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Alternative measures of internal distance in estimating home bias in trade: the case of Croatia

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ABSTRACT

The existence of home bias in trade is considered as one of six main puzzles in international economics. The measurement of the average intra-national distance has become the crucial issue in estimating the home bias in goods trade for countries with no internal trade data. The aim of this article is to demonstrate how different internal distance measurement affects home bias in trade. The results of the analysis indicate that sub-unit based weighted measures perform better in the assessment of Croatia's internal distance than area based and measures based on relation to neighbour countries. In estimating the model, we use data on import values for Croatia according to standard gravity theory. Regression analysis corroborates theoretical assumptions regarding the impact of geographical distance of countries and transport costs on bilateral trade flows; imports from world are positively correlated with the GDP of imported countries and negatively correlated with the distance between them. The values of home bias variable for Croatia's total imports were slightly higher than results obtained from previous explorations for EU countries meaning that there is still place for Croatia's deeper integration into EU trade flows.

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1. Introduction

The existence of home bias in trade is considered as one of six main puzzles in international economics according to Obstfeld and Rogoff (2000) sparking a debate which attempts to explain the phenomenon. Deardorff's *Glossary of International Economics* defines home bias as 'a preference, by consumers or other demanders, for products produced in their own country compared to otherwise identical imports.' It describes an instance when a consumer differentiates between imported goods and domestic products and tends to purchase the domestic variety. McCallum (1995) was the first to conduct an empirical analysis that emphasises consumption asymmetry affected by national borders. Using classic Tinbergen (1962) gravity model, the author concludes that 1988 intra-national merchandise trade flows among Canadian provinces were 22 times higher than the trade between Canada and

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the US after controlling for the effects of economic size and distance. The theory of gravity equations was developed by Anderson (1979) and it tells us that the region will trade more with its bilateral partner the more it is resistant to trade with all other regions. The study of EU countries is appealing because countries within the Union are highly integrated, which is especially evident after the elimination of border controls and the harmonisation of standards and regulations imposed by the 1992 Single Market Programme.

The estimation of border effects requires a measurement of the internal distance and the external distance. The internal distance can be defined as 'the distance of a country from itself' (Head & Mayer, 2000). On the other side the external distance is the distance between the country and its trading partners. The measurement of the average intra-national distance has become the crucial issue in estimating the home bias in goods trade for countries for which no internal trade data exist. Trefler (1995) showed that home bias helps to explain why countries trade with each other less than would be predicted by the Heckscher-Ohlin model, i.e., the 'case of the missing trade'. Evans (2001) identified two potential causes of 'home bias'; pure location factors such as barriers to imports or access to a local distribution network and an inherent preference for domestic goods per se. The author found out that the tendency to purchase domestic goods rather than imports arises almost entirely from pure location factors. Turrini and Van Ypersele (2002) stated that even between perfectly integrated and similar countries the legal system differs, so that legal costs are higher when business is done abroad. This is especially evident in industries characterised by high turnover. Anderson and Wincoop (2001) found that national borders reduce trade between US and Canada by about 44% while reducing trade among other industrialised countries by about 30%. The aim of the article is to show implications of different internal distance measurement on estimating home bias in trade for Croatia. In section two we give empirical findings on home bias in trade. Alternative measures of internal distance measurement in estimating home bias in trade are presented in section three. After giving theoretical framework in first three chapters, the methodology and empirical analysis is conducted in the fourth section of the article. Section five contains a summary and conclusion.

2. Empirical findings on home bias in trade puzzle

Many economists have contributed to the development of theory for home bias in trade. This research can be divided into two groups: intra-country (provincial) research (Canada, USA[1] and Spain and other countries[2]) and country–to-country research (mostly OECD and EU countries). Some economists provided sectoral analysis for various import sectors. Table 1 lists all papers analysing the country-to-country border effect.

Wei (1996) examined the home country bias in goods market among OECD countries in the period between 1982 and 1994. He came to the conclusion that an average OECD country imports about two and a half times as much from itself as from an otherwise identical foreign country after controlling for economic sizes of exporter and importer, distance, geographic location and possible linguistic tie. The size of home bias depended on degree of substitutability among goods produced in different countries as well as on the barriers to trade. Helliwell (1997) approximated data for the volumes and distances of internal trade in OECD countries, the 1988–1992 border effect for unrelated OECD countries was estimated above 12. Nitsch (2000), using a standard gravity model, found that average EU country intra-national trade is about 10 times as high as international trade with an EU partner

Table 1. Overview of country-to-country border effect.

Paper	*Country*	*Sectoral analysis*	*Time period observed*	*Border effect*
Wei (1996)	OECD	No	1982–1994	2.6–10
Helliwell (1997)	OECD	No	1988–1992	>12
Nitsch (2000)	EU-10	No	1979–1990	7–10
Head and Mayer (2002)	EU-12	Yes	1992–1995	3,1
Vancauteren (2002)	EU-10	Yes	1990–1998	5.7–19.7
Chen (2004)	EU-7	Yes	1996	3.6
Hess (2005)	China	Yes	1994–2002	8–37
Balta and Delgado (2007)	EU-15	No	1997–2003	11.5–29.4
Pacchioli (2011)	EU-15	No	1996–2002	16.6–24.3

Source: Authors.

country of similar size and distance. This article provided two major contributions at that time: first, a conceptually more sophisticated method to approximate average distances within countries and second, analysing the degree of home bias in the European Union.

Head and Mayer (2002) developed a new measure of 'effective' distance between and within geographical units. Their major finding is that the existing measures used in the literature overestimate effective distances and that this distance inflation is stronger the closer the two nations are to each other. They show how use of the existing methods for calculating distance leads to 'illusory' border and adjacency effects. They then applied that method to data on interstate trade in the US and inter-member trade in the European Union and found out that post-single market Europe in 1992–1995 was only marginally fragmented with a border effect of 3.1. Vancauteren (2002) estimated the impact of technical barriers[3] such as to trade on bilateral trade flows of individual EU countries and evaluated the downward impact of national borders on trade flows. He found substantial home bias for sectors where differences in technical regulations are not thought to be important for the EU-10 countries for the period between 1990 and 1998 in the range of 5.7 to 19.7. According to that, technical barriers to trade cannot be the only factor linked to the home bias effect and other attributes such as differences in preferences, price competition and other non-tariff barriers may also explain the presence of home bias. Chen (2004) also examined border effects among EU-7 countries for the year 1996. A typical European country trades 3.6 times more with itself than with another country. According to this author key reasons for explaining the border effects across industries were low transportability, specialisation in production and economies of scale. Hess (2005) empirically investigated the effects of decreasing trade costs on China's home bias in trade. For that purpose, he used data on import values for a set of 49 countries, 30 OECD member and 19 non-OECD member countries from Asia for the years between 1994 and 2002. The estimated border effect ranged between eight and 37. The article produced three main results: first, the estimations showed a significant decrease in China's home bias over time that suggests a higher level of integration, second, the WTO dummy showed a high negative effect on Chinese imports in 1994 that led to a lower level of the home bias variable and the third, the distance elasticity is greater than one and increased over time. Balta and Delgado (2007) evaluated the success of integration policies in the EU by assessing the magnitude and evolution of home bias across Europe in goods and services markets and equity portfolio holdings. Despite the process of European integration, the degree of home bias in the product markets remains considerably high, meaning that Europeans mostly shop at home. Home bias for goods decreased between mid-90s and 2000 but it stagnated afterwards, which might indicate a lack of effect of integration policies. The approximated home bias for EU-15 in the period between 1997 and 2003 ranged between 11.5 and 29.4. Pacchioli (2011) came to similar results as Balta and Delgado (2007). Estimations based on single equation cross-sectional analysis for each of the markets considered separately support the hypothesis of the home-bias effect. Estimated results showed that an average EU country trades more within its borders than with other member states about three to four times as much as a random US state does.

3. Alternative measures of internal distance in estimating home bias in trade

In estimating home bias in trade one should use some form of internal distance measurement. This section gives an overview of various internal distance measures. All internal distance measures can be divided into three groups: internal distance measures in relation to neighbour countries, area based internal distance measures and sub-unit based weighted averages. The overview of internal distance measures is presented in Table 2.

Internal distance can be defined as distance between units in the same country which represents transport costs. The correct measure of domestic (internal) distance is very important issue because it directly affects the estimated border effects. There has been little consensus about appropriate measure of internal distance. According to Head and Mayer (2002) most measures of internal distances overestimate internal distances with respect to international distances because they try to calculate average distances between consumers and producers without taking into account the fact that inside a country goods tend to travel over smaller distances. Intra-national trade statistics are rarely available but are important in constructing the model for analysis. Wei (1996) proposed an interesting method for estimating home bias in trade introducing variable *OWNSTATEDUMMY* representing imports from itself (subtracting exports from total production). Wei (1996) also presented formula for country's total volume of intra-national trade approximated by one-quarter of the distance from the country's capital to the capital of the 'nearest' neighbour country.

Table 2. Overview of internal distance measures.

Internal distance measure
I. Measures based on relation to neighbour countries:
1. $d_{ii} = 0.25 \cdot \min_j(d_{ij})$, one quarter distance to the nearest neighbour country, Wei (1996)
2. $d_{ii} = 0.5 \cdot average(adjacency)$, one half averaged over all neighbour countries, Wolf (1997, 2000)
II. Area based measures:
3. $d_{ii} = \sqrt{area/\pi}$, average distance between two points in a population uniformly distributed across the disk, Leamer (1997), Nitsch (2000)
4. $d_{ii} = 0.33\sqrt{area/\pi}$, average distance between two points in a circular country, Redding and Venables (2000)
5. $d_{ii} = 0.67\sqrt{area/\pi}$, production concentrated in a single point, consumers uniformly distributed across the disk, Head and Mayer (2000)
6. $d_{ii} = 0.52\sqrt{area}$, internal distance of cities represented as square grid, Helliwell and Verdier (2001)
III. Measures using sub-unit based weighted averages:
7. $d_{ii} = 2w_{i:2}d_{i.12}$, distance between two largest cities adding a weight for the share of the population in the top two cities, Wolf (2000), Helliwell and Verdier (2001)8. $d_{ii} = \left(\sum_{k\in i}(y_k/y_i)\sum_{l\in j}(y_l/y_j)d_{kl}^{\theta}\right)^{1/\theta}$, Constant elasticity of substitution, Head and Mayer (2002)9. $d_{ii} = \sum_{j=1}^{R} w_j\left(\sum_{k=1}^{R} w_k d_{jk}\right)$, Arithmetic mean distance, Head and Mayer (2000), Helliwell and Verdier (2001), Antweiler (2007)10. $d_{ii} = \frac{\sum k\in C_i \sum l\in C_j D_{kl}W_{kl}}{\sum k\in C_i \sum l\in C_j W_{kl}}$, Harmonic mean distance, Head and Mayer (2002), Antweiler (2007)

Source: Head and Mayer (2002) and authors' addition.

On the other hand, Wolf (1997, 2000) approximated internal distance as one half averaged over all neighbour countries. These measures of internal distance are measures based on relation to neighbour countries. Nitsch (2000) criticised both measures implying that they 'suffer from possible geographical inconsistencies'. Wei's approach implicitly assumes that the capital cities are equally close to the border which is not a realistic assumption. To illustrate this problem Nitsch compared distances between German capital Bonn and Danish capital Copenhagen. Faced with these problems, Nitsch complements on Leamer (1997) introducing a new measure for internal distances; area based measures based on the radius of a disk. The advantage of his measure is that it can be calculated using only one input data – area of the country. Nitsch (2001) indicates a possible problem that can arise in the analysis (different shapes of countries, internal structures and trading patterns) emphasising it is questionable whether this is a correct measure for internal distance. He suggests to derive country's average intra-national distance from the geographical size of the country multiplying it by the square root of an area by a scaling constant. A few other researchers have contributed to the evolution of area based internal distance measures. Redding and Venables (2000) linked intra-country transport costs to the area of a country to give the average distance between two points in a circular country. Head and Mayer (2000) assumed the production is concentrated in a single point and consumers uniformly distributed across the disk, while Helliwell and Verdier (2001) calculate internal distance of cities represented as square grids. The third group of internal distance measures are measures based on sub-unit weighted averages using actual data on the spatial distribution of economic activity across nations. They require data on economic activity, land area, longitude and latitude within country. In order to calculate the internal distance of American states Wolf (2000) used the distance between two largest cities adding a weight for the share of the population in the top two cities. Head and Mayer (2002) argue that average distances are not the appropriate measure of internal distance and advocate for a constant elasticity of substitution aggregation (also called effective distances) that takes into account that desired trade between two sides is inversely related to the distance between them. The use of average distances instead of effective distances will lead to biased upwards border effects or 'illusory border effects'.

Antweiler (2007) introduces a distance measure that is based on a weighted arithmetic[4] and harmonic mean of distances between small latitude-longitude squares within each country using Gridded Population of The World (GPWv3) database. He also showed that internal and external distances vary over time as populations move within countries and that these distance measures affect results of different types of gravity equation estimations in a significant manner. The main difference between the arithmetic and the harmonic mean is that the harmonic mean gives greater weight to smaller distances while the arithmetic mean gives greater weight to larger distances. Antweiler preferred the harmonic mean because it is consistent with the 'gravity' potential of trade links (Antweiler, 2007).

4. Methodology and empirical analysis

The methodology of the article is consistent with the earlier testing of border effect using Wei's (1996) contribution. Wei showed how the gravity equation could be used to estimate border effects when data on trade flows by sub-national units are not available. The imports 'from itself' are calculated as the value of production minus exports to other countries. The border effect is estimated by using the coefficient of a dummy variable

*OWNSTATEDUMMY*taking value 1 for the observations related to internal trade. Gravity empirics was tested using 2012 imports values (in EUR) for Croatia's 106 trading partner countries in a sample which covers 99.81% of total imports in Croatia in 2012. The data was collected from The Croatian Bureau of Statistics based on values for foreign trade in goods in 2012. Partner GDP values were taken from Eurostat and World Bank sources for the year 2012. Aerial distance was calculated as the shortest distance aerial between two capital cities of partner countries engaged in bilateral trade.

Proposed Statistical gravity model equation is as follows:

$$\log IMPORTS_{ijt} = \beta_0 + \beta_1 \log GDP_{jt} + \beta_3 COMMON\_BORDERUMMY_{ij} + \beta_4 EU\_27DUMMY_j + \beta_5 OWNSTATEDUMMy_i \quad (1)$$

$i = 1$ - reference country (Croatia),
$j = 1...106$ - partner country,
$t = 2012$ - base year,
$IMPORTS_{ijt}$ - imports to Croatia from j - *th* partner country in year t (in EUR),
GDP_{jt} - j - *th* partner country GDP in year t (in EUR),
$DISTANCE_{ij}$ - distance from Croatia's capital Zagreb to j - *th* country capital city,
$COMMON\backslash BORDERDUMMY_{ij}$ - 1 if Croatia share common border with j - *th* partner country, otherwise 0,
$EU\backslash 27DUMMY_j$ - 1 if j - *th* partner country is EU member country, otherwise 0,
$OWNSTATEDUMMY_i$ - imports 'from itself', 1 for Croatia, otherwise 0.

If empirical results comply with the theoretical background of the gravity model described in the previous chapters then expected signs of regression parameters β_i should be: $\beta_1 > 0, \beta_2 < 0, \beta_3 > 0, \beta_4 > 0$ and $\beta_5 > 0$ along with the high R^2 value and statistical significance of all independent variables. Before starting with regression analysis we must calculate various internal distance indicators for Croatia earlier presented in Table 2. First internal distance indicator is *WEID*, which is referred as Wei distance (Wei, 1996), calculated as one quarter distance to the nearest Croatia's neighbour country. Croatia's nearest neighbour country is Slovenia with the distance between two capital cities (Zagreb and Ljubljana) of 117 km. One quarter of this distance is calculated Wei distance which amounts to 29.25 km. Second internal distance indicator is *WOLFD*, which is referred as Wolf distance (Wolf, 1997) calculated as one half averaged over all Croatia's neighbour countries[5]. The value of this indicator is 171 km. Third internal distance indicator is named $AREA_1$ representing the average distance between two points in a population uniformly distributed across the disk (Leamer, 1997; Nitsch, 2000). Area represents Croatia's land area which extends to 56,534 square kilometres. The value of this indicator is 134.15 km. Fourth internal distance indicator is $AREA_2$ representing internal distance of cities represented as square grid (Helliwell & Verdier, 2001). The value of this indicator is 123.64 km. Next internal distance indicator is *SUBWA* meaning sub-unit based weighted averages. Instead of taking into account only two biggest cities, average internal distance in Croatia was approximated using intra- and inter-county distances between 21 county capitals (formula 2). We also added weights for the share of population and GDP per capita in different counties. Methodology is identical to Nitsch (2001).

In Figure 1, Table 3 and the Appendix data and data sources on population, GDP per capita, intra- and inter-county distances of each of 21 Croatia's administrative units (counties) needed for calculation of *SUBWA* indicator are presented.

We distinguish between two sorts of distances; distances between countries and distances within counties. Intra-county distances were calculated using Nitsch's formula $\sqrt{area/\pi}$ for area based measures. Internal distances between counties (inter-county distances) were calculated as aerial distances between each county capital city from the other one.

$$d_{ii} = \frac{\sum_i (\sqrt{area_i/\pi} \bullet w_i^2) + \sum_{ij,i \neq j} (d_{ij} w_i w_j)}{\sum_{ij} (w_i w_j)} \tag{2}$$

i, j = 1...21 - Croatia's counties (Bjelovar-Bilogora…Zagreb)

w - weights for share of population and GDP in counties.

Taking all data and adding weights for the share of a population and GDP per capita in counties, average internal distance for Croatia was calculated which amounts at 185.4 km. The value of this indicator, compared with the value of area based indicators, is relatively higher due to Croatia's characteristic shape as the outlines of its borders resemble a tight arc. Area based indicators have greater accuracy if the shape of a country is more uniform and circular. In addition to that, the vast amount of economic activity in Croatia is located in the city of Zagreb, so it is necessary to use weights for share of population and economic activity presented with GDP per capita. Therefore, we believe the *SUBWA* indicator better performs in assessment of Croatia's internal distance than area based measures and measures based on relation to neighbour countries.

The last two indicators of internal distance are *ARITM*and *HARM*meaning weighted arithmetic and harmonic mean. The values for these indicators[6] were taken from Antweiler (2007) for the year 2000 which amounts at 177.9 and 63.4 km respectively. According to Antweiler arithmetic averages tend to be significantly larger than harmonic mean because they give greater prominence to long distances. On the other hand, harmonic means give greater weight to short distances. The value of indicator *ARITM*is similar to value of *SUBWA* indicator because we also use arithmetic mean of distances in our calculus. In Table 4 we present calculated internal distance indicators for Croatia.

In Figure 2 we present the world's total imports in Croatia for the year 2012.

From the sample of 106 import countries Croatia's highest import value was from Italy (2,706,506,000 €) and lowest from Afghanistan (99,000 €). Obviously, Croatia does not import from some other parts of the world which were not included in the analysis like Central Africa, Greenland and South America. If we look at import values by continents presented in Table 5, Croatia imports mostly from Europe (80.35%) and Asia (14.11%)[7] while the import from other countries was not so significant.

Next step in the analysis was to assess home bias variable for Croatia using static gravity model equation. Regression analysis in expression (1) corroborates theoretical assumptions regarding the impact of geographical distance of countries and transport costs on bilateral trade flows; imports from world are positively correlated with the GDP of imported countries and negatively correlated with the distance between them. The connection between these can be illustratively seen in Figure 3 which represents Croatia's imports and distance over continents along with the size of countries measured by GDP.

Figure 1. Map of administrative units in Croatia. Source: *GPW(v.3) SEDAC*.

Table 3. Calculation of intra- and inter-county distances for Croatia.

County	Capital city	Area	Population	GDPpc	Intra-county distance	Inter-county distance
Bjelovar-Bilogora	Bjelovar	2,640	119,764	7,677	28.9	144.6
Brod-Posavina	Slavonski Brod	2,030	158,575	5,606	25.4	184.0
Dubrovnik-Neretva	Dubrovnik	1,781	122,568	9,990	23.8	361.3
Istria	Pazin	2,813	208,055	12,810	29.9	243.8
Karlovac	Karlovac	3,626	128,899	7,634	33.9	154.9
Koprivnica-Križevci	Koprivnica	1,748	115,584	9,371	23.5	230.5
Krapina-Zagorje	Krapina	1,229	132,892	6,576	19.7	165.0
Lika-Senj	Gospić	5,353	50,927	8,707	41.2	184.2
Međimurje	Čakovec	729	113,804	8,349	15.2	170.0
Osijek-Baranja	Osijek	4,155	305,032	8,112	36.3	221.3
Požega-Slavonia	Požega	1,823	78,034	6,229	24.0	162.5
Primorje-Gorski Kotar	Rijeka	3,588	296,195	12,305	33.7	206.4
Šibenik-Knin	Šibenik	2,984	109,375	7,239	30.8	221.6
Sisak-Moslavina	Sisak	4,468	172,439	8,325	37.7	136.8
Split-Dalmatia	Split	4,540	454,798	7,952	38.0	237.6
Varaždin	Varaždin	1,262	175,951	8,834	20.0	164.6
Virovitica-Podravina	Virovitica	2,024	84,836	6,399	25.3	157.3
Vukovar-Syrmia	Vukovar	2,454	179,521	5,974	27.9	236.7
Zadar	Zadar	3,646	170,017	8,388	34.0	208.5
Zagreb County	Zagreb	3,060	317,606	7,803	31.2	148.7
City of Zagreb	Zagreb	641	790,017	17,814	14.2	148.7

Note: The city of Zagreb acts both as a county and a city and is not part of any other county, while Zagreb County is a separate administrative unit encompassing territory outside the city of Zagreb.
Source: The Croatian Bureau of Statistics and authors' calculations.

Table 4. Internal distance indicators calculated for Croatia.

Internal distance measure	Internal distance for Croatia (km)
WEID	29.2
WOLFD	171.0
AREA1	134.2
AREA2	123.6
SUBWA	185.4
ARITM	177.9
HARM	63.4

Source: Authors' calculations and Antweiler (2007).

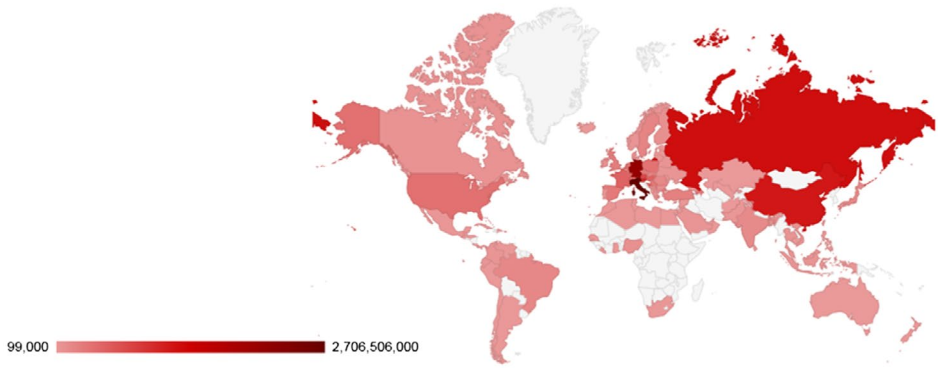

Figure 2. Croatia's imports from the World (2012, in EUR). Source: Croatian Bureau of Statistics (2012) and authors.

Table 5. Croatia's imports by Region (2012, in thousand euros).

Region	Import Value	Share in %
Europe	12,988,354	80.35
Asia	2,279,969	14.11
North and Central America	488,311	3.02
South America	246,232	1.52
Africa	150,982	0.93
Oceania	9,874	0.06
Total	16,163,722	100

Source: The Croatian Bureau of Statistics and authors' calculations.

Size of the bubbles represents the value of imports in Croatia from various partner countries. Due to Croatia's Mediterranean orientation and its close connection with the European Union most of the trade is created with countries in near proximity, most notably Italy, Germany, Slovenia, Austria, Bosnia and Herzegovina (also seen in Figure 4) while the rest of the non-Europe imports is made from the Russian Federation and China.[8]

OLS estimates of Croatia's total imports are presented in Table 6. All independent variables are significant (*GDP*,*AERIAL\DISTANCE* and *COMMON\BORDERDUMMY* under 1% significance, *OWNSTATEDUMMY*under 5% significance and *EU\27DUMMY*under 10% significance). Coefficient of determination (*R* squared of distribution) is not relatively high (0.68) but still explains a great portion of variability in dependent variable *IMPORTS*. The variable of special interest is *OWNSTATEDUMMY*. Exponential value of this variable represents home bias effect for imported goods in Croatia. The values of this variable

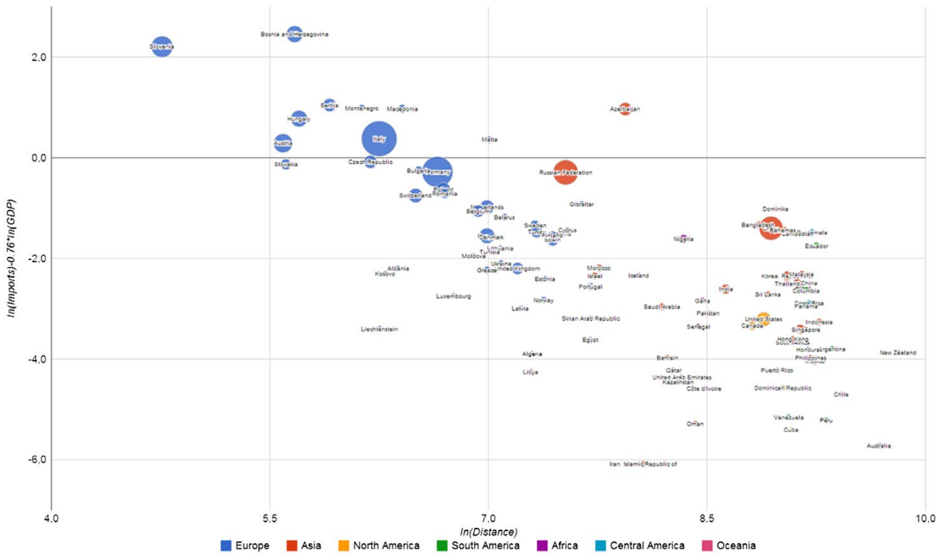

Figure 3. Croatia's imports and distance over continents. Source: Authors.

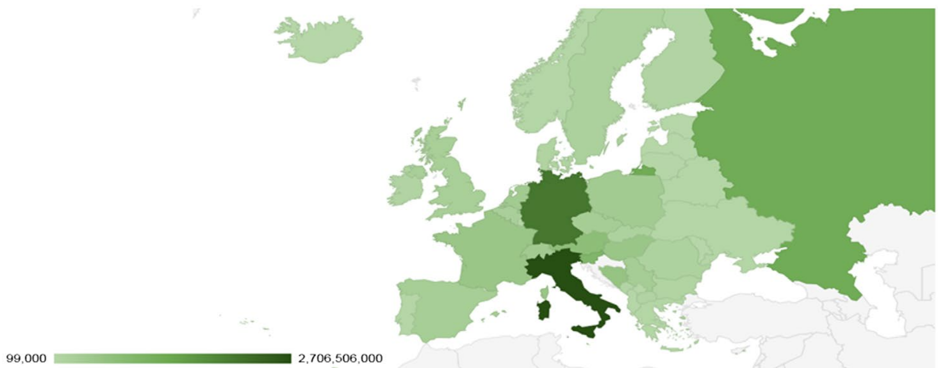

Figure 4. Croatia's imports from EU_27 (2012, in EUR). Source: Croatian Bureau of Statistics (2012) and authors.

vary from 17.29 to 56.26 depending on various internal distance indicators. The results are consistent with the previous studies on home bias in EU countries; the value of home bias in Croatia is slightly higher than the previous research on EU countries but it can be explained by lower level of Croatia's market segmentation and country's integration level.

In order to distinguish imports from EU-27 countries in regard to total World imports another OLS estimates has been presented in Table 7.

This time *EU\27DUMMY* variable and *COMMON\BORDERDUMMY* were excluded from the analysis due to low significance. *R*- squared of distribution is 0.86 meaning the model is very well explained. It is interesting that imports are now more sensitive to the variable *AERIAL\DISTANCE* meaning that the smaller distances in trade much more affect total imports. Values of home bias variable presented by the *OWNSTATEDUMMY* are similar to values where total world imports were used ranging from 4.62 up to 64.07. With higher

Table 6. OLS estimates of Croatia's total imports.

log(IMPORTS)	WEID	WOLFD	AREA1	AREA2	SUBWA	ARITM	HARM
Constant	2.34	2.34	2.34	2.34	2.34	2.34	2.34
Log(GDP)	0.76*** (10.43)	0.76*** (10.43)	0.76*** (10.43)	0.76*** (10.43)	0.76*** (10.43)	0.76*** (10.43)	0.76*** (10.43)
Log(AERIAL_ DISTANCE)	-0.64*** (-3.83)	-0.64*** (-3.83)	-0.64*** (-3.83)	-0.64*** (-3.83)	-0.64*** (-3.83)	-0.64*** (-3.83)	-0.64*** (-3.83)
COMMON_BOR-DER Dummy	2.28*** (3.52)	2.28*** (3.52)	2.28*** (3.52)	2.28*** (3.52)	2.28*** (3.52)	2.28*** (3.52)	2.28*** (3.52)
EU_27 Dummy	0.73* (1.86)	0.73* (1.86)	0.73* (1.86)	0.73* (1.86)	0.73* (1.86)	0.73* (1.86)	0.73* (1.86)
OWNSTATE Dummy	2.85* (1.85)	3.98*** (2.71)	3.12** (2.05)	3.57** (2.40)	4.03** (2.69)	4.01** (2.56)	3,34** (2.43)
exp (OWNSTATE Dummy)	17.29	53.52	22.64	35.51	56.26	55.14	28.22
Adjusted R-squared	0.68	0.68	0.68	0.68	0.68	0.68	0.68
S.E. of regres-sion	1.33	1.33	1.33	1.33	1.33	1.33	1.33
F-statistic	45.29	45.29	45.29	45.29	45.29	45.29	45.29
Observations	106	106	106	106	106	106	106

***, **, *denote significance at 1, 5 or 10%.
Note: OLS estimates show White heteroscedasticity consistent standard errors and covariances; t-statistic in parentheses.
Source: Authors' calculations.

Table 7. OLS estimates of Croatia from EU_27 imports.

log(IM-PORTS)	WEID	WOLFD	AREA1	AREA2	SUBWA	ARITM	HARM
Constant	7.99	7.99	7.99	7.99	7.99	7.99	7.99
Log(GDP)	0.78*** (8.75)	0.78*** (8.75)	0.78*** (8.75)	0.78*** (8.75)	0.78*** (8.75)	0.78*** (8.75)	0.78*** (8.75)
Log(AERIAL_ DISTANCE)	-1.41*** (-6.95)	-1.41*** (-6.95)	-1.41*** (-6.95)	-1.41*** (-6.95)	-1.41*** (-6.95)	-1.41*** (-6.95)	-1.41*** (-6.95)
OWNSTATE Dummy	1.53* (1.50)	4.03*** (4.90)	3.69** (4.37)	3.58** (4.20)	4.16** (5.09)	4.09** (4.99)	2,63** (2.85)
exp (OWN-STATE Dummy)	4.62	56.26	40.04	35.87	64.07	59.73	13.87
Adjusted R-squared	0.86	0.86	0.86	0.86	0.86	0.86	0.86
S.E. of regres-sion	0.73	0.73	0.73	0.73	0.73	0.73	0.73
F-statistic	56.85	56.85	56.85	56.85	56.85	56.85	56.85
Observations	28	28	28	28	28	28	28

***, **, *denote significance at 1, 5 or 10%.
Note: OLS estimates show White heteroscedasticity consistent standard errors and covariances; t-statistic in parentheses.
Source: Authors' calculations.

level of Croatia's EU integration, it can be expected grater preference for imported goods and consequently lowering the values of home bias in trade.

5. Conclusion

There has been little consensus about appropriate measure of internal distance. The correct measure of domestic (internal) distance is very important issue because it directly affects the estimated border effect. The aim of the article is to present the evolution of internal distance measurement in estimating home bias in trade using Croatia as appropriate case study country. Firstly, all internal distance measures were divided into three key groups. Taking into account Croatia's characteristic shape as the outlines of its borders resemble a tight arc, we conclude that sub-unit based weighted averages indicators better perform in assessment of Croatia's internal distance than area based measures and measures based on relation to neighbour countries. The methodology used in the analysis is consistent with the earlier testing of border effect using Wei's (1996) contribution. The results of econometric regression analysis corroborate theoretical assumptions regarding the impact of geographical distance of countries and transport costs on bilateral trade flows; imports from world are positively correlated with the GDP of imported countries and negatively correlated with the distance between them. Due to Croatia's Mediterranean orientation and its close connection with the European Union, most of the trade is created with countries in near proximity, most notably Italy, Germany, Slovenia, Austria, Bosnia and Herzegovina while the rest of the non-Europe imports is made from Russian Federation and China. The results are consistent with the previous studies on home bias in EU countries; the value of home bias in Croatia is slightly higher than the previous research on EU countries but it can be explained by lower level of Croatia's market segmentation and level of countries economic integration. In order to compare results with other countries in the region panel data analysis could be applied for future research. With higher level of Croatia's EU integration greater preference for imported goods and consequently lowering the values of home bias in trade can be expected. The results of the analysis still indicate greater preferences for domestic goods in Croatia which can give stimulus to economic policy holders in Croatia in preserving domestically and export-oriented production against strong import pressures.

Notes

1. McCallum (1995), Helliwell (1996, 1997), Hillberry (1998), Anderson and Smith (1999) investigated and proved the existence of the external border effect between Canada and United States.
2. Gil-Pareja et al. (2005), Minondo (2007), Requena and Llano (2010), Ghemawat et al. (2010), Llano-Verduras et al. (2011) investigated region-to-country trade in Spain regions and provinces while Ferto and Soos (2008) and Leitao and Faustino (2013) investigate intra industry trade in Portuguese medical and optical sector. Majkovič and Turk (2007) provided recent developments in Slovene-Croatian agri-food trade.
3. Technical barriers to trade exists to ensure that technical regulations, standards, testing, and certification procedures do not create unnecessary obstacles to trade.
4. Helliwell and Verdier (2001) were first to use arithmetic means in their calculus.
5. Croatia has land border with six countries: Italy, Slovenia, Bosnia and Herzegovina, Hungary, Serbia and Montenegro.
6. The author also used share of population and economic activity as weights.
7. Data were taken from Croatian Bureau of Statistics.
8. Similar conclusion can be seen in Jošić and Nikić (2013).

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Appendix

I. Data and Data Sources: Country-to-country trade

Countries in the Sample: (106)

Afghanistan, Albania, Algeria, Argentina, Australia, Austria, Azerbaijan, Bahamas, Bahrain, Bangladesh, Belarus, Belgium, Bosnia and Herzegovina, Brazil, Bulgaria, Cambodia, Canada, Chile, China, Columbia, Costa Rica, Côte d'Ivoire, Cuba, Cyprus, Czech Republic, Denmark, Dominican Republic, Dominica, Ecuador, Egypt, Estonia, Finland, France, Ghana, Georgia, Germany, Gibraltar, Greece, Guatemala, Honduras, Hong Kong, Hungary, Iceland, India, Indonesia, Iran, Ireland, Israel, Italy, Japan, Jordan, Kazakhstan, Republic of Korea, Kosovo, Latvia, Liberia, Libya, Liechtenstein, Lithuania, Luxembourg, Macedonia, Malaysia, Malta, Mexico, Moldova, Montenegro, Morocco, Netherlands, New Zealand, Nigeria, Norway, Oman, Pakistan, Panama, Peru, Philippines, Poland, Portugal, Puerto Rico, Qatar, Romania, Russian Federation, Saudi Arabia, Senegal, Serbia, Singapore, Syria, Slovakia, Slovenia, South Africa, Spain, Sri Lanka, Sweden, Switzerland, Taiwan, Tanzania, Thailand, Tunisia, Turkey, Ukraine, United Arab Emirates, United Kingdom, United States of America, Uzbekistan, Venezuela, Vietnam.

Trade Data: The data on imports between Croatia and its trading partner countries from Europe and World were taken from The Croatian Bureau of Statistics (2012) *Foreign Trade in Goods of the Republic of Croatia*, January–December 2012. Following Wei's (1996) definition in order to obtain Croatia's imports from itself, we calculate the difference between its total production and its total exports to foreign countries. Service and transport sectors were excluded from the analysis because as they do not affect merchandise trade data. Data on production and exports of goods were taken from The Croatian National Bank, 2013. Bulletin – Statistical Survey, No. 194, July 2013.

Income Data: The data on real income (GDP) in current prices were taken from the World Bank report, 2013. Gross domestic product ranking table. Available at: [http://data.worldbank.org/data-catalog/GDP-ranking-table].

External distance to Croatia: This value was approximated as aerial distance between national capital cities from Croatia's capital Zagreb. The data were taken from the web page [http://www.distancefromto.net].

II. Data and Data Sources: County-to-county trade for Croatia

Counties in the sample: (21)

Bjelovar-Bilogora, Brod-Posavina, Dubrovnik-Neretva, Istria, Karlovac, Koprivnica-Križevci, Krapina-Zagorje, Lika-Senj, Međimurje, Osijek-Baranja, Požega-Slavonia, Primorje-Gorski Kotar, Šibenik-Knin, Sisak-Moslavina, Split-Dalmatia, Varaždin, Virovitica-Podravina, Vukovar-Syrmia, Zadar, Zagreb County, City of Zagreb.

Internal distance within and between counties: Internal distances within counties were calculated using Nitsch's (2000) formula ($\sqrt{area/\pi}$) for area based measures while internal distances between counties were calculated as average aerial distance between capital cities of each county. The data on distances between capital cities were taken from the web page [http://www.distancefromto.net].

Population and income data: Data on population and income (GDP per capita, in EUR) were taken from The National Bureau of Statistics.