Border Effects in the Enlarged EU Area.
Evidence from Imports to Applicant Countries

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1. Introduction

This paper looks at the issue of border effects in the enlarged EU economic space. Evidence of border effects in the exchanges of CEECs countries is still an undeveloped issue in the literature. Only Sousa and Disdier (2002) have assessed the effect of legal framework on bilateral trade flows of Hungary, Romania and Slovenia with EU and CEFTA countries using the 'border effects' approach. Referring to the period 1995-1998 they find more significant border effects towards CEFTA countries than towards EU countries. In this paper we have considered accession countries of different size and other characteristics, i.e. Hungary, Poland, Czech Republic, Romania, Latvia and Cyprus. We have measured the extent to which internal trade exceeds international trade in a set up where controls for other economic determinants of commerce have been considered.

Until now the issue of border effects has been investigated along different dimensions. A central point of recent discussions has been the definition of the geographical entities that are actually separated by relevant borders. First evidence in the literature concentrated on borders between countries (McCallum, 1995; Wei, 1996; Nitch, 2000; Head and Mayer, 2000). These papers show surprisingly large and time enduring border effects comparing intra-national and international exchanges of Canada, US and Europe. Starting from Wolf (1997, 2000) border effects have been investigated also at the intra-national level. Referring to the US, Wolf (1997, 2000) finds intra-state trade excessive relative to inter-state trade, such evidence suggesting a degree of market fragmentation also at the national level. Similar intra-national evidence for an EU country has been recently provided by Head and Mayer (2003). Administrative borders in France have been shown to have a negative impact for trade. Examining the question whether nations or intra-national geographical entities, such as regions, express non-linearities in the propensity to exchange goods, other things constant, aims directly at the black box, i.e. the 'nature' of border effects. If border effects are a direct consequence of protection, or barriers to trade, then they should disappear at the intra-national level. Their presence in country level analysis cannot just be linked to barriers to trade, but may reflect other factors, such as the spatial distribution of production (Wolf, 2000), the presence of social and business networks (Head and Mayer, 2003) but also a pure 'home bias' in consumer or firm preferences.

Our paper does not aim to address directly the issue of defining the elements that contribute to create a border. We look at border effects at the country level with the aim of evaluating whether

market fragmentation in the CEECs area, particularly when referring to imports from EU countries, is more relevant than existing evidence for trade within the EU 15. Such concern is mainly motivated by the fact that barriers in movements of goods between the EU and the CEECs have been started to be dismantled relatively recently mainly through mutual recognition agreements and the adoption of the *acquis communautaire* by the applicant countries.

We investigate on border effects at the country level having in mind two important points:

1. the possibility of inflated border effects due to mismeasurement in distances (Head and Mayer, 2000). Information at the regional level both for CEECs and EU countries has been used in order to construct a weighted measure of distance both for between-countries and internal distances. Both arithmetic and harmonic means have been tested in order to check for differences in results when using a formula of aggregation more coherent with suggestions from previous gravity exercises.
2. the need to isolate border effects from impediments to trade due to technical barriers. A comparison between internal and international movements of goods requires a proper control for protection measure which can still operate in a liberalised trade area. As in Brenton and Vancauteren (2000) we consider this issue in the context of the impact of regulatory policies on international trade flows. We look at the extent of border effects for sectors grouped according to the approach adopted by the EU to remove technical barriers to intra-EU trade. The gravity model is applied to data that identifies separately sectors subject to the different approaches to the removal of technical barriers in the EU.

The paper proceeds as follows: the next section reviews findings on country level border effects. We then discuss the issue of distance measurement (section 3) and technical barriers to trade (section 4). Section 5 discusses the model and the several econometric issues raised by estimating gravity equations. We then discuss the data in section 6 and present results in section 7. Conclusions follow.

2. Literature

In order to measure the effects of technical barriers on bilateral trade flows in the Central and Eastern European countries we use gravity method to look at border effects. Since the study of McCallum (1995) there has been a growing research effort on the so-called border effects.

McCallum (1995) found that trade flows between Canadian provinces were about 22 times as large as their trade with US states of same size and distances. Several studies arrived at similar results looking at trade in North America, OECD and Europe[1].

Head and Mayer (2000) estimated the size of border effects in the European Union by using the gravity approach on sectoral data. Compared to McCallum's results the paper finds lower border effects: on average Europeans purchased 14 times more from domestic producers than from foreign ones. After grouping industries according to the importance of non-tariff barriers the paper assesses whether these categories display any correlation with the size of the estimated border effect. The paper finds no correlation between non-tariff barriers and the border effect, and the authors conclude that the cause of the border effects lies in the bias of consumer preferences towards domestically produced goods.

Brenton and Vancauteren (2001) also apply a gravity model to European sectoral data in order to identify the variation of border effects between the different types of sectors. The paper grouped sectors by the approach the EU adopted to removing technical barriers (old approach, mutual recognition, new approach and sectors where technical barriers are not important). The paper finds that border effects are significant for all groups of sectors except for those subject to mutual recognition. Border effects are high also for sectors where technical barriers are not important which suggests that other factors than policy-induced barriers also play a role.

Chen (2002) examines the border effects for a set of European countries at three different levels: pooled level, country level and industry-specific level. The paper finds important differences in border effects between industries. The estimates for border effects range from zero to 4000 at industry specific-level. The paper also seeks to find an explanation for the causes of border effects by taking into consideration transportability of products, 'multilateral trade resistance[2], information costs[3], spatial clustering, technical and non-tariff barriers to trade. The paper finds that technical barriers to trade, firm and product-specific information costs increase border

[1] See, among others, Anderson (2001), Anderson and van Wincoop (2001), Chen (2002), Evans (1999, 2001), Head and Mayer (2000), Helliwell (1995, 1997, 1998, 2000), Helliwell and Verdier (2000), Hillberry (1999,2001), Hillberry and Hummels (2002), Nitsch (2000), Wei (1996), and Wolf (1997, 2000).

[2] Anderson and Wincoop (2001) argue that bilateral trade is not only influenced by bilateral trade barriers but also by the average trade barriers that both partners face with all their trading partners, which they call 'multilateral trade resistance'. Chen (2002) instead of constructing the multilateral resistance terms included country fixed-effects .

[3] Information costs captured partly by average firm size calculated for each sector and by using three dummies for industries according to whether search costs are assumed to be lower or higher.

effects, while on the other hand non-tariff barriers are not significant. Moreover, industries which are not tied to a specific location display larger border effects.

Evidence on CEECs countries is still quite scarce. Only the work of Sousa and Disdier (2002) assess the effect of legal framework on the bilateral trade flows of Hungary, Romania and Slovenia with EU and CEFTA countries using the 'border effects' approach for the period 1995-1998. To measure legal framework quality the paper uses the 'extensiveness and effectiveness of legal reform' EBRD indicator. The paper finds that the quality of legal framework strongly influences the export decisions of the EU producers, while CEFTA producers are less affected by this quality. Furthermore the border effects of Slovenia, Hungary and Romania are more significant towards CEFTA countries than towards EU countries.

As in Sousa and Disdier we also aim to assess the magnitude of border effects within Central and Eastern European countries. We use a similar grouping of sectors as Brenton and Vancauteren (2001) as we examine how intra-country trade flows compare to external trade flows, across different groups of sectors, and whether the magnitude of this border effect is different within different Central and Eastern European countries.

3. The Issue of Distance Measurement

An issue linked to understanding the nature of border effect is how to provide estimates robust to controls for other elements giving an economic meaning to borders between states. Exchanges between economic actors are normally found to cost more if they cross any kind of administrative borders. Accounting for the difference in the costs involved in moving products within a country or between countries is therefore a crucial point.

The gravity approach to modelling exchanges between economic actors contains the idea that space involves costs, other things equal. Such costs are captured by geographical (distance) variables. Wei (1996) 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 idea is that internal trade can be represented by the value of production minus exports to other countries. The coefficient of a dummy taking the value of 1 for the observations related to internal trade can then be interpreted as the border effect. Such an approach will provide accurate results only if other

aspects at the country level, linked to the existence of a border, are controlled for and measured in an accurate way. Since gravity relates negatively flows with distance, border effects are crucially dependent on how distances are measured[4].

The estimation of such effects requires the measurement of the distance between a country and its trade partners and, importantly, the measurement of internal distances[5]. The accuracy of such measures has been shown to be crucial in finding border effects which are not illusory (Head and Mayer, 2002). If internal distances are overestimated with respect to international distances border effects will be inflated, since the 'true' smaller distance would account for the '*excess'* in within country exchanges. Measuring internal and international distances so as to minimise any source of bias therefore becomes a fundamental step.

Point to point measures (great circle distance between country centres) have normally been used in the gravity literature for obtaining between-countries distances. The selection of which city to consider as the economic centre of a country is a potential source of bias if countries are not small, trade partners are not far from each other, and when the economic activity is not concentrated in the chosen city (Head and Mayer, 2001). Exchanges between European countries easily fall into one of the previous categories. Large countries tend to share borders and their economic centres tend to be more than one, and geographically dispersed rather then concentrated in the main or capital city. Data on GDP shares for NUTS1 European regions provide some clear evidence of the European geography of production and of its evolution in time.

With respect to internal distances several methods have been used in the literature. Portions of the distance between a country to its neighbours, (Wei, 1996; Wolf, 1997, 2000) or distances between the two major cities of a country have been replaced by area based measures (Nitsch, 2000, Redding and Venables, 2000; Head and Mayer, 2000; Helliwell and Verdier, 2001) due to the risk of possible geographical inconsistencies (Nitsch, 2000). Weighted averages, which use actual data on the spatial distribution of production within a country, rather than geometric assumptions on the shape of the available space, are computationally heavier and more complex. They require, in fact, within country data on activity, area, longitude and latitude. The first

[4] Related to distance is the geographical dimension of production. Other country aspects include trade policy measures affecting the movements of goods across borders.

[5] For internal distance it is meant the distance a country from itself (Head and Mayer, 2001)

conclusion from comparing the two methods affirms that area-based approximations may be good indicators of averages using detailed data at the sub-national level (Nitsch, 2000). More recently Head and Mayer (2001) pointed out the need for a constant elasticity of substitution aggregation of internal distances between districts, so that a measure of effective distance is obtained.[6] Defining *i* and *j* two states with respectively *k* and *l* districts, whose total income (GDP) is defined by the *y* variables, the formula that satisfies the definition of effective distance between countries *i* and *j* (d_{ij}) is:

$$d_{ij} = \left(\sum_{k \in i} \left(\frac{y_k}{y_i} \right) \sum_{l \in j} \left(\frac{y_l}{y_j} \right) d_{kl}^{\theta} \right)^{1/\theta} \qquad 1$$

Such a formula is a generalisation of the standard formula used to calculate the average distance (as in Head and Mayer, 2000), which assumes $\theta = 1$. Several gravity exercises have shown θ value to be around –1. Accepting such an assumption the harmonic mean will be defined.
Along with the argument of using a measure for θ consistent with results from the gravity literature, there is a potential case for inflated border effects from using the arithmetic mean. Whenever different, the harmonic mean is less than the arithmetic mean. If the difference in the two measures is in absolute terms higher for internal distances, illusory border effects may be due simply to the use of an aggregation formula (the arithmetic mean) which overestimates more the internal distances than the international ones[7].

We have used information at the regional level so as to construct a weighted measure of distance both for between-countries and internal distances. In formula (1) we have used regional GDP shares as weights. The use of a weighted measure has the main advantage of an integrated methodology for calculating both international and intra-national distances.

[6] Defining state the smallest unit for which trade data are available and districts the smallest unit for which geographic information is available, effective distance between two states is defined as the solution of an equation summing trade between all the districts as a function of district-to-district distances. See Head and Mayer (2001) page.13.
[7] In other words, it is not the difference between the two aggregation schemes that matters. It's the bias in the relative measure of distance (international versus internal) imposed by using one or the other which is crucial in raising illusory border effects.

Relying on Head and Mayer (2000 and 2001) we have extended the calculation of average and effective distances (international and internal) to 6 reporting CEECs countries (Cyprus, Bulgaria, Czech Repubblic, Hungary, Latvia and Poland). Both arithmetic and harmonic means have been calculated in order to check for differences in results from using an aggregation formula coherent with evidence on the distance variable from previous gravity exercises.

Distances have been calculated by applying the great circle formula to latitude and longitude data of the main city of each region. The main city is the more populated city which most of the time coincides with the administrative capital of the region (data on population have been recovered from www.citiesandagglomerations.com). Data on the weight of each region have been collected from REGIO database, which provides GDP data for NUTS regions in the EU, and since 1992 in the accession countries as well. The weights used refer to 1996, since the dynamics of the spatial distribution of economic activities does not significantly vary from year to year. The internal distances within each region have been calculated by using Head and Mayer (2000) area based formula ($.67*\sqrt{area/\pi}$) which assumes that production in sub-national regions is concentrated in a single point at the center of a disk and consumers are uniformly distributed across the disk.

International distances have been calculated with respect to all 15 EU countries (Belgium and Luxemburg have been merged) and the other trade partners in the region (Czech Republic, Estonia, Lithuania, Slovenia, Slovakia, Romania, Turkey). Regional detailed data on latitude and longitude and economic weight for partners' regions have been used in order to construct a weighted measure. NUTS1 level of disaggregation has been considered[8].

International and internal distance calculations are presented in Table 1. As shown in the last rows the arithmetic mean is always bigger than the harmonic one. There is a potential for having illusory border effects since for each country (except Cyprus) the difference is bigger for the internal measure (in bold character) than for the international distances. This means that border effects are likely to arise because the overestimation of internal distances will fail to explain the

[8] Finland and Sweden have been considered as a country concentrated in one region whose main cities are Helsinki and Stockholm. Data on GDP provide sufficient evidence main activities are concentrated in that region. NUTS2 regions have been used for Portugal and Ireland.

higher internal trade. What could look like a border effect risks being simply an unaccounted distance effect. Therefore results obtained with both means will be compared[9].

4. Technical Barriers to Trade and the EU Instruments to their Removal

Differences in national technical regulations and standards can have important adverse effects on the bilateral trade flows, it increases costs, distorts production processes and discourages business co-operation. On the other hand the full harmonisation of all product-related technical regulations can result in cumbersomely slow and ineffective procedures. In the EU before the '80s harmonisation of all product categories was achieved by the so-called 'old approach'. Harmonization was very technical requiring in-depth consultations. Moreover, the adoption of old approach directives required unanimity in the Council of Ministers. These long delays resulted in ineffectiveness since national regulations were produced at a much faster rate than the production of harmonised EU directives (Pelkmans (1987)). A number of old approach directives still remain in force covering a wide range of product groups such as pharmaceuticals, foodstuffs and motor vehicles.

In order to minimise technical barriers to trade in the EU and to reduce the costly procedure of product by product, or component by component, harmonisation of technical regulations, the EU initiated a 'new approach' which combines both harmonisation of different regulations and mutual recognition. Harmonization under the New Approach is required when for similar products the different national regulations differ significantly and Mutual Recognition cannot be achieved. One of the key elements which allow harmonization under New Approach to be more effective than Old Approach is that the directives can be adopted by majority voting. Furthermore, only essential requirements are indicated for the producers or service providers thus giving greater flexibility.

Also Cyprus has been considered as one region which includes only the Greek part, since data on the Turkish part of the island have not been found.

[9] Cyprus has been considered as one region, since the lack of geographical disaggregated data. Therefore Helliwell and Verdier (2001) area based formula (.52* $\sqrt{area}$) has been used for calculating its internal distance and does not vary between the arithmetic and the harmonic mean. The choice of this particular formula has been motivated by the particular shape of Cyprus.

The principle of mutual recognition was applied in cases where the harmonisation of regulations and standards is not considered essential from either a health/safety or an industrial point of view. The principle of mutual recognition means that, in any sectors which have not been subject to harmonisation measures, or which are covered by minimal or optional harmonisation measures, every country is obliged to accept into its territory products which are legally produced and marketed in another country. In other words, a producer or service provider who has fulfilled the requirements of his country of origin can sell his products or provide his services in the partner country. However it often requires accreditation of testing and certification of bodies, and a mutual recognition arrangement between bodies, because countries often regulate risks in slightly different ways for the same product (Brenton, Sheehy, Vancauteren (2001)).

As part of the pre-accession strategy a special type of mutual recognition agreement (Protocols to the Europe Agreement on Conformity assessment and Acceptance of industrial products (PECAs)) was recently concluded with several accession countries. According to these agreements mutual recognition operates on the basis of the acquis communautaire. PECAs treat all mandatory approval procedures in the sectors that they cover. They are made up of a framework establishing general principles and procedures for the mutual recognition of results of conformity assessment and mutual acceptance of industrial products. However, our data covers the period 1992-1998 when these mutual recognition agreements were not yet implemented.

The EU expects Candidate Countries to apply the transposition of harmonised European product legislation at the latest by the date of accession. The application of the complex EU legislation on goods requires reform of both product legislation and administrative traditions based on national preferences and controls. Thus it requires a transitional period for the accession countries to be able to transpose the legislation. Several countries had applied the *acquis communautaire* in the field by 1999, while some other countries are still working on the transposition of EU regulations.

5. The Model and data

We estimate the following gravity equation:

$$\ln X_{ij} = \alpha + \beta_1 \ln GDP_i + \beta_2 \ln GDP_j + \beta_3 \ln POP_i + \beta_4 \ln POP_j + \beta_5 \ln R_i +$$
$$+ \beta_6 \ln D_{ij} + \sum_{ijk} \gamma_{ijk} DUM_{ijk}$$

where:

X_{ij} is the value of imports by country *i* from country *j*;
GDP_i is the level of income in country *i*;
POP_i is the level of population in country *i*;
D_{ij} is the distance between the trading centres of the two countries.
R_{ij} is the remoteness of country *i* in relation to all trading partners with the exception of country *j*.

The more remote is country *i* from other partners the greater the amount of trade is expected with country *j*.
DUM_{ijk} are a set of *k* dummy variables. Separate dummy variables are included to reflect the effects of adjacency between *i* and *j*, if *i* and *j* have common borders, if there is a free trade agreement between *i* and *j*, and to reflect the size of the border effect ($j = i$).

The issue of the correct model to be used to estimate a gravity equation has been raised by Mátyás (1997, 1998a, 1998b). What plays a crucial role for estimating non-biased gravity parameters are proper controls for the heterogeneity in trade flows across countries (which is not accounted for by GDP or population variables) and controls for business cycle effects. Panel data analysis allows such controls to be implemented. Business cycle effects can be controlled as time fixed effects, i.e. treated as constants and estimated.
With respect to countries' heterogeneity, a different approach has to be followed due to the presence of a country effect variable, distance, whose inclusion is crucial in our case. Distance cannot be estimated if both fixed effects for reporting and partners countries are included (it is equivalent to a time invariant variable which cannot be estimated if controls for each individual are included). The alternative random effect specification has been proven to be inadequate whenever there is a specific interest in the openness of the economies under analysis (Mátyás, 1998b).

Therefore we have followed the approach of estimating a standard panel Gravity model which includes dummy controls for each period, and for each reporting country including a control for the possible influence in the standard errors from the left source of heterogeneity. We have calculated robust standard errors across groups (partner countries) which account for the correlation in the error term due to the fact that some observations share the same partner country. Such procedure has been accounted by Moulton (1986) and involves correcting the variance-covariance matrix in order to take into account the correlation in the error for those observations that share the same partner country.

Another econometric issue arises since our dependent variable is censored around the zero value. Though only a few observations (less than 4% of the observations) are characterised by zero values, since our sample refers to aggregations of sectors, a tobit specification is a good methodology to correct the OLS bias from censoring. On the other hand, tobit estimates are strongly sensitive to the non-normality distribution and heteroschedasticity structure of the residuals. In order to obtain consistent estimates of the coefficients of interest we also present results obtained with a Censored Least Absolute Deviations (CLAD) estimator applied to a specification which includes time and country effects.

Adjacency dummy in the gravity equations tends to be highly significant. This can be partly due to the fact that neighboring countries can be expected to have an additional stimulus to trade because of similarity of tastes, an awareness of common interests, some personal and business linkages specially when the border regions are highly populated or when in the past the border was somewhere else (for example in the case of some Central and Eastern European countries). Aitken (1973) also argues that neighboring countries are likely to experience significant additional amounts of international trade in mainly locally traded goods, especially where border regions are densely populated as in much of Europe. However Head and Mayer (2002) argue that the possible main explanation of the significance of the adjacency dummy is due to mismeasurements of the distance. We include such dummies and our results would confirm Head and Mayer (2002) argument.

Our adjacency dummy and the dummies for different free trade agreements take the value of one only for inter-country trade. Therefore with the border effect dummy we can interpret the additional tendency to trade within a country than with another country that is not adjacent and doesn't have free trade agreement.

6. The Data

Our data set consists of trade flows for the period 1992-1998 between a sample of accession countries (Cyprus, Bulgaria, Hungary, Latvia and Poland) and EU countries and other accession countries.[10] Both trade and production data originate from the World Bank Trade and Production Database and the data is in International Standard Industrial Classification (ISIC) Rev. 2. The World Bank database is constructed from the COMTRADE database for trade data and the production data was constructed from UINIDO and OECD sources. Trade data was originally in SITC rev. 2 classification and then it was transformed to ISIC rev.2 by the World Bank. Both production and trade data are in thousands of US dollars and covers 28 manufacturing sectors. Trade and production data was transformed into NACE 70 classification, in order to group products into three broad groups of new approach and mutual recognition sectors, old approach sectors, and mixed sectors (where both old and new approach applies to the products[11]). To group products into these three different categories we use the data from the detailed study undertaken for the Commission's review of the impact of the Single Market in the EU (CEC (1998)[12]). This study provides information, at the 3-digit level of the NACE classification (about 120 manufacturing industries), of the dominant approach used by the Commission to the removal of technical barriers in the EU.

As in previous studies on border effects, internal trade is measured here by the difference between domestic production and the value of exports.

Population and GDP data is obtained from the World Development Indicators database. Constant GDP values were used where the data are in thousands of US dollars.

[10] EU 15 Member States, with Belgium and Luxembourg aggregated as one country, while the number of accession countries varies by reporting countries and years depending on the data availability.

[11] Products under mixed approach could not have been separated into old and other approach, partly due to the conversion from ISIC to NACE70 and partly because for certain products both approaches apply.

[12] CEC (1998), 'Technical Barriers to Trade', Volume 1 of Subseries III Dismantling of Barriers Of the Single Market Review, Office for Official Publication, Luxembourg

The remoteness of importing country *i* in relation to trading partner *j* is given as the weighted average distance between country *i* and all trading partners other than *j*, where the weights are given by the GDP of the trading partners:

$$R_{ij} = \sum_{k \neq j} D_{ik} / GDP_k$$

To capture the effects of different preferential trade agreements of the reporting countries, we included three dummies: a dummy for Europe Agreements, a dummy for CEFTA and a dummy for other bilateral trade agreements concluded between the reporting and partner country. In all cases, we choose the date of entering into force of the agreement instead of the signing date.

7. Econometric Results

Table 2 summarises the results of the OLS estimation. For each of our three categories, old approach, other and mixed approach, the two types of remoteness and distance measures are used.

While GDP of the partner country is always significant, and takes the expected sign, the GDP of the reporting country takes different signs for different product categories and is not always significant. Interestingly for old approach products, GDP of the reporting country is significant at 5% level and its coefficient is around –2.3. This implies that countries with lower GDP levels tend to import fewer products in old approach goods from the EU.

Distance and remoteness take the expected sign for all the three different categories. Distance is significant in all cases. While the effect of distance on trade is always less negative when distance is measured with the arithmetic method than when it is measured with the harmonic method, the effects of remoteness on imports tends to be higher when distance is measured with the arithmetic method. Remoteness was found significant only for mixed approach products (and only at 10% level).

The dummy which stands for the Europe Agreement is significant and positive for all product categories and its coefficient is the highest for old approach products. This result suggests that the Europe Agreements had the largest positive affects on trade in old approach products, which

might be also the result of the foreign direct investment by EU firms in accession countries which was significant during this period in sectors where technical barriers to trade were important.

The dummy which captures the border effect is significant and high for all three categories, being highest for old approach and smallest for other approach. Measuring distance with the harmonic method would imply 114 times more internal trade in old approach products while 25 times more internal trade in other approach products than the country's trade with its partners. These estimates are slightly more than half of those which we obtain using the arithmetic method. Using the arithmetic method we find that a country trades with itself 295 times more in old approach products, while 62 times more in other approach products. These results imply rather high border effects, in all three groups the coefficient is higher than those measured by Brenton and Vancauteren (2001). Brenton and Vancauteren (2001) found that in old approach products in 1997 a country would trade with itself 38 times more than with other countries, while in mutual recognition products the authors did not find significant border effects.

The home-biased effect is the strongest in the case of old approach products, and the lowest in the other approach category, while mixed approach is between the two (which is in line what one would expect due to the fact that mixed approach contains products for which both old and other approach applies).

In order to better understand our results on home bias we run the same regression including country specific dummies for home trade. The results are presented in Table 3. In this case home dummy captures the home bias of Cyprus, while dummy Poland, Hungary, Bulgaria, Latvia home measures respectively the home biased of each country. All of these dummies are significant and take a rather high value with the exception of the dummy capturing the home biased effects of Cyprus. In the case of Bulgaria, when distance is measured with the harmonic method, internal trade in old approach product is 467 times higher, in other approach products 38 times higher, and in mixed approach products 82 times higher than trade with partner countries.

Distance is significantly affecting trade in all three categories. Moreover, the coefficient of distance for old approach products has the highest negative effect on trade compared to other and

mixed approach. For old approach products, the coefficient of the distance is -2.36 when measured with the harmonic method. This coefficient is higher than the estimates found usually in the literature, but similar to the estimates of Sousa and Disdier (2002) who estimated the effects of legal framework as a trade barrier on certain Central and Eastern European countries. The coefficient of remoteness is also rather high, but only significant in the case of mixed approach.

Table 4 presents the results of obtained with a Censored Least Absolute Deviations (CLAD) estimator applied to a specification which includes country effects. This method allows to control for the censoring at zero value of our dependent variable. When the data are censored, OLS will result in coefficient estimates that are biased toward zero. Traditional statistical analysis prefers maximum likelihood methods or related procedures to deal with the issue of censoring. However the validity of tobit or similar procedure requires correct specification of the error distribution where departures from the standard assumptions, in particular normality, imposes a strong price in terms of consistency (Johnston di Nardo, 1997)[13]. Semiparametric procedures lessen the dependence on a particular distribution of the residuals and the requirement of no heteroskedasticity in their structure, due to the minimization of the sum of absolute residuals from the sample median.[14] We have applied the procedure presented in Chay and Powell (2001) to a specification without including country specific home trade dummies. As before, while GDP of the partner country is always significant and takes the expected sign, the GDP of the reporting country takes different signs for different product categories. Distance takes the expected sign for all the three different categories and remoteness turns out to be significant but with the wrong sign at least for old approach and other approach products. The less remote is a partner to a reporting country, relative to other alternatives trade partners, the higher is trade, as expected, only for mixed approach products. The home bias effect is again higher for old approach products, while lower for other approach. Mixed approach products fall as expected between the two above categories.

[13] We have also estimated a tobit model to both specifications (with and without home trade dummies). The results are very similar to those obtained using OLS estimation method and the CLAD procedure.
[14] As reported in Chay and Powell (2001) for censored panel data with fixed effects, maximum likelihood estimation methods will generally be inconsistent even when the parametric form of the conditional errors distribution is correctely specified.

7. Conclusions

We have looked at the issue of border effects by investigating imports of 6 accession countries differing in size and other characteristics (Hungary, Poland, Czech Republic, Romania, Latvia and Cyprus). Measuring national border effects contributes to evaluate whether market fragmentation between the EU and the accession area is more relevant than is suggested by estimates of border effects between the EU-15. Such a concern is mainly motivated by the fact that barriers in movements of goods between the EU and the CEECs have been dismantled relatively recently.

Following Brenton and Vancauteren (2000) we have considered the extent of border effects for sectors grouped according to whether technical regulations are important and then by the approach adopted by the EU to remove technical barriers to intra-EU trade. We group products in three categories; old approach, other approach (including mutual recognition, new approach), and mixed approach (which includes products where old approach and another approach is applicable). Our results suggest that the border effects are the largest for old approach products, where we expect to have the most important technical barrier to trade due to complicated harmonization procedures. The 'other approach' category has the smallest border effects, while the 'mixed approach' products are in between the two previous categories. Our countries of interest would trade with themselves 114 times more in old approach products, while only 25 times more in other approach products. When considering country specific border effects Hungary had the highest border effects, followed by Bulgaria, Poland and Latvia.

Our results suggest that the border effect is important for accession countries and these effects are more important than in the case of EU countries as shown by previous studies. The importance of home bias in trade with other accession countries relative to internal trade and towards EU partner countries varies according to the approach to the removal of technical barriers to trade. The results are comparable to the results of Brenton and Vancauteren (2001), who found that membership of a free trade agreement with the EU is important for New and Old Approach products but is insignificant for mutual recognition products. We also found similar trends, although we found that trade in New Approach and mutual recognition products between the

accession countries and the EU is also mitigated, although to a lesser extent than in Old Approach products.

All accession countries included in our estimation trade with itself more than with other countries, and home bias is higher than in the case of EU countries. Home bias is highest for old approach products, accession countries in our sample tend to use more home produced products where technical regulations are more complex than products imported from abroad. These border effects in products with important technical barriers to trade are mitigated for EU partner countries, but not for other accession countries. This might be also the result of the foreign direct investment by EU firms in accession countries which was significant during this period in sectors where technical barriers to trade were important. Much of this investment probably led to production consistent with EU standards (Brenton and Vancauteren (2001)). On the other hand for new approach products and for products where mutual recognition principle applies being an EU partner country offsets the border effects to a smaller extent.

The dummy which takes a value of one when a country has implemented the Europe Agreements and zero otherwise captures in our estimation mainly the effect of the free trade agreement between the EU and accession countries. The coefficient of this dummy implies that the implementation of the Europe Agreements had a positive effect on accession countries' bilateral trade flows during the 1992-1998. This effect varied between the different sectors. For trade in products where we expect to have higher barriers to trade, the free trade agreement between accession countries and the EU had higher positive effects on trade flows than in products where technical barriers play smaller role. It also implies that trade in products which are highly regulated the accession countries tend to trade more with the EU than with other accession countries.

We have also controlled for the possibility of inflated border effects due to mismeasurement in the distance variable by using a formula of aggregation in constructing the mean for the distance variable more coherent with suggestions from previous gravity exercises (Head and Mayer, 2002). Both arithmetic and harmonic means for the international and internal measures of distances have been found negative and significant for all type of products. The border effect

coefficients for the harmonic mean have been found consistently smaller, regardless the relevance of technical barriers. Furthermore distance has also been found to be a slightly smaller impediment when using the effective measure. On the other hand distance has the strongest negative effect for imports of products regulated by the old approach. In other words imports which are more likely to be affected by technical barriers tend to have origin from nearer countries.

The magnitude of the estimated border effects seems to be too large to be consistent only with the presence of trade barriers. In this paper we did not aim to explain fully what causes this high estimate for border effects, we rather tried to see whether we could observe some difference in the importance of border effects in trade in products with different magnitude of technical barriers. Thus what we could conclude from our results is that there are larger and more persistent border effects for sectors where technical regulations constitute major barriers to trade. However, border effects, although to a lesser extent, are also significant for products, where technical regulations are less cumbersome. Interestingly this result is different from findings of Brenton and Vancauteren (2001), the authors found higher levels of border effects for sectors where technical regulations did not constitute major barriers to trade. Furthermore, the presence of border effects in sectors where technical regulations are less important can also be explained by other factors, such as rules of origin, spatial distribution of production, the presence of social and business networks, consumer or firm preferences and for our estimation also by tariffs. Although tariffs were gradually dismantled during the period, moreover we did not find significant reduction of border effects over time.

Our results suggest that the estimated level of border effects is partly due to policy-related constraints, thus there is an important role for policy makers to remove these barriers. The level of trade of accession countries is substantially lower than what would arise in the absence of border effects, which is much more pronounced in trade with other accession countries than in the trade of accession countries with the EU. Certainly the border effects are present not only due to policy related constraint, but the larger border effects for products with higher technical barriers to trade suggests that an important part of the border effects in the case of the accession countries could be eliminated by removal of such barriers.

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Table 1 International and internal weighted distances for Bulgaria, Czech Republic, Hungary, Latvia, Poland, Cyprus.

	Bel	Den	Ger	Gre	Spai	FR	Irel	Italy	Lux	Neth	Au	Port	Finl	Swe	UK	Bulg	Cze	Esto	Hun	Lit	Latv	Pol	Rom	Slove	Slova	Turk	Cyp
Average [1]																											
Bulgaria	1812	1688	1482	529	2143	1848	1772	1126	1628	1830	956	2824	1946	1906	2235	179	1089	1852	682	1316	1505	1107	360	897	820	379	1118
Czech R.	796	660	486	1416	1635	1015	695	821	668	775	246	2218	1292	1064	1195	1089	149	1209	427	853	969	386	925	424	304	1426	2198
Hungary	1168	1037	837	1030	1767	1289	1102	799	1004	1170	318	2411	1484	1344	1582	682	427	1392	129	913	1081	526	543	366	203	1015	1781
Latvia	1504	805	1236	1984	2580	1855	1258	1746	1486	1398	1132	3127	451	545	1766	1505	969	358	1081	201	116	659	1223	1323	968	1696	2417
Poland	1048	623	737	1517	1975	1322	874	1128	964	987	520	2551	1011	855	1403	1107	386	923	526	534	659	255	877	704	399	1395	2168
Cyprus	2933	2784	2596	1000	3055	2918	2899	2107	2738	2957	2065	3733	2853	2913	3366	1118	2198	2764	1781	2237	2417	2168	1312	1989	1916	772	42.2
Harmonic [2]																											
Bulgaria	1807	1686	1455	453	2084	1820	1762	1073	1621	1825	943	2816	1944	1904	2221	116	1073	1850	666	1314	1500	1083	300	883	809	345	1111
Czech R.	780	651	417	1387	1578	966	663	774	650	757	225	2208	1290	1062	1170	1073	64.7	1207	390	847	966	323	881	419	225	1417	2193
Hungary	1162	1034	798	993	1705	1257	1088	765	997	1164	281	2404	1481	1342	1566	666	390	1389	80.6	908	1077	478	466	341	174	1010	1778
Latvia	1502	799	1210	1968	2548	1833	1255	1730	1484	1393	1130	3121	442	530	1758	1500	966	347	1077	187	54.8	631	1208	1322	963	1694	2414
Poland	1026	575	662	1480	1922	1280	841	1088	944	960	481	2539	993	830	1377	1083	323	904	478	495	631	167	828	679	333	1378	2157
Cyprus	2932	2784	2584	983	3023	2903	2896	2076	2738	2957	2063	3733	2853	2913	3358	1111	2193	2764	1778	2237	2414	2157	1296	1989	1913	772	42.2
Difference between Arithmetic and Harmonic Mean [3]																											
Bulgaria	6	2	26	76	60	28	10	53	7	6	13	8	2	1	14	**63**	16	2	16	2	4	24	60	14	11	34	6
Czech R.	16	9	69	29	57	50	32	47	18	18	21	10	2	2	25	16	**85**	2	38	6	4	63	44	5	79	9	6
Hungary	5	4	39	36	62	32	14	34	7	6	37	7	3	3	16	16	38	3	**49**	5	5	48	77	25	30	5	3
Latvia	2	6	26	16	33	22	3	16	1	5	3	6	8	15	7	4	4	11	5	15	**62**	28	15	1	5	3	3
Poland	21	49	75	37	53	42	34	40	20	27	38	12	18	24	26	24	63	19	48	39	28	**88**	49	25	67	17	11
Cyprus	0	0	12	17	33	15	4	31	0	0	2	1	0	0	7	6	6	0	3	0	3	11	17	0	3	0	0

[1]: Weighted arithmetic mean across the regions of country *i* of the weighted mean distance for each region in country *i* with regions of country *j* (GDP regional shares are used as weights)

[2]: Weighted harmonic mean across the regions of country *i* of the weighted harmonic mean distance for each region in country *i* with regions of country *j* (GDP regional shares are used as weights)

[3]: 1-2

Table 2 OLS, without country specific home dummies

	Old approach with arithmetic distance	Old approach with harmonic distance	Other approach with arithmetic distance	Other approach with harmonic distance	Mixed approach with arithmetic distance	Mixed approach with harmonic distance
Ln GDP	0.941	0.978	0.951	0.983	1.103	1.135
Partner	(0.269)***	(0.261)***	(0.212)***	(0.209)***	(0.218)***	(0.215)***
Ln Pop	-0.196	-0.239	-0.035	-0.073	-0.197	-0.233
Parnter	(0.326)	(0.316)	(0.302)	(0.295)	(0.302)	(0.299)
Ln GDP	-2.336	-2.344	0.736	0.735	1.851	1.834
Reporting	(0.945)**	(0.954)**	(1.182)	(1.199)	(0.729)**	(0.691)**
Ln Pop	5.878	5.704	-8.088	-8.276	-6.233	-6.360
Reporting	(5.368)	(5.461)	(5.141)	(5.262)	(4.137)	(4.090)
adjacency	0.366	0.138	-0.294	-0.485	0.023	-0.174
	(0.669)	(0.686)	(0.538)	(0.545)	(0.550)	(0.533)
EA	1.257	1.250	0.910	0.901	0.701	0.695
	(0.280)***	(0.283)***	(0.316)***	(0.319)***	(0.312)**	(0.311)**
CEFTA	-0.765	-0.941	0.723	0.572	0.710	0.559
	(0.875)	(0.879)	(0.577)	(0.568)	(0.588)	(0.593)
Home	5.686	4.734	4.130	3.314	5.177	4.371
	(1.642)***	(1.779)**	(1.144)***	(1.164)***	(1.113)***	(1.192)***
LnRemote	1.171	1.033	0.761	0.646	3.314	3.175
	(2.248)	(2.137)	(1.825)	(1.760)	(1.631)*	(1.546)*
LnDistance	-1.685	-1.820	-1.520	-1.626	-1.367	-1.488
	(0.643)**	(0.599)***	(0.297)***	(0.261)***	(0.429)***	(0.403)***
Country dummy	included	included	included	included	included	included
Constant	-45.113	-40.512	94.750	99.053	30.683	34.694
	(77.334)	(76.801)	(59.889)	(60.166)	(57.512)	(57.275)
Observations	718	718	718	718	718	718
R-squared	0.70	0.70	0.73	0.73	0.75	0.75

Robust standard errors in parentheses * significant at 10%; ** significant at 5%; *** significant at 1%

Table3 OLS, including country specific home dummies

	Old approach with arithmetic distance	Old approach with harmonic distance	Other approach with arithmetic distance	Other approach with harmonic distance	Mixed approach with arithmetic distance	Mixed approach with harmonic distance
Ln GDP	1.127	1.126	1.061	1.064	1.233	1.237
Partner	(0.206)***	(0.211)***	(0.192)***	(0.197)***	(0.213)***	(0.215)***
Ln Pop	-0.434	-0.449	-0.181	-0.196	-0.354	-0.370
Parnter	(0.235)*	(0.234)*	(0.275)	(0.278)	(0.288)	(0.289)
Ln GDP	-2.534	-2.410	0.591	0.671	1.727	1.801
Reporting	(0.950)**	(0.940)**	(1.185)	(1.183)	(0.654)**	(0.664)**
Ln Pop	5.777	5.275	-7.956	-8.295	-6.404	-6.740
Reporting	(5.029)	(4.990)	(4.975)	(5.022)	(4.068)	(4.090)
adjacency	-0.261	-0.328	-0.697	-0.785	-0.399	-0.479
	(0.676)	(0.706)	(0.532)	(0.566)	(0.503)	(0.516)
EA	1.249	1.228	0.923	0.910	0.686	0.673
	(0.251)***	(0.248)***	(0.303)***	(0.303)***	(0.296)**	(0.296)**
CEFTA	-0.956	-1.081	0.614	0.495	0.581	0.470
	(0.872)	(0.877)	(0.562)	(0.555)	(0.608)	(0.612)
Home	-2.050	-1.681	-0.785	-0.625	-0.134	0.034
	(2.636)	(2.604)	(1.519)	(1.533)	(1.961)	(1.979)
LnRemote	0.761	0.888	0.553	0.617	3.019	3.072
	(1.915)	(1.925)	(1.710)	(1.706)	(1.489)*	(1.478)**
LnDistance	-2.472	-2.364	-2.018	-1.966	-1.892	-1.839
	(0.642)***	(0.631)***	(0.374)***	(0.372)***	(0.473)***	(0.473)***
HUNhome	10.546	9.324	7.420	6.476	7.818	6.925
	(1.430)***	(1.177)***	(1.027)***	(0.930)***	(1.016)***	(0.858)***
BULhome	7.295	6.147	4.520	3.645	5.240	4.403
	(1.565)***	(1.346)***	(0.972)***	(0.881)***	(1.398)***	(1.251)***
POLhome	6.368	5.233	3.862	3.012	3.756	2.948
	(1.747)***	(1.509)***	(1.166)***	(1.082)**	(1.513)**	(1.374)**
LATVhome	5.761	3.826	2.687	1.146	4.016	2.529
	(1.322)***	(0.905)***	(0.836)***	(0.682)	(1.168)***	(0.893)***
Country dummy	included	included	included	included	included	included
Constant	-30.777	-27.498	101.176	103.772	41.597	44.325
	(66.493)	(66.521)	(55.125)*	(55.651)*	(56.873)	(57.092)
Observations	718	718	718	718	718	718
R-squared	0.73	0.73	0.75	0.75	0.77	0.77

Robust standard errors in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%

Table 6 CLAD

	Old approach with arithmetic distance	Old approach with harmonic distance	Other approach with arithmetic distance	Other approach with harmonic distance	Mixed approach with arithmetic distance	Mixed approach with harmonic distance
Ln GDP Partner	1.111 (0.045)***	1.363 (0.076)***	1.038 (0.063)***	0.908 (0.024)***	1.053 (0.047)***	1.199 (0.039)***
Ln Pop Parnter	-0.252 (0.050)***	-0.597 (0.083)***	-0.045 (0.068)	0.084 (0.028)***	-0.190 (0.055)***	-0.384 (0.043)***
Ln GDP Reporting	-3.281 (0.538)***	-3.714 (0.955)***	-0.768 (0.765)	2.112 (0.304)***	0.659 (0.563)	1.673 (0.490)***
Ln Pop Reporting	3.547 (3.560)	8.864 (5.895)	-7.263 (4.841)	-11.073 (1.972)***	-3.923 (3.597)	-4.077 (2.923)
adjacency	-0.015 (0.130)	-0.071 (0.213)	0.049 (0.172)	-0.089 (0.070)	0.165 (0.131)	0.147 (0.116)
EA	1.048 (0.097)***	0.755 (0.166)***	0.740 (0.136)***	0.609 (0.053)***	0.688 (0.106)***	0.508 (0.086)***
CEFTA	0.575 (0.189)***	0.743 (0.258)***	0.314 (0.228)	-0.027 (0.091)	0.767 (0.180)***	0.260 (0.145)*
Home	5.482 (0.260)***	5.791 (0.448)***	2.886 (0.334)***	2.519 (0.154)***	4.013 (0.238)***	3.518 (0.250)***
LnRemote	-1.467 (0.485)***	-4.256 (0.811)***	-4.326 (0.687)***	-0.650 (0.257)**	1.129 (0.522)**	2.131 (0.430)***
LnDistance	-1.892 (0.092)***	-1.761 (0.159)***	-2.052 (0.123)***	-1.964 (0.053)***	-1.840 (0.096)***	-1.905 (0.083)***
Country dummy	included	included	included	included	included	included
Constant	20.766 (43.838)	-22.972 (72.469)	149.243 (59.562)**	126.907 (24.080)***	40.104 (44.117)	19.435 (35.776)
Observations	718	718	718	718	718	718

Robust standard errors in parentheses

* significant at 10%; ** significant at 5%; *** significant at 1%