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HOME BIAS AND EUROPEAN INTEGRATION

The article estimates the size of home bias between 28 EU states between 2010 and 2018 and its variance between 17 industries. The assumption of the work is that home bias can be treated as a measure of integration: the smaller it is, the more countries are integrated. The aim of the article is to analyze bilateral trade flows of 28 EU states, and using Poisson pseudo-maximum-likelihood method calculate border effect for trade between these countries. Disaggregation of data into 17 production sectors will help to estimate the border effect more precisely. The methodology of the research is based on the gravity model estimation of panel data for 17 sectors, 28 countries and 9 years.

Using gravity model approach, it has been detected that the home bias is still present within the EU; however, it is decreasing with time, proving that the level of integration between states has increased. Another finding of the research is the diversity of home bias between sectors: it varies between 86.48 and 2.58, which can be explained by the difference in the rate of substitution between goods of domestic and foreign origin across industries.

JEL: F02; F13; F47

Introduction

The European Union has passed a long historical way of integration. From divided by the aftermath of World War the II European countries, it developed into the union with common principles and mutual solidarity. Results of integration are clearly visible: the EU has a share of almost a quarter of the World's GDP and stands in line with the global leaders: US and China. Free movement of labour and capital together with common economic policies have definitely increased trade between member states. Implementation of the common currency has removed currency exchange risk, which had a positive impact on trade flows as well.

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However, despite the long way of adjustments and integration of Europe, intra-EU trade is still not homogeneous, as it may be expected from the solid economic union. The Common Market is fragmented. It has been noticed that there is a tendency of countries to prefer intra-national to international trade, even if a distance with a neighbour is small and there are no trade barriers. That preference towards intra-national trade is known as home bias or border effect phenomenon. Wei (1996) has found that the EU bias average is smaller than in the rest of the countries in the world and shows a decreasing pattern. (Roman, Calvo, 2012) have also detected decreasing pattern in the home bias for EU states, the estimated coefficient was detected to be 2.7. The Border effect can be computed as an exponential of dummy estimate coefficient (exp^2,7), so Roman and Calvo's research has shown that countries' intra-national trade for EU exceeds international by more than 14 times. That result is surprising, because the distances in the EU are relatively small and there are no tariffs and almost no limits to trade.

1. Literature Review

1.1. Stages of Economic Integration

Home bias is assumed to measure the level of integration between states: the higher it is, the less integrated countries are. There was no connection found between the presence of the home bias and the specific integration stage; however, its size is directly connected to the latter.

There are several stages which several countries need to pass to become an economic union. Despite the fact that there are many ways of possible integration paths, we consider it appropriate to summarize them in 3 key stages.

Free Trade Agreement (FTA) is the first stage of economic integration. Member-countries of FTA are eliminating trade tariffs against each other, and create an institution which regulates and resolves disputes. Elimination of the tariffs can be applied to a single sector or the whole economy; however, free movement of people and capital is not a must.

On the basis of FTA, countries may decide to integrate their economies further and to sign Customs Union agreement (CU) which requires member-countries to develop and maintain a common external trade policy (Holden, 2003). That is usually done by limiting 3rd countries' access to the CU by adding quotas or creating additional external tariffs. All members of CU are presented as one unity during the economic summits or negotiations.

Under the CU, re-exportation from one member-country to others is impossible, due to the common tariff for all of them. So, instead of re-selling foreign goods, countries have to develop their own production.

Despite the benefits, joining the CU means restrictions of independent trade and foreign policies for its members. Previous trade connections are challenged by the new barriers of trade, which of course may damage relations with other non-member neighbours.

After passing steps of FTA and CU, member-countries may decide to complete the integration process and create an Economic Union. The Union includes free movement of

the labour force and capital, one single foreign trade policy and unified product regulations. Moreover, it has a common social and economic policy implemented in every member-country. Of course, it is unlikely that all of the members will be on the same level of economic development, so there is a system of regulation and balancing economies. Weaker countries are receiving donations from the common fund. The size, frequency and purpose of these donations are regulated by the Institution, in which every state is proportionally presented.

The idea of the union in Europe was born before the World War II, e.g. Stresemann, Herriot and many other politicians and economists proposed an idea of "United States of Europe" in the early 1930 s. "Pan-Europa", published in 1923 by Richard Coudenhove-Kalergi, showed a possible way of integrating Europe around three pivots of power: Germany, France, and the UK. It claimed that the Holy Roman Empire, with the up-to-date amendments, will cause another Golden Age of Europe. First integration thoughts resulted as the aftermath of World War I, and several political contradictions between potential member states.

Obstacles to integration between European states evolved into "casus belli" for Germany, there was no political power or will to resolve confrontation peacefully, and the World War II started.

Despite the severity of the Great War, the "common" Europe idea began to grow as fast as never before, and no one expected that the War would result in such a dramatic political change on the continent.

9th May 1950 is known now as Europe Day. That is the date of the famous French foreign minister's, Robert Schuman's speech. He managed to bring the new perspective on Franco-German relations after several centuries of opposition, and he proposed to replace nationalism with cooperation. "The coming together of the nations of Europe requires the elimination of the age-old opposition of France and Germany" (Schuman, 1950). He proposed real actions to be taken as first steps to further integration: coal and steel production in both countries was said to be regulated by the common institution. At that time, coal and steel were the main resources of the industrial growth, so the integration of those spheres of industry solved several problems at once.

On 18th April 1951, less than a year after the Schuman's speech, the Treaty of Paris was signed by six countries: Germany, France, Luxemburg, Belgium, the Netherlands, and Italy. According to Article 2 of the agreement, its aim was to create a common market for coal and steel, to support the economic development of the countries, resolve after-war unemployment puzzle and to increase living standards.

Probably, the most important step to complete EU integration was made in 1992. The Maastricht Treaty declared the creation of the European Union, based on EEC. The Treaty had a three-pillar structure, developing achievements of previous agreements and creating new ones. The integration process has turned the EU into one of the three biggest economies in the world in line with China and US.

To sum up, 50 years of economic integration had led the EU to the top of world best economic performers chart. Out of separate states, a solid economic union with common

values and policies has been created. Obviously, joined efficiency and output of 28 countries is significantly higher than in every single member alone. However, even in such a well-integrated union, there are limits to integration, such as home bias, which will be described and tested in the next chapters of the work.

1.2. Development of Trade Theory

Home bias is defined as a preference of country of internal over international trade. The size of the bias can be presented as a ratio of intra-national to international exports. It is noticeable from the current literature on home bias topic that results of different authors may vary dramatically. The reasons of discrepancies are in the basic background of the research. Models to reveal and measure home bias are based on trade theory as a milestone. The outcome of the investigation into the home bias phenomenon depends on assumptions and methods of research.

Theories of trade were created to study and explain the basis of trade between the countries, and its effects for both domestic and foreign economies. Depending on if the effects are positive, mixed or negative, the government can create a policy to stimulate or limit trade flow.

The absolute advantage theory was created by the "father of economics", Adam Smith (1776). According to the author, absolute advantage is achievable, when a country produces certain good at a lower cost than the other ones. Having an absolute advantage, the country should focus on the production of that good or specialize in it to have the maximal benefit from foreign trade.

Smith's idea was later on refined by David Ricardo (1817). He argued that there is no need to have an absolute advantage to benefit from trade. To address some issues that were not answered in the absolute advantage theory, the theory of comparative advantage was propounded by David Ricardo (1817). Ricardo argued that countries would mutually benefit from trade even if one achieved an absolute advantage over the other in producing all of the goods that they trade.

The Heckscher–Ohlin Theorem (H-O model) was developed on the basis of the Ricardian model by E. Hecksher and B. Ohlin (Bergstrand, 1990). Each country in pair has two factors of production in their endowments: labour and capital. The model is based on the assumptions of unequal distribution of resources between countries. One country is capital-abundant, which is a scarce factor for the other one. Each country specializes in the production of a good that intensively uses an abundant factor of production and imports a good which intensively uses a scarce production factor. That specialization is the main basis of trade between countries and represents a comparative advantage (Blaug, 1992). One of the main assumptions of H-O model is immobility of factors of production between the states, whereas within the country factors behave as imperfect substitutes of each other.

The new trade theory (NTT) was created by Paul Krugman (1979). He assumes that the increasing returns to scale and network effects are the main drivers of trade flows. Companies which first achieved increasing returns to scale receive the first mover

advantage, as they could manipulate prices and behave as a monopolist. Krugman argues that if there are enormous economies of scale and increasing returns to specialization in an industry, the global demand for goods and services may cause a number of firms to decrease. That means that in the long run firms would require benefits from the state to enter the market and maintain competitiveness, playing against first movers. The Krugman's model is based on several assumptions: firstly, there are two identical countries (home (H) and foreign (F)) and these countries share the same preferences and technologies. Secondly, labour is presented as the only non-tradable factor of production; both countries have the same endowment of labour. Consumer preferences are identical, as well.

According to Krugman, intra-industry trade occurs when countries exchange varieties of similar but not identical goods. Krugman (1979) argues that the gains from trade arise due to a larger number of varieties of goods available to consumers. Greater production of each type results in higher real income as prices are reduced due to increasing market size and competition. Krugman maintains that the comparative advantage does not only depend on the differences in factor endowments; it rather depends on the economies of scale and network effects that occur in the critical industries.

Home bias is an international trade phenomenon, so the trade theory should explain it. Depending on the selected theoretical framework, home bias may be explained differently. The article is focused on the integration of EU countries with no economic barriers to trade; thus, from the variety of described models, Tinbergen type is the most appropriate, as it does not take trade barriers into account.

Border effect or a home bias can be defined as excision of intra-national trade over international even under the condition of no trade barriers. Home bias is detected and measured by comparing internal and external trade flows of a country. To detect bias estimation with the dummy variable is used. The latter takes value 1 only if intra-trade has occurred. Depending on means and methods of the research, bias takes the value between 5 and 20, meaning that the country tends to trade with itself 5 to 20 times more.

The border puzzle was first noticed by McCallum (1995). The research was done just after the North American Free Trade Agreement's (NAFTA) implementation in 1994. NAFTA was aimed to remove trade barriers between the US, Canada and Mexico and to make trade more intensive. The author used data of 1998 to see how trade barriers are affecting the trade between the US and Canada. Moreover, Canada and the US were especially interesting, as those are close to each other geographically and culturally. As a methodology, Tinbergen (1962) type gravity model with distances, shipments of goods from importer to exporter and dummy variable, which indicated inter-province trade, was chosen. Research had a solid background of 693 observations and a promising theoretical foundation.

The result was surprising: it turned out that Canadian provinces strongly prefer to trade with each other than with foreign ones. Intra-province trade for Canada turned out to be up to 20 times higher than the trade with the US. Such a high number could not be explained by cultural difference, distance or trade barriers. The author suggested that due to that fact implementation of NAFTA will not change much in the volumes of trade.

Helliwell (1996) did the same research as McCallum, but data was taken for different period: 1993-1996. So, the period covered both times before and after NAFTA came into force. Research proved previous findings; however, the size of the effect turned out to be smaller and is equal to 18.

Wei (1996) was among other economists who thought McCallum's and even Helliwell's home bias coefficients were too high. He tested home bias among OECD countries using 9 years. Wei assumed that home bias dummy can be taken as export of the county to itself; in his work, he presented it as total production of the country minus exports to the rest of the world. The research concluded that the actual number for home bias for tested countries did not exceed 2.5. However, after adding several control variables, part of the trade pattern deviation was still not explained, so the bias should not only be explained by the trade barriers. Wei detected a link between the demand elasticity for goods produced in different countries and home bias, which goes in line with Armington. But the most important finding of the work was that there was the overall tendency of the bias to decrease. Especially it was visible in case of the EU states, as border effect in those decreased by half between 1982 and 1994.

Home bias, in general, can be interpreted as a marker of integration: the more integrated countries are, the lower the value of the home bias coefficient will be observed between them.

2. Methodology

2.1. Development of Gravity Model

The gravity model was first to detect the home bias problem and is now most frequently used to investigate it. Gravity models help to estimate trade flows between countries on the basis of distance and corresponding trade barriers between them. Since the EU has abolished borders, it is interesting to use the gravity model and see how countries are trading without trade barriers.

The gravity model of trade represents the application of the Newtonian Gravity Law to the trade between countries (Anderson, 2016). The key assumption of the model is that there will be a direct connection between the trade flow and size of exporting and importing countries, and that there is a negative relation between trade flows and distance between the countries. According to the Newton's Law, flow $\mathbf{X}_{ij}$ from an exporting state *i* to an importing state j is described by the equation below.

$$X_{ij} = G\frac{Y_i E_j}{D_{ij}^{\ 2}} \tag{1}$$

Where:

G is the gravitational constant,
$\mathbf{Y_i}$ is the relevant economic activity mass at origin country,
$\mathbf{E_j}$ is the relevant economic activity mass at the destination country,
$\mathbf{D_{ij}}$ is the distance between the country of origin and the destination.

The first breakthrough in the gravity models was achieved by Tinbergen in 1962. His equation states that there is a direct link between the economic size of two countries and trade volume. Moreover, the latter is inversely related to the distance between these states. Tinbergen took GDP as a proxy of the economic size of countries.

Equation can be presented in the following form (Tinbergen, 1962):

$$X_{ij} = A\frac{Y_i^{\alpha} E_j^{\beta}}{D_{ij}^{\gamma}} \tag{2}$$

Where:

α – elasticity of GDP of country-importer,
β – is the elasticity of GDP of the country exporter,
A – is a constant,
γ – elasticity of geographical distance between countries.

The model holds up under the assumption that there is a dependence between the amount of exports and the economic size of the country. The country with relatively small GDP cannot export the same amount as a more productive one; this is the basis for the interaction of countries' economic masses. The economic size can also be taken as GDP per capita or as population; thus, it helps to capture not only the production level of the country, but also the value of consumption. This is important because the gravity of the economy has three "components" which create pressure on other countries: domestic supply of goods, which interacts with foreign demand force and the other way around, between home demand and foreign supply. These two pairs of interacting forces will shape trade flows between the economies (Tinbergen, 1962).

Chaney (2014) criticizes early gravity models, because distance elasticity in those models is mostly presented as a linear variable. The geographical distance itself does not include or somehow present any type of economic or technological barriers. The type of the transport used, political preferences, and the nature of the traded good itself are emitted variables.

The next step in gravity models' development was made by Armington in 1969. He was the first to come up with the hypothesis that not only the type of product (e.g. machinery, chemicals, and energy carriers) matters for consumers, but also the country of product's origin (Armington, 1969). According to his studies, there is a country of origin bias, which appears due to the historical or gained preferences of consumers.

Armington hypothesis expanded an understanding of the gravity modelling mechanisms as he suggested to split all goods traded between the countries in several classes. He also proposed to distinguish between tradable and non-tradable goods; tradable goods were said to have different trade costs, depending on the country of origin.

Anderson (1979) applied Armington's approach and integrated it into his model. As a basis of his model, he used traditional gravity equation of the Tinbergen type. The model was extended by the addition of the following assumption: both trading countries produce two types of goods: tradable and non-tradable one. That was done to make the model more realistic, as before it was restricted to only one differentiated good per country. The assumption on transportation cost, indicating a trade barrier, was also added to make the

model closer to reality. The final look of the Anderson model, which includes two countries and multiple traded goods is given below:

$$X_{ij} = \frac{Y_i \Phi_i \Phi_j Y_j}{\Sigma_j \Phi_j Y_j} \frac{1}{f(d_{ij})} \left(\sum_j \frac{Y_i \Phi_i \Phi_j Y_j}{\Sigma_j \Phi_j Y_j} \frac{1}{f(d_{ij})} \right)^{-1} \quad (3)$$

Where:

X_{ij} – bilateral trade flows from exporting country to importing,
Y_i – GDP of exporter country,
Y_j – GDP of importer country,
Φ_i – share of expenditures on all traded goods in the total expenditure of the exporting country,
Φ_j – share of expenditures on all traded goods in the total expenditure of importing country,
d_{ij} – distance between trading countries.

The left-hand side of the equation (3) corresponds to the economic distance between two trading countries, and the right-hand side corresponds to the economic distance from a country-exporter to other possible partners. Both parts are presented in relation to global expenditure and global trade, respectively.

Linder (1961), in his essay, proposed a hypothesis that similar countries have similar demand and supply structures. So, although they exchange the same category of goods, products will be differentiated. Even if two industrial countries trade with each other, they will both benefit from it, because each countries' consumers will have a wider choice of alike but not identical goods.

Another attitude towards gravity modelling was presented by Deardorff, who took Hecksher-Ohlin theory (described above) as a foundation of his model. Deardorff proposed two possible scenarios with different assumptions: frictionless and impediments trade options.

The first scenario is based on several strong assumptions, the first of which being homogeneity of tradable goods. According to Deardorff, the variety of goods exists in a joined basket, composed of exports from all involved countries. Consumers may select a desired good from that basket. World market equilibrium remains stable because of the transparency of each single market and perfect competition between producers and countries. The final equation of the model in that scenario is presented below.

$$X_{ij} = \frac{Y_i Y_j}{Y^w} \left(1 + \sum_k \lambda_k \alpha_{ik} \beta_{jk} \right) \quad (4)$$

Where:

X_{ij} – bilateral exports of two countries,
Y_i – GDP of exporter,
Y_j – GDP of importer,
Y^w – compounded GDP of all potential trade partners in the world,
α_{ik} – level of production of good k in the country-exporter,
β_{jk} – level of consumption of good k in the country-importer,

λ_k – global income from sales of good k.

The equation states that import of one country from another depends on the share of production of both countries in the world production. Since there are no transportation costs, the distance does not affect the model, as it has been replaced with arbitrary preferences as the main determinant of the volume of trade.

The second scenario proposed by Deardorff includes trade barriers. According to Krugman (Krugman, Obsfield, 2006), during the trade between two countries, the price of production factors will be changing, with the increase of trade volume, until it becomes equal in all countries.

Deardorff's equation indicates a new factor that was not considered in gravity models before: it proved that the gravity mass of the country is relative, subject to the distances to other countries. If the distance between the two considered countries is taking a lower value than the distance with the rest of the countries, then the standard gravity equation does not hold. To balance the distance gap, it was proposed to use the inflation level of considered countries.

Trade flows in the model are affected not only by distance and trade barriers, but also by the price level.

Inflation acts as a geographical barrier: increase of prices in the exporter country will make it less attractive for importers and the other way around. In such a case, the main influence on trade flows between the countries comes from a comparative advantage: a country may be more advanced in the overall technology level, but its unique specification in technology could make it less attractive to trade partners.

Distance is another milestone of gravity models. There were several methodologies to capture the distance within the model. The most commonly used method is to take distance as real geographical distance between countries. On the one hand, that is easy and reliable: data is available and at the same time reliable. On the other hand, a straight line between states is rather a proxy then a real measure, because trade flows are connected to roads and routes rather than to the shortest possible distance. Thus, the second methodology uses average of length of roads between two trading countries. Both methodologies presented above can be applied only to international trade, as in the case of intra-national trade; the country of origin is the same as the country of destination.

Head (2001) has proposed a solution for the problem of measuring intra-national distances:

$$x_{ij} = 0.67 \frac{\sqrt{Area}}{\pi} \tag{5}$$

Where:

x_{ij} – internal distance, meaning that country of origin is same as destination,

Area – Area of the country.

Due to the absence of trade barriers and relatively close location of EU members, Head's assumption of each economy as a "disc in which all production concentrates in the centre and consumers are randomly distributed through the rest of area" holds well (Head, 2001).

2.2. Home Bias as a Trade Phenomenon

Nowadays, there are many approaches to the estimation of gravity models; the paper focuses on Poisson Pseudo-maximum likelihood (PPML). The very first estimation of the gravity model of Tinbergen type was done in the log-linear form: both parts of the regression were transformed into the natural logarithm form. It helped to smooth data and to overcome problems of scaling (too big and too small values included in one equation) and unit roots. However, despite the obvious benefits of having regression in the log-linear form, there are disadvantages of this approach as well. First of all, the gravity model estimation requires a relatively big data set, and some values may be missing or have zero value. The Log-linear method will ignore and omit those observations, adding restrictions on the data set. Moreover, Silva and Tenreyro (2006) have detected that using natural logarithms may cause the presence of heteroscedasticity in the model. In a multiplicative model, the natural logarithm of the error term includes the variance of itself. The expected value of the error term will depend on several variables, if the error term is heteroscedastic, which breaks the crucial assumption of OLS. Thus, OLS estimator will be biased and will not be the best possible for this kind of model.

The "Log of Gravity" proposed by Silva and Tenreyro presented the new approach: PPML. According to their study, PPML shows better overall performance then OLS. First of all, PPML solves the problem of zero observations, because it uses levels instead of logarithms, so, in PPML, there will be more observations available. Moreover, PPML was proved to be robust to heteroscedasticity.

2.3. Data Description and Transformation

Bilateral trade data was taken from STAN database (OECD) as real bilateral exports between each pair of 28 countries, gravity data was taken from CEPII, the data covers 2010-2018[3] time period. Industries which were included in the research are presented in the table below. Industries of production are disaggregated by ISIC Rev. 3 (International Standard Industrial Classification of All Economic Activities). The choice of the industries is explained by diversification and data completeness.

Data for the research in the following chapter was taken for 28 EU states. International distances are provided by CEPII database; the distance of intra-national trade was calculated by Formula (5).

[3] There was a specific time period of 9 years for the study (2010-2018). 2019 was not taken into account, because no data were available for the study period for individual countries and Industries selected for the research.

Table 1

Industries selected for the research

Variable Name	Sector of production	Variable Name	Sector of production
Hagr	Agriculture, hunting and related service activities	Hpha	Pharmaceuticals
Hfor	Forestry, logging and related service activities	Hrub	Rubber and plastics products
Hfish	Fishing, fish hatcheries, fish farms and related services	Hmet	Basic metals and fabricated metal products
Hmin	Mining and Quarrying	Hfmet	Fabricated metal products, except machinery and equipment
Hfoo	Food products and beverages	Hmach	Machinery and equipment
Htob	Tobacco products	Htra	Transport equipment
Htex	Textiles and textile products	Hotra	Other transport equipment
Hwoo	Wood and products of wood and cork	Hpap	Pulp, paper, paper products, printing and publishing
Hche	Chemicals excluding pharmaceuticals		

Source: STAN Database, OECD.

Internal import of countries is taken as a proxy for home bias. According to Wei's (1996) definition, home bias is "imports from itself in excess of what it [country] would be imported from an otherwise identical country" (Wei, 1996, p.9). As there is no possibility to find internal export of a country to itself in any database, internal export is calculated by Wei's methodology:

Internal Imports = Total Production – Exports to the World

Data represents a panel of 104677 observations (28 importers, 28 exporters, 9 years and 17 sectors), out of which 45911 (4.3% of the overall dataset) are missing values, due to information unavailability. To keep the panel strongly balanced and to address zero observations, PPML was chosen as the method of estimation.

3. Empirical Research

3.1. Model Specifications

Regression equation takes the following form:

$$\mathbf{bitrade_{ij}} = \beta_0 + \beta_1 \mathbf{dist_{ij}} + \beta_2 \mathbf{contig_{ij}} + \beta_3 \mathbf{Y_i} + \beta 4 \mathbf{Y_j} + \beta_5 \mathbf{lang_{ij}} + \\ + \beta_6 \mathbf{home_k} + + \alpha_i + \alpha_j + \tau + \iota + \varepsilon \qquad (6)$$

Where:

bitrade$_k$ij – k-sectoral bilateral exports between home and foreign countries, (thousands USD in current prices), calculated on the basis of STAN, OECD,

dist – distance between home and the foreign country in kilometres, data taken from CEPII database and calculated on the basis of CEPII.

$\mathbf{Y_h}$ – GDP of home county (thousands USD in current prices), data taken from CEPII database,
$\mathbf{Y_f}$ – GDP of foreign county,(thousands USD in current prices), data taken from CEPII database,
$\mathbf{lang_{ij}}$ – dummy variable taking value 1 if there is the common language spoken in country pair and 0 otherwise, data taken from CEPII database
$\mathbf{contig_{ij}}$ – dummy variable taking value 1 if countries are sharing common border and 0 otherwise, own elaboration,
$\mathbf{home_k}$ – dummy variable taking value 1 if there is internal import in k sector and 0 otherwise, own elaboration,
$\boldsymbol{\alpha_j}$, $\boldsymbol{\alpha_j}$ – fixed effect to capture exporter and importer in country pair,
$\boldsymbol{\tau}$ – time fixed effect, $\boldsymbol{\iota}$- industry fixed effect, ε – error term.

Distance is expected to have the only negative sign of the coefficient. Distance in the model is the main limit of trade; since there are no tariffs between EU countries, distance is taken as a proxy of transportation cost. All other signs are expected to be positive: literature review presented a strong positive correlation between GDP of both exporter and importer and bilateral trade flows. Having a common language and sharing the common border are expected to make trade flows more intense. Home bias is expected to have a positive sign as per previous researches.

OLS regression was used with robust command in Stata, which makes standard errors robust to heteroscedasticity. PPML is robust itself, according to Santos Silva and Tenreyro, developers of the approach. "Our method (PPML) is robust to different patterns of heteroscedasticity" ("Log of gravity", 2006, p. 653). Data has been tested on the presence of multicollinearity and autocorrelation.

To test autocorrelation in the estimations, the Wooldridge test was used *xt* serial in STATA. H0 of the test is no first-order autocorrelation. In all equations, there was no statistical reason to reject H0, so I can conclude that regressions are not affected by the autocorrelation.

Wooldridge test for autocorrelation in panel data

H0: no first-order autocorrelation

F(1, 8097) = 0.894

Prob> F = 0.3358

Every equation was tested for multicollinearity, using VIF test after running a regression. Variance Inflation Factor (VIF) shows by how much variance of the coefficient is affected by multicollinearity. If VIF estimator exceeds the value of 10 (see table 2), this means that there is significant multicollinearity, which can cause bias in the regressions. Since VIF coefficient is less than 10 and, at the same time, 1/VIF is never below 0.10, it can be concluded that there is no multicollinearity in the tested dataset.

Table 2

Results of VIF Test

Variable	VIF	1/VIF	Variable	VIF	1/VIF
lndistone	1.46	0.683889	Hmet	1.01	0.986123
contig	1.41	0.708434	Htra	1.01	0.986201
comlang_off	1.17	0.853114	Htob	1.01	0.986321
lngdpo	1.08	0.929309	Hfish	1.01	0.98647
lngdpd	1.07	0.937185	Hmach	1.01	0.986698
Hfmet	1.02	0.983312	Hotra	1.01	0.987365
Hpap	1.02	0.983312	Hagr	1.01	0.98784
Hwoo	1.02	0.983487	Htex	1.01	0.988042
Hmin	1.02	0.983988	Hche	1.01	0.988102
Hrub	1.02	0.984114	Hfor	1.01	0.988598
Hfoo	1.02	0.984311	Hpha	1.01	0.986123
Mean VIF			1.07		

Source: own elaboration.

3.2. Model Results and Interpretation of Outcomes

It should be noted that due to specifics of PPML methodology, a dependent variable must be in values, whereas independent ones are in the natural logarithm form (Santos Silva, Treneyro, 2006).

Signs of all of the variables in the table above are expected and in line with the literature review. The only negative coefficient belongs to distance, which indicates an inverse relation between distance and trade flows, which is in line with the theoretical background. Surprisingly, a common language turned out to be insignificant in the model. This can be explained by the relative simplicity of the model and by possibly omitted variables (see table 3). The last column of the table represents estimated home bias by industries; as it has been mentioned, the exponent of the home variable coefficient is showing how much intra-national trade exceeds international. The biggest home bias value is observed in agriculture, hunting and related service activities sector (86.48), forestry, logging and related service activities (38.36), and fishing, fish hatcheries, fish farms and related services (45.42).

The smallest home bias values are observed among the transport equipment sector (2.58), machinery and equipment sector (4.22), and chemistry sector (5.76). In the case of transport equipment, estimations showed that selected countries tend to trade just 2.6 times less with other countries than they do with themselves. This proves the hypothesis of difference in the bias level among different sectors of production. The difference between the largest and the smallest home bias value is huge and equals 83.9. Surprisingly, the average of estimated home bias values of all of the tested sectors turned out to be 22.3, which is not that far from McCallum's result.

Table 3

Results of Estimations

R-squared: .62797112							
Number of observations: 94176							
$bitrade_{ij}$	Coef.	Std.Err.	z	P>|z|	[95%	Conf.Interval]	Home bias value (e^Coef.)
$lndist_{ij}$	-1,21402	0,030188	-40,21	0.000	-1,2722	-1,153266	-
$contig_{ij}$	1,043368	0,076027	13,72	0.000	0,893746	1,190664	-
$lang_{ij}$	0,021212	0,079608	0,27	0.80	-0,13465	0,176933	-
lnY_i	0,323166	6,365572	0,05	0.000	0,322796	0,322846	-
lnY_j	0,369393	6,576522	0,06	0.000	0,368988	0,369009	-
_cons	11,43048	0,253411	45,11	0.000	10,92581	11,910400	-
Industry specific Home bias coefficients							
Hagr	4,465056	0,425081	10,50	0.000	3,629524	5,290514	86,48032
Hfor	3,650871	0,4617	7,91	0.000	2,744262	4,549102	38,35757
Hfish	3,820172	0,440977	8,66	0.000	2,954004	4,677624	45,4221
Hmin	3,288322	0,424159	7,75	0.000	2,455475	4,113610	26,70754
Hfoo	3,639448	0,424732	8,57	0.000	2,805218	4,465369	37,92255
Htob	3,007895	0,441306	6,82	0.000	2,141691	3,867119	20,18498
Htex	1,638027	0,439914	3,72	0.000	0,775573	2,496430	5,140359
Hwoo	2,750904	0,426214	6,45	0.000	1,914438	3,580959	15,61658
Hpap	3,197143	0,425938	7,51	0.000	2,360884	4,026036	24,38341
Hche	1,751311	0,440968	3,97	0.000	0,88671	2,611618	5,755966
Hpha	1,877267	0,440612	4,26	0.000	1,013268	2,736701	6,527368
Hrub	2,212904	0,425523	5,20	0.000	1,378196	3,042353	9,126104
Hmet	3,035077	0,425369	7,14	0.000	2,200055	3,863081	20,74033
Hfmet	3,138196	0,42517	7,38	0.000	2,303483	3,965671	22,98967
Hmach	1,440186	0,441547	3,26	0.001	0,574684	2,302059	4,218915
Htra	0,948215	0,44208	2,14	0.034	0,082039	1,811812	2,581431
Hotra	1,98905	0,424121	4,69	0.000	1,157251	2,816068	7,298143

Source: own elaboration.

Differences in the coefficients can be explained by the elasticity of substitution between home and foreign good. Hillberry (2002) considers that elasticity of substitution may vary depending on the type of the product. Thus, the results of the work may be different from other researchers due to the level and type of disaggregation of goods.

The elasticity of substitution varies between industries, and depends on consumers' preferences within the home country. The nature of the good itself plays a great role as well: how easily the good can be transported from one country to another, if the good loses its value during transportation or not; moreover, the industry development may be different for each of the countries. For the agriculture and fishery sectors, it is crucial to optimize the distance between a producer of raw material and a manufacturer, as transportation of those kinds of products may require special vehicles which increase transportation cost. Moreover, goods from those industries, as well as raw materials, require special storage and treatment during transportation. That may explain why there is so high home bias level in those industries. On the other hand, transport equipment just like machinery and equipment

goods and raw materials can be easily transported, as they are not losing any value during transportation.

For the second part of the study, it has been decided to estimate the equation below to see the development of home bias between 2010 and 2018 for selected countries.

$$bitrade_{ij} = \beta_0 + \beta_1 dist + \beta_2 contig + \beta_3 Yh + \beta_4 Y_f + \beta_5 lang + \beta_7 home2010k + \\ + \beta_8 home2011k + \beta_9 home2012_k + \beta_{10} home2013_k + \beta 11 home2014k + \\ + \beta 12 home2014k + \beta 13 home2016k + \beta_{14} home2017_k + \beta_{15} home2018_k + \alpha_i + \\ + \alpha_j + \tau + \varepsilon$$

Where:

$bitrade_{kij}$ – k-sectoral bilateral exports between home and foreign countries, (thousands USD in current prices), calculated on the basis of STAN, OECD,

$homet_k$ – dummy variable taking value 1 if there is internal import in k sector for each of 9 years and 0 otherwise,

dist – distance between home and the foreign country in kilometres, data taken from CEPII database and calculated on the basis of CEPII,

Y_h – GDP of the home county (thousands USD in constant prices), data taken from CEPII database,

Y_f – GDP of foreign county (thousands USD in constant prices), data are taken from CEPII database,

$lang_{ij}$ – dummy variable taking value 1 if there is the common language spoken in country pair and 0 otherwise, data taken from CEPII database,

$contig_{ij}$ – dummy variable taking value 1 if countries are sharing common border and 0 otherwise, own elaboration,

α_j , α_j – fixed effect to capture exporter and importer in country pair,

τ – time fixed effect, ι- industry fixed effect, ε – error term.

Because dummy are variables included in the model, typical fixed effects model of *xt*reg, *fe* in STATA cannot be used thus, it has been decided to add the latter manually. To include fixed effects, dummies for year, industry, the country of origin and the country of destination were used.

The fixed effect is represented as 28 dummy variables, which take value 1 only when each of the countries is acting as an exporter. On the contrary, the country of destination dummy takes value 1 if the country is importing. The same type was used to capture industries fixed effect.

To test time evolution of the home bias, Hagr type dummy has been replaced by the Hyear type. Results of estimations for year-specific home bias coefficients are presented in table 4.

After specification of the home variable was changed: dummy variable now indicates yearly development of home bias. The model held well after the reconsideration of dummies. Distance has the only negative sign, indicating that the model performs in line with the theory. On the basis of table 4, there was constructed a chart to show the evolution of home bias with time.

Table 4

Results of Estimations for year-specific home bias coefficients

R-squared: 43627597					
Number of observations: 94176					
$bitrade_{ij}$	Coef.	Robust Std. Err	z	P>|z|	Home bias (e^Coef.)
$lndist_{ij}$	-0,878945	0,093003	-9,45	0	-
lnY_i	0,112662	0,026102	4,32	0	-
$lang_{ij}$	0,000922	0,183266	0,01	0,994	-
$contig_{ij}$	0,310663	0,177597	1,75	0,083	-
lnY_j	0,134017	0,025043	5,35	0	-
_cons |	7,838771	0,615185	12,74	0	-
Year-specific home bias coeeficiens					
$Home2010_k$	1,289024	0,261564	4,93	0	3,647499
$Home2011_k$	1,453758	0,297254	4,89	0	4,281522
$Home2012_k$	1,640093	0,250668	6,54	0	5,133782
$Home2013_k$	1,603992	0,249660	6,42	0,001	4,949629
$Home2014_k$	1,316569	0,265875	4,95	0	3,751447
Home2015	1,375931	0,263915	5,21	0	3,950143
$Home2016_{k3}$	1,360181	0,261817	5,20	0	3,900799
$Home2017_k$	1,329713	0,260879	5,10	0	3,766982
$Home2018_k$	1,137265	0,2619757	4,34	0	3,177475

Source: Own elaboration.

Coefficients in column 3 represent the level of home bias in the specified year; these are significantly lower comparing to the ones in table 3, as now there is no specification of industries. This proves once again that the size of the border effect may vary because of the model specifications.

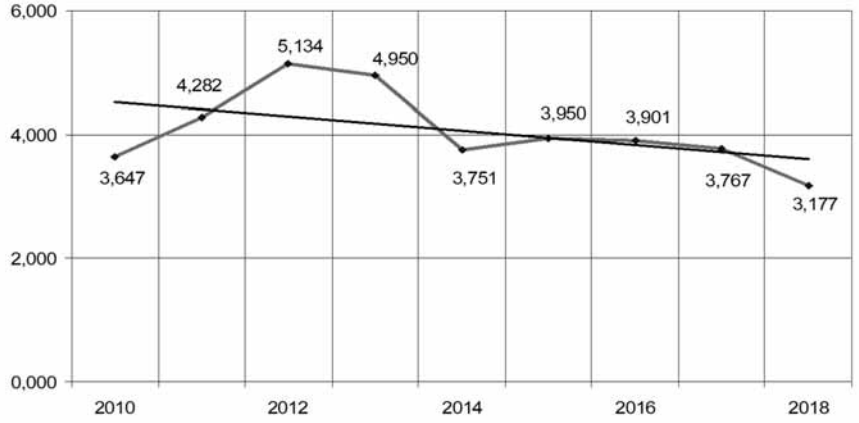
The blue line corresponds to the home bias, the black one to its trend value. As it was assumed, there is a declining trend of home bias with the average growth rate of. This tendency can be explained by the increase in integration and openness to trade between countries. As well as changes in the structure of production, export and internal market saturation. The fact that the preferences of countries in goods and services, as well as their quality and price have significantly changed, plays a significant role in the conditioned dynamics.

The blue line corresponds to the home bias, the black one to its trend value. As it was assumed, there is a declining trend of home bias with the average growth rate of -10% per year. This tendency can be explained by the increase in integration and openness to trade between countries. Relatively high shifts can be explained by the transition period of new countries in the EU.

According to the results of the study, the bias has been decreasing since 2015 due to integration processes in the EU. Efforts are constantly being made in the EU to balance consumer preferences between goods of domestic and foreign origin. Also, a decrease in prejudice towards the home and, as a result, further integration is limited by the rather low promotion of foreign goods by buyers and their conviction that foreign goods are equivalent to domestic ones.

Chart 1

Evolution of home bias for selected countries 2010-2018



Source: own elaboration.

Consumers continue to discriminate against foreign goods, even though they are the closest substitutes for domestic goods. The increase in demand and consumption of domestic goods, respectively, affected the level of saturation of the market with goods.

So, the decrease in the dynamics of the level of home bias between EU countries can be explained by the integration of countries and the development of a common market. Despite the fact that countries still prefer inner trade, the ratio of intra-national to international trade in EU is decreasing. Countries are becoming more open to trade with each other.

Summary and Conclusions

The Single Market and the Currency Union are definitely the greatest achievements of the EU. Barriers of trade were dramatically reduced in the EU during the period of its integration. Introduction of free movement of labour and capital, elimination of tariffs and creation of common external tariff were aiming to synchronize trade flows and develop the new trade connections between member countries. However, home bias, which was found to be among the main limits of integration nowadays, is present between EU countries.

Gravity modelling approach makes it possible not only to detect the presence of the home bias, but also to measure it in a quantitative way. Recent studies have identified that home bias in the EU was relatively low in comparison to the rest of the world; however, it was present. The main hypothesis of the article was that there is a border effect between EU countries and that it has decreased with the integration of the EU. Hypothesis one was proved to be correct and the second one turned out to be partially correct. The article has

detected and measured the border effect between 28 EU states by industries. Home bias was observed to vary across industries. The biggest home bias value was observed in agriculture, hunting and related service activities sector (86.48). The smallest home bias values were observed among the transport equipment sector (2.58).

According to the results, home bias is indeed reduced by the integration processes of the EU. However, there are still some efforts to be taken to balance consumers' preferences between goods of home and foreign origins. Consumers are still discriminating foreign goods, despite the fact that these are the closest possible substitutes to the home ones.

Home bias reduction and, as a result, further integration can be achieved by promoting foreign goods to customers and making them believe that foreign is an equivalent to domestic. However, preferences are driven not only by rational thinking, prices or income. Some people think that by buying domestic goods, they save their neighbours' jobs. So, the true reasons of home bias remain yet to be investigated.

The limitations of the article, first of all, are connected to data unavailability. Data on bilateral trade is present only for a limited time period, and there are missing values. Moreover, the research was based on a relatively simple model. Thus, the home bias level may not be precise. The article focuses on the detection of the home bias rather than on explanation of its phenomenon due to the fact that the true reason of home bias is still not explained.

As per a recommendation for further research, it will be interesting to see how home bias will behave on a wider timescale. It would be also interesting to focus on the comparison of home bias level between original members of EU and countries which joined in the latest decade, as a methodology of the paper produced only the general outcome, without specific information for each of the countries.

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