Impact of EU enlargement on cereals trade: a policy evaluation using network data

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Summary

The effect of EU policies on the agricultural sectors of Central-Eastern European Countries (CEECs) is a topic of interest, especially within the broader theme of the impact of EU enlargement policies on the economy of entrant countries. However, specific studies about the contribution of the Common Agricultural Policy (CAP) on the evolution of agricultural trade of CEECs are lacking. We propose an innovative methodology of program evaluation taking into account the network information, by using Propensity Score Matching and Social Network Analysis within the classical framework of the gravity models. We concentrate our analysis on the trade cereals market: as we are dealing with dyads (pairs) of countries, we create different alternatives of Treatment variables, i.e. three different groups of treated and untreated dyads. Our findings suggest that the effect of being involved in the EU enlargement is positive for each case, but the choice of the counterfactual is crucial for the estimation process.

Keywords: EU enlargement, Trade, Social Network Analysis, Policy evaluation.

JEL Classification codes: C21, F13, Q17.

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1. INTRODUCTION

The evaluation of policies has always played a central role in providing evidence-based elements enabling to know the effect of economic or social programs on specific targets. Within the ongoing debate about the effects of the EU enlargement on entrant countries, particular attention is devoted to the impact of the Common Agricultural Policy (CAP) *acquis* on the structural adjustment of the agricultural sectors of Central-Eastern European Countries (CEECs) (Kiss, 2012; Lovec and Erjavec., 2012; Csaki and Jambor, 2013a; Csaki and Jambor, 2013b). In these countries, the implementation and the effectiveness of the payment schemes under Pillar I of the CAP have been the objectives of other studies focusing, in particular, on farmers' propensity to risk and attitude to invest, as well as on inputs market and productivity (Ciaian and Swinnen, 2006; Regoršek and Erjavec, 2008; Ciaian and Kancs, 2012; Mattews et al., 2017). However, the impact of adhesion to CAP on agricultural trade of new entrant states, in particular the CEECs, is either missing or slightly mentioned in literature as deriving from potential distortive effects of the direct payments schemes and some measures of the Rural Development Programmes (RDPs) of the CAP.

Although the dynamics of trade policy adjustments are mainly related to the sphere of trade agreements, within the framework of the European *acquis communautaire* such adjustments are comprehensive of a wider settlement process, involving institutional, economic and social sectors, leading to the adhesion to the EU policies. Indeed, all other things being equal, changes in international trade flows following the EU accession might be partially determined by sectorial policies affecting, both directly and indirectly, the level of production as well as the output prices, especially in agriculture. A further element having potential influence on the evolution of trade flows, within the context of the EU accession process, is the change in the structure of the trade networks, especially those changes originated by variations in international policy. Such condition might closely regard both the former-Soviet states and their trade partners, which either enter the EU or are potential candidate entrants.

The complexity of such framework implies the necessity to shift from the traditional analysis of agricultural trade policies, measuring the impact of changes in trade agreements on trade flows, to a different approach. The focus of the analysis shall be on the change in trade flows due to the presence of a wider sectorial policy, taking into account the elements characterizing the trade networks.

For such a reason, in this paper we propose to evaluate the impact of CAP on the agricultural trade of New Member States (NMS) through an innovative evaluation methodology developed by Arpino et al. (2017), by merging propensity score matching and the social network features of the trade between countries, within the classical framework of the gravity models. Particular attention will be given to those countries that joined the EU within the period 2001-2010, i.e. the so-called "fifth enlargement" in 2004 (even if this enlargement includes also Romania and Bulgaria, which accessed in 2007). Our units of analysis are country dyads, i.e. a pairs of countries sharing a trade partnership; we create different alternatives of Treatment variables considering the countries that were involved in the 2004-2007 EU enlargement, i.e. three different groups of treated and untreated dyads. For each treatment, we create a proper counterfactual group in order to estimate the impact of EU (and CAP) accession on agricultural trade.

We suppose that integrating network statistics in evaluation studies improves the analysis, because direct and indirect connections of a country, as well as its tendency to cluster with its neighbours, tend to convey some relevant information on latent characteristics of the country. Disregarding this information could seriously bias the estimate of the causal effect of the treatment. In order to test the methodology, we decided to restrict the analytical focus upon the trade of cereals, such to refer to a commodity and whose price dynamic are common to the entire area under study.

The paper continues by illustrating the policy background in section 2. Sections 3 and 4 present the data collection process and the methodology, respectively. Section 5 illustrates the results, followed by a concluding discussion in section 6.

2. POLICY BACKGROUND

2.1. Policy context

The fall of the Berlin wall and the Soviet Union breakup originated a transition period during which Central and Eastern European as well as Balkan Peninsula States abandoned the communist/socialist institutions and opened to liberalization. At that time, the response of the EU was to provide for political and economic support to the nearest EU border countries, namely the CEECs and post-Soviet countries, by extending the Generalized System of Preferences (GSP) and then offering (and signing) the Association Agreement (AA), defining the path for accession. The first countries to start the accession negotiations through the AA were Czechia, Estonia, Hungary, Poland and Slovenia in 1998, while Bulgaria, Latvia, Lithuania, Romania and the Slovak Republic joined the AA in 1999. Such agreements, beyond establishing free trade conditions and openness to common market, actually set up the formal engagement of CEECs to converge to the EU *acquis communautaire*. The process of CEECs was quite quick, leading to the accession of Poland, Czechia, Hungary, Slovakia, Estonia, Latvia, Lithuania and Slovenia in 2004, and of Bulgaria and Romania in 2007. After the experience of the accession process of 2004, the EU promoted the European Neighbourhood Policy (ENP) with the aim of establishing a political and economic cooperation with the new border countries finalized to achieve the regulatory convergence. The interested countries are mainly the ones that became independent from the Soviet Union, namely Armenia, Azerbaijan, Belarus, Georgia, Moldova, and Ukraine, together with other transition countries located in the Balkans Peninsula, such as Albania, Bosnia-Herzegovina, Croatia, Kosovo, Macedonia, Montenegro and Serbia. Among those, only Croatia joined the EU in 2013.

The negotiations that led to the accession of ten CEECs countries in 2004 generated concerns in EU-15 (the so-called Old Member States (OMS) at that time) about the conditions of the economic supports granted after the join. Particular worries were related to the support intensities and implementation schemes of the Direct Payments (DP) provided under the common agricultural policy (CAP) framework, particularly for the potential impacts that such payments could have had on the structural adjustment of the agricultural sector of NMS and, in turn, of the common and international agricultural markets (Swinnen, 2002). In fact, the negotiation processes concluded with the establishment of a CAP phasing-in process by allowing NMS (except Slovenia) to adopt the Single Area Payment Scheme (SAPS) with an initial support level set at 25% of the support level of OMS. The intensity of SAPS in NMS was set to increase over the next 10 years, up to 100% in 2013 (currently the SAPS will still be in place until 2020). Beyond the SAPS, NMS were allowed to finance the agricultural sector by the means of a Complementary National Direct Payment (CNDP) scheme, up the 50% of the support level of OMS. On the other side, in OMS the DP of CAP was implemented through the Single Payment Scheme (SPS), a scheme that provided lump sum support independently from the area and crops cultivated.

2.2. Literature review

The accession of NMS to EU in 2004 occurred in a climate of both political and scientific uncertainty concerning the immediate and future economic impacts of accession, especially regarding the agricultural sectors of the NMS. Indeed, those countries were still facing a deep transformation characterized by the adaptation of the pre-accession institutional and economic domestic conditions to the well-established common market conditions of OMS. Such transition process had highly characterized the adjustment of the structural, market and trade conditions of the agricultural sectors of NMS (Swinnen, 2002). The empirical evidence of the impact of CAP implementation in NMS has been mostly focused on the general economic performance of the agricultural sectors, including the evolution of agricultural trade, and on land capitalization of DP (Ciaian and Swinnen, 2006; Regorsek and Erjavec, 2008; Ciaian and Kancs, 2012; Csaki and Jambor, 2015; Matthews et al. 2017).

The empirical findings of the impact of CAP on NMS are diverse and not always in agreement. Although trade flows and, especially, agricultural trade flows with OMS have experienced a growing trend (Regorsek and Erjavec, 2008), no study, at our knowledge, have tried to isolate the effect of CAP on agricultural trade. In fact, many studies limited the scope of investigation upon the impact of SAPS on land markets, demonstrating that in some NMS, characterized by large farm size and mostly rented land, the DP have not impacted the agricultural sector because the capitalization was accrued by landowners (Ciaian and Swinnen, 2006; Ciaian and Kancs, 2012). However, for other NMS in which the structure of the agricultural sector was characterized by lower shares of rented land as well as higher averages of workers per farm (high agricultural employment with respect to other economic sectors), the empirical studies show different results (Matthews et al., 2017). Such differences are highly dependable upon the differences observed among initial conditions, such as, *inter alia*, differences in capital endowment and different distribution of agricultural land quality and quantity (Matthews et al., 2017).

3. DATA COLLECTION AND SAMPLE CHARACTERISTICS

We have created a subset of the UN Comtrade database for cereals trade (Harmonized System code 10). This database covers bilateral trade flows for 236×235 institution pairs, including observations like "World", "Areas NES (not elsewhere specified)", and "Overseas Territories" between 1962 and 2016. Because we are interested in assessing the impact of the European Union enlargement on cereal trade, we consider only countries which are allowed to become members of the EU, i.e. countries:

"*within geographical Europe, which respect and commit to the values set out in Article 2 TEU, namely: respect for human dignity, freedom, democracy, equality and the rule of law; respect for human* *rights, including the rights of persons belonging to minorities; and respect for a pluralistic society and for non-discrimination, tolerance, justice, solidarity and equality between women and men*" (Consolidated versions of the Treaty on European Union and the Treaty on the Functioning of the European Union, 2012/C 326/01).

To be accepted in the EU, these countries must satisfy three eligibility criteria ("*Copenhagen Criteria*"): stable institutions, a functioning market economy, and the ability to implement the political and economic obligations of membership. Potentially, there are 49 nations which have (or could have) the characteristics to be EU members, but we have excluded 6 countries from our analysis due to the lack of data: San Marino, Liechtenstein, Principality of Monaco, Vatican City State, Serbia, and Montenegro. The remaining 43 countries comprise our dataset (Table 1).

Table 1. List of countries

Albania (ALB)	Croatia (HRV)	Greece (GRC)	Netherlands (NLD)	Spain (ESP)
Andorra (AND)	Cyprus (CYP)	Hungary (HUN)	Norway (NOR)	Sweden (SWE)
Armenia (ARM)	Czechia (CZE)	Iceland (ISL)	Poland (POL)	Switzerland (CHE)
Austria (AUT)	Denmark (DNK)	Ireland (IRL)	Portugal (PRT)	TFYR of Macedonia (MKD)
Azerbaijan (AZE)	Estonia (EST)	Italy (ITA)	Rep. of Moldova (MDA)	Turkey (TUR)
Belarus (BLR)	Finland (FIN)	Latvia (LVA)	Romania (ROU)	Ukraine (UKR)
Belgium (BEL)	France (FRA)	Lithuania (LTU)	Russian Federation (RUS)	United Kingdom (GBR)
Bosnia Herzegovina (BIH)	Georgia (GEO)	Luxembourg (LUX)	Slovakia (SVK)	
Bulgaria (BGR)	Germany (DEU)	Malta (MLT)	Slovenia (SVN)	

Source: own elaboration

In particular, we focus on data from 2001 to 2010. The outcome variable of main interest is the average value (in dollars) of cereals bilateral trade between a pair of countries *i* and *j*. Following Arpino et al. (2017), we have retained all the four possible flows of trade (export from *i* to *j*, export from *j* to *i*, import from *i* to *j*, import from *j* to *i*) to calculate the average, deflating by the Cereals Price Index. Since in UN Comtrade data imports are recorded "cif" (cost insurance and freight) while exports are "fob" (free on board), we have retained only exporters' declarations. In this case, our outcome variable is the average value of cereals export from *i* to *j* and from *j* to *i*, when the pair of countries jointly declare all the four flows. Moreover, we have also included in our analysis dyads made by countries that declare to export into other countries, and the latter that declare to import from the first. This is a situation where we observe dyads that include net exporters and net importers. Within this case, the outcome variable is simply the value of cereals export from *i* to *j*.

Pairs of countries that do not fall into these casuistries were excluded from the analysis. We have decided to follow this procedure in order to avoid possible bias due to the absence of equivalence between two declarations. As an example, when a dyad is composed by a country that declares an export flow to another country, but the latter does not declare the same flow as an import, we do not consider this dyad into the analysis (Table 2).

Table 2. Casuistries of trade flows considered in our dataset

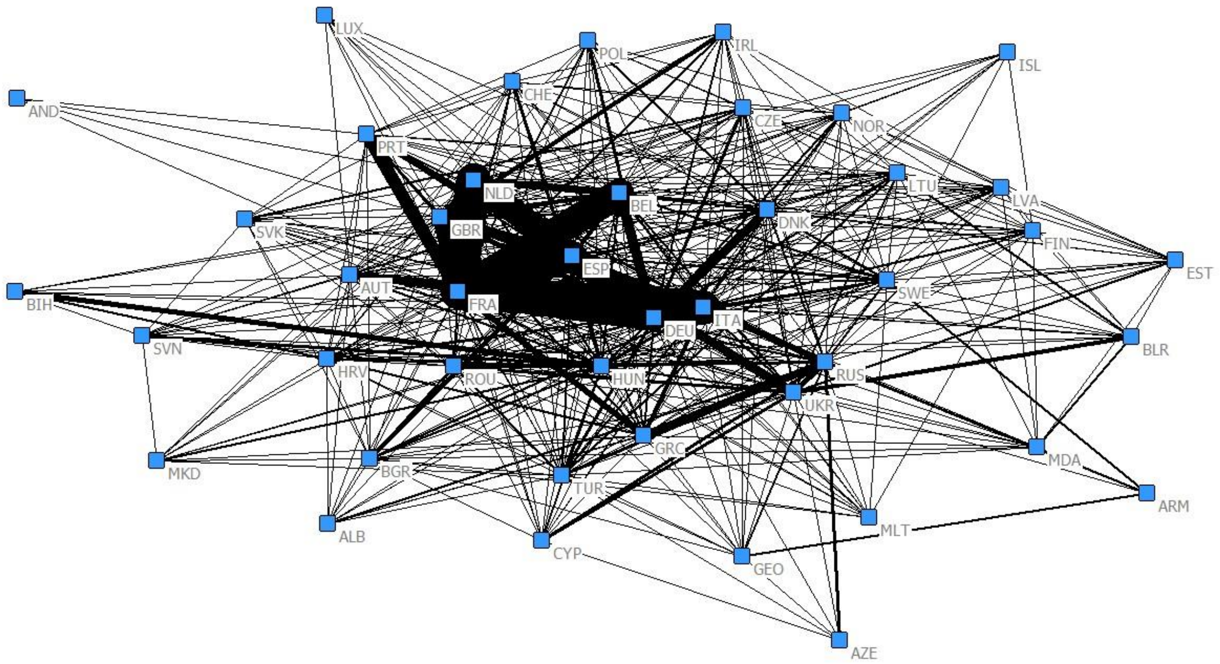
Country i	Country j	Inclusion
Export no, import no	Export no, import no	No
Export no, import no	Export yes, import no	No
Export no, import no	Export no, import yes	No
Export no, import no	Export yes, import yes	No
Export yes, import no	Export no, import no	No
Export yes, import no	Export yes, import no	No
Export yes, import no	Export no, import yes	Yes
Export yes, import no	Export yes, import yes	No
Export no, import yes	Export no, import no	No
Export no, import yes	Export yes, import no	Yes
Export no, import yes	Export no, import yes	No
Export no, import yes	Export yes, import yes	No
Export yes, import yes	Export no, import no	No
Export yes, import yes	Export yes, import no	No
Export yes, import yes	Export no, import yes	No
Export yes, import yes	Export yes, import yes	Yes

Source: own elaboration

Our dataset also comprises information on background variables, mainly standard variables in the gravity model literature: GDP and GDP per capita of exporters and importers, and the logarithm of GDP and GDP per capita; distance, contiguity, log product of land area, and common languages between country pairs; whether two countries are landlocked or island nations (Grant and Lambert, 2008). Monetary variables are expressed in dollars. Furthermore, we have created a dummy variable which takes the value of one if a country was a member of the former Warsaw Pact (Albania, Armenia, Azerbaijan, Belarus, Bulgaria, Czechia, Estonia, Georgia, Hungary, Latvia, Lithuania, Poland, Republic of Moldova, Romania, Russian Federation, Slovakia, Ukraine), or a member of the former Yugoslavia (Bosnia Herzegovina, Croatia, Slovenia, TFYR of Macedonia). Finally, we have information on EU membership status of each country. There are three main groups to consider in our study: 1) countries which were UE members before 2001 (Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal, Spain, Sweden, and United Kingdom); 2) countries which became EU members in the 2004-2007 period (Bulgaria, Cyprus, Czechia, Estonia, Latvia, Lithuania, Malta, Poland, Romania, Slovakia, Slovenia, and Hungary); 3) countries which were not EU members until 2010 (Albania, Andorra, Armenia, Azerbaijan, Belarus, Bosnia Herzegovina, Croatia, Georgia, Iceland, Norway, Republic of Moldova, Russian Federation, Switzerland, TFYR of Macedonia, Turkey, Ukraine).

Additional information concern the network structure that emerges from the trade relationships between countries. In recent years, some authors have applied Social Network Analysis (SNA) to international trade data (De Benedictis and Tajoli, 2011; Kim and Shin, 2002). The main assumption is that trade network is an undirected graph $G(N, E)$ that consists of a set of nodes, identifying potential trade partners $N = \{1, \ldots, n\}$, and a list of edges, which correspond to realized trade partnerships $E = \{(i, j), (i, k), (k, j), \ldots\}$ for $\{i, j, k, \ldots\} \in N$. A "dyad" is defined by a pair of actors and the possible relational tie. Representing a network of trade flows gives emphasis to the relationships between countries, and SNA allows quantifying these relationships by using network statistics. Figure 1 illustrates the average trade flows of cereals, during the 2001-2003 period, between the 43 countries included in our dataset. Each node represents a specific country, and the presence of an edge between two nodes means that two countries had a trade relationship during the 2001-2003 period. Thick edges indicate a large trade of cereals: according to the graph of Figure 1, Belgium, France, Germany, Italy, Netherlands, Portugal, Spain, and United Kingdom are the largest traders in Europe, and additionally they take a central position in the network, i.e. they have many connections.

Figure 1: Average cereals trade flows in the 2001-2003 period



Source: own elaboration based on UN Comtrade data

The position of each country can be "quantified" by using two standard measures of network centrality (Prell, 2012): the degree centrality ($C_{D(i)}$), and the eigenvector centrality ($C_{E(i)}$). The first one is a measure of local centrality, and it is calculated for each node by counting the number of direct connections:

$$C_{D(i)} = \sum_{j=1}^{n} x_{ij} \qquad (1)$$

Where x_{ij} is the value of the tie from country i to country j (which can be equal to one or zero). The eigenvector centrality is a measure of global centrality, and it describes the influence of a node in a network. It is based on the idea that, for a single node, being connected with high-central nodes contribute to its centrality; the eigenvector centrality of a node is therefore determined by the eigenvector centrality of its neighbours. Equation (2) is known as the *eigenvector equation*:

$$Ax = \lambda x \qquad (2)$$

Solving the above equation means find the value of x, which is the unit eigenvector and refers to the largest eigenvalue of the adjacency matrix A, while λ is a constant. These measures define the position of each country in the European cereals trade network, both at the local and global level. Consequently, each dyad in our analysis will assume two different values for each network measures, one per country.

4. METHODOLOGY

In our study, units are country dyads (*i*, *j*) and the treatment variable is the involvement in the 2004-2007 EU enlargement. We consider 2001-2003 as the pre-treatment period, and 2008-2010 as the post-treatment period. Bulgaria and Romania were unable to join in 2004 and they accessed to EU in 2007, but the European Commission states that they are part of this enlargement: for this reason, even if the treatment started in 2004, we observe in 2007 which countries were treated and which not.

For each dyad (*i*, *j*), we can observe two potential outcomes: $Y_{ij}(1)$, which is the value of cereals trade between country *i* and country *j* if the dyad has been treated, and $Y_{ij}(0)$, which is the value of cereals trade between country *i* and country *j*, if the dyad has not been treated. As it is not possible to observe both performance for the same dyad, it is necessary to build a counterfactual group where the observable characteristics of the untreated dyads are similar to the ones of the group of treated.

The treatment variable T_{ij} has three alternative definitions, and the number of treated and controls for each scenario is shown in Table 3:

- T_{ij}=1 if both countries in dyad (*i*, *j*) were involved in the 2004-2007 EU enlargement, and T_{ij}=0 if only one country was involved in the 2004-2007 EU enlargement (from now, first scenario);
- T_{ij}=1 if both countries in dyad (*i*, *j*) were involved in the 2004-2007 EU enlargement, and T_{ij}=0 if no country was involved in the 2004-2007 EU enlargement (from now, second scenario);
- T_{ij}=1 if only one country in dyad (*i*, *j*) was involved in the 2004-2007 EU enlargement, and T_{ij}=0 if no country was involved in the 2004-2007 EU enlargement (from now, third scenario).

Table 3. Treated and untreated observations (three alternative definitions)

	first scenario	second scenario	third scenario
Untreated	216	254	254
Treated	44	44	216

We rely on the Average Treatment Effect on the Treated (ATT) to estimate the impact of EU enlargement on cereals trade, which is defined as (Caliendo and Kopeinig, 2005):

$$ATT = E[Y_{ij}(1) \mid T_{ij}=1] - E[Y_{ij}(0) \mid T_{ij}=1] \quad (3)$$

Unfortunately, since we can not observe the counterfactual mean for those being treated (E[$Y_{ij}(0)$ | T=1]), we have to find a proper counterfactual amongst the untreated ones, assuming that the treatment effect for each treated is independent of treatment participation of other dyads. This assumption is known as the Stable Unit Treatment Value Assumption (SUTVA).

Following the seminal work of Arpino et al. (2017), propensity score matching has been chosen as method to compare treated and control dyads, using nearest neighbor as matching algorithm. In order to draw inference for causal effects, we must assume that the assignment mechanism is strongly ignorable given pre-treatment variables (Rosenbaum and Rubin, 1983; Rubin, 2008). As pre-treatment variables, we consider also the network measures, in compliance with the study of Arpino et al. (2017). However, as degree centrality and eigenvector centrality are highly correlated (Valente et al., 2008), only one centrality measure is used to calculate the propensity score, and we have decided for the eigenvector centrality. Two hypotheses are needed to be coherent with the above assumption of strong ignorability of the assignment mechanism:

1. if $p(X_{ij}, N_i, N_j)$ is the propensity score, the pre-treatment variables must be balanced given the propensity score: $T_{ij} \perp X_{ij}, N_i, N_j \mid p(X_{ij}, N_i, N_j)$;
2. the assignment to treatment is unconfounded given the propensity score: $(Y_{ij}(1), Y_{ij}(0)) \perp T_{ij} \mid p(X_{ij}, N_i, N_j)$.

X_{ij} are a set of pre-treatment characteristics of the dyad, N_i is the network measure of country *i* and N_j is the network measure of country *j*. The vector of covariates includes background variables for each country, such as the logarithm of the GDP, as well as dyad information, such as the product of land areas for country *i* and country *j*.

In order to achieve better estimation results, propensity score matching has been combined with Difference-In-Differences (DID) estimator, as this strategy allows to control for divergences in trend performances between treated and controls (Abadie, 2005; Fotopoulos and Psallidas, 2009). Blundell and Costa Dias (2000), among many others, emphasize the benefits of this combination: the matching procedure accounts for differences in observable characteristics, while DID accounts for the unobserved determinants of participation to the treatment represented by dyad/time-specific elements.

$$ATT = \frac{1}{N_{Tij\,=\,1}} \sum_{ij \in T_{ij}=1} \left([Y_{ij\,POST} - Y_{ij\,PRE}] - \sum_{ij \in T_{ij}=0} [Y_{ij\,POST} - Y_{ij\,PRE}] \right) \tag{4}$$

The estimator of Equation (3) takes the form illustrated in Equation (4). This new estimator is constructed by matching differences in pre-treatment and post-treatment outcomes for the treated dyads to weighted averages of differences in pre-treatment and post-treatment outcomes for the controls. The differences are matched on the propensity score; since we are using nearest neighbor as matching algorithm, weights are defined by $1/N_{Tij\,=1}$.

5. RESULTS

For each alternative definition of treated and controls, we have estimated the impact of EU enlargement on cereals trade. Since we are dealing with three different scenarios, we initially have investigated what could be the combination of the same observable pre-treatment dyad' characteristics that can be used to calculate the three propensity scores. As discussed in the previous section, a probit model is estimated in order to assess the probability (for a dyad) to be treated. The predicted probability of being treated, resulting from the models in Table 4, forms the basis of the matching procedure. For each probit, we have used the following variables: the number of landlocked nations in the dyad; the product of land area; the logarithm of the GDP of country *i*; the logarithm of the GDP per capita of country *i*; the logarithm of the GDP per capita of country *j*; a dummy variable equal to one if *i* and *j* share a common border; the number of landlocked nations in the dyad; the logarithm of the bilateral distance between *i* and *j*, measured in kilometres using the great-circle distance formula; the eigenvector centrality of country *i*; the eigenvector centrality of country *j*.

To assess how well, for each scenario, the propensity score matching performs, it has been calculated the difference between treated and controls in terms of each pre-treatment variable, and it has been run a simple t-tests on the differences. This is a necessary condition for the balancing hypothesis (Dehejia and Wahba, 2002).

Table 4. Probit results, predicting the probability to be treated (three alternative definitions)

Variable	first scenario	second scenario	third scenario
Landlocked	0.47*	0.42	0.23
	(0.27)	(0.29)	(0.16)
Area product	0.00	0.00	0.00**
	(0.00)	(0.00)	(0.00)
Log GDP reporter	0.00	-0.41*	-0.47***
	(0.22)	(0.23)	(0.10)
Log GDP reporter (per capita)	-0.38	-0.27	-0.17
	(0.26)	(0.25)	(0.11)
Log GDP partner (per capita)	-0.31*	-0.35**	-0.28***
	(0.16)	(0.15)	(0.07)
Borders	0.20	-0.33	-0.41
	(0.47)	(0.46)	(0.28)
Islands	0.22	0.96**	0.56**
	(0.51)	(0.44)	(0.24)
Log distance (km)	0.10	-0.72**	-0.22
	(0.33)	(0.32)	(0.16)
Eigenvector reporter	-6.18	13.42**	19.13***
	(6.17)	(6.08)	(3.67)
Eigenvector partner	-12.32**	-1.23	0.03
	(5.51)	(4.36)	(2.35)
Constant	7.24*	17.66***	14.19***
	(4.41)	(4.97)	(2.22)

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1
Source: own elaboration

As shown in Table 4, there are some meaningful dissimilarities between the probit results. In the first scenario (first scenario), the propensity to be treated increase when country *i* and country *j* are landlocked, while significantly decrease when GDP per capita and eigenvector centrality of country *j* increase. With regard to the second scenario (second scenario), being treated is positively affected by the presence of island countries in the dyad and the eigenvector centrality of country *i*, but it is negatively affected by the GDP of country *i*, the GDP per capita of country *j*, and the distance between countries. The last scenario (third scenario) is basically equivalent to the second one, but also the product of land area of dyads' countries influences the propensity to be treated, even if its effect is not relevant.

Once derived the estimated probabilities of being treated, we have matched the treated dyads with those (untreated) that are included in their respective control groups. As a last step, DID is applied to estimate the ATT by taking into account pre-post differences, i.e. reducing endogeneity due to the empirically observed growth of trade between countries (Ortiz-Ospina and Roser, 2016).

Table 5 shows the estimates of the Average Treatment effect on the Treated, obtained by using the three scenarios. ATT is positive and statistically significant in all cases. However, estimates are particularly higher in the first and the second scenario: according to the first scenario, the ATT is equal to around 5.8 millions of dollars, which means that being involved in the 2004-2007 EU enlargement increases bilateral cereals trade amongst dyad' countries of this figure; in the second scenario, the ATT is slightly higher, reaching the amount of 6.6 millions of dollars. The third scenario is the lowest one, in terms of impact: a treated dyad has, on average, an increase of the bilateral trade between its countries of around 3.5 millions of dollars.

Table 5. Average Treatment effect on the Treated (ATT) on cereals trade flows (three alternative definitions)

Treatment	ATT	Standard error	t-test
First scenario	5.81e+06	3.32e+06	1.747
Second scenario	6.56e+06	2.57e+06	2.551
Third scenario	3.48e+06	1.81e+06	1.925

Source: own elaboration

This results are in line with those found by Artan and Lubos (2011), and Bojnec and Fertő (2008), which describe an increase of agrarian trade of the newly accessed EU Member States due to the 2004-2007 enlargement. Our findings suggest that the impact of EU accession on cereals trade is larger when both countries in dyad (i, j) were involved in the enlargement (first scenario and second scenario).

6. CONCLUSIONS

Measuring the impact of EU policies on the agricultural trade of CEECs is a key issue. However, empirical assessments are always problematic, since they must be faced a number of challenges. The most relevant relies on the fact that we do not know how CEECs' trade would change if they did not become EU members. Moreover, inter-relationships amongst EU members and not-EU members affect the policy impact, i.e. it is necessary to consider the network' structure within the evaluation framework.

The present paper tries to shed light on this topic by considering these elements. By applying a non-parametric approach of propensity score matching and Difference-In-Differences estimator, we have empirically evaluated the effect of the 2004-2007 EU enlargement on cereals trade. Specifically, we have estimated the effect, in value terms, on the exchange of cereals between pairs of countries (dyads) for the period 2001-2010. Following recent developments in the specialized literature, we have included network statistics in our model, in order to consider new elements that can lead to better estimates.

The analysis reveals a positive and statistically significant impact of the EU enlargement on cereals trade. Since we have considered three alternative definitions of treatment (dyads which have been involved in the enlargement Vs. dyads which have not been involved), we have observed an higher impact when both countries in dyads have been engaged in the programme. This result is extremely interesting, as it could means that the EU membership has been very effective for CEECs countries as a whole, while its impact has been lower when considering the exchange with previous EU members or other non-EU countries.

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