzicki and Umiński (2017). The impact varies for VIIT and HIIT with the adverse impact of road infrastructure on HIIT in the joint sample of regions and of seaports on VIIT (please refer to M10 in Tables 3, 5 & 7). The results need further investigation. Further investigation shows that the results vary between Polish and Spanish regions. More analysis is thus required to draw more general conclusions.

7. Conclusions

In the present study using a unique dataset, we have conducted an analysis of determinants of IIT within a region-country framework at the level of NUTS2 regions of Poland and Spain. The IIT has been measured at the 4-digit level of products CN classification and then decomposed into its horizontal and vertical components. The analysis has been carried out for all the Spanish and Polish NUTS-2 regions with all existing trade partners on a bilateral basis over the period 2005-2014. In order to obtain unbiased results, we have utilised a novel empirical approach - a semi-mixed effect model estimated with the Poisson Pseudo Maximum Likelihood estimator.

We have estimated the models jointly for all Spanish and Polish regions and then disjointly in a comparative manner – in order to identify incongruities of reaction to various factors investigated (only selected ones have been however discussed in the present paper due to size limitations). These factors included both traditional factors, postulated by the standard theoretical models, as well as a number of factors related to the regional dimension of our analysis such as regional path dependence, quality of regional institutions or the core or peripheral nature of reporting region.

On the basis of a critical review of the theoretical literature, we have formulated a number of testable hypotheses which we tried to empirically verify in our samples. Most of the hypotheses which are drawn from general international trade theory seem to hold in the region-country setting. Some of the hypotheses have been however rejected, which could be due to the specific nature of the dataset.

The study contributes significantly to the analysis of determinants of IIT. We go beyond the traditional approach to IIT analysis (focused on countries). By treating regions as small open economies, participating in international trade, we are able to show new, interesting aspects of IIT and its determinants.

We would like to stress that more general conclusions can be formulated if the analysis performed is applied to a larger number of countries. Nonetheless, the simultaneous analysis for two EU Member States allows drawing more conclusions than the analysis for a single economy. More research is necessary in order to make further progress.

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Table 1. Descriptive statistics of utilized variables

Variable	Description	Obs	Mean	Std. Dev.	Min	Max	Data source
access_2_sea	Region with access to sea (dummy variable)	91,630	0.314	0.464	0	1	Own elaboration
adj	Adjacency between a region and a given trade partner (dummy variable)	91,630	0.00312	0.0558	0	1	Own elaboration
border_region	Border region (dummy variable)	91,630	0.543	0.498	0	1	Own elaboration
c_inst_qual	Country's institutional quality	76,650	-0.0161	0.997	-2.669	2.120	World Governance Indicators
c_k2l	K/L ratio of a trade partner	59,640	143,933	138,526	2,096	635,955	PWT 9.0
diff_inst_quality	Difference in institutional quality (log of absolute difference)	76,650	-0.465	0.981	-9.236	1.167	Own elaboration
diff_k2l	Difference between K/L (log of absolute difference)	59,640	11.44	1.108	0.804	13.27	Own elaboration
diff_tfp	Difference in TFP levels (log of absolute difference)	63,249	-1.286791	1.075428	-12.69395	.7640905	Own elaboration based on QoG Regional dataset and PWT 9.0
diff_y	Difference in income per capita levels (log of absolute difference)	63,249	1.189089	.9216241	.0000467	4.921044	Own elaboration based on QoG Regional dataset and PWT 9.0
eu28	Partner country in the EU28	91,630	0.0946	0.293	0	1	Own elaboration
Euroz	Partner in eurozone (dummy variable)	91,630	0.0783	0.269	0	1	Own elaboration
geo_landlocked	Trade partner landlocked	82,390	0.168	0.374	0	1	CEPII
hiit_ship	Horizontal IIT	29,990	0.0160	0.0725	0	1	Own elaboration using Izba Celna & DataComex Español
History	Common historical links between a region and a	73,920	0.0565	0.231	0	1	Own elaboration

	given trade partner (Polish and Spanish regions)						
iit_ship	IIT	50,337	0.0389	0.0957	0	1	Own elaboration using Izba Celna & DataComex Español
ln_distance	The log of distnace between region's and trade partner's capital cities (in kilometeres)	91,619	8.542	0.879	-9.262	9.901	Own elaboration
ln_no_fdi_area_za	N. log of cumulated no. of FDI in a region per km2 zero adjusted	91,630	4.91e-05	0.000704	0	0.0670	PAIiIZ & DataInvex Español
ln_no_fdi_cum	N. log of cumulated no. of FDI in a region	6,253	2.277	1.717	0	8.196	PAIiIZ & DataInvex Español
ln_no_fdi_cum_za	N. log of cumulated no. of FDI in a region zero adjusted	91,630	0.170	0.745	0	8.196	PAIiIZ & DataInvex Español
ln_pop_c	Log of total population of a trade partner	63,700	8.667	2.186	1.564	14.13	PWT 9.0
ln_pop_r	Log of total population of a given region	91,630	7.396	1.034	4.173	9.036	QoG Regional dataset
ln_value_esp_reg_fdi_abroad_za	Log of value of foreign FDI by Spanish NUTS2 regions abroad zero adjusted	91,630	-6.186	3.244	-6.908	17.24	DataInvex Español
ln_value_fdi_in_esp_za	Log of value of foreign FDI in Spanish NUTS2 regions zero adjusted	91,630	-6.907	0.0682	-6.908	7.983	DataInvex Español
ln_y_c	Real GDP of a trade partner	63,700	9.183	1.252	5.820	11.98	PWT 9.0
ln_y_r	Real GDP of a region	82,719	9.820	0.551	8.716	10.74	PWT9.0 and QoG Regional dataset
mega1	Dummy variable – metropolitan region MEGA 1 in accordance with ESPON classification	91,630	0.0571	0.232	0	1	Own elaboration based on EPSON classification
mega2	Dummy variable –	91,630	0	0	0	0	Own elaboration based on

	metropolitan region MEGA 2 in accordance with ESPON classification						EPSON classification
mega3	Dummy variable – metropolitan region MEGA 3 in accordance with ESPON classification	91,630	0.0571	0.232	0	1	Own elaboration based on EPSON classification
mega4	Dummy variable – metropolitan region MEGA 4 in accordance with ESPON classification	91,630	0.257	0.437	0	1	Own elaboration based on EPSON classification
metro	Dummy variable – metropolitan region in accordance with ESPON MEGA classification (MEGA 1-4)	91,630	0.371	0.483	0	1	Own elaboration based on EPSON classification
pl_common	Region in the common former partition with a given trade partner (Polish NUTS2 only)	91,630	0.00228	0.0477	0	1	Own elaboration
pl_p_aus	Region in the Austro-Hungarian partition (Polish NUTS2 only)	91,630	0.000480	0.0219	0	1	Own elaboration
pl_p_deu	Region in the former Prussian partition (Polish NUTS2 only)	91,630	0.00108	0.0329	0	1	Own elaboration
pl_p_rus	Region in the former Prussian partition (Polish NUTS2 only)	91,630	0.000720	0.0268	0	1	Own elaboration
r_inst_qual	Regional institutional quality	91,630	-0.0228	0.201	-0.908	0.763	QoG Regional dataset
r_k2l	K/L ratio of a region	83,300	169,544	99,888	42,147	367,722	Own elaboration
r_tr_mway_tkm2	Motorways (kilometre/1000 square km) of the region	91,630	15.58	21.09	0	98	QoG Regional dataset
r_tr_rl_tkm2	Total railway lines	91,630	39.74	35.38	0	175	QoG Regional dataset

	(kilometre/1000 square km) of the region						
region_landlocked	Region landlocked	91,630	0.314	0.464	0	1	Own elaboration
size_similarity	Size similarity index	63,249	0.354	0.136	0.0144	0.500	Own elaboration
viit_ship	Vertical IIT	29,990	0.0486	0.0874	0	0.985	Own elaboration using Izba Celna & DataComex Español

Source: Own elaboration.

Table 2. Determinants of IIT for a joint sample of Polish and Spanish NUTS-2 regions

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
VARIABLES	IIT	IIT	IIT	IIT	IIT	IIT	IIT	IIT	IIT	IIT	IIT	IIT
ln_y_c	0.509***	0.501***										
	(0.0163)	(0.0166)										
ln_y_r	0.182***	0.157***										
	(0.0239)	(0.0248)										
ln_distance	-0.466***	-0.466***	-0.516***	-0.528***	-0.556***	-0.515***	-0.507***	-0.499***	-0.512***	-0.428***	-0.523***	-0.481***
	(0.0149)	(0.0148)	(0.0133)	(0.0132)	(0.0129)	(0.0142)	(0.0144)	(0.0144)	(0.0146)	(0.0160)	(0.0141)	(0.0140)
eu28	0.283***	0.260***	0.563***	0.696***		0.698***	0.708***	0.572***	0.687***	0.308***	0.726***	0.483***
	(0.0218)	(0.0227)	(0.0226)	(0.0222)		(0.0223)	(0.0223)	(0.0226)	(0.0226)	(0.0239)	(0.0226)	(0.0240)
size_similarity		0.521***	1.934***									
		(0.133)	(0.115)									
ln_pop_c			0.167***	0.166***	0.143***	0.164***	0.163***	0.164***	0.162***	0.227***	0.201***	0.200***
			(0.0112)	(0.0116)	(0.0108)	(0.0117)	(0.0117)	(0.0113)	(0.0117)	(0.0104)	(0.0112)	(0.0108)
ln_pop_r			0.287***	0.279***	0.274***	0.277***	0.268***	0.276***	0.268***	0.309***	0.284***	0.294***
			(0.0134)	(0.0136)	(0.0141)	(0.0136)	(0.0139)	(0.0137)	(0.0139)	(0.0130)	(0.0137)	(0.0134)
euroz					0.698***							
					(0.0195)							
adj						0.229***	0.148***	0.110***	0.124***	0.192***	0.108***	0.0818**
						(0.0391)	(0.0392)	(0.0379)	(0.0394)	(0.0375)	(0.0381)	(0.0351)
border_region							0.228***	0.236***	0.230***	0.228***	0.225***	0.248***
							(0.0212)	(0.0211)	(0.0213)	(0.0189)	(0.0207)	(0.0203)
diff_y								-0.298***				-0.507***
								(0.0170)				(0.0233)
diff_tfp									-0.0352***			
									(0.00811)			
c_k2l										3.68e-06***		
										(7.55e-08)		
r_k2l										5.31e-07***		
										(1.23e-07)		
diff_k2l											0.0780***	0.275***
											(0.0114)	(0.0173)
Constant	-6.306***	-6.191***	-3.681***	-2.782***	-2.298***	-2.858***	-2.981***	-2.810***	-2.979***	-5.393***	-4.272***	-6.452***
	(0.276)	(0.270)	(0.170)	(0.165)	(0.156)	(0.165)	(0.166)	(0.164)	(0.166)	(0.167)	(0.215)	(0.256)
Observations	40,446	40,446	40,446	40,799	40,799	40,799	40,799	40,446	40,446	39,691	39,691	39,354
R-squared	0.162	0.164	0.176	0.171	0.178	0.172	0.170	0.177	0.173	0.245	0.190	0.208
Year FE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Log likelihood	-5723	-5721	-5765	-5847	-5848	-5846	-5836	-5751	-5785	-5485	-5661	-5544
BIC	-425428	-425421	-425335	-429341	-429338	-429332	-429342	-425340	-425273	-417073	-416731	-412990

*Note: Estimated in STATA 14. All regressions carried out using semi-mixed effect model with eu28 as a clustering variable. Robust standard errors in parentheses. * Significant at 10 per cent level; ** significant at 5 per cent level; *** significant at 1 per cent level.*

Table 3. Determinants of IIT for a joint sample of Polish and Spanish NUTS-2 regions

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
VARIABLES	IIT	IIT	IIT	IIT	IIT	IIT	IIT	IIT	IIT	IIT
ln_pop_c	0.154***	0.205***	0.179***	0.167***	0.185***	0.109***	0.156***	0.165***	0.165***	0.165***
	(0.0113)	(0.0105)	(0.0115)	(0.0123)	(0.00960)	(0.0112)	(0.0113)	(0.0112)	(0.0111)	(0.0112)
ln_pop_r	0.276***	0.322***	0.291***	0.279***	0.0846***	0.0897***	0.257***	0.146***	0.0407*	0.235***
	(0.0139)	(0.0131)	(0.0132)	(0.0140)	(0.0202)	(0.0146)	(0.0141)	(0.0216)	(0.0223)	(0.0140)
ln_distance	-0.533***	-0.408***	-0.497***	-0.506***	-0.490***	-0.485***	-0.499***	-0.488***	-0.500***	-0.523***
	(0.0142)	(0.0129)	(0.0138)	(0.0150)	(0.0174)	(0.0140)	(0.0144)	(0.0146)	(0.0148)	(0.0156)
eu28	0.551***	0.139***	0.462***	0.557***	0.0941***	0.356***	0.541***	0.596***	0.564***	0.530***
	(0.0236)	(0.0232)	(0.0229)	(0.0236)	(0.0321)	(0.0239)	(0.0230)	(0.0227)	(0.0225)	(0.0232)
diff_y	-0.280***	-0.254***	-0.335***	-0.303***	-0.209***	-0.218***	-0.283***	-0.295***	-0.302***	-0.301***
	(0.0178)	(0.0199)	(0.0176)	(0.0180)	(0.0315)	(0.0171)	(0.0170)	(0.0170)	(0.0168)	(0.0168)
adj	0.0977**	0.239***	0.0574	0.0997**	-0.169***	-0.182***	0.0868**	0.131***	0.128***	0.0952**
	(0.0382)	(0.0377)	(0.0367)	(0.0392)	(0.0396)	(0.0395)	(0.0370)	(0.0391)	(0.0379)	(0.0378)
border_region	0.219***	0.229***	0.247***	0.231***	0.196***	0.315***	0.267***	0.229***	0.282***	0.248***
	(0.0206)	(0.0201)	(0.0209)	(0.0216)	(0.0230)	(0.0210)	(0.0217)	(0.0208)	(0.0225)	(0.0198)
geo_landlocked	-0.269***									
	(0.0273)									
region_landlocked	-0.121***									
	(0.0225)									
c_inst_qual		0.613***								
		(0.0111)								
r_inst_qual		-0.111**								
		(0.0458)								
diff_inst_quality			0.245***							
			(0.0157)							
history				0.00625						
				(0.0421)						
ln_no_fdi_cum					0.0754***					
					(0.00792)					
ln_no_fdi_cum_za						0.217***				
						(0.00607)				
ln_no_fdi_area_za							45.90***			
							(6.746)			
metro								0.273***		
								(0.0327)		
mega1									0.729***	
									(0.0455)	
mega3									0.441***	

									(0.0476)	
mega4									0.272***	
									(0.0338)	
r_tr_mway_tkm2										0.00332***
										(0.000526)
r_tr_rl_tkm2										0.000649**
										(0.000301)
access_2_sea										0.0973***
										(0.0263)
Constant	-2.445***	-4.559***	-2.946***	-2.793***	-1.128***	-1.214***	-2.620***	-2.054***	-1.219***	-2.347***
	(0.176)	(0.158)	(0.162)	(0.172)	(0.194)	(0.167)	(0.167)	(0.197)	(0.202)	(0.167)
Observations	39,567	39,429	39,429	38,052	5,145	40,446	40,446	40,446	40,446	40,446
R-squared	0.178	0.254	0.200	0.184	0.354	0.207	0.177	0.177	0.187	0.183
Year FE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Log likelihood	-5596	-5369	-5565	-5436	-1604	-5678	-5740	-5744	-5733	-5744
BIC	-415220	-414106	-413725	-397814	-43445	-425476	-425352	-425344	-425345	-425322

*Note: Estimated in STATA 14. All regressions carried out using semi-mixed effect model with eu28 as a clustering variable. Robust standard errors in parentheses. * Significant at 10 per cent level; ** significant at 5 per cent level; *** significant at 1 per cent level.*

Table 4. Determinants of HIIT for a joint sample of Polish and Spanish NUTS-2 regions

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
VARIABLES	HIIT	HIIT	HIIT	HIIT	HIIT	HIIT	HIIT	HIIT	HIIT	HIIT
ln_y_c	0.275***									
	(0.0532)									
ln_y_r	-0.312***									
	(0.0627)									
ln_distance	-0.215***	-0.296***	-0.260***	-0.253***	-0.235***	-0.239***	-0.234***	-0.142***	-0.284***	-0.280***
	(0.0360)	(0.0324)	(0.0339)	(0.0339)	(0.0344)	(0.0344)	(0.0348)	(0.0431)	(0.0363)	(0.0360)
eu28	0.166***	0.135***		0.135***	0.158***	0.114**	0.179***	0.173***	0.200***	0.102*
	(0.0544)	(0.0501)		(0.0506)	(0.0506)	(0.0529)	(0.0521)	(0.0557)	(0.0533)	(0.0586)
ln_pop_c		-0.154***	-0.154***	-0.162***	-0.162***	-0.156***	-0.158***	-0.0805**	-0.103***	-0.0962***
		(0.0280)	(0.0270)	(0.0278)	(0.0278)	(0.0275)	(0.0279)	(0.0329)	(0.0319)	(0.0315)
ln_pop_r		0.0873***	0.0948***	0.0811***	0.0621*	0.0686**	0.0628*	0.178***	0.112***	0.124***
		(0.0308)	(0.0304)	(0.0309)	(0.0322)	(0.0322)	(0.0323)	(0.0338)	(0.0318)	(0.0316)
euroz			0.408***							
			(0.0453)							
adj				0.908***	0.760***	0.723***	0.765***	0.811***	0.652***	0.621***
				(0.0858)	(0.0862)	(0.0847)	(0.0870)	(0.0868)	(0.0857)	(0.0833)
border_region					0.454***	0.464***	0.451***	0.391***	0.455***	0.469***
					(0.0560)	(0.0555)	(0.0563)	(0.0504)	(0.0540)	(0.0536)
diff_y						-0.128**				-0.266***
						(0.0501)				(0.0755)
diff_tfp							0.0220			
							(0.0208)			
c_k2l								2.23e-06***		
								(2.28e-07)		
r_k2l								-2.00e-06***		
								(3.31e-07)		
diff_k2l									0.0425*	0.150***
									(0.0252)	(0.0407)
Constant	-2.020**	-0.972***	-1.390***	-1.206***	-1.493***	-1.438***	-1.504***	-4.048***	-2.562***	-3.756***
	(0.862)	(0.358)	(0.330)	(0.357)	(0.360)	(0.363)	(0.362)	(0.412)	(0.483)	(0.578)
Observations	25,671	25,897	25,897	25,897	25,897	25,671	25,671	25,702	25,702	25,481
R-squared	0.013	0.012	0.013	0.015	0.017	0.017	0.017	0.024	0.017	0.019
Year FE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
log likelihood	-1855	-1874	-1869	-1870	-1861	-1842	-1843	-1770	-1792	-1771
BIC	-258937	-261436	-261446	-261434	-261442	-258932	-258930	-259388	-259354	-256907

*Note: Estimated in STATA 14. All regressions carried out using semi-mixed effect model with eu28 as a clustering variable. Robust standard errors in parentheses. * Significant at 10 per cent level; ** significant at 5 per cent level; *** significant at 1 per cent level.*

Table 5. Determinants of HIIT for a joint sample of Polish and Spanish NUTS-2 regions

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
VARIABLES	HIIT	HIIT	HIIT	HIIT	HIIT	HIIT	HIIT	HIIT	HIIT	HIIT
ln_pop_c	-0.153***	-0.125***	-0.152***	-0.174***	0.132***	-0.207***	-0.164***	-0.155***	-0.156***	-0.158***
	(0.0268)	(0.0315)	(0.0315)	(0.0281)	(0.0293)	(0.0261)	(0.0272)	(0.0272)	(0.0275)	(0.0271)
ln_pop_r	-0.00168	0.116***	0.0879***	0.0658**	-0.0804	-0.133***	0.0531*	-0.243***	-0.228***	-0.00419
	(0.0352)	(0.0342)	(0.0319)	(0.0335)	(0.0579)	(0.0349)	(0.0320)	(0.0569)	(0.0583)	(0.0348)
ln_distance	-0.304***	-0.196***	-0.240***	-0.221***	-0.381***	-0.218***	-0.237***	-0.209***	-0.206***	-0.180***
	(0.0342)	(0.0355)	(0.0352)	(0.0365)	(0.0519)	(0.0339)	(0.0344)	(0.0350)	(0.0359)	(0.0394)
eu28	0.0784	-0.0697	0.0364	0.109**	0.0937	-0.0846	0.0873	0.165***	0.169***	0.180***
	(0.0550)	(0.0593)	(0.0560)	(0.0547)	(0.0897)	(0.0556)	(0.0532)	(0.0540)	(0.0537)	(0.0536)
diff_y	-0.116**	-0.133**	-0.167***	-0.0986*	-0.0964	-0.0419	-0.114**	-0.124**	-0.120**	-0.134***
	(0.0519)	(0.0577)	(0.0520)	(0.0526)	(0.0781)	(0.0515)	(0.0500)	(0.0502)	(0.0510)	(0.0517)
adj	0.732***	0.842***	0.702***	0.785***	0.0688	0.401***	0.706***	0.802***	0.804***	0.859***
	(0.0859)	(0.0867)	(0.0890)	(0.0887)	(0.0916)	(0.0788)	(0.0832)	(0.0889)	(0.0895)	(0.0885)
border_region	0.396***	0.447***	0.472***	0.460***	0.468***	0.552***	0.495***	0.445***	0.452***	0.186***
	(0.0539)	(0.0556)	(0.0560)	(0.0571)	(0.0641)	(0.0566)	(0.0563)	(0.0538)	(0.0587)	(0.0506)
geo_landlocked	-0.232***									
	(0.0652)									
region_landlocked	-0.481***									
	(0.0529)									
c_inst_qual		0.356***								
		(0.0320)								
r_inst_qual		-0.422***								
		(0.118)								
diff_inst_quality			0.151***							
			(0.0361)							
history				-0.317***						
				(0.122)						
ln_no_fdi_cum					0.0911***					
					(0.0223)					
ln_no_fdi_cum_za						0.267***				
						(0.0149)				
ln_no_fdi_area_za							62.30***			
							(10.33)			
metro								0.666***		
								(0.0930)		
mega1									0.562***	

									(0.130)	
mega3									0.702***	
									(0.139)	
mega4									0.659***	
									(0.0922)	
r_tr_mway_tkm2										-0.0129***
										(0.00201)
r_tr_rl_tkm2										0.00523***
										(0.000682)
access_2_sea										0.707***
										(0.0679)
Constant	-0.549	-2.616***	-1.507***	-1.411***	-1.774***	0.120	-1.297***	0.370	0.229	-1.487***
	(0.379)	(0.401)	(0.373)	(0.380)	(0.523)	(0.360)	(0.361)	(0.447)	(0.460)	(0.360)
Observations	25,147	25,242	25,242	24,539	5,056	25,671	25,671	25,671	25,671	25,671
R-squared	0.022	0.023	0.019	0.018	0.073	0.024	0.016	0.023	0.023	0.032
Year FE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
log likelihood	-1787	-1780	-1797	-1744	-553.6	-1818	-1838	-1831	-1831	-1818
BIC	-253123	-254206	-254183	-246397	-42699	-258970	-258930	-258943	-258923	-258950

*Note: Estimated in STATA 14. All regressions carried out using semi-mixed effect model with eu28 as a clustering variable. Robust standard errors in parentheses. * Significant at 10 per cent level; ** significant at 5 per cent level; *** significant at 1 per cent level.*

Table 6. Determinants of VIIT for a joint sample of Polish and Spanish NUTS-2 regions

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
VARIABLES	VIIT	VIIT	VIIT	VIIT	VIIT	VIIT	VIIT	VIIT	VIIT	VIIT
ln_y_c	0.322***									
	(0.0176)									
ln_y_r	0.116***									
	(0.0250)									
ln_distance	-0.326***	-0.383***	-0.391***	-0.369***	-0.363***	-0.364***	-0.363***	-0.334***	-0.387***	-0.378***
	(0.0148)	(0.0134)	(0.0134)	(0.0144)	(0.0146)	(0.0146)	(0.0149)	(0.0167)	(0.0140)	(0.0138)
eu28	0.204***	0.476***		0.477***	0.486***	0.419***	0.487***	0.268***	0.513***	0.402***
	(0.0220)	(0.0226)		(0.0226)	(0.0227)	(0.0234)	(0.0228)	(0.0237)	(0.0225)	(0.0241)
ln_pop_c		0.138***	0.119***	0.135***	0.135***	0.135***	0.136***	0.198***	0.170***	0.171***
		(0.0115)	(0.0106)	(0.0117)	(0.0117)	(0.0115)	(0.0116)	(0.0103)	(0.0105)	(0.0104)
ln_pop_r		0.202***	0.196***	0.201***	0.195***	0.201***	0.195***	0.240***	0.207***	0.218***
		(0.0146)	(0.0149)	(0.0146)	(0.0148)	(0.0147)	(0.0148)	(0.0144)	(0.0145)	(0.0144)
euroz			0.497***							
			(0.0192)							
adj				0.268***	0.207***	0.179***	0.208***	0.219***	0.162***	0.138***
				(0.0403)	(0.0403)	(0.0398)	(0.0411)	(0.0365)	(0.0384)	(0.0369)
border_region					0.165***	0.175***	0.164***	0.162***	0.163***	0.178***
					(0.0206)	(0.0206)	(0.0207)	(0.0186)	(0.0202)	(0.0201)
diff_y						-0.154***				-0.255***
						(0.0174)				(0.0239)
diff_tfp							0.000301			
							(0.00861)			
c_k2l								2.58e-06***		
								(8.03e-08)		
r_k2l								3.11e-07**		
								(1.30e-07)		
diff_k2l									0.0313***	0.123***
									(0.0110)	(0.0160)
Constant	-4.867***	-3.000***	-2.704***	-3.075***	-3.174***	-3.076***	-3.183***	-5.013***	-3.817***	-4.817***
	(0.298)	(0.165)	(0.157)	(0.165)	(0.167)	(0.167)	(0.168)	(0.178)	(0.212)	(0.249)
Observations	25,671	25,897	25,897	25,897	25,897	25,671	25,671	25,702	25,702	25,481
R-squared	0.109	0.132	0.135	0.132	0.132	0.135	0.132	0.197	0.149	0.158
Year FE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
log likelihood	-4279	-4314	-4313	-4313	-4309	-4269	-4275	-4173	-4235	-4190
BIC	-258526	-261028	-261031	-261020	-261017	-258515	-258504	-259037	-258924	-256489

*Note: Estimated in STATA 14. All regressions carried out using semi-mixed effect model with eu28 as a clustering variable. Robust standard errors in parentheses. * Significant at 10 per cent level; ** significant at 5 per cent level; *** significant at 1 per cent level.*

Table 7. Determinants of VIIT for a joint sample of Polish and Spanish NUTS-2 regions

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
VARIABLES	VIIT	VIIT	VIIT	VIIT	VIIT	VIIT	VIIT	VIIT	VIIT	VIIT
ln_pop_c	0.133***	0.185***	0.163***	0.140***	0.192***	0.0822***	0.126***	0.135***	0.137***	0.136***
	(0.0117)	(0.0108)	(0.0113)	(0.0124)	(0.00941)	(0.0116)	(0.0116)	(0.0115)	(0.0115)	(0.0116)
ln_pop_r	0.221***	0.263***	0.222***	0.195***	0.134***	0.0279*	0.183***	0.0524**	-0.0197	0.180***
	(0.0147)	(0.0143)	(0.0140)	(0.0152)	(0.0201)	(0.0155)	(0.0150)	(0.0225)	(0.0235)	(0.0153)
ln_distance	-0.375***	-0.330***	-0.372***	-0.361***	-0.498***	-0.339***	-0.361***	-0.348***	-0.361***	-0.363***
	(0.0148)	(0.0133)	(0.0138)	(0.0159)	(0.0162)	(0.0142)	(0.0147)	(0.0149)	(0.0152)	(0.0166)
eu28	0.406***	0.156***	0.338***	0.400***	0.0798**	0.239***	0.390***	0.446***	0.426***	0.418***
	(0.0245)	(0.0233)	(0.0230)	(0.0247)	(0.0327)	(0.0243)	(0.0238)	(0.0233)	(0.0231)	(0.0236)
diff_y	-0.162***	-0.146***	-0.189***	-0.153***	-0.213***	-0.0733***	-0.138***	-0.150***	-0.163***	-0.158***
	(0.0181)	(0.0195)	(0.0178)	(0.0181)	(0.0329)	(0.0177)	(0.0175)	(0.0175)	(0.0174)	(0.0174)
adj	0.158***	0.250***	0.114***	0.228***	-0.188***	-0.0466	0.162***	0.204***	0.194***	0.172***
	(0.0402)	(0.0363)	(0.0379)	(0.0425)	(0.0409)	(0.0381)	(0.0386)	(0.0409)	(0.0399)	(0.0406)
border_region	0.185***	0.163***	0.184***	0.162***	0.123***	0.245***	0.204***	0.172***	0.200***	0.192***
	(0.0205)	(0.0196)	(0.0203)	(0.0212)	(0.0228)	(0.0202)	(0.0211)	(0.0205)	(0.0223)	(0.0203)
geo_landlocked	-0.0508*									
	(0.0285)									
region_landlocked	0.0523**									
	(0.0222)									
c_inst_qual		0.441***								
		(0.0119)								
r_inst_qual		-0.142***								
		(0.0455)								
diff_inst_quality			0.208***							
			(0.0138)							
history				-0.283***						
				(0.0411)						
ln_no_fdi_cum					0.0658***					
					(0.00771)					
ln_no_fdi_cum_za						0.196***				
						(0.00591)				
ln_no_fdi_area_za							45.62***			
							(7.095)			
metro								0.308***		
								(0.0319)		
mega1									0.631***	
									(0.0457)	

mega3									0.380***	
									(0.0454)	
mega4									0.310***	
									(0.0328)	
r_tr_mway_tkm2										0.00188***
										(0.000515)
r_tr_rl_tkm2										0.00123***
										(0.000303)
access_2_sea										-0.0530**
										(0.0253)
Constant	-3.088***	-4.545***	-3.328***	-3.081***	-1.747***	-1.663***	-2.905***	-2.214***	-1.621***	-2.912***
	(0.181)	(0.169)	(0.164)	(0.176)	(0.209)	(0.172)	(0.169)	(0.202)	(0.211)	(0.176)
Observations	25,147	25,242	25,242	24,539	5,056	25,671	25,671	25,671	25,671	25,671
R-squared	0.139	0.211	0.165	0.134	0.332	0.168	0.131	0.137	0.146	0.138
Year FE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Log likelihood	-4156	-4069	-4136	-4047	-1332	-4224	-4261	-4263	-4258	-4267
BIC	-252708	-253961	-253837	-246006	-42691	-258597	-258523	-258519	-258507	-258489

*Note: Estimated in STATA 14. All regressions carried out using semi-mixed effect model with eu28 as a clustering variable. Robust standard errors in parentheses. * Significant at 10 per cent level; ** significant at 5 per cent level; *** significant at 1 per cent level.*

Institute for Development

Institute for Development
ul. J. Czyżewskiego 6/1, | 81-706 Sopot
e-mail: office@instytut-rozwoju.org
www.instytut-rozwoju.org