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The Benefits of the EU Single Market: Evidence from the Gravity Model

Abstract

Empirical economic studies based on gravity models have generally portrayed European integration in a highly positive light. However, the success of Eurosceptic parties in the German regional elections and the Dutch legislative elections highlights growing resistance to further integration. This phenomenon may be explained by the fact that the benefits of integration are often not immediately visible; they tend to manifest indirectly through increased trade volumes between member states. Nevertheless, these political outcomes also cast doubt on the reliability of modelling results. Therefore, our goal is to quantify the impact of EU membership on sectoral trade flows using a gravity model of foreign trade for the period of 2006–2017. To achieve this, we conducted over 850 regressions. Our analysis indicates that exports between EU member states are, on average, 20%–30% higher throughout the business cycle compared to similar non-EU countries. Additionally, we assessed the distribution of membership benefits across individual member states. Our findings reveal that Hungary, Slovakia, and Czechia experienced the most significant increases in trade with other EU countries.

Keywords

Gravity model | European Integration | Exports

JEL Codes

F13, F15

1. Introduction

Empirical economic studies based on gravity models have typically presented a highly favourable view of European integration. Studies conducted particularly after the Lehman Brothers crisis indicated an increase in benefits.

However, such results conflict with the perceived actual benefits of membership. For example, the recent victories of Eurosceptic parties in the German regional elections and Netherlands' elections pose a major challenge for European integration. The Party for Freedom (PVV) emerged as the winner in the Netherlands in 2023, proposing NEXIT, i.e., leaving the EU. The Alternative für Deutschland became a mainstream party with victories in the regional election in the Eastern lands of the country.

Disappointment with EU policies appears to be growing across Europe. This may be partly explained by the nature of the benefits of European integration, which are often less immediately visible. These benefits tend to manifest in areas such as increased trade volumes between member states, while the costs are frequently amplified in media discourse (Bijsmans, 2021). However, the real issue may also lie in whether the parameters associated with the benefits of membership have changed recently or whether the models accurately capture the actual benefits. Therefore, we aim to provide a quantitative assessment of the impact of EU membership on trade flows.

We utilised the gravity model of the foreign trade during the years of 2006–2017, based on the United Stated International Trade Commission (USITC) ITPD-E dataset and Dynamic Gravity Dataset. The

dataset contains information about the trade flows between every major economy in the world. We analysed every bilateral pair of countries, where the value of transactions exceeds USD 1 bn.

Our analysis suggests that the value of exports between EU member states is 20%-30% higher compared to similar countries that are not part of the EU, depending on the phase of the business cycle. We also calculate the distributed impact of membership between members. Our model suggests that Hungary, Slovakia and Czechia experienced the biggest increase in trade with EU countries of nearly 70%. Poland's benefit from the increase in trade also exceeds the EU average. In the case of the Netherlands, the numbers align closely with the average, while Germany benefits even more than Poland but less than other Central and Eastern European (CEE) countries.

The structure of the paper is as follows: Section 2 reviews the literature on gravity modelling and trade agreements in the context of the economic benefits of European integration. Section 3 outlines the methodological framework for modelling foreign trade using gravity equations. Section 4 presents empirical results. Finally, Section 5 concludes by summarising the main findings and discussing the limitations of the applied models.

2. Literature Review

This section presents a literature review on the economic performance and trade benefits associated with EU integration. While numerous studies highlight the economic advantages, recent Eurosceptic movements have increasingly opposed European integration, advocating for withdrawal from the Union. The literature indicates that criticism primarily targets the social dimensions of EU integration, whereas trade benefits have remained relatively stable over time.

Classical literature often emphasises the significant economic benefits of participating in the EU internal market. Research on structural changes in trade frequently references Jan Tinbergen's (1962) gravity model analysis. In the previous millennium, publications predominantly relied on a naïve approach to gravity models, which incorporated data on economic size and binary variables. These models often produced notably large estimates regarding the impact of trade agreements. In 2003, a study by

Anderson and van Wincoop (2003) formalised the use of geographical variables and cultural factors, such as a common language. The study showed a significantly smaller impact of the EU on exports. Controlling for unobserved barriers and global market effects suggests that two EU members trade roughly 8%–10% more with each other thanks to the EU. At the same time, the naïve models showed a 26% increase (Baldwin & Taglioni, 2007).

The papers published after the Global Financial Crisis suggested increased effects of EU membership with greater volatility of results. Verstegen et al. (2017) suggested that participation in the eurozone increases GDP per capita by approximately 1.1% to 8.5%, depending on the country. Hagemeyer et al. (2021) estimated that the GDP of CEE countries grew by over 30% due to their participation in the EU single market. These studies employed the synthetic control method, a somewhat controversial approach that assumes a country's economy would have followed a similar trajectory to selected benchmark countries had it not joined the EU. The observed GDP increase is then compared to the weighted average of these benchmarks.

Gravity models also produced varying results following the Global Financial Crisis, though the vast majority indicated a strengthening economic impact. Studies conducted for countries that joined the EU after 2004 suggested diminishing export benefits, estimated at around 14%-15% (Čipkutė, 2016). At the same time, the authors estimated models suggesting an export increase of 30%-50% in more developed EU countries (Mayer et al., 2018; Spornberger, 2022; Virag-Neumann, 2015). The significant discrepancy may result from analysing only aggregate data. Head and Mayer (2021) utilised disaggregated gravity models to compare the interconnectedness between the EU countries and the US states. They concluded that the intensity of trade flows is comparable in each of the areas. However, they did not examine the average impact of trade agreements. Our aim is to present a similar analysis utilising sectoral level data.

Contrary to the model indications, the economic benefits tend to be less visible in EU countries. The Eurobarometer Survey indicates that positive image of the EU was at the level of 50% visible in the first decade of the new millennium and fell to 30% during the crisis. The first visible tensions in the EU escalated after application of austerity policies in Southern Europe (Magone, 2015). The Troika reforms were strongly contested in the Southern countries of the EU, which

led to rise of fair-left and far-right parties (Carrieri & Vittori, 2021). As a result, the Eurobarometer survey conducted in 2013 shows that southern and CEE countries (i.e., Portugal, Spain, Greece, Italy, Cyprus, Czechia, Slovakia, Slovenia, Bulgaria, Romania) feel that their voice does not count in the European Union. Results in those regions fall short of the 29% positive answers (EU average). Such levels indicated significant social tensions, for example, protests against austerity policies. The current results are somewhat more optimistic—during the years 2017–2025, 45% to 55% of voters expressed trust. Nevertheless, certain problems are still emerging even at present. Smaller or less central economies more often express more critical or even Eurosceptic views (Vasilopoulou, 2018). We also observed an increasing polarisation and hardening of positions among individuals holding negative views of the EU.

Distrust toward the European Union has spread over the past decade, gradually reaching even the core members. The most prominent manifestation of this trend was the United Kingdom's decision to leave the EU. While Brexit had multiple causes, it was largely driven by growing dissatisfaction with the uneven distribution of the benefits of economic integration—particularly in terms of national income growth and access to public services—as well as concerns over free labour movement and migration (Arnorsson & Zoega, 2018; King, 2021). These concerns were not confined to the UK alone; similar sentiments began to surface across continental Europe, including in several key Euro Area economies (Rosamond, 2016). The problem of the socio-economic divide has been also present in Germany, rising the support for Alternative für Deutschland party (Weisskircher, 2020). Secondly, migration and climate policies played a role during political campaign in the Netherlands (Otjes, 2022).

A recurring theme across these events is the widespread distrust toward quantitative estimates of the potential economic costs associated with a disintegration of the European Union. Empirical studies have consistently projected considerable negative effects resulting from reduced integration. Dhingra et al. (2017) reported that Brexit should decrease Britain's GDP by 6.3% – 9.4%, compared to a scenario where they remain. The UK's National Institute of Economic and Social Research estimates it at 11%-12% (Kaya et al., 2023). Despite the prominence of such estimates in public discourse, they failed to gain sufficient credibility among the general public and were largely discounted in shaping popular opinion.

The evidence challenges the findings on the economic benefits of integration. One possible explanation could be a limited understanding of the true advantages of participating in the European internal market. Rodríguez-Pose and Dijkstra (2021) analysed relationships between the distribution of the structural funds and support for the EU between the regions. Authors concluded that regions with investments from the funds are more enthusiastic about participating in the EU. Another possibility is that the optimistic indications from the models were inaccurate. In such a case, utilising low-aggregated data to recalibrate the sectoral impact of the models would be valuable.

Such considerations have likewise motivated our study on existing research on Central and Eastern Europe that has typically focused solely on broad aggregates. The novelty of this paper is analysis at the level of individual products.

3. Methodology

This section describes the methodology used in the analysis. We utilised the United States International Trade Commission (USITC) data to estimate gravity models. The ITPD-e database breaks down the trade of goods into 123 industries ranging from agriculture, forestry and fishing to manufacturing. The database also covers 47 types of services. All in all, trade values for 170 sectors are reported.

Our aim was to use gravity equations. Such a technique assumes economic relationships behave similarly to Newton's law of universal gravitation, i.e., trade flow increases with the size of the economy measured by GDP and decreases with the physical distance. This can be modelled with formula 1:

$$Trade\ Flow_{i,j,t} = \frac{GDP_{i,t} * GDP_{j,t}}{Distance_{i,j}^2} * costs_{i,j,t} \quad (1)$$

where i and j are indices for the country participating in the panel, and t describes time period. We assume that $costs_{i,j,t}$ behaves as random disturbance $e_{i,j,t}$. Such a model can be easily log-linearised to the following form:

$$\ln(\text{Trade Flow}_{i,j,t}) = \ln(\text{GDP}_{i,t}) + \ln(\text{GDP}_{j,t}) - 2 * \ln(\text{Distance}_{i,j}) + e_{i,j,t} \quad (2)$$

The model is estimated econometrically based on the following equation:

$$\ln(\text{Trade Flow}_{i,j,t}) = \beta_0 + \beta_1 \ln(\text{GDP}_{i,t}) + \beta_2 \ln(\text{GDP}_{j,t}) + \beta_3 \ln(\text{Distance}_{i,j}) + e_{i,j,t} \quad (3)$$

The final equation also includes a vector of dummy variables representing geographical characteristics and trade agreement information. Potential extensions could incorporate variables related to tariff rates, which would be particularly suitable for analysing the structure of trade wars. However, this was beyond the scope of our paper, as our analysis focuses specifically on the impact of EU membership on trade flows.

The analysed equation can be estimated using the standard Ordinary Least Squares (OLS) estimator, which is the typically chosen specification for gravity modelling. However, there are two important considerations when constructing a gravity model. First, we exclude zero and small trade flows below USD 1 billion per year. There is an ongoing debate regarding whether this exclusion results in data truncation, which could potentially impact the robustness of the findings (Krisztin & Fischer, 2015). The primary rationale for including small trade flows is to enrich the dataset with additional information. However, a key question arises: Do these flows genuinely add meaningful value to the analysis?

Anderson and van Wincoop (2003) emphasise that the theory of international trade provides relatively weak justification for heterogeneity among small countries. During estimation, including such economies may obscure the overall picture rather than enhance the analysis. The authors also highlight that border effects can be distorted by the disproportionate influence of small economies, leading to non-representative results.

Secondly, there is a known critique of Silva and Tenreiro (2006), highlighting that heteroscedasticity can introduce biases in parameter estimation. To address this issue, the authors propose estimating the nonlinear model from equation (4) using the Pseudo Poisson Maximum Likelihood (PPML) method, which offers greater robustness in the presence of heteroscedasticity.

$$\text{Trade Flow}_{i,j,t} = \beta_0 * \text{GDP}_{i,t}^{\beta_1} * \text{GDP}_{j,t}^{\beta_2} * \text{Distance}_{i,j}^{\beta_3} \quad (4)$$

There is ongoing debate whether this argument is valid. Martínez-Zarzoso (2013) provided evidence that performance between log-linearised models does not vary from the PPML. Burger et al. (2009) highlights problems of overdispersion and inflated number of zero flows during the estimation. They prefer the negative binomial estimation, which partially addresses both issues. On the other hand, Siliverstovs and Schumacher (2009) argue that PPLM estimates of elasticity in the sectoral data is more reliable. But all in all, the results suggest rather minor differences between specifications from equations two and three. Linders and De Groot (2006) conclude that the choice of method should be based on both economic and econometric considerations. However, even though omitting zero flow causes loss of information, their results suggest that such a solution often leads to acceptable results.

Gómez-Herrera, (2013) points out that zero trade flows in data in OLS models leads to sample selection bias and loss of information. However, he emphasises that it is especially important in disaggregated datasets in which over 50% of values are zero. It is not the case of USITC ITPD-E dataset and Dynamic Gravity Dataset that we utilised. Additionally, Gómez-Herrera highlights that use of the PPML model does not behave so well for an aggregated dataset in the presence of unobserved heterogeneity. Therefore, we have decided to use OLS models in our estimations.

4. Results

This section describes results of our analysis. First, we analyse output from the standard OLS estimation focusing on the semi-elasticities related to membership in the European Union.

Intuitively, the most visible benefit of access to the single market would be an increase in trade volume. EU countries report higher exports in relation to GDP compared to other advanced and emerging economies. The benefits are particularly visible in the Netherlands and the CEE countries. The World Bank reports that Dutch exports of goods and services amount to 92.6% of GDP, twice as high as in Germany and three times as much as in other major EU economies (France, Italy). The level is similar in Slovakia (92.4%) and

Table 1. Gravity model parameters – OLS estimates based on exports and imports in 2017

Variable	Estimate	Std. Error	T value	Pr(> t)
Intercept	-14.65	0.24	-60.55	0.00
$\ln(\text{Distance}^2)$	-0.78	0.01	-62.57	0.00
$\ln(\text{GDP}_{\text{domestic},t})$	1.40	0.01	149.88	0.00
$\ln(\text{GDP}_{\text{partner},t})$	1.09	0.01	117.36	0.00
Dummy variable: Common border	0.67	0.12	5.68	0.00
Dummy variable: WTO membership	1.25	0.05	26.35	0.00
Dummy variable: EU membership	0.24	0.11	2.21	0.03
Dummy variable: Common legal origins	1.00	0.08	13.24	0.00
Dummy variable: Common language	0.56	0.04	14.08	0.00

Source: Own study

slightly lower in Hungary (80.3%). For comparison, the average level in Southeast Asian countries reaches 32% of GDP.

First, we present the results of standard models estimated using aggregated export and import data between the countries. The model shows that EU membership increased trade flows by approximately 25% in 2017. Additional trade activity is observed when both countries are EU members. The model also indicates that a 1% increase in a country's GDP raises its export value by 1.4%, while a 1% increase in its partner's GDP boosts exports by 1.1%. Significant trade increases are evident when countries share certain characteristics: A common border (+67%), a common language (+56%), or similar legal origins (+100%).

In the case of emerging markets, a notable disparity exists between countries that adhere to WTO rules and those that do not. On average, WTO membership has increased trade volumes by 125%. The model parameters are presented in Table 1.

Secondly, we replicated this model for previous years and analysed the evolution of parameters over time – one model for each year. Such an exercise suggests that the increase in trade has become more pronounced following the Global Financial Crisis. To investigate this trend, we estimated cross-sectional models for each year independently and compared the parameters associated with EU membership. Our findings reveal a noticeable increase in trade between member countries during the period 2010–2012. Overall, the estimated impact has remained relatively stable, with minor fluctuations likely influenced by the business cycle.

The estimated parameter corresponding to EU membership in the subsequent iteration of the model is presented in Figure 1. The evolution of all parameters over time is presented in Appendix 1.

Next, we conducted a total of 850 linear regressions, comprising 170 sectors analysed over the last 5 years applied to sectoral data. This comprehensive approach allowed for a thorough assessment of trade patterns across various sectors and time periods. Such approach allows us to distinguish effects between countries. The average benefit in 2017, aggregated from sectoral data, amounts to 25%—a result consistent with the standard equation based on export aggregates. With this specification, a greater impact is attributed to WTO membership, while the effect of a shared border is significantly smaller.

This exercise highlighted that the trade benefits are strongly concentrated within specific sectors. To visualise this, we present an analysis using data from 2017. This sector-based approach reveals a slightly different cumulative impact of EU membership compared to models relying solely on export aggregates; however, the differences are relatively minor. The most substantial trade gains are observed in sectors such as consumer products, food, and automotive industries. Notably, exports of electronics, automotive parts, and motor vehicles are approximately 200% higher compared to similar non-EU countries. The list of sectors that reap the greatest benefits is presented in Figure 2. Conversely, the number of sectors showing no significant trade benefits is relatively small, primarily involving industries subject to strict environmental regulations, such as metal casting and coke ovens.

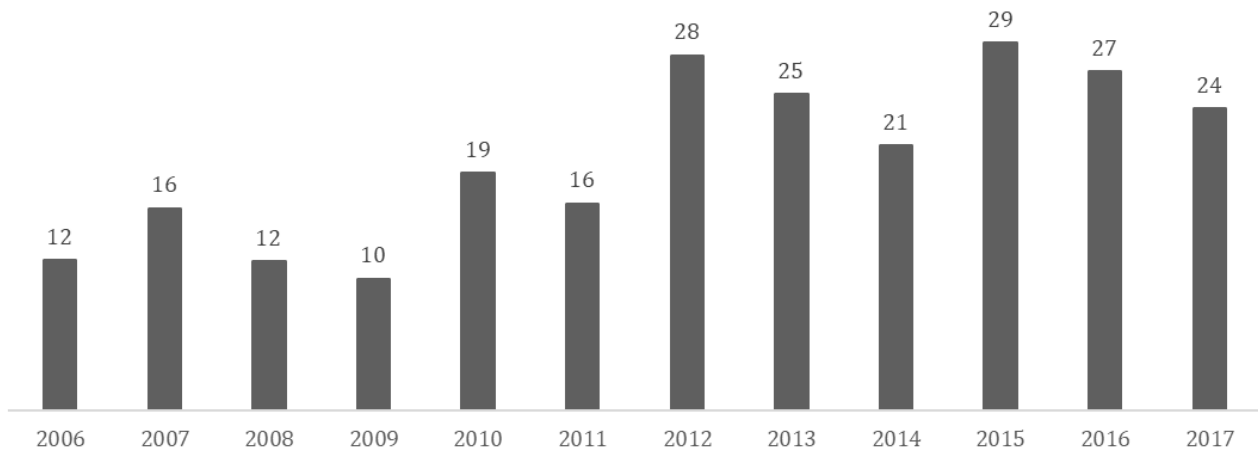


Figure 1. Percentage increase in trade related to EU membership in 2006–2017, based on the gravity model
Source: own calculations based on USITC data

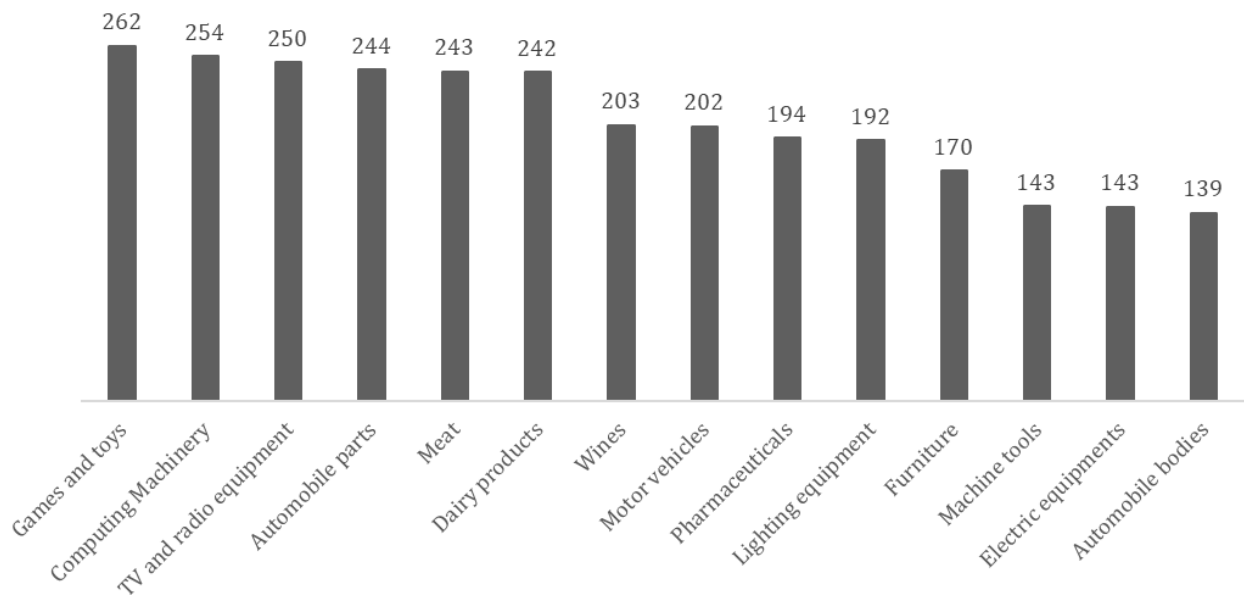


Figure 2. Percentage increase of exports related to EU membership in selected sectors in the year 2017
Source: own calculations based on USITC data

Based on the calculated sectoral statistics, we were able to present EU membership influence on trade across countries. The CEE countries are strongly benefiting from their participation in the German automotive supply chain. We matched the estimated benefits in all 170 sectors with the countries' exports profiles. This enabled us to identify idiosyncratic differences between the countries. We identified the greatest impact of EU membership in the smaller Visegrad countries. In the case of Hungary, Slovakia, and Czechia, exports were approximately 70% higher than in case of similar economies that are not part of the EU. The benefits are also visible in Germany: The

gravity model suggests that exports to EU countries are 45% higher due to EU membership. From this perspective, the benefits visible in Poland are less pronounced, but they are still sizeable. According to our model, the country's exports to EU countries are approximately 36% higher due to EU membership. The exact values of the percentage increase in exports achieved by the largest member states are presented in Figure 3.

To verify the accuracy of these findings, we repeated the analysis using a panel model with fixed effects for both countries and years. Most parameters remain similar to the OLS specification; the only

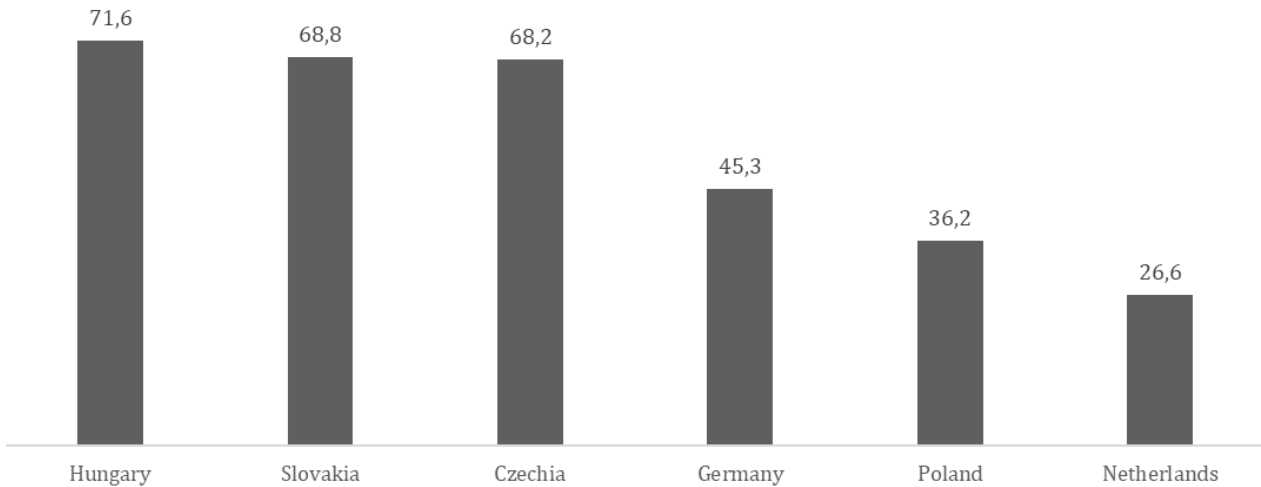


Figure 3. Percentage increase in trade related to EU membership in 2006–2017, based on the gravity model
Source: own calculations based on USITC data

Table 2. Gravity model parameters—OLS estimates (2017) vs. fixed effects

Variable	Estimate OLS (cross-sectional, aggregated data)	Estimate FE (panel, sectoral data)
Intercept	-14.65	-2.93
$\ln(\text{Distance}^2)$	-0.78	-0.91
$\ln(\text{GDP}_{\text{domestic},t})$	1.40	1.13
$\ln(\text{GDP}_{\text{partner},t})$	1.09	-0.13**
Dummy variable: Common border	0.67	-0.31
Dummy variable: WTO membership	1.25	2.57
Dummy variable: EU membership	0.24	0.28
Dummy variable: Common legal origins	1.00	1.25
Dummy variable: Common language	0.56	0.64

Source: Own study

difference appears in the case of the GDP of the country of origin, which becomes insignificant under the panel specification. The comparison is presented in Table 3.

5. Conclusions

We analysed international trade flows using gravity models to estimate the impact of EU membership on export volumes. Our findings indicate that the EU single market boosts trade between member states by approximately 20%-30%, with notable benefits for countries such as the Netherlands and those in CEE.

CEE countries have particularly benefited from their integration into the German automotive supply chain. Among the smaller Visegrad nations—Hungary, Slovakia, and Czechia—exports increased by approximately 70% because of EU membership. Germany also experienced a substantial gain, with its exports to other EU countries rising by around 45%.

Our analysis reveals that the most substantial trade gains are concentrated in the consumer products, food, and automotive sectors. Notably, exports of electronics, automotive parts, and motor vehicles stand out, showing a remarkable 200% increase compared to similar non-EU countries.

In the context of the literature on gravity models, the study demonstrates a similar scale of impact of EU membership as seen in classic works (Anderson & van Wincoop, 2003). At the same time, the recalculated conclusions are weaker than those suggested by some studies (Mayer et al., 2018; Spornberger, 2022).

The conducted study provided a concise assessment of benefits related to export growth due to EU membership. Sector-specific results were presented, allowing for the construction of national profiles of export benefits related to EU membership. This approach enabled a broader assessment of international relationships.

It should be noted, however, that our study has certain limitations. The gravity models rely on a relatively simple, atheoretical representation of trade flows. A valuable exercise is to compare its results with those of other approaches. The standard benchmarks include theoretically grounded outcomes from Computable General Equilibrium (CGE) models, such as those generated by Global Trade Analysis Project (GTAP). The study also does not allow for an assessment of the reasons behind the gap between the estimated benefits of EU membership and their public perception. Answering this question would significantly enhance our understanding of the processes unfolding within the EU and help fill an existing gap in the literature.

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Appendix 1

The table below presents the regression coefficients from the OLS estimation. Each regression was conducted independently using data from individual years.

Table A1. Gravity model parameters – OLS estimates based on exports and imports over the years 2005–2017 on aggregated data

Variable	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Intercept	-12.51	-13.76	-14.06	-14.64	-14.34	-14.20	-14.16	-14.26	-14.40	-14.24	-14.18	-14.46	-14.65
$\ln(\text{Distance}^2)$	-0.71	-0.70	-0.70	-0.70	-0.72	-0.72	-0.74	-0.74	-0.75	-0.77	-0.76	-0.77	-0.78
$\ln(\text{GDP}_{\text{domestic},t})$	1.31	1.34	1.34	1.36	1.38	1.36	1.36	1.36	1.36	1.37	1.38	1.39	1.40
$\ln(\text{GDP}_{\text{partner},t})$	1.04	1.09	1.07	1.06	1.06	1.05	1.06	1.06	1.07	1.08	1.07	1.09	1.09
Dummy variable: Common border	0.83	0.88	0.87	0.97	0.80	0.75	0.75	0.76	0.66	0.62	0.67	0.62	0.67
Dummy variable: WTO membership	0.40	0.46	0.73	0.89	0.96	1.02	1.04	1.16	1.25	1.27	1.16	1.24	1.25
Dummy variable: EU membership	0.03	0.12	0.16	0.12	0.10	0.19	0.16	0.28	0.25	0.21	0.29	0.27	0.24
Dummy variable: Common legal origins	0.93	1.04	0.96	0.98	1.02	1.00	1.01	0.99	1.02	0.95	0.92	1.02	1.00
Dummy variable: Common language	0.80	0.79	0.81	0.89	0.82	0.80	0.74	0.73	0.73	0.69	0.63	0.56	0.56

Source: Own study