International Trade in the European Union

The Role of Converging Political Preferences, Environmental Policies and Infrastructure Investments

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Contents

List of Figures

List of Tables

Introduction

In the contemporary era of globalization, international trade has become a cornerstone of economic growth, regional convergence, cultural exchange, and geopolitical interdependence. Within this context, the European Union (EU) stands as a remarkable example of regional economic and political integration, fostering trade relationships among its member states through committing to joint laws and policies. This thesis reflects upon various dimensions of international trade within the EU, shedding light on the influence of converging and diverging political preferences, environmental policies, and infrastructure investments on trade flows at both country and regional levels. The main objective of this thesis is to deepen the understanding of factors determining and promoting trade integration in the EU Single Market.

When the EU and its predecessor institutions were founded, creating a common market was an incremental strategy of achieving the main goal of securing European peace and promoting cooperation. This goal was realized in two phases: firstly, by establishing the European Coal and Steel Community in 1951, controlling resources to prevent weapon production; and secondly, by forming the European Economic Community in 1958, creating the Common Market. This dismantled internal trade barriers. The Customs Union and the Single Market amend the European Economic Community by facilitating seamless cross-border trade through tariff alignment, elimination of non-tariff barriers and regulatory harmonization, fostering a more integrated European Union. These mechanisms benefit producers by enabling them to access larger markets without encountering trade barriers, as well as consumers by offering them a wider array of competitively priced goods and services from across the EU member states, ultimately promoting economic growth and enhancing well-being.

Today, the EU ranks as one of the largest trading blocs with intra-EU trade having more than doubled from 2002 to 2023 which amounted to roughly 60% of total EU trade in 2023[1], and is unique in the level of economic and political integration. Especially, the supra-national institutions and decision-making authorities, the EU Single Market, and the common currency, stand out in international comparison. Despite all the EU's successes, it faces constant

[1] Statistics are retrieved from EU 2023a and EU 2023b.

challenges. One of these is that despite efforts to create a common market barriers to trade persist, for example, differences in transport infrastructure, taxation, licensing and certification, competition policy and various, national interests. The rise of Euro-skeptic opinions and Brexit show how different national interests challenge the EU and highlight that unsuccessful harmonizing of member states' interests can result in different national policies and thus barriers to trade.

Examining enduring trade barriers and the effectiveness of trade-promoting policies within the EU is, given the EU's imperfections and challenges, of pivotal relevance. Bridging knowledge gaps in the area of regional and international economics, with a special focus on the EU, is thereby essential for advancing academic understanding as well as for formulating policy recommendations that can guide the EU towards improved economic cohesion and integration. Moreover, the results are also of interest for the reduction of trade barriers in other areas, e.g. for the impact of international political developments (such as sanctions and alliances related to the war between Russia and Ukraine), for the impact of environmental policies in general and for infrastructure investments (such as Biden's Bipartisan Infrastructure Law or the Road Belt Initiative).

The EU's journey towards a supranational union has been characterized not only by economic integration but also by the alignment of political preferences among its member states. Thereby, the EU's political integration process did not follow a straight line, with Brexit being the most notable example of disintegration. The first chapter of this thesis examines the interdependence of the political and economic integration process by raising the question of how changes in the similarity in political preferences affect intra-EU trade integration.

Answering this question involves two steps. First, constructing a novel measure for similarity in political preferences based on voting outcomes of roll call votes in the European Parliament from 1995–2016. Thereby, the level of similarity in political preferences indicates whether a member state is more or less likely to align with EU policies in following years and can be interpreted as a signal about a member state's future relations to the EU. Second, the effect of changes in the similarity in political preferences is examined by applying a theory-consistent gravity estimation of trade on intra-EU trade flows. The findings of this chapter suggest that member states converging to the EU's political mainstream experience a reduction in domestic trade and an increase in trade with other EU member states. This result is interpreted such that publicly demonstrating support for EU mainstream policy is perceived as a signal of long-term alignment with EU policies. This alignment signal hence promotes long-term trade relations by reduced policy uncertainty.

Building on the results of chapter one, the second chapter delves into the question of whether differences in environmental policy preferences within the EU have given rise to "pollution havens". In recent years, environmental concerns have gained unprecedented prominence on the global stage. The importance and urgency of climate change and its consequences thereby intensified the need to implement policies that protect the environment. National differences in the preference for environmental protection and the stringency of environmental regulation thereby affect comparative advantages in (emission intensive) production. This chapter utilizes voting records on environmental policies from roll call votes in the European Parliament to measure the revealed environmental policy preference of EU member states from 2000–2014. To examine whether differences in revealed environmental policy preferences create intra-EU "pollution-havens", a gravity model of trade on carbon embodied trade flows is applied. The analysis shows no evidence for differences in environmental policy preferences affecting intra-EU carbon imports and hence no evidence for intra-EU "pollution-havens". The results of this chapter provide evidence for binding multilateral environmental agreements successfully eliminating comparative advantages for emission-intensive industries.

The third chapter of this thesis shifts the focus of revealed policy preferences to the effect of cohesion policy in the form of infrastructure investment. Infrastructure investments aim at creating new links in the infrastructure network and removing bottlenecks in order to reduce trade barriers caused by the lack of adequate infrastructure. This chapter analyses the role of infrastructure investments in shaping intra-EU trade flows at NUTS-2 regional level. Focusing on the construction of new roads and the upgrade of existing roads within the Trans-European Transport Network, the question on whether improved connectivity promotes trade flows at the NUTS-2 regional level is examined. For the analysis, three novel datasets are combined: Data on NUTS-2 level trade flows for mainland EU from 2011 to 2019; manually collected information on the completion of a Trans-European Transport Network's road segment on NUTS-2 regional level and customized data on bilateral year-specific travel times. Leveraging a theory-consistent gravity model of trade, this chapter finds a significantly positive effect of improved road connectivity on road freight. More specifically, an increase in the NUTS-2 pairs optimal route on a completed road segment by one percent increases trade by 0.22% on average. The results of this chapter reveal that improved infrastructure helps facilitate trade and promotes economic linkages of NUTS-2 regions thereby reducing persistent trade costs in the EU Single Market.

In essence, this thesis addresses various areas of international trade within the EU. With a focus on converging political preferences, environmental policies, and infrastructure investments these chapters provide a deeper understanding of the dynamics of intra-EU trade. Thus, this thesis contributes to the existing body of knowledge shedding light on existing trade barriers as well as trade-facilitating and trade-shaping policies.

CHAPTER 1

Convergence in Political Preferences and the EU Single Market[1]

Abstract

Using voting outcomes from the European Parliament to measure the similarity of political preferences between individual member states and the rest of the European Union, we demonstrate that member states, which converge to the EU's political mainstream, benefit from an increase in bilateral trade with other EU member states. We argue that our political convergence measure is informative about the political uncertainty that shrouds each member state's future commitment to the EU's Single Market, and that a reduced political uncertainty – signaled through an observable political convergence – is conducive to an increase in intra-EU trade.

[1]This chapter is joint work with Christiane Hellmanzik and Jens Wrona. This chapter is not published.

1.1 Introduction

On occasion of the European Single Market's 30^{th} anniversary the European Comission (2023) celebrated the common market as "one of the major achievements of European integration, and one of its key drivers". Empirical support for this claim has recently been provided by Felbermayr et al. (2022), who estimate the trade-enhancing effect of the European Single Market to increase member states' goods trade by 46%.

In this paper we focus on intra-EU trade to identify the trade-creating effect that a convergence to the EU's political mainstream has on member states' trade with the rest of the union. Using detailed voting records from the European Parliament (cf. Hix et al., 2022) to measure the similarity of political preferences between each member state and the rest of the union, we are able to show that countries, whose voting behavior has been well aligned with the EU's political mainstream in the past, feature more bilateral trade with other EU member states and less intra-national trade. We argue that our political convergence measure is informative about the political uncertainty that surrounds each member state's future commitment to common EU policies (like the Single Market), and that – in line with the recent literature on that matter (cf. Handley and Limão, 2015; Graziano et al., 2020a,b; Handley and Limão, 2022) – reduced political uncertainty is conducive to an increase in bilateral trade with the rest of the EU.

To identify the differential impact that a convergence to the EU's political mainstream has on member states inter- versus intra-national trade, we adopt a simple approach to estimate the impact of country-specific variables in a structural gravity estimation framework – first proposed by Heid et al. (2021) and later refined by Beverelli et al. (2023). In a gravity setting all country-specific variables are perfectly collinear with the importer- and exporter-specific fixed effects, that are typically used to absorb the endogenous and highly non-linear multilateral resistance terms characterized by Anderson and van Wincoop (2003). As a consequence it is not possible to identify the direct effect of country-specific variables, that influence bilateral trade flows through the gravity equation's monadic components.[2] To overcome this identification challenge, Beverelli et al. (2023) combine international trade with domestic production data, to impute intra-national trade flows, which subsequently are used to identify an interaction between the country-specific variable of interest (which in Beverelli et al. (2023) is institutional quality) and a border dummy indicating trade crossing borders. Although Beverelli et al.'s (2023) estimation approach cannot identify effects of country-

[2] Head and Mayer (2014) review the various microeconomic foundations of the structural gravity model that all result in an isomorphic multiplicatively separable gravity equation with two country-specific monadic terms (see also Anderson and van Wincoop (2004) and Yotov et al. (2016) for further reviews). At the importer-side the monadic term is given by the ratio of the importing country's aggregate expenditure and the inward multilateral resistance term (which corresponds to the importing countries ideal price index). The corresponding monadic term at the exporter-side is given by the exporting country's aggregate production divided by the outward multilateral resistance term.

specific variables that are mediated through the gravity equation's monadic components, it is particularly well-suited to identify the differential impact that country-specific variables, like non-discriminatory policies in Heid et al. (2021), have on the costs of trading internationally instead of domestically. Since we do not expect the similarity of political preferences between a single member state and the rest of the EU to have any meaningful impact on the monadic components of the gravity model or on the member state's internal trade cost, we are able to identify the trade-creating effect of political convergence based on a change in the (expected) relative costs of trading internationally versus domestically.

To consistently estimate the interaction effect between our country-specific political convergence measure and the border dummy, we follow Nizalova and Murtazashvili (2016), who demonstrate that the differential impact of a variable of interest can be consistently estimated even when the particular variable of interest is correlated with omitted variables. The necessary condition for Nizalova and Murtazashvili's (2016) convenient result to hold is that the factor with which the variable of interest is interacted is itself uncorrelated with the variable of interest and with the variables that are omitted from the regression. Our identification strategy therefore requires the dummy variable indicating trade crossing borders to be exogenous, which we ascertain through a series of robustness checks that account for sample composition effects that results from the accession of new EU member states.

In order to tackle reversed causality concerns, according to which countries that become economically more dependent on a trade partner realign their voting behavior towards that trade partner (cf. DiCaprio and Sokolova, 2018; Kleinman et al., 2022), we capitalize on the panel structure of our data and include in our preferred specifications country-pair-specific fixed effects (cf. Baier and Bergstrand, 2007). By doing so, we are able to identify the trade-creating effect associated with the convergence – rather than with the similarity – of political preferences. This distinction is important because estimates which are identified from cross-sectional variation tend to overstate the importance of shared political preferences, which we attribute to reversed causality effects that materialize in the medium to long run. Since yearly changes in bilateral trade flows over a comparatively short time span (1995-2016) are less likely to shift the political preferences of individual member states, we find it quite encouraging that we are able to identify a strong and significant trade-creating effect of political convergence in our very demanding panel setting with time-invariant country-pair fixed effects.

Retrieving and analyzing information on political preferences from roll call votes – in particular from the Congress and the Senate of the United States – has a long tradition in the political science and political economy literature (e.g. Snyder and Groseclose, 2000; Cox and Poole, 2002; Conconi et al., 2014, 2020). Roll call votes from the European Parliament have been used to study individual voting behavior (cf. Hix, 2002; Faas, 2003), party cohesion (cf. Hix et al., 2005, 2007; Hix and Noury, 2009) and coalition formation (cf. Kreppel, 2001;

Kreppel and Hix, 2003). In order to measure the overlap in political preferences between individual member states and the remainder of the EU, we construct a simple and transparent similarity index that is based on the sum of the products of vote shares (see Melitz and Toubal (2014) for a comparable index of language similarity in a gravity setting). Tracing each member state's overlap in political preferences with the rest of the EU across time, not only reveals a substantial inter-temporal variation, which we exploit for identification, but also some secular trends at the country-level. Following the UK on its road to Brexit, we find a continued decline the similarity of political preference with the rest of the EU, which resulted in the UK turning from the second most aligned country in 1995 to the least aligned country in 2016.

In our preferred specification, a strong and statistically significant trade-increasing effect of the converging to the EU's political mainstream is identified with a time lag of three years, which we systematically vary from zero to five years as part of our robustness analysis. According to our preferred estimate a member states would experience a 14.87% increase in its bilateral trade with the rest of the EU, when moving from the 25^{th} to the 75^{th} percentile in the 2016 distribution of the similarity of political preferences across EU member states. When focusing on observed changes in the similarity of political preferences with the rest of the EU from 2007 to 2013, we find that the impact on member states' trade with the remainder of the EU from 2010 to 2016 ranges from a loss of 2.4% for Malta to a gain of 1.4% for Romania.

We offer robust support for a strong and statistically significant trade-creating effect of converging to the EU's political mainstream across specifications that employ different samples and data sources, alternative estimators, and various similarity measures to quantify the overlap between the political preferences of individual member states and the rest of the European Union. Two of our robustness checks are particularly relevant for corroborating the trade-enhancing effect of converging to the EU's political mainstream.

To identify the differential impact of converging political preferences on member states' international versus domestic trade we rely for our baseline estimations on imputed intra-national trade flows from the International Trade and Production Database for Estimation (ITPD-E) compiled by Borchert et al. (2021, 2022). In a major robustness check, we replicate our main result based on observed intra- and international trade flows from the European Road Freight Transport (ERFT) survey (cf. Santamaría et al., 2023), which are reported at the level of European NUTS-2 regions. The additional use of disaggregated regional trade data not only allows us to improve the quality of our border estimates but also confirms that our main result is not adversely affected by potential measurement errors in the imputed inter-national trade flows from the ITPD-E.

Since we rely in our preferred specification on country-pair-specific fixed effects to absorb all time-invariant heterogeneity, we are mainly concerned about unobserved time trends, that could confound the estimation of the trade-creating effect of converging to the EU's political mainstream. We therefore account in a series of additional robustness checks for cultural convergence/divergence at the country-pair level (cf. Felbermayr and Toubal, 2010) as well as for the role of country-specific economic and political uncertainty (cf. Ahir et al., 2022) and the popular support for the European Union. Reassuringly, we find that neither the magnitude nor the significance of our baseline result are affected by adding these additional time-variant control variables.

The remainder of this paper is structured as follows: In Section 1.2 we explain how to measure the similarity of political preferences within the EU. Subsection 1.2.1 introduces and explains the roll call vote data from the European parliament, which then is used in Subsection 1.2.2 to construct an index that measures the extent to which individual member states' political preferences overlap with those of the rest of the EU. In Section 1.3 we identify the trade-creating effect of converging political preferences on member states' bilateral trade with the rest of the union. After discussing our empirical identification strategy and our data in the Subsections 1.3.1 and 1.3.2, respectively, we report our main results in Subsection 1.3.3. Section 1.4 contains three sets of comprehensive robustness checks. In Subsection 1.4.1 we use disaggregated trade flows between European NUTS-2 regions to avoid the imputation of intra-national flows. Subsection 1.4.2 accounts for sample composition effects that could compromise our identification strategy. In Subsection 1.4.3 we introduce additional control variables to account for unobserved time-variant heterogeneity. Section 1.5 concludes our analysis.

1.2 Similarity of Political Preferences within the EU

Building up on the latest generation of international trade models with heterogeneous firms, a growing empirical literature (cf. Handley and Limão, 2015; De Sousa et al., 2020; Carballo et al., 2022) has shown that economic and political uncertainty has a direct impact on firms' exporting decisions, and that lower uncertainty would be associated with more international trade (cf. Handley and Limão, 2022). Focusing more narrowly on political uncertainty, Hassan et al. (2019) show that firms which are exposed to political risk entrench hiring and investment (see also Bloom, 2014; Baker et al., 2016; Bloom et al., 2007). Handley and Limão (2015), Handley and Limão (2017) and Carballo et al. (2022) demonstrate that, by reducing the threat of a trade war, trade agreements can mitigate trade policy uncertainty, which fosters international trade between member states (see Handley and Limão (2022) for a review).

The European Single Market, which celebrates its 30$^{\text{th}}$ anniversary in 2023 and is regarded as one of the EU's greatest achievements (cf. European Comission, 2023), allows goods and services to move around the EU almost as freely as within a single country (cf. Head and

Mayer, 2021).[3] Before the United Kingdom left the EU as a consequence of the 2016 Brexit referendum, the common market expanded together with the EU, and hence was seen as a prime example of a trade agreement that simultaneously grew in breath and depth.[4] As such, the Single Market not only helped to reduce the uncertainty about member states' trade policy (cf. Handley and Limão, 2015) but also contributed to the narrative of a sustained trade integration among all member states of the EU. The emergence and the subsequent rise of euroskeptic parties in many European countries (cf. Serricchio et al., 2013; Kaeding et al., 2020), and most notably the Brexit of the United Kingdom (cf. Fossum and Lord, 2023), have raised concerns that intra-European trade integration through the Single Market could slow down, come to an halt, or even be partially reversed because individual member states diverge from the EU's political mainstream which favors a sustained trade integration (cf. The Economist, 2018).

In order to measure whether the political preferences of a member state's electorate converge/diverge to/from the political views in the rest of the EU, we propose a new time-varying similarity measure that quantifies the overlap in political preferences among member states. Member states that share similar political preferences are more likely to find a common ground, which reduces political uncertainty that otherwise would result from long-lasting dissents, political stalemates or the (partial) disintegration of the EU through the exit of single member state (cf. Graziano et al., 2020b,a). Using detailed data on all roll call votes in the European Parliament from 1995 to 2016, therefore allows us to construct a forward looking measure, which is informative about the political uncertainty that surrounds each member state's commitment to common EU policies.

In measuring the similarity of political preferences we proceed in two steps: In Subsection 1.2.1 we explore the voting in the European Parliament, and show that individual (roll call) votes are informative about the political preferences of the representatives' national electorates. We then aggregate in Subsection 1.2.2 individual votes to compute a measure of similarity in political preferences, which quantifies the extent to which political preferences of each member state overlap with the political views in the rest of the EU.

1.2.1 Roll Call Votes in the European Parliament

Retrieving and analyzing information on political preferences from roll call votes – in particular from the Congress and the Senate of the United States – has a long tradition in the political science and political economy literature (e.g. Snyder and Groseclose, 2000; Cox and Poole, 2002; Conconi et al., 2014, 2020). Published voting records from roll call votes in the

[3]Sizeable trade-reducing border effects associated with cross-border trade in the EU's Single Market (cf. Nitsch, 2000; Mika, 2017; Santamaría et al., 2023) suggest that non-tariff barriers remain an important obstacle for trade integration within the EU. See Head and Mayer (2013) for a review of the earlier literature.

[4]Prior to the formal establishment of the Single Market through the Single European Act, which came into effect at the 01.01.1993, free trade within the European Economic Community was guaranteed through the European Union Customs Union. See also Dinan (2014) for a historical review.

European Parliament have been studied to gain a better understanding of individual voting behavior (cf. Hix, 2002; Faas, 2003), party cohesion (cf. Hix et al., 2005, 2007; Hix and Noury, 2009), and coalition formation (cf. Kreppel, 2001; Kreppel and Hix, 2003).

Voting in the European Parliament can be performed in several ways: Showing hands is the standard way of voting and used to handle the majority of the large number of votes in the European Parliament (cf. European Parliament, 2021a). All other decisions are taken by roll call vote and – in rare instances – by secret ballot. According to Carrubba et al. (2006); Hix et al. (2007), and Finke (2015) up to one third of all plenary votes in the European Parliament have been performed by roll call, which since 2009 necessarily includes all final decisions of the European Parliament. A roll call vote may also be requested by political groups or Members of the European Parliament (cf. European Parliament, 2021b), and is used whenever a vote by show of hands delivers an unclear outcome (cf. European Parliament, 2021a). Members of the European parliament can vote “yes”, “no” or “abstain”.[5] Treating “abstain” as a unique voting outcome is important because it was found to be often chosen by Members of Parliament with a conflict of interest (cf. Mühlböck and Yordanova, 2017; Font, 2018).

Data on roll call votes from the European parliament is available for all legislative periods of the European Parliament (i.e. 1979–2019) and includes detailed voting information for each Member of the European Parliament (MEP) (Hix et al., 2022).[6] For our analysis we focus on the years 1995 to 2016, and include only those roll call votes on which MEPs from all member states have voted, which leaves us with $26,102$ votes (96.16% of all votes). The number of roll call votes performed in the European Parliament is increasing over the sample period and amounts to an average of $1,186$ roll call votes per year.[7] Although it is difficult compare individual voting outcomes across time (because votes differ in terms of their topics), we find that the shares of votes that can be attributed to specific policy areas is remarkable stable over time.[8]

The political science literature (cf. Kiewiet and McCubbins, 1991; Corbett et al., 2000; Kreppel, 2001; Carrubba et al., 2006) has identified two main motives for political groups and Members of the European Parliament to request a vote by roll call:[9] Roll call votes may

[5] In addition to voting “abstain” the members of the European Parliament have two other options of avoiding a definitive decision: They can decide to register (which proves their presence during the voting) but not to participate in the voting or they can abstain from the whole parliamentary session during which the voting is performed (cf. Hix et al., 2018). Following Hix et al. (2018), we neglect these strategic non-voting decisions in our analysis. Font (2018) discusses strategic voting.

[6] In Table A1.5 of Appendix A1.2, we report all compositional changes of the European Parliament that resulted from the accession of new member states and from changes in the number of delegates per member state.

[7] In Figure A1.1 of Appendix A1.2 we report the total number of roll call votes and the share of final votes per year in the European Parliament from 1995 to 2016.

[8] In Figure A1.2 of Appendix A1.2, we compare the vote shares of major policy areas across time.

[9] Hix et al. (2007) and Kaniok and Mocek (2017) address concerns regarding the representativeness of roll call votes for the voting behaviour in the European Parliament caused by strategic selection of votes, and argue that roll call votes cover the most important votes and therefore are a valuable source for measuring political preferences in the European Parliament.

be used as a discipline device to reinforce group cohesion within a political group (disciplining motive) or to signal the political preferences of a group or a Member of Parliament to national and international stakeholders (signaling motive).

In Table 1.1, we demonstrate that the individual voting of the Members of the European Parliament is well aligned with the interests of their respective national parties that represent their respective national electorates.

Table 1.1: Determinants of Individual Voting Behavior in the European Parliament

Dependent Variable: Voting decision ("yes"/"no") of Member of the European Parliament i on vote v					
Model:	Linear Probability Model			Logit	Probit
Specification:	(1)	(2)	(3)	(4)	(5)
Majority Voting ("yes" versus "no"):					
$National\ party_{iv}$	0.8161***	0.8110***	0.8059***	274.4997***	3.0553***
	(.0066)	(.0064)	(.0066)	(17.0478)	(.0317)
$Member\ state_{iv}$	0.0173***	0.0178***	0.0173***	1.7662***	0.2587***
	(.0011)	(.0011)	(.0012)	(.0506)	(.0129)
$European\ party\ group_{iv}$	0.1386***	0.1414***	0.1471***	9.9468***	1.0852***
	(.0061)	(.0058)	(.0062)	(.4669)	(.0248)
Fixed Effects:					
Member of European Parliament i		✓	✓		
Vote v			✓		
Summary Statistics:					
Observations	13,503,866	13,503,865	13,503,865	13,503,866	13,503,866
(Pseudo-)R^2	0.9038	0.9049	0.9054	0.8476	0.8478

Note: The estimation sample consists of 26,101 distinct votes cast by 2,617 Members of the European Parliament between 1995 and 2016. Members of the European Parliament without a party affiliation (3.6%) are excluded. Outcome variable takes value one for voting outcome: "yes" and value zero for voting outcome "no". "Abstain" votes (4%) are excluded. Robust standard errors, clustered for Members of the European Parliament. Significance: * $p < 0.10$, ** $p < .05$, *** $p < .01$.

Analyzing the individual voting decisions of 2,617 MEPs on 26,102 distinct votes between 1995 and 2016, we estimate the probability that MEPs voted with "yes" instead of "no" when the majority of their (i.) national party, (ii.) member state delegation and (iii.) European party group voted with "yes" instead of "no".[10] According to Column (1) of Table 1.1, individual voting decisions are highly correlated with the majority voting within the MEP's national parties. Correlations with the majority voting within the groups of MEP's that share the same origin state or the same European party group are much weaker. The inclusion of individual fixed effects for each MEP (cf. Column (2) of Table 1.1) and vote-specific fixed effects (cf. Column (3) of Table 1.1) has virtually no effect on the results and does not improve the overall performance of the model in a meaningful way. Logit (cf. Column (4) of Table 1.1) and Probit (cf. Column (5) of Table 1.1) estimations confirm the OLS results, which are also in line with previous findings on the determinants of MEPs' policy preferences and the (relative) influence of multiple principals (e.g. Berry et al., 1998; Hix, 2004; Hix and Noury, 2007; Høyland and Hansen, 2014).

[10] In Tables A1.6 and A1.7 of Appendix A1.2 we list all national parties and all European party groups in the European Parliament from 1995 to 2016.

To measure how coherent the members of the same (i.) national party (indexed by mnemonic n), (ii.) member state delegation (indexed by mnemonic m) and (iii.) European party group (indexed by mnemonic e) voted on a specific vote v in year t, we follow Hix et al. (2005) and compute for each of the categories $k \in \{n, m, e\}$ the average agreement index for vote v

$$AI_{kvt} = \sum_{j(k)} \frac{1}{M_{j(k),t}} \left(\frac{3}{2} \frac{\max\{N^y_{j(k),vt}, N^n_{j(k),vt}, N^a_{j(k),vt}\}}{\sum_{\ell \in \{y,n,a\}} N^\ell_{j(k),vt}} - \frac{1}{2} \right), \tag{1.1}$$

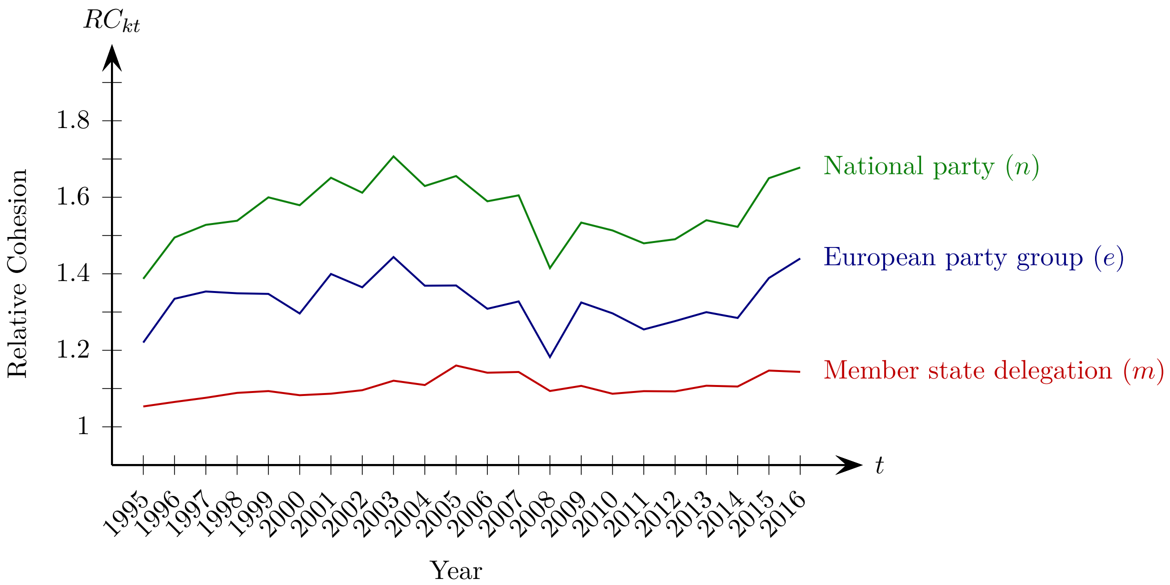
in which $N^y_{j(k),vt}$ denotes the number of "yes" votes expressed by subgroup $j(k)$ in category k on a given vote v in year t, $N^n_{j(k),vt}$ denotes the number of "no" votes, $N^a_{j(k),vt}$ denotes the number of "abstain" votes and $M_{j(k),t}$ denotes the size of subgroup $j(k)$ in year t.[11] By construction, the agreement index AI_{kvt} takes a value of one when all members within each subgroup $j(k)$ voted together and a value of zero when the members of each subgroup $j(k)$ are equally divided between the three voting options "yes", "no" and "abstain". In order to compare the cohesion across the three aforementioned categories over time, we average across all votes in a given year t, and compute relative cohesion $RC_{kt} \equiv AI_{kt}/AI_t$ for category k as the ratio of the average agreement index AI_{kt} for category k and the average agreement index AI_t for all members of the European Parliament.

According to Figure 1.1, which reports the relative cohesion in the European Parliament from 1995 to 2016, voting is most cohesive among MEPs that come from the same national party, followed by the voting of MEPs that belong to the same European party group. In contrast, we find that the cohesion among MEPs that share the same origin state barely differs from the average cohesion level in the European Parliament (see also Attiná, 1990; Hix et al., 2005, 2018).

Together, the results from Table 1.1 and Figure 1.1 suggest that MEPs predominantly vote along (national) party lines, and that their voting behavior therefore is informative about the political preferences of their national electorates. Roll call votes from the European Parliament hence can be used to consistently compute trends in the similarity of political preferences among different member states of the union.

[11] We report the complete list of all national parties (n), member state delegations (m), and European party groups (e) that constitute the subgroups $j(k)\ \forall\ k \in \{n, m, e\}$ in Tables A1.6 and A1.7 in the Appendix A1.2.

Figure 1.1: Relative Cohesion within the European Parliament



Note: Figure 1.1 depicts the relative cohesion of national parties (n), member state delegations (m), and European party groups (e) from 1995 to 2016. Relative cohesion for category $k \in \{n, m, e\}$ is measured by $RC_{kt} = AI_{kt}/AI_t$, in which AI_{kt} is the average of the vote-specific agreement index in Eq. (1.1) and AI_t is the average agreement index in the European Parliament.

1.2.2 Similarity of Political Preferences

We measure the similarity in political preference between a given member state m and the rest of the European Union (excluding this member state) by the sum of the products of (vote) shares. In doing so we follow Disdier and Mayer (2007) as well as Melitz and Toubal (2014), who used the sum of the products of shares to measure language similarity.[12] Relying on the sum of the products of shares SPS_{mvt} as a simple and transparent similarity measure, we compute

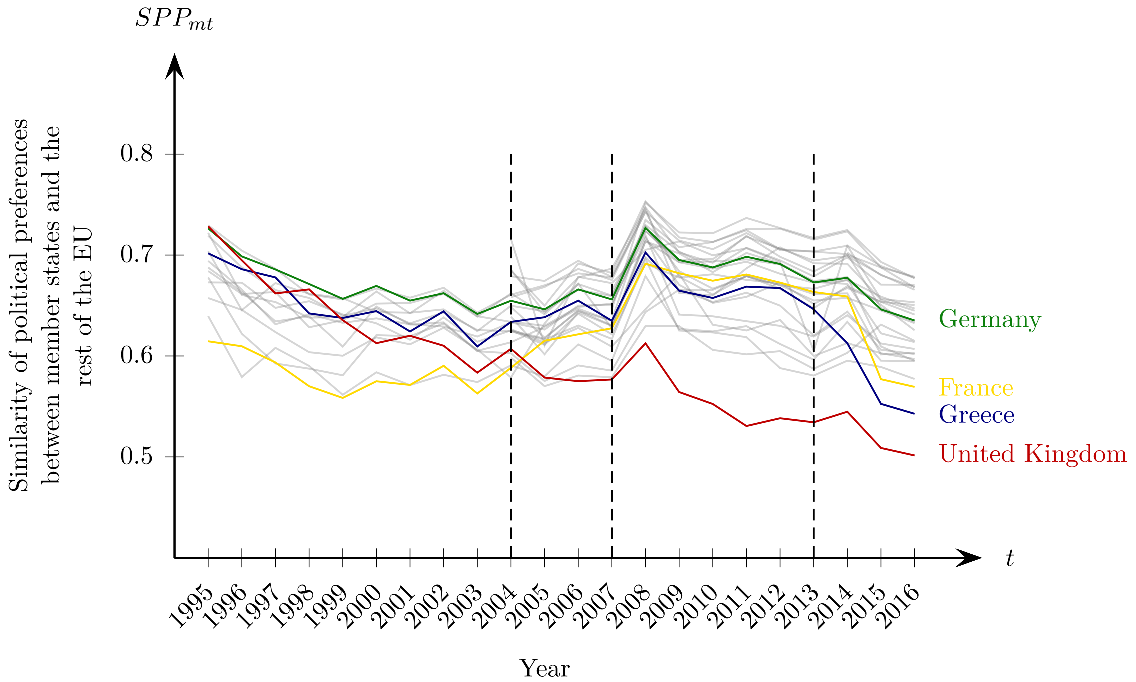
$$SPS_{mvt} \equiv \sum_{\ell \in \{y,n,a\}} \frac{N^{\ell}_{mvt}}{\sum_{l \in \{y,n,a\}} N^{l}_{mvt}} \cdot \frac{\sum_{\hat{m} \neq m} N^{\ell}_{\hat{m}vt}}{\sum_{l \in \{y,n,a\}} \sum_{\hat{m} \neq m} N^{l}_{\hat{m}vt}}, \tag{1.2}$$

maintaining the same notation as in Eq. (1.1). Based on a given vote v in year t the sum of the products of shares SPS_{mvt} measures the overlap in political preferences between member state m and the political mainstream of the European Union (consisting of all member sates $\hat{m} \neq m$). Intuitively, the sum of the products of shares reaches its lower bound $SPS_{mvt} = 0$ if the voting behavior of representatives from member state m shows zero overlap with the voting behavior of representatives from the rest of the union (i.e. $\min\{N^{\ell}_{mvt}, \sum_{\hat{m} \neq m} N^{\ell}_{\hat{m}vt}\} = 0 \; \forall \; \ell \in \{y, n, a\}$). On the contrary, the sum of

[12] See also Guiso et al. (2009), who proxy cultural similarity by religious similarity, which is measured by the sum of products of population shares adhering to the same religion.

the products of shares reaches its upper limit $SPS_{mvt} = 1$ for perfectly overlapping vote shares (i.e. $N^{\ell}_{mvt}/\sum_l N^l_{mvt} = \sum_{\hat{m}\neq m} N^{\ell}_{\hat{m}vt}/\sum_l \sum_{\hat{m}\neq m} N^l_{\hat{m}vt}\ \forall\ l,\ell \in \{y,n,a\}$). By averaging across all roll call votes V_t in year t we compute the similarity in political preferences $SPP_{mt} \equiv (1/V_t)\sum_{v=1}^{V_t} SPS_{mvt}$, which captures the extent to which member state m's political preferences overlap with those of the remaining EU member states.

Figure 1.2: Similarity of Political Preferences between Member States and the Rest of the EU



Note: Figure 1.2 depicts the similarity of political preferences between member states and the rest of the EU from 1995 to 2016. The similarity of political preferences is measured by $SPP_{mt} = (1/V_t)\sum_{v=1}^{V_t} SPS_{mvt}$ with V_t as the number of votes v in year t and the sum of the products of vote shares SPS_{mvt} given by Eq. (1.2).

In Figure 1.2 we plot how the similarity of political preferences between each member state and the rest of the European Union evolved between 1995 and 2016. Compared to the late '90s, in which the political preferences of most member states were equally well aligned with the political mainstream of the European Union, we observe a fanning out towards the end of our sample period. We argue that this divergence is the combined result of several long-run trends: New member states, which joined the union during the 2004, 2007 and 2013 enlargements, appear to have political preferences, that are more similar to the EU's political mainstream than those of the old member states. In addition to this composition effect, we observe a secular decline in the extent to which the political preferences of the UK are aligned with those of the remaining member states. Starting out as the second most aligned member state in 1995, we find that the similarity in the political preferences between the UK and the rest of the EU plunged to an all-time low in 2016 – in a process that in hindsight can be described as the road to Brexit. At the same time, we find that the global financial crisis of 2007/2008 and the ensuing European dept crisis created a spirit of unity among most member states, that is reflected through a steep increase in the similarity of political preferences after 2007, that is only partially reversed in the subsequent years.[13] In the following, we will use the rich and plausible variation in member states' alignment with the EU's political mainstreamfrom Figure 1.2 to find out whether converging political preferences in the EU are an signal for more enhanced economic integration, that ultimately results in more bilateral trade among member states.

1.3 Political Convergence and Trade in the EU Single Market

With our measure of similarity of political preferences from Section 1.2.2 at hand, we are now equipped to explore whether the convergence/divergence of single member states to/from the EU's political mainstream is reflected in the member state's trade with the rest of the EU. We proceed in three steps: In Subsection 1.3.1 we derive the canonical gravity model and explain our identification strategy. We then use Subsection 1.3.2 to describe our data and Subsection 1.3.3 to summarize and interpret our main results.

1.3.1 Identification

The canonical gravity model – to which Head and Mayer (2014) refer as the workhorse model of the empirical trade literature – can be derived from a wide class of microeconomic foundations (cf. Arkolakis et al., 2012).[14] Following Anderson and van Wincoop (2003), we assume an endowment economy with Constant Elasticity of Substitution (CES) preferences. We allow for multiple sectors $s = 1, \dots, S$, and denote the elasticity of substitution between varieties within sectors by $\sigma_s > 1$.[15] Optimal expenditures X_{dost} on goods from sector s in origin o shipped to destination d at time t then can be solved as

$$X_{dost} = \frac{E_{dst} Y_{ost}}{Y_{st}} \left(\frac{t_{dost}}{P_{dst} \Pi_{ost}} \right)^{1-\sigma_s}, \tag{1.3}$$

in which Y_{ost} is the value of industry-level output in origin country o at time t, E_{dst} is destination d's expenditure on goods from sector s at time t, t_{dost} captures sector-specific and time-variant bilateral trade frictions, and P_{dst} as well as Π_{ost} denote the in- and outward multilateral resistance terms, respectively.

[13] Braghiroli (2015) provides evidence in favor of a general increase in party group cohesion during and after the European debt crisis.

[14] See also the reviews by Head and Mayer (2014) and Yotov et al. (2016), which provide an exhaustive overview.

[15] When dropping the sector-specific index s, the single-sector model emerges as a special case.

In order to estimate the effect of converging political preferences among EU member states on bilateral trade within the union, we adopt the methodology of Beverelli et al. (2023), who demonstrate how the effect of a country-specific variable (e.g. institutional quality) on bilateral trade can be consistently estimated in a gravity setting. To this end, we specify the following empirical gravity model

$$X_{dost} = \exp\left(\lambda_{dst} + \gamma_{ost} + \eta BRD_{do} + \beta_k BRD_{do} \times SPP_{o,t-k} + \boldsymbol{GRV'}_{dot}\boldsymbol{\delta}\right) \times \varepsilon_{dost}. \qquad (1.4)$$

To obtain Eq. (1.4), we replace the bilateral trade cost t_{dost} in Eq. (1.3) by a vector of gravity variables $\exp(\boldsymbol{GRV}_{dot})$, which may include any determinant of bilateral trade cost (e.g. geographic distance), and we explicitly include BRD_{do} which is a dummy variable indicating trade crossing international borders and $BRD_{do} \times SPP_{o,t-k}$ which is an interaction between the border dummy and our measure for similarity in political preferences $SPP_{o,t-k}$, which we include with time lags of $k = 0, \ldots, 5$ years. We introduce destination- and origin-specific fixed effects, λ_{dst} and γ_{ost}, respectively, that also vary by sector s and time t to control for all country-specific variation at the im- and exporter side. By including these fixed effects, we also account for multilateral resistance to trade (see for a discussion Head and Mayer (2014) among others). We denote the error term by ε_{dost}.

As rightly pointed out by Beverelli et al. (2023), it is not possible to identify the impact of any country-specific characteristic (on the importer or on the exporter side) in a traditional gravity specification due to perfect multicolinearity with the included destination- and origin-specific fixed effects.[16] To overcome this limitation, Beverelli et al. (2023) propose a methodology, which utilizes on a newly constructed database (cf. Borchert et al., 2021, 2022) that not only includes bilateral trade flows between countries but also each country's intra-national trade. It therefore is possible to separate the effect that a variable has on a country's bilateral trade with other countries from the effect that this variable has on the country's intra-national trade by interacting the variable of interest with a border dummy, that takes a value of one if trade crosses a border and a value of zero otherwise. In a first application, Heid et al. (2021) identify the effects of non-discriminatory trade policies (e.g. most favored-nation (MFN) tariffs) that apply differentially to exports and imports. Beverelli et al. (2023) extend this approach to focus on arbitrary country-specific variables, which posses additional multicolinearity challenges and requires a different interpretation of the estimates as in Heid et al. (2021). In our application, the interaction term $BRD_{do} \times SPP_{o,t-k}$ in Eq. (1.4) can be defined either at the export or the import side but not simultaneously for both origins

[16] This argument straightforwardly extends to the inclusion of linear combinations of importer and exporter characteristics, such as their difference or sum. As a consequence, Head and Mayer (2014, p. 158) conclude that the effects of bilateral variables which are constructed from country-specific variables can only be identified under specific functional form assumptions. While it is possible to identify the impact of the product of two country-specific variables (cf. Rauch and Trindade, 2002), which is non-linear transformation, it is impossible to identify the impact of the sum (or of the log of the product) of two country-specific variables.

and destinations (for details see Appendix A of Beverelli et al. (2023)). Accordingly, it is not possible to simultaneously identify the (potentially) differential impact of similarity in political preferences on exports versus imports, which is why we interpret coefficient β_k from Eq. (1.4) as the effect that (lagged) similarity in political preferences has on an EU member state's total bilateral trade with the rest of the union.

The most prominent challenge with the identification of the effect that converging/diverging political preferences within the EU have on member state's bilateral trade with the rest of the union relates to the potential endogeneity of political preferences due to reversed causality. Measuring the political alignment of country pairs based on the observed voting behavior in the United Nations General Assembly, Kleinman et al. (2022) show that countries which become economically more dependent on a trade partner realign their voting behavior towards that trade partner. Similarly, DiCaprio and Sokolova (2018) find that countries, which are signing a regional trade agreement politically converge in terms of the voting behavior that they display in the United Nations General Assembly. To address endogeneity concerns in our gravity setting, we combine three different approaches from the existing gravity literature to identify the causal impact that a political convergence/divergence among EU member states has on bilateral trade within the Single Market.

Capitalizing on the panel structure of our data, we follow Baier and Bergstrand (2007) (and large parts of the subsequent gravity literature) and extend our baseline specification in Eq. (1.4) to include destination- and origin-specific fixed effects that in our case also vary by sector. In doing so, we ensure that all time-invariant differences in member states' alignment with the political mainstream of the European Union are completely absorbed, which means that the trade-creating effect we are hoping to identify can be attributed to the actual convergence and not just to the (time-invariant) similarity of political preferences. This distinction is important because estimates which are identified from cross-sectional variation are likely to overstate the importance of shared political preferences in the presence of reversed causality: more similar political preferences may result in more trade, but more trade could also result in a political realignment. While it is plausible, that the economic integration into the Single Market affects the political preferences of a member state, it seems less likely that changes in trade flows, which are observed over the comparatively short time span from 1995 to 2016, are shifting the political preferences of member states.[17] To further mitigate endogeneity concerns, we also rely on our panel setting to control comprehensively for all country-pair- and sector-specific differences that do not change over time. The ability to effectively account for time-invariant unobserved heterogeneity is of particular relevance,

[17] Similar arguments are made to alleviate endogeneity concerns due to reversed causality, when identifying the trade-creating effect of regional trade agreements (cf. Baier and Bergstrand, 2007), (im)migrant networks (cf. Bratti et al., 2014; Felbermayr et al., 2015), social connectedness (cf. Bailey et al., 2021) and institutional quality (cf. Beverelli et al., 2023).

when focusing on a highly selective sub-sample of countries like the member states of the European Union, which share many commonalities (cf. Head and Mayer, 2021).

We argue that the voting behavior in the European Parliament is informative about the political uncertainty that surrounds each member state's commitment to common EU policies in general and to the EU's Single Market in particular. Since, political uncertainty has a negative impact on firms' exporting activity (Handley and Limão, 2022), we expect that member states who convergence to the EU's political mainstream benefit from reduced political uncertainty and as a consequence from more international trade in the future. Due to the signaling function that the voting in the European Parliament has for market participants, we would not expect that a convergence to the EU's political mainstream has an instantaneous effect on the respective member state's bilateral trade with the rest of the union. We therefore follow Rose and Spiegel (2011, pp. 665), and include the similarity of political preferences $SPP_{o,t-k}$ in Eq. (1.4) with a flexible lag structure, that in our preferred specification assumes $k = 3$ but more generally allows for $k = 0, \ldots, 5$.[18] If the convergence in political preferences only has a delayed (but no contemporaneous) effect on member states' trade with the rest of the EU, we would see this result as suggestive evidence in favor of our signaling hypothesis and as a further remedy against reversed causality concerns.

To alleviate remaining endogeneity concerns, we follow Beverelli et al. (2023), who argue that in a gravity setting interaction terms with the border dummy BRD_{do} – such as our variable of interest $BRD_{do} \times SPP_{o,t-k}$ – can be consistently estimated because the border indicator BRD_{do} is an exogenous variable. Beverelli et al. (2023) thereby draw on an econometric argument from Nizalova and Murtazashvili (2016), who demonstrate that the differential impact of a particular variable of interest can be consistently estimated even when this variable is correlated with omitted variables. The necessary condition for this convenient result to hold is that the factor with which our variable of interest is interacted is itself uncorrelated with the variable of interest and with the variables that are omitted from the regression. In our setting, the (lagged) similarity in political preferences $SPP_{o,t-k}$ is the variable of interest and the border dummy BRD_{do} is the variable with which it is interacted. The border indicator BRD_{do} is exogenous by construction, which is why we can rule out that it systematically varies with the similarity in political preferences or with any omitted variable.[19] The interaction term $BRD_{do} \times SPP_{o,t-k}$ between the border indicator and the similarity in political preferences, which identifies the differential impact that a convergence to the EU's political mainstream has on member states' international versus intra-national trade, can therefore be consistently estimated.

[18] See Fan and Lu (2021) for the trade-creating signaling effect of international summit visits by government representatives. Vicard (2009) explores the lagged effects of regional trade agreements.

[19] We are aware of the fact that the accession of new member states during our sample period (1995-2016) results in an unbalanced panel with a non-random variation in the border dummy BRD_{do}. We therefore replicate in Section 1.4.2 our main results based on a balanced panel which is comprised of the 14 member states that formed the European Union in 1995.

1.3.2 Data

In addition to the voting data from the European Parliament, which is introduced and described in Subsection 1.2.1, we use data on intra-EU trade which is combined with standard gravity variables to obtain our results. In the following, we offer details on the sources and the construction of all the variables that we use in our analysis.[20]

Our primary source for intra-EU trade flows at the country-pair level is the International Trade and Production Database for Estimation (ITPD-E) compiled by Borchert et al. (2021). For our analysis we focus on the years from 2000 to 2016 and observe a maximum of 28 EU member states (as of July 1$^{st.}$, 2013), whose manufacturing trade we observe at the level of 120 disaggregated industries.[21] Intra-national trade flows are not directly observed but consistently calculated at the industry-level by taking the difference between the values of total production and total exports (see Borchert et al. (2021) for details). There are three reasons, why the inclusion of intra-national trade flows is desirable: First, domestic trade flows are quantitatively important and account for 42% of the aggregate manufacturing exports within the EU. Second, in consistency with theory, gravity estimates can be obtained from the choice of consumers between domestic and foreign commodities. Third, the effect of international borders can be consistently estimated, which allows us to differentially identify the impact that a variable of interest has on inter- versus intra-national trade (cf. Yotov, 2012; Heid et al., 2021; Beverelli et al., 2023). As an alternative to the ITPD-E, we rely on the European Road Freight Transport (ERFT) survey (cf. Santamaría et al., 2023) to directly observe intra- and international trade flows, which are reported at the level of NUTS-2 regions.[22]

To control for observed and unobserved determinants of bilateral trade, we complement a rich set of fixed effects by proxies for bilateral trade costs that are widely used in the gravity literature (see Head and Mayer (2014, pp. 160) for a recent meta-study). In particular, we use data on bilateral distance, contiguous borders, common official language, colonial relationships and currency unions from the CEPII's GeoDist database (see Mayer and Zignago (2011) for details).[23] Bilateral distances between and within NUTS-2 regions are computed as population-weighted harmonic means (cf. Head and Mayer, 2009) over the bilateral distances

[20]Table A1.1 lists all variables and its data sources.

[21]See Borchert et al. (2022) for benchmark estimates at the industry-level.

[22]We impose the same restrictions on regions, industries and shipments as Santamaría et al. (2020) to extract regional trade flows from the European Road Freight Transport (ERFT) survey, and apply sampling weights in the aggregation to the NUTS-2 level. By filling missing observations with zeroes and linearly interpolating pair-specific time series we obtain a fairly balanced panel that covers 252^2 NUTS-2 region pairs from 2011 to 2019. Duranton et al. (2014) show that gravity estimations that are based on trade volumes instead of trade values yield comparable results, which is why we rely on trade volumes from the European Road Freight Transport (ERFT) survey that are reported in 100kg.

[23]As a key advantage of CEPII's GeoDist database inter- and intra-national distances are consistently computed as population-weighted harmonic means over bilateral distances between national population centers(cf. Head and Mayer, 2009).

between the 10 most populated agglomerations based on the NUTS-2 shape files from the GISCO statistical unit dataset, which we also use to compute contiguous borders between NUTS-2 regions. Information on official language at the level of NUTS-2 regions is based on CEPII's GeoDist database, which we manually extend based on our own calculations. As additional time-variant control variables, we adopt the World Trade Uncertainty Index from Ahir et al. (2022) and Felbermayr and Toubal's (2010) cultural proximity measure that is computed from bilateral point scores in the Eurovision Song Contest. The European Union's Eurobarometer is used to measure the support for the EU by focusing on the question: "Generally speaking, do you think that [our country's] membership of the European Union is ...?".

1.3.3 Results

In Table 1.2, we present as our main result the point estimates that we obtain from estimating our preferred specification in Eq. (1.4) with a time lag of $k = 3$ periods. Throughout all specifications, we find a large, positive, and statistically significant estimate on the interaction term $BRD_{do} \times SPP_{o,t-3}$, suggesting that a convergence to the EU's political mainstream promotes member states' bilateral trade with the rest of the union.[24] In Column (1) of Table 1.2 we estimate a log-linearized version of Eq. (1.4), which includes a rich set of fixed effects, that account for sector-specific time trends across all origins and destinations. As common in the gravity literature (cf. Head and Mayer, 2014), we include as proxies for bilateral trade costs log geographic distance ($\ln(DIST_{do})$) together with a set of dummy variables, that control for international borders (BRD_{do}), contiguous borders ($CONTG_{do}$), common official language ($LANG_{do}$), colonial relationships ($COLNY_{do}$) and currency unions ($CRRY_{dot}$). Reassuringly, we find that our parameter estimates for these control variables are comparable to those found in gravity literature (cf. Head and Mayer, 2014; Borchert et al., 2022). To account for reverse causality concerns we follow Baier and Bergstrand (2007) and absorb in Column (2) of Table 1.2 all time-invariant bilateral variation by including country-pair-specific fixed effects that also vary along the industry dimension. As before, we find a large and significant trade-creating effect of converging political preferences. We do note, however, that the parameter estimate on $BRD_{do} \times SPP_{o,t-3}$ in Column (2) is smaller in magnitude and more precisely estimated as its counterpart in Column (1). We argue that this difference is the result of controlling for reversed causality, and find it quite encouraging that we obtain a positive and highly significant effect of converging political preferences in a very demanding panel structure with a rich structure of fixed effects. As we have argued before, it is of eminent importance to identify the trade-creating effect of political convergence from changes in the

[24]As part of the robustness analysis, we show in Table A1.12 in Appendix A1.2 that qualitatively identical results are obtained for a series of alternative measures of similarity in political preferences.

similarity of political preferences over time, which is why a panel regression with country-pair fixed effects is our preferred specification.

Table 1.2: The Trade-creating Effect of Converging to the EU's Political Mainstream

Dependent variable: Sectoral/aggregate exports from origin o to destination d at time t								
Model:	OLS				PPML			
Data:	Sectoral		Aggregate		Sectoral		Aggregate	
Specification:	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Variable of interest:								
$BRD_{do} \times SPP_{o,t-3}$	2.3846***	1.1218***	2.5290***	1.1705***	2.6436***	1.4141***	1.9996***	1.8832***
	(.5617)	(.1023)	(.5805)	(.2058)	(.3818)	(.1589)	(.3807)	(.2560)
Controls:								
$\ln(DIST_{do})$	−2.0804***		−1.4365***		−1.2501***		−1.0188***	
	(.0677)		(.0748)		(.0565)		(.0729)	
BRD_{do}	−2.9775***		−2.5357***		−3.3538***		−2.8281***	
	(.3755)		(.3867)		(.2589)		(.2894)	
$CONTG_{do}$	0.2906***		0.1822*		0.0359		0.1020	
	(.1038)		(.0949)		(.0586)		(.0861)	
$LANG_{do}$	0.1472		0.0230		0.2497*		0.6354***	
	(.1620)		(.1292)		(.1395)		(.1432)	
$COLNY_{do}$	1.9631***		1.6217***		1.2456***		1.0595***	
	(.3447)		(.2920)		(.2512)		(.2370)	
$CRRY_{dot}$	0.1322*	0.1252***	0.0764	0.0373	0.0726	0.0170	0.0430	−0.0324
	(.0708)	(.0267)	(.0613)	(.0434)	(.0885)	(.0278)	(.1196)	(.0362)
Fixed effects:								
Origin-sector-time	✓	✓			✓	✓		
Destination-sector-time	✓	✓			✓	✓		
Origin-time			✓	✓			✓	✓
Destination-time			✓	✓			✓	✓
Country-pair		✓		✓		✓		✓
Summary statistics:								
Observations	981,662	981,662	9,471	9,471	1,079,509	1,079,509	9,473	9,473
(Pseudo-)R^2	0.7998	0.8207	0.9453	0.9880	0.9509	0.9580	0.9789	0.9974

Note: Robust standard errors in parentheses are clustered at the country-pair level. Significance: * $p < 0.10$, ** $p < .05$, *** $p < .01$.

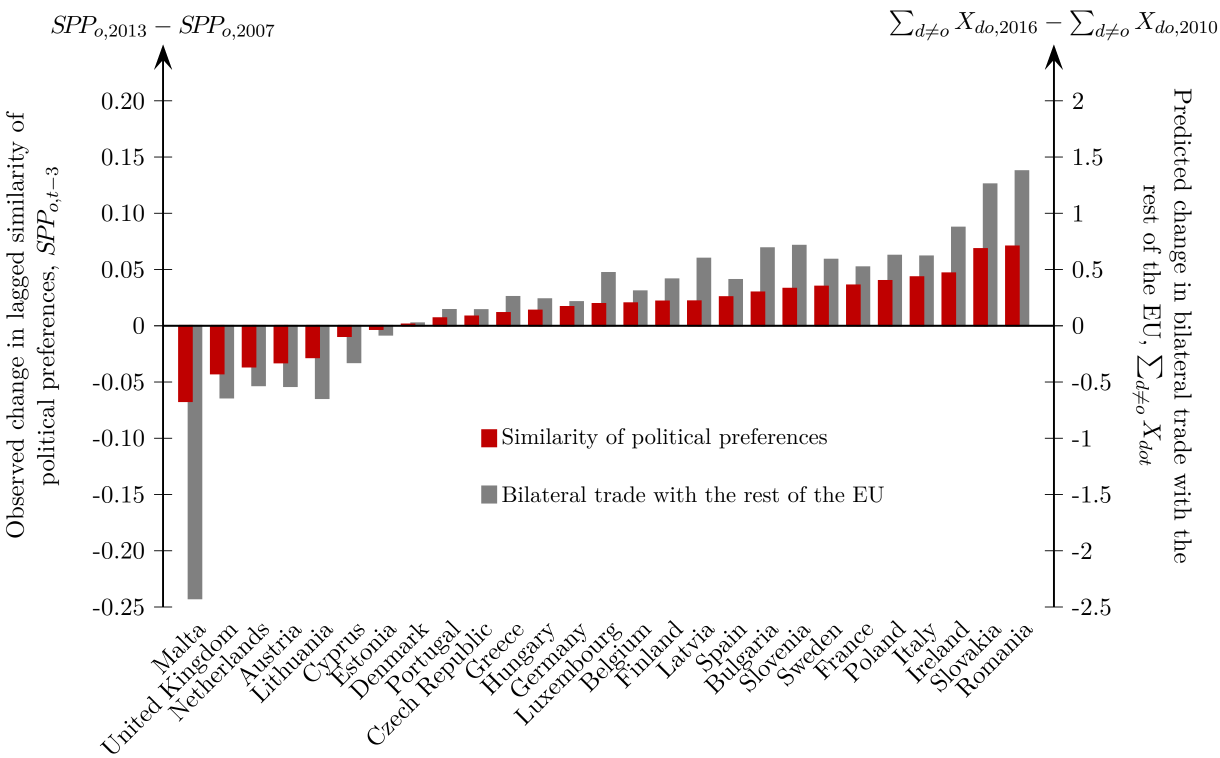
In Columns (3) and (4) of Table 1.2 we focus on aggregate manufacturing exports to replicate the sector-level results of Columns (1) and (2), respectively. Whereas in Column (3) log aggregate exports are regressed on the complete set of time-varying origin- and destination-specific fixed effect, country-pair fixed effects are added in Column (4) to account for time-invariant unobserved heterogeneity. Reassuringly, we find that the estimates from Columns (3) and (4) of Table 1.2 are consistent with the sector-level results from Columns (1) and (2), which reinforce our main results of a large and statistically significant trade-creating effect of converging political preferences within the EU's common market.

In Columns (5) to (8) of Table 1.2 we replicate the results from Columns (1) to (4) from the same Table, respectively, using the Poisson Pseudo Maximum Likelihood (PPML) estimator proposed by to estimate the gravity model from Eq. (1.4) in its multiplicative form. Although missing observations, are a minor issue (at least in our aggregate data), we rely on the PPML estimator to take into account information that is contained in zero trade flows, and to obtain consistent estimates in the presence of heteroscedasticity. As previously documented in the gravity literature (cf. Head and Mayer, 2014; Yotov et al., 2016), we find that OLS and PPML estimates (in particular for geographic distance) differ in their magnitude. Against the background of this familiar picture, we find that the PPML estimates on our variable of interest $BRD_{do} \times SPP_{o,t-3}$ from Columns (5) to (8) obey the same qualitative pattern and as the OLS estimates from Columns (1) to (4), respectively. We therefore interpret the overall resemblance of OLS and PPML estimates as further suggestive evidence in favor of a sizable and statistically significant trade-creating effect of converging political preferences.[25] What are the quantitative effects of converging/diverging to/from the EU's political mainstream on member states' bilateral trade with the rest of the union? To answer this question, we compute that a member state which moves from the 25$^{\text{th}}$ to the 75$^{\text{th}}$ percentile in the 2016 distribution of political similarity across EU member states would experience a 14.87% increase in its bilateral trade with the rest of the union, which seems a reasonable estimate in comparison to the 46% increase in goods trade that Felbermayr et al. (2022) associate with membership in the Single Market. In Figure 1.3 we compute the partial equilibrium effects that observed changes in the lagged similarity of political preferences $SPP_{o,t-3}$ from 2007 to 2013 have on each member states' international trade with the rest of the EU between 2010 and 2016.[26] On average, the observed changes in the similarity of political preferences from 2007 to 2013 are associated with an average increase in bilateral trade with the rest of EU that amounts to 0.22%. For the 27 member states covered in Table 1.3 changes in bilateral trade with the rest of the EU range from -2.4% for Malta to 1.4% for Romania. It is important to note that these changes not only depend on the observed change in the similarity of political preferences $SPP_{o,t-3}$ but also on the country-specific estimates for the border dummies BRD_{do}, which introduce additional heterogeneity on top of what we observe in Figure 1.2.

[25]To make sure that our results are not driven by potential outliers, we conduct a series of additional robustness checks, whose results are reported in Tables A1.10 and A1.11 of Appendix A1.2. In Table A1.10 we focus on a subset of our voting data to construct the similarity of political preferences by considering only final votes and only votes on economic matters. We also exclude votes from single policy areas to make sure that our results are not exclusively driven by votes on a specific topic, and re-weight votes by the respective voting turn-out when constructing our measure of similarity of political preferences to guarantee that votes with high turn-out are not under-represented. Throughout all these robustness checks we find a strong and significant trade-creating effect of converging to the EU's political mainstream. In Table A1.11 of Appendix A1.2 we omit countries, in which Euro-skeptical parties quickly gained popularity. Reassuringly, we find that our results are neither altered by dropping the Netherlands, the UK nor Greece.

[26]Table A1.8 in Appendix A1.2 reports the numerical changes depicted in Figure 1.3.

Figure 1.3: Changes in Member States' Trade with the EU Predicted by Changes in $SPP_{o,t-3}$



Note: Figure 1.3 plots the observed changes in the lagged similarity of political preferences from 2007 to 2013 together with the predicted changes in the bilateral trade with the rest of the EU for 27 member states between 2010 and 2016 (excluding Croatia, which did not join before 2013). Predictions are based on the OLS estimates from Column (4) of Table 1.2.

We conclude the discussion of our main result by exploring the timing of the trade-creating effect of converging to the EU's political mainstream. As explained in Subsection 1.3.1, we follow Rose and Spiegel (2011) and allow the similarity of political preferences $SPP_{o,t-k}$ to have a delayed effect with a lag of $k = 0, \ldots, 5$ years. In Table 1.3 we replicate our sector-level regressions from Table 1.2 for $k = 0, \ldots, 5$, which also allows us to compare lagged effects (for $k > 0$) with the contemporaneous effect (for $k = 0$).[27] Across all specifications, we find positive and significant lagged effects of similar political preferences on member states bilateral trade with the rest of the EU, which is compatible with a dynamic trade-creating effect that builds up over time. One possible explanation for the delayed impact on member state's trade is that a more aligned voting in the European Parliament is seen as a signal for reduced economic uncertainty in the future, and that it takes time for economic agents to adjust their behavior based on this information update. When focusing on our preferred

[27] Similar results are obtained when using aggregate instead of sectoral trade flows (see Table A1.9 of Appendix A1.2).

specification, in which identification exclusively relies on changes in the similarity of political preferences, because all time-invariant variation is absorbed through country-pair fixed effects, we are also able to identify a contemporaneous trade-creating effect of converging to the EU's political mainstream, that in magnitude and significance is comparable to the trade-creating effects that materialize in later periods.

Table 1.3: Timing of the Trade-creating Effect of Converging to the EU's Political Mainstream

Dependent variable: Sectoral exports from origin o to destination d at time t						
Timing:	$k = 0$	$k = 1$	$k = 2$	$k = 3$	$k = 4$	$k = 5$
Model:			OLS			
$BRD_{do} \times SPP_{do,t-k}$	-4.7559^{*}	1.1919	2.0726^{***}	2.3846^{***}	2.3465^{***}	1.9754^{***}
	(2.7058)	(1.2090)	(.7580)	(.5617)	(.5765)	(.4476)
Model:			PPML			
$BRD_{do} \times SPP_{do,t-k}$	1.3448^{**}	1.9834^{***}	2.3608^{***}	2.6436^{***}	2.5731^{***}	2.4080^{***}
	(.6586)	(.5061)	(.4150)	(.3818)	(.3775)	(.3643)
Fixed Effects:						
Origin-industry-time	✓	✓	✓	✓	✓	✓
Destination-industry-time	✓	✓	✓	✓	✓	✓
Model:			OLS			
$BRD_{do} \times SPP_{do,t-k}$	2.2854^{***}	1.2858^{***}	1.2061^{***}	1.1218^{***}	0.5121^{***}	0.5121^{***}
	(.5413)	(.1967)	(.1967)	(.1023)	(.0912)	(.0996)
Model:			PPML			
$BRD_{do} \times SPP_{do,t-k}$	1.4786^{***}	1.3469^{***}	1.3661^{***}	1.4141^{***}	0.9930^{***}	0.6223^{***}
	(.2090)	(.1696)	(.1624)	(.1589)	(.1292)	(.1292)
Fixed Effects:						
Origin-industry-time	✓	✓	✓	✓	✓	✓
Destination-industry-time	✓	✓	✓	✓	✓	✓
Country-pair	✓	✓	✓	✓	✓	✓

Note: Robust standard errors in parentheses; clustered at country-pair level. Significance: * $p < 0.10$, ** $p < .05$, *** $p < .01$.

1.4 Robustness

To scrutinize our main result from Section 1.3.3 we propose three sets of additional robustness checks: In Subsection 1.4.1 we replicate our mains result based on observed trade flows between NUTS-2 regions instead of using the country-level data with imputed intra-national trade flows from Borchert et al. (2021). In Subsection 1.4.2 we account for compositional changes in our sample of EU member states, to ensure that Nizalova and Murtazashvili's (2016) identification strategy (which in our application requires a strictly exogenous border dummies) is not compromised by the non-random variation introduced to our set of border variables through the accession of new EU member states. In Subsection 1.4.3 we account for any remaining unobserved heterogeneity that is not absorbed through the introduction of country-pair fixed effects (cf. Baier and Bergstrand, 2007) by adding additional country-pair specific control variables that also vary over time.

1.4.1 Intra-national Trade

As explained in Subsection 1.3.1, our ability to identify the trade-creating effect of converging to the EU's political mainstream on member states' trade with the rest of the union crucially depends on the availability of intra-national trade data. Standard datasets on international trade are constructed from customs data, and therefore do not contain information on intra-national trade flows. It therefore has become standard practice to impute missing intra-national trade flows by combining international trade with domestic production data (cf. Chen, 2004; Oberhofer and Pfaffermayr, 2021; Heid et al., 2021; Beverelli et al., 2023). In this subsection, we rely on auxiliary regional trade data, to replicate our baseline results from Table 1.2 based on observed intra-national trade flows instead of relying on imputed intra-national trade flows from Borchert et al. (2021). Specifically, we use the European Road Freight Transport (ERFT) survey (see Santamaría et al. (2023) for more details) to directly observe intra- and international trade flows of all EU member states at the level of NUTS-2 regions. Focusing on disaggregated trade-flows between the EU's NUTS-2 regions rather than on member states' aggregate trade offers two key advantages: Since intra-national trade flows can be directly observed in the regional trade data, we do not have to rely on the imputation method proposed by Borchert et al. (2021), which eliminates a potential source of measurement error. Also, there is a marked difference in the number of intra-national trade flow per member state and year. The International Trade and Production Database for Estimation (ITPD-E) contains exactly one (imputed) observation on intra-national trade per country and year, which means that the border dummies BRD_{do} are identified from a limited number of intra-national trade flows. On the contrary the number of intra-national trade flows per country and year in our regional datasets is increasing quadratically in the number of NUTS-2 regions per country, which enables us to identify the border dummies BRD_{do} with a substantially higher precision than in Table 1.2.

Table A1.2 in the Appendix reports OLS and PPML results based on the European Road Freight Transport (ERFT) survey, which allows us to study trade volumes between all NUTS-2 regions of the EU from 2011 to 2019.[28] Reassuringly, we find a strong and significant trade-creating effect of converging to the EU's political mainstream on member states' bilateral trade with the rest of the union at the level of European NUTS-2 regions.[29] While the

[28]See Combes et al. (2005) for a theoretical foundation and an empirical implementation of a gravity model based on trade volumes instead of trade values.

[29]Table A1.2 contains the same set of control variables as Table 1.2. A binary border indicator (REG_BRD_{do}) is added in Table A1.2 to account for a possible home bias at the level of NUTS-2 regions (cf. Hillberry and Hummels, 2008).

PPML estimate in Column (2) of Table A1.2 is slightly smaller than our baseline estimates from Table 1.2, we find that the OLS estimate from Column (1) of Table A1.2 is substantially larger. One possible explanation for this differences in the PPML and OLS results is that – unlike in our country-level trade data – a substantial share of the observations feature zero trade flows at the level of NUTS-2 regions. These zeros (and their informational content) are omitted in log-linearized OLS gravity estimations, which could explain the difference in outcomes if PPML is used to estimate the gravity model in its multiplicative form which permits the inclusion of zeros.

1.4.2 Sample Composition

As explained in Subsection 1.3.1, we follow Beverelli et al. (2023) in adopting an econometric argument from Nizalova and Murtazashvili (2016), according to which the differential impact of an endogenous variable of interest can be consistently estimated through an interaction term provided that the factor with which the variable of interested is interacted is strictly exogenous. Since we are interested in estimating the differential impact that a member state's convergence to the EU's political mainstreaming has on its inter- versus intra-national trade, we interact our measure of similarity of political preferences $SPP_{o,t-k}$ in Eq. (1.4) with the border dummy BRD_{do}. According to Nizalova and Murtazashvili (2016), the effect of the interaction term $BRD_{do} \times SPP_{o,t-k}$ then can be consistently estimated provided that the border dummy BRD_{do} is exogenous. Unlike Beverelli et al. (2023), who argue that the border dummy BRD_{do} is exogenous by construction because changes that mostly result from the splitting of countries can be ignored in a large panel of countries, we are concerned that the accession of 10 new member states (Cyprus, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Slovakia and Slovenia) in 2004 as well as the accession of Bulgaria and Romania in 2007 and the accession of Croatia in 2013 introduces a non-random variation to our border dummy which is defined over a maximum of 28 EU member states. We therefore focus as an robustness check on two subsamples that consist of a balanced panel of EU member states, and replicate in Table A1.3 from the Appendix our baseline results from Table 1.2 for the sample of EU-15 countries, whose trade we observe from 2000 to 2016, and for the sample of EU-27 countries, for which we observe the similarity of political preferences from 2007 onward.

Across all specifications of Table A1.3 we find a strong trade-creating effect of converging to the EU's political mainstream, which is always statistically distinguishable from zero. When comparing the results of our most demanding panel specification with country-pair-specific fixed effects across the Tables 1.2 and A1.3, we find that the points estimates of $BRD_{do} \times SPP_{o,t-3}$ from the shorter panel of EU-27 countries (Columns (5) to (8) of Table A1.3) have the same magnitude as their counterparts from Table 1.2. Focusing on the sub-sample of EU-15 countries over the entire sample period (Columns (1) to (4) of Table A1.3) results in points estimates of $BRD_{do} \times SPP_{o,t-3}$, which are substantially larger than their counterparts from Table 1.2. We interpret these results as suggestive evidence, that the accession of new member states does not compromise Nizalova and Murtazashvili's (2016) identification strategy, and that our baseline regressions from Table 1.2, which are based on an unbalanced panel of the EU-28 member states, deliver conservative estimates for the trade-creating effect of converging to the EU's political mainstream.

1.4.3 Unobserved Time-variant Heterogeneity

With all time-invariant unobserved heterogeneity being completely absorbed through country-pair fixed effects, which we have introduced in our most demanding and therefore preferred specifications from Table 1.2, all remaining endogeneity concerns are related to unobserved time trends, which could confound the estimation of the trade-creating effect that a convergence to the EU's political mainstream has on member states bilateral trade with the remainder of the union. Table A1.4 in the Appendix therefore introduces three additional time-variant control variables, which account for (i.) cultural convergence/divergence at the country-pair level, (ii.) country-specific economic and political uncertainty, and (iii.) the popular support for the European Union to our preferred (sector-level) specifications with country-pair fixed effects.

To tackle the concern that a member state's convergence/divergence to/from the EU's political mainstream observed in Figure 1.2 is only one facet of a more comprehensive convergence/divergence process, that simultaneously affects member states' bilateral trade through multiple channels, we account for cultural convergence/divergence by incorporating Felbermayr and Toubal's (2010) cultural similarity measure. Felbermayr and Toubal (2010) proposed to use the song-quality-adjusted voting outcomes from the Eurovision Song Contest (ESC) as a time-variant proxy for cultural similarity among the participating nations.[30] Quality-adjusted ESC scores are obtained by regressing the bilateral scores granted during the contest on song-specific fixed-effects, which control for the quality of the respective song. The regression residuals, i.e. the part of the variation in bilateral ESC scores which is not explained by song-specific fixed-effects, are then used as a proxy for cultural affinity at the country-pair level.[31] Reassuringly, we find that the trade-creating effect of converging to the EU's political mainstream remains virtually unchanged when controlling in our preferred specification with country-pair fixed effects from Table A1.4 for cultural similarity based on

[30] Felbermayr and Toubal (2010, pp. 281-284) discuss voting patterns in the Eurovision Song Contest and report correlations between quality-adjusted ESC scores and other measures of cultural similarity.

[31] We impose that bilateral cultural similarity based on quality-adjusted ESC scores assumes its maximum value if im- and exporter are the same country (in the ESC voting in favor of the own contestants is not permitted). Countries for which the index of cultural similarity based on quality-adjusted ESC scores can not be computed because they did not compete in the ECS in a certain year are omitted from our sample for the respective year.

quality-adjusted ESC scores.[32] At the same time, we do not find that changes in cultural similarity have a trade-creating effect that is statistically distinguishable from zero. This finding is compatible with the results from Felbermayr and Toubal (2010, pp. 289-291), who show that the effect of bilateral cultural similarity on aggregate trade loses its statistical significance as soon as country-pair fixed effects are introduced to absorb all time-constant variation.[33]

In Section 1.2, we have argued that converging political preferences are conducive to reducing the political uncertainty that surrounds each member state's political commitment to common EU policies. Of course, there are many more factors that create political and economic uncertainty at the country level (cf. Baker et al., 2016; Pierce and Schott, 2016; Acemoglu et al., 2016; Altig et al., 2020), which is why we interact in Specifications (3) and (4) of Table A1.4 the lagged country-level World Uncertainty Index $WUI_{o,t-3}$ recently proposed by Ahir et al. (2022) with the border indicator BRD_{do} to account for the differential impact that political and economic uncertainty has on member states' bilateral trade. To construct a comprehensive measure of political and economic uncertainty that covers an unbalanced panel of 143 countries since the early 50's Ahir et al. (2022) rely on the frequency of the word "uncertainty" in the quarterly published Economist Intelligence Unit country reports.[34] Introducing $BRD_{do} \times WUI_{o,t-3}$ to our panel regressions with country-pair fixed effects from Table A1.4 does not alter our conclusion regarding the trade-creating effect of converging political preferences, which continues to have the same magnitude and significance as in Table 1.2.

In a final robustness check from Table A1.4, we distinguish between the similarity in political preferences, which is constructed from the voting behavior in the European Parliament, and the popular support for the European Union, which on an annual basis is surveyed through the Eurobarometer by asking the question: "Generally speaking, do you think that [our country's] membership of the European Union is ...?".[35] In comparison to the share of respondents from the Eurobarometer who are supportive of the EU, we expect that the aligned voting behavior, which is recorded in the European Parliament's roll call votes, creates a (relatively) stronger signaling effect. Specifications (5) and (6) of Table A1.4 confirm this expectation: Whereas our measure for the similarity of political preferences $SPP_{o,t-3}$ is associated with a strong and statistically significant trade-creating effect, no such effect can

[32]In Table A1.13 of Appendix A1.2 we replicate the sector-level results from Table A1.4 based on aggregate trade flows.

[33]Felbermayr and Toubal (2010) demonstrate that the trade-creating effect of bilateral cultural similarity remains statistically significant after the introduction of county-pair fixed effects when focusing on trade in differentiated rather than homogeneous products (cf. Rauch, 1999).

[34]See Baker et al. (2016) for a similar text-based approach that is restricted to a smaller sample of just 12 countries.

[35]Eurobarometer respondents were given the response options: (a) "A good thing", (b) "Neither", (c) "A bad thing" and (d) "Don't know". We focus on the share of respondents that decided in favor of response option (a) "A good thing" to measure the popular support for the European Union.

be identified based on the broad support for the European Union as reported by the Eurobarometer $EURO\_BAR_{o,t-3}$, which we include with a lag of $k = 3$ years in an interaction term $BRD_{do} \times EURO\_BAR_{o,t-3}$ with the border variable BRD_{do}.

We conclude our discussion of the robustness analysis by showing that simultaneously including the aforementioned control variables $CULT\_SIM_{do,t}$, $BRD_{do} \times WUI_{o,t-3}$ and $BRD_{do} \times EURO\_BAR_{o,t-3}$ in Columns (7) and (8) of Table A1.4 does not alter our conclusion regarding the trade-creating effect of converging to the EU's political mainstream.

1.5 Conclusion

In this paper we have shown that member states, which converge in terms of their political preferences to the mainstream of the European Union benefit from more bilateral trade with other member states and feature less intra-national trade. We argue that our measure of similarity in political preferences is informative about the political uncertainty that surrounds each member state's commitment to common EU policies (like the EU's Single Market). The convergence of a member state to the EU's political mainstream (documented through the voting outcomes in the European Parliament) therefore is perceived as a signal which reduces political uncertainty, that is a major obstacle for investments that facilitate the bilateral trade between Single Market economies.

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CHAPTER 2

Intra-EU Trade-embodied Carbon Emissions: Is there Voting for Dirty Comparative Advantages?[1]

Abstract

I use voting outcomes from the European Parliament to construct a novel sector-specific measure for revealed environmental policy preferences for EU member states. Applying a theory-consistent structural gravity model on intra-EU carbon embodied in trade between 2000 and 2014, this study finds that binding multilateral environmental agreements successfully eliminate comparative advantages for emission intensive industries.

[1] This chapter is published as an article in the Economics Letters, Vol. 231, Maren Kaliske, Intra-EU trade-embodied carbon emissions: Is there voting for dirty comparative advantages?, Copyright Elsevier (2023).

2.1 Introduction

Rising CO_2 levels evoke political pressure to implement effective environmental policies combating emissions. Which policies are effective against climate change is unclear as individual countries achieve to halt or reduce emissions while global emissions continue rising.

This study exploits the unique setting of the European Union (EU) where environmental policies are binding to all member states. Utilizing data on roll call votes from the European Parliament, I calculate a novel sector-specific policy preference of legislative nature. Considering the EU allows to examine whether common binding environmental policies eliminate within EU comparative (dis)advantages in emission intensive industries arising from country-specific policy preferences.

This study relates to the Pollution Haven Hypothesis (PHH). According to the PHH differences in national environmental regulations incentivize firms to relocate a pollution-intensive good's production to relatively lenient countries, i.e. pollution havens, from which relatively emission intensive goods are exported to countries with high environmental standards. Studies using the gravity model of trade find (weak) evidence for international and intra-EU pollution havens (cf. Jug and Mirza, 2005; Aichele and Felbermayr, 2015; Martínez-Zarzoso et al., 2017). These studies consider national differences in the commitment to non-binding agreements – proxying the intention to reduce emissions - or in environmental policies. In this paper I hypothesize that the dynamics within a multilateral agreement are different if enforced policies are binding for the countries involved. Using sector-specific environmental preferences allows incorporating multilateral resistances and sector fixed effects in the econometric model controlling for general equilibrium effects and sector-specific emission intensities, respectively. I thereby overcome econometric challenges of previous studies where these fixed effects were collinear to the explanatory variable.

Results show no evidence for differential environmental policy preferences affecting intra-EU carbon imports. This finding is rationalized by the binding nature of EU policies which require all members to comply in the long-run. This finding implies that short-term differences in environmental policy preferences are insufficient to create intra-EU "dirty" comparative advantages, thus providing evidence for pursuing binding multilateral agreements.

The paper proceeds with Section 2.2 describing the data. Section 2.3 explains the identification strategy. Section 2.4 discusses the results, Section 2.5 concludes.

2.2 Data

2.2.1 Environmental Policy Preferences

In order to consistently measure environmental policy preferences varying by country and sector I rely on Member of Parliament level voting records from the European Parliament (Hix et al., 2022).[2] Individual voting records from the European Parliament are an established data source in political science, and can be used to approximate the underlying policy preferences (e.g. Hix, 2002).

To measure environmental policy preferences I use $2,413$ out of $22,136$ votes cast in the European Parliament between 1995 and 2014. These $2,413$ votes have a main environmental objective, which is identified by means of a keyword search and a subsequent evaluation of each vote.[3] Votes are then manually assigned to the sectors included in the World Input-Output Tables based on a keyword search.[4]

Member states i's average share of "yes" votes on environmental ballots targeting sector s in year t measures revealed environmental policy preference according to

$$\mathit{REPP}_{ist} \equiv (1/V_{st}) \sum_{v=1}^{V_{st}} \frac{N^y_{ivst}}{\sum_{l\in\{y,n,a\}} N^l_{ivst}}. \tag{2.1}$$

The fraction $N^y_{ivst}/\sum_{l\in\{y,n,a\}} N^l_{ivst}$ gives member state i's share of "yes" ballots in the total ballots cast on vote v affecting sector s in year t. The annual average is calculated by taking the mean over all votes v targeting sector s in year t (V_{st}). The variable REPP_{ist} is defined between zero and one. A zero value indicates that a member state has not voted in favor of any environmental vote, a value of one implies 100% support of all environmental votes. Increasing values of REPP_{ist} indicate greater support for environmental policies.[5]

Figure 2.1 reveals the average REPP_{ist} from 2007 to 2014 for each member state of the European Union.

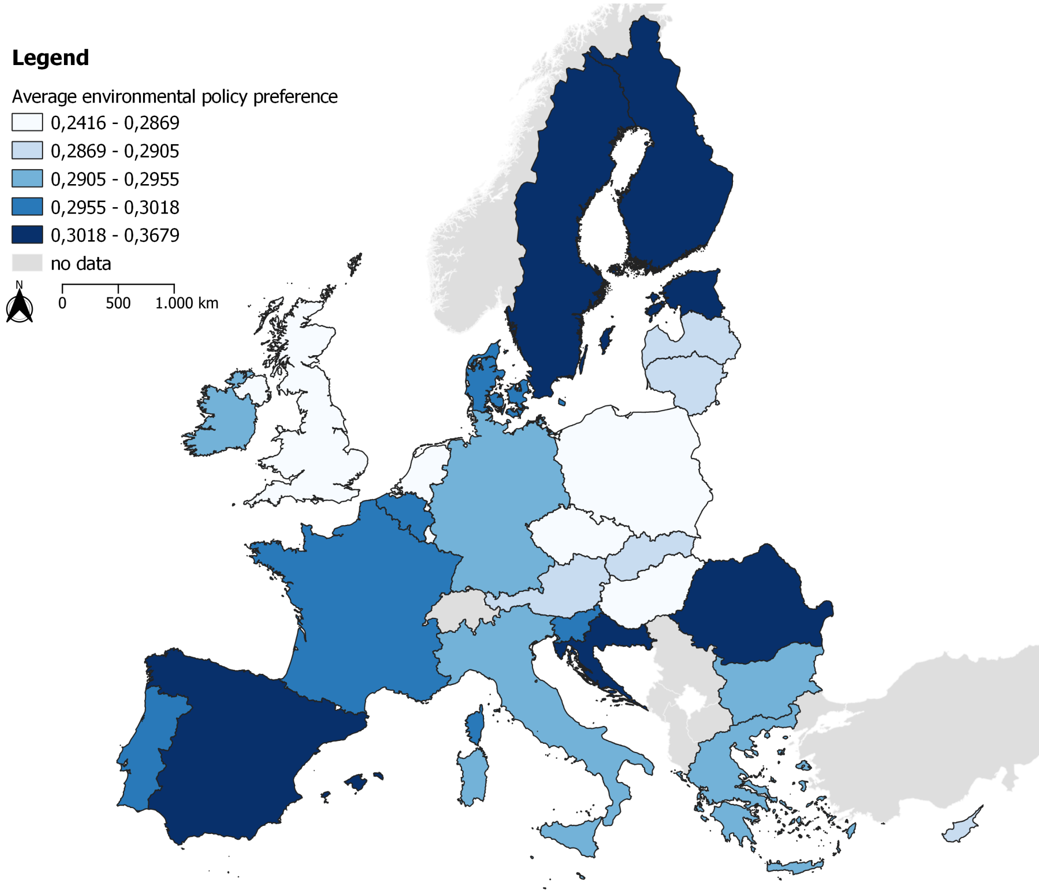
[2] Excluding Croatia as it joined the EU in 2013.

[3] I proceed in three steps. First, all policy areas not pertaining to the environment (e.g. Human Rights, Budget) are excluded. Second, votes are selected based on a word search (combinations and variations), e.g. "sustainable", "environment", "pollution", "carbon", "renewable". And third, I manually double-check the titles of all selected votes for sample validation.

[4] Manually checking the titles and (if necessary) the texts of all selected votes. Votes are either assigned to a specific sector (e.g. the vote "Fishery resources in Mediterranean" is assigned to the "agriculture, forestry and fishery" sector) or to all sectors if no sector-specific focus was identified (e.g. the vote: "Building a sustainable Europe"). See Figure A2.1 for the share of environmental votes per year and Table A2.4 for all policy areas in the European Parliament.

[5] See Tables A2.5 and A2.6 for summary statistics on the REPP_{ist} variable by sector and country, respectively.

Figure 2.1: Average Revealed Environmental Policy Preference by Country



Note: Based on own calculations using the European Parliament voting data for the years 2007-2014.

2.2.2 Trade-Embodied Carbon Emissions

In order to compute the carbon content of trade (hereafter carbon trade), I use the multi-regional input–output framework (cf. Shapiro, 2020). For my analysis I use multi-regional input–output tables and sectoral CO_2-emissions from the World Input Output Database (Timmer et al., 2015; Corsatea et al., 2019), which covers 56 (20 broad) sectors, 43 countries and the years 2000 to 2014.[6]

To account for fragmented value chains when computing carbon trade, I proceed in three steps: First, I calculate the time-varying country- and sector-specific emission intensity of local production.[7] Second, I multiply the emission intensities by the Leontief inverse matrix to obtain upstream emission intensities. Upstream emission intensities measure emissions

[6] Listed in Tables A2.2 – A2.3.

[7] The mainstream methodology obtains emission intensities by dividing sectoral emissions by gross output. However, I follow Wang and Ang (2018) in using value-added instead of gross output. Value-added and CO_2

of country i's sector s goods at time t incorporating emissions embodied in intermediate inputs. Finally, I multiply the upstream emission intensities by country i's sectoral trade. The resulting carbon trade measures the average CO_2 emissions included in country i's sector s imports from country j at time t.[8]

2.3 Identification Strategy

To identify the effect of differences in environmental policy preferences on intra-EU carbon imports I estimate the following gravity equation for EU member states[9]:

$$X_{ijs,t} = \exp\left[\gamma_{it} + \lambda_{jt} + \mu_{ijs} + \beta_k \Delta REPP_{ijs,t-k} + \mathbf{X}'_{ijt}\delta\right] \times \varepsilon_{ijt}. \tag{2.2}$$

Sector s carbon imports X_{ijst} between importer i and exporter j in year t depend on the fixed effects γ_{it}, λ_{jt} and μ_{ijs}, a vector of time-varying standard controls $\mathbf{X}_{ijt}$[10] and an error term ε_{ijt}. The importer-time ($\gamma_{i,t}$) and exporter-time (λ_{jt}) fixed effects control for out- and inward multilateral resistances, respectively. Using sector-level carbon imports allows to apply pair-sector fixed effects (μ_{ijs}) which absorb time-invariant factors between trading partners and sectors.

The coefficient of interest β_k captures the effect of $\Delta REPP_{ijs,t-k}$, i.e. the difference in environmental policy preferences between importer i and exporter j on policies affecting sector s at time $t-k$ ($\Delta REPP_{ijs,t-k} \equiv REPP_{is,t-k} - REPP_{js,t-k}$). The effect of $\Delta REPP_{ijs,t-k}$ is examined contemporaneously and lagged by one to five years ($0 \leq k \leq 5$). Changes in trade flow patterns underlie firm level decisions and are therefore first observable with a lag.

The sign and significance of the β_k's and β_{sk}'s estimates reveal whether the PHH holds within a binding multilateral agreement. If binding multilateral agreements leave scope for country-specific implementation the PHH might hold, suggesting an significantly positive estimate. However, if policies within the agreement are effectively enforced, national preferences should become indecisive for regulatory comparative advantages.

2.4 Results & Discussion

Table 2.1 presents the baseline results (OLS and PPML) of differential sector-specific environmental policy preferences between the importer and exporter lagged by one year.[11]

emissions both measure locally produced quantities. Gross output, however, measures the accumulated value along the value chain which is not comparable with local CO_2 emissions.

[8]For a detailed description see Appendix A2.

[9]To unravel sector heterogeneity a second specification includes a sector specific interaction term of the $\Delta REPP_{ijs,t-k}$ variable.

[10]Table A2.1 lists all variables and sources.

[11]Results are consistent and shrinking with higher lags (Tables A2.12 and A2.13). Table A2.11 includes control variables' estimates.

Table 2.1: Baseline Results for Environmental Policy Preferences and Carbon Imports

Dependent Variable: Carbon Imports				
Model:	OLS		PPML	
Specification:	(1)	(2)	(3)	(4)
$\Delta REPP_{ijs,t-1}$	-0.3632^{***}		-0.1132	
	(.0501)		(.1657)	
$D_s \times \Delta REPP_{ijs,t-1}$				
Agriculture, forestry and fishing (A)		-0.4120^{***}		-0.2086^{*}
		(.0644)		(.1232)
Mining & quarrying (B)		-0.4875^{***}		-0.1723
		(.0816)		(.3661)
Manufacturing (C)		-0.5031^{***}		-0.1130
		(.0656)		(.2232)
Electricity, gas, steam and air conditioning supply (D)		-0.4395^{***}		-0.5450^{*}
		(.0768)		(.2854)
Water supply; sewerage, waste management and remediation activities (E)		-0.6530^{***}		0.0044
		(.0827)		(.1554)
Construction (F)		-0.3376^{***}		-0.1312
		(.0520)		(.1079)
Wholesale and retail trade; repair of motor vehicles and motorcycles (G)		-0.3589^{***}		0.2354^{**}
		(.0547)		(.0953)
Transportation and storage (H)		-0.3540^{***}		0.0968
		(.0583)		(.1289)
Services (I-S)		-0.3032^{***}		-0.0353
		(.0486)		(.0582)
Controls:	✓	✓	✓	✓
Fixed Effects:				
Origin-Time	✓	✓	✓	✓
Destination-Time	✓	✓	✓	✓
Origin-Destination-Sector	✓	✓	✓	✓
Summary Statistics:				
Observations	428,049	436,152	428,178	436,281
(Pseudo-)R^2	0.9735	0.9735	0.9906	0.9907

Note: Standard errors in parentheses and clustered at country-pair level. Significance: * $p < 0.10$, ** $p < .05$, *** $p < .01$.

Columns (1) and (2) present the OLS estimates with the logarithm of carbon imports as the dependent variable. The OLS estimates indicate a significantly negative effect of differential environmental policy preferences on carbon imports. Intuitively, an importer with higher revealed environmental policy preferences than the exporter significantly reduces carbon imports in the following year. Further, Column (2) displays sectoral effect heterogeneity, i.e. the effect is stronger for relatively emission intensive sectors. Columns (3) and (4) show PPML estimates with carbon imports in levels. Accounting for heteroscedasticity in PPML renders the estimates insignificant which suggests no effect of differential environmental policy preferences on carbon imports. 2.1 shows that the effect of sectoral environmental policy support differences on carbon imports is either significantly negative or insignificant indicating that multilateral binding policies abolish comparative advantages in "dirty" production.[12] To compare my findings to the literature, I reduce the set of fixed effects and use the OECD's Environmental Policy Stringency (EPS) measure. Tables A2.9 and A2.10 present the results which – in line with my baseline finding – do not find that differences in environmental policy preference or stringency affect carbon imports. Robustness checks validate these results: (1) The differential effect for imports from Eastern European countries displays opposite effects in OLS (negative) and PPML (positive). These opposing results do not allow concluding that there is an effect and do not support previous findings from the literature (cf. Martínez-Zarzoso et al., 2017)[13]; (2) adding a measure of political similarity and using the EPS maintains the results, indicating that the $REPP_{is,t}$ variable reflects environment-specific policy preferences[14]; (3) extending the analysis to non-EU countries when using the EPS shows that the results are not driven by sample selection[15]; and (4) accounting for potential measurement error in the $REPP_{is,t}$ variable by excluding accession years diminishes the significance, underlining that there is no significant effect of differences in environmental policy support on carbon imports.[16] I minimize endogeneity concerns by applying pair-sector fixed effects absorbing time-invariant, pair-specific sectoral factors and partialling out levels in the country pair's trade relationships. Remaining threats to identification stem from (a) reverse causality which is obviated by using the lagged environmental preference variable and (b) time-varying, pair-specific political processes which are captured by controlling for bilateral political similarity.

[12] Table A2.8 presents estimation results using carbon exports as the dependent variable. Enhancing the baseline findings the OLS results in Table A2.8 show that countries with relatively higher environmental policy preferences compared to their trading partner are characterized by significantly less carbon exports. This is in line with the hypothesis that environmental policies increase the costs of production of relatively dirty goods, which leads to fewer exports of these goods. Again, using PPML renders the coefficient estimates statistically insignificant, except for sectors D and G.

[13] Table A2.14.

[14] Tables A2.15 and A2.16.

[15] Table A2.16.

[16] Table A2.17.

2.5 Conclusion

This paper analyzes whether the EU as a binding multilateral agreement prevents differences in environmental policy preferences to create comparative advantages in emission intensive industries. Following the literature on the PHH this study hypothesizes that differences in revealed environmental preferences create comparative (dis-)advantages and incentivize sourcing pollution-intensive products from countries with lower environmental standards. Using a novel measure for revealed environmental policy preferences based on voting outcomes from the European Parliament this study contributes by tracing actual environmental policy preferences varying by sector. Theory-consistent structural gravity estimation does not reveal evidence for differences in environmental policy preference creating intra-EU comparative advantages. The results are rationalized by successful EU policies which are binding to all member states. Convergence to agreed standards by member states prevents firm-relocations to relatively pollution-friendly countries within the Single Market. Joint policies are therefore found to be an effective measure for combating CO_2 emissions.

The policy implications are that binding supra-national environmental policies work by diminishing incentives for carbon leakage between involved countries. However, leaking incentives remain between countries in- and outside the agreement supporting border adjustment mechanisms.

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CHAPTER 3

Connecting EU Regions: The Influence of Road Construction on Regional Trade[1]

Abstract

Do cohesion policies and infrastructure investments increase regional trade integration in the EU? Using the EU's commodity flow survey (ERFT) for the years 2011-2019 and infrastructure investments as part of the Trans-European Transport Network (TEN-T), I find an inter-regional trade-enhancing effect on NUTS-2 trade flows. To ensure that this result is not driven by endogenous timing or location of these projects, I consider the effect of road construction at NUTS-2 pair level and apply a restrictive set of fixed effects. Further, to control for infrastructure improvements beyond the TEN-T, I calculate year-specific travel times between any NUTS-2 pair. This study thereby provides novel empirical evidence of a trade-enhancing effect across intra-national as well as international borders for mainland EU NUTS-2 regions.

[1]This chapter is not published.

3.1 Introduction

The European Union (EU) spent around 34% of its 2014-2020 multi-annual budget on social, economic and territorial cohesion (cf. European Commission, 2023). The goal of these policies is to reduce social and economic regional disparities by means of investments in infrastructure and networks. To this end, the EU formalized its long-standing vision of an EU-wide transportation infrastructure network and developed the TEN-T (Regulation (EU) No 1315/2013) in 2013. The Trans-European Transport Network (TEN-T)[2] encompasses railroads, roads, inland waterways, maritime shipping routes as well as ports, airports and railroad terminals.

The EU-wide transportation network's goal is to close connectivity gaps and to remove bottlenecks thus helping EU regions to improve trade integration by reducing barriers to trade. For this purpose, approximately 23 billion Euro (2% of the multi-annual budget) has been spent directly on the TEN-T, including investments in road infrastructure, between 2014 and 2020 (cf. European Union, 2022c). In 2019, around 53% of the intra-EU freight was transported on roads, highlighting the importance of road infrastructure for intra-EU trade integration by means of exploiting the potential of price differences and comparative advantages between EU regions.

This paper provides empirical evidence on whether these investments in transportation infrastructure, and physical road infrastructure in particular, succeed in improving accessibility and regional economic integration. For my study the ongoing construction of roads in order to complete the planned TEN-T will serve as variation – albeit not entirely exogenous – in accessibility improvements to this EU-wide road network. In examining the inter-regional trade effects of the TEN-T's implementation this study relates to three strands of literature. First, this study links to the overarching literature of cohesion policies in the EU. Second, by examining the trade effects of infrastructure investments this study connects to the literature on international trade and infrastructure projects. And third by using NUTS-2 level trade flows this study relates to the sub-field of trade literature which concerns regional level trade flows.

The literature on EU cohesion policy regarding road infrastructure provides mixed results.[3] While some studies find little impact on regional growth (cf. Crescenzi and Rodríguez-Pose, 2012), others show that expanded road networks can stimulate economic development (cf. Duranton and Turner, 2012; Goldmann and Wessel, 2020). In the context of infrastructure investment in the EU, the TEN-T offers a unique project which has been used to evaluate the EU cohesion policy and its regional effects. Early evidence on the TEN-T draws a mainly skeptical picture of the effectiveness of transport infrastructure on regional cohesion in the

[2]In the course of the paper, the abbreviation TEN-T is used to refer to the Trans-European Transport Network.

[3]Fiaschi et al. (2018) provide a summary of the literature on the effectiveness and the effects of EU cohesion policy in general.

EU as it indicates that the infrastructure projects do not generate sufficiently large welfare and spillover effects (Roger Vickerman and Wegener, 1999; Papadaskalopoulos et al., 2005; Bröcker et al., 2010). However, Goldmann and Wessel (2020) are the first to examine the direct and indirect growth effects of the recent TEN-T construction plans on NUTS-3 level in Eastern Europe. They find that NUTS-3 regions with direct access to the TEN-T experience significantly higher economic growth than NUTS-3 regions without direct access. However, they remain agnostic about the economic channel. By extending Goldmann and Wessel's study to the comprehensive network of the EU and considering mainland EU, this chapter provides evidence for the intra-EU trade effect of newly constructed roads of the TEN-T and proposes trade integration as the channel through which regions experience growth.

By examining trade integration as a potential channel of the TEN-T's impact on regional economic cohesion this study also relates to the literature on international trade and in particular the literature examining the role of infrastructure for trade. Infrastructure, in general, is a key parameter of transaction costs. Improving (road) infrastructure reduces transaction costs and promotes trade (cf. Limão and Venables, 2001; Redding and Turner, 2015). The trade effect of infrastructure investments is examined in two types of studies: The first provides reduced-form evidence on the effects of changes in accessibility indices on country and regional level economic transactions (cf. Donaubauer et al., 2018; Gibbons et al., 2019). Similar to this study, these studies exploit changes in travel time, as a proxy for changes in trade costs, to examine the effect of infrastructure investments.[4] The second type considers general equilibrium models in combination with large-scale infrastructure projects used as quasi-random variation to estimate the effect of infrastructure projects on trade in a one-country multiple-region setting. Among others, Coşar et al. (2021) find that the reduction in travel time caused by country wide road upgrades in Turkey has a positive and significant effect on trade between Turkish districts. The finding by Coşar et al. (2021) suggests that a ten percent decrease in bilateral travel time increases trade by around 8.2 percent. In sum, this strand of literature mostly focuses on national infrastructure campaigns improving connectivity of regions, e.g. the development of the US Interstate Highway System, large-scale capacity upgrades to the Turkish highway network or the Indian railroad (cf. Michaels, 2008; Duranton et al., 2014; Donaldson, 2018; Coşar et al., 2021; Adler and van Ommeren, 2016). Beyond that there are a few studies consider infrastructure projects affecting international trade across country borders, i.e. the expansion of the Panama Canal or the Road Belt Initiative, and find trade promoting effects (cf. Heiland et al., 2019; Baniya et al., 2020).

In contrast to the above papers, this study considers a setting with multiple regions and multiple countries in the EU. The only study considering road infrastructure investment in a multiple-region and multiple-country setting is the study by Shevtsova et al. (2021) who estimate the change in Generalized Transport Costs induced by the amount of EU

[4]Travel times are a popular and established measure for infrastructure improvements in regional, urban and transport economics (e.g. Small, 2012; Adler and van Ommeren, 2016; Allen and Atkin, 2022).

funding assigned to each NUTS-2 region. Their ex-ante general equilibrium evaluation of the effects of changes in the Generalized Transport Cost Matrix induced by the planned TEN-T investments indicate an average export enhancing effect of 0.4 percentage. I provide gravity model estimates of improved accessibility on NUTS-2 level trade flows and thereby quantifying ex-post trade effects of new road infrastructure as part of the TEN-T.[5]

Finally, this study uses data on sub-national level and contributes to the literature on regional trade. Typically studies examining sub-national trade flows in the US, France, Japan or the EU are based on Commodity Flow Surveys (e.g. Hillberry and Hummels, 2003; Coughlin and Novy, 2012; Durand and Decoville, 2020; Coughlin and Novy, 2021; Santamaría et al., 2020). A first set of empirical studies provide evidence for persistent effects of historic borders like the former inner German border (cf. Nitsch and Wolf, 2013) or finds that economic patterns built over long times cause domestic trade networks to be separated by "illusionary borders" (cf. Wrona, 2018). While this paper sits at the intersection of the literature on regional trade and the literature on trade effects of infrastructure projects by using regional trade flows in the EU and the TEN-T and is thereby similar to the studies by Combes and Lafourcade (2005) and Coşar et al. (2021). This study's novelty consists of analyzing trade as well as infrastructure improvements continuously from 2011 to 2019 for multiple countries and multiple regions in EU mainland.

The research question of this study centers on whether transportation infrastructure investments enable EU NUTS-2 regions to better integrate into the EU Single Market. A theory consistent gravity equation on the effect of completing the construction of a road segment on cross-border trade serves as the baseline specification. The study combines three main datasets and thereby contributes to the literature in three ways: First, it uses customized and manually collected data on the year of completion of road segments which are part of the TEN-T, building on the work by Goldmann and Wessel (2020). Second, generating and using year-specific travel times between EU NUTS-2 regions contributes by providing a simple time-varying measure of bilateral transportation costs which are found to be a good proxy for the Generalized Transportation Cost Matrix (e.g. Combes and Lafourcade, 2005; Hinz, 2017) and helps to isolate the effect of improvements in the road network triggered by the EU co-funded road construction on trade flows. And third, using the EU commodity flow survey (European Road Freight Transport Survey) which provides trade flows between EU NUTS-2 regions allows to examine trade integration in the EU Single Market on a regional level (e.g. Coughlin and Novy, 2021). This paper is thereby the first to apply cross-country and regional level trade data to the question of infrastructure investments' trade effects. Combined these contributions lead to novel empirical evidence of a trade-enhancing effect across intra-national as well as international borders for mainland EU NUTS-2 regions.

Combining these data, I built up my identification strategy which is tailored to the setting

[5] The TEN-T is not fully completed yet. This study hence does not aim at a final evaluation of the policy.

and research question at hand. The empirical strategy first is built upon two components: First, I define a bilateral and time-varying variable identifying NUTS-2 pairs whose optimal route is affected by road construction as part of the TEN-T. Related studies examining the trade effect of road construction use the change in bilateral travel times (cf. Donaubauer et al., 2018; Gibbons et al., 2019; Coşar et al., 2021). By focusing on the TEN-T I do not observe the full universe of road segments in the EU, hence relying only on the change in travel times is here not possible when trying to isolate the effect of completed road segments on trade. I hence define a variable identifying whether a NUTS-2 region pair is affected by a completed road segment of the TEN-T. Second, using data which varies on a sub-national and time specific level allows to apply a restrictive set of fixed effects absorbing time-invariant NUTS-2 pair specific factors as well as country-pair specific time trends. This restrictive set of fixed effects accounts for the potential endogenous location of completed road segments. The results of the baseline gravity estimation suggest that NUTS-2 pairs affected by a completed road segment on their optimal route start trading relatively more with other NUTS-2 regions after the access to the EU-wide TEN-T was improved. In terms of magnitude the results suggest that an increase of the optimal travel route using a completed road segment of the TEN-T by one percent increases trade on average by 0.22 percentage which is similar in size to the effect found by Shevtsova et al. (2021).

The paper proceeds as follows: After summarizing background information on the TEN-T and the data on road construction in Section 3.2, Section 3.3 describes the data on the bilateral travel times and the connectivity effects of road construction. An introduction of the regional trade data, the estimation strategy and the presentation of the empirical analysis follow in Sections 3.4 and 3.5. Section 3.6 concludes.

3.2 The Trans-European Transport Network

The EU spends a significant fraction of its total budget on cohesion policy. In the period from 2014 to 2020 around 34% of the total multiannual budget were spent on cohesion policies and infrastructure projects (cf. European Commission, 2023).[6] Transport infrastructure is

[6] Understanding the effectiveness and distributional consequences of cohesion policy in general is an important topic and studied in regional and public economics. Empirical studies examining the effects of infrastructure investments on economic cohesion find ambiguous evidence for the effectiveness of cohesion policy but significant effects on the distribution of population and economic activity (Brinkman and Lin, 2019; Asher and Novosad, 2020; Baum-Snow et al., 2017). Baum-Snow et al. (2017) studying the effect of road and rail construction in China provide evidence for decentralization of population and economic activity and welfare enhancements through reduction in commuting and transportation costs. Crescenzi and Rodríguez-Pose (2012) examine the effect of transport infrastructure endowment on regional growth in the EU-15 between 1990 and 2004 and do not find a robustly significant effect on economic growth. On the contrary, Duranton and Turner (2012) structurally estimate the effect of the US Interstate Highway System on economic growth and find that an increase in city-level stock of highways increases employment significantly. In the same vein, Gibbons et al. (2019) exploit variation in accessibility changes of British firms to small-scale geographical areas and find a significant positive effect of road construction on firm outcomes. Allen and Arkolakis (2022) exploit variation

thereby one of the main instruments which aims at economic and social cohesion. In 2013, the EU formalized the plan of an EU-wide infrastructure network in Regulation (EU) No 1315/2013. This TEN-T consists of railroads, roads, inland waterways, maritime shipping routes as well as ports, airports and railroad terminals. By formalizing the development of an EU-wide transport network the EU aims at social and economic regional cohesion by closing connectivity gaps and removing bottlenecks. The Trans-European Transportation Network therefore coordinates infrastructure investment in physical infrastructure as well as in research and innovation for smart technologies. The initiative intends to complete the construction of the Core Network until the 31^{st} of December 2007 and the Comprehensive Network until the 31^{st} of December 2050 (cf. European Union, 2013a).

The implementation of the TEN-T is financed by a set of EU funds under the umbrella of the Connecting Europe Facility consisting of several European Structural and Investment Funds.[7] The budget is distributed to individual projects via a selection process. The selection process is performed by an external expert group and is based on the relevance, maturity, impact and quality of the project proposal (European Union, 2013b). Priority is given to projects of the Core Network and projects with high European value added, i.e. filling cross border missing links, removing key bottlenecks and creating multi-modal nodes. The EU budget is planned in periods, the years of observation in this study touch two EU budget periods: the 2007 to 2013 period as well as the 2014 to 2020 period. In the period from 2014 to 2020 the Connecting Europe Facility co-financed over 1500 transportation projects with a volume of approximately 23 billion Euro (European Union, 2022a). Importantly, financial support from the European Structural and Investment Funds is only distributed to NUTS-2 regions eligible to the Cohesion Funds.[8] The EU only partially supports infrastructure projects as part of the TEN-T, the larger share of the costs is financed by national or regional authorities (cf. European Parliament, 2023).

The Directorate-General Mobility and Transport of the European Commission is responsible for the implementation of the TEN-T. The status and progress of the TEN-T is documented and published in the TENtec Interactive Map Viewer[9]. The underlying map provides

in the U.S. highway network and the Seattle road network to examine intra- and international trade effects and find positive welfare effects through reduced congestion. Finally, Banerjee et al. (2020) investigate the effects of access to transportation infrastructure on economic development in Chinese regions and find strong divergence effects between well and poorly connected regions. They identify limitations in factor mobility to be the reason limiting materialization of benefits rather than inefficiency of infrastructure construction (See Fiaschi et al. (2018) for a more detailed summary of the literature).

[7]The European Regional Development Fund, the European Social Fund, the Cohesion Fund, the European Agricultural Fund for Rural Development and the European Maritime and Fisheries Fund.

[8]Countries whose Gross National Income (GNI) per capita is below the 90% of the EU average GNI per capita are eligible to EU Cohesion Funds. In the period from 2014 to 2020 these countries were Bulgaria, Croatia, Cyprus, the Czech Republic, Estonia, Greece, Hungary, Latvia, Lithuania, Malta, Poland, Portugal, Romania, Slovakia and Slovenia (European Union, 2022b).

[9]The Interactive map can be accessed via `https://ec.europa.eu/transport/infrastructure/tentec/tentec-portal/map/maps.html#&ui-state=dialog`.

geo-referenced data on the TEN-T covering the EU-28 countries plus Norway, Liechtenstein and Switzerland. The data includes information on individual segments of the road, rail, waterway network including nodes such as ports and airports and detailed information on the type of segment, type of measure and its status of construction but not on the year of completion (cf. European Union, 2022d).[10]

The aim of this study is to examine the effect of improved road connectivity on regional trade in the EU and hence primarily considers the road network of the TEN-T.[11] The data provided by the Directorate-General Mobility and Transport of the European Commission offer detailed information in order to identify road segments which have been upgraded or newly constructed and are completed or under construction in the period 2011 to 2019 considering the first year after completion, respectively.[12] Building on the data by Goldmann and Wessel (2020), I complement the year of completion for road segments whose construction was completed in the years 2011 to 2019. The customized dataset contains information on new and upgraded road segments of the TEN-T and the year of completing the construction.

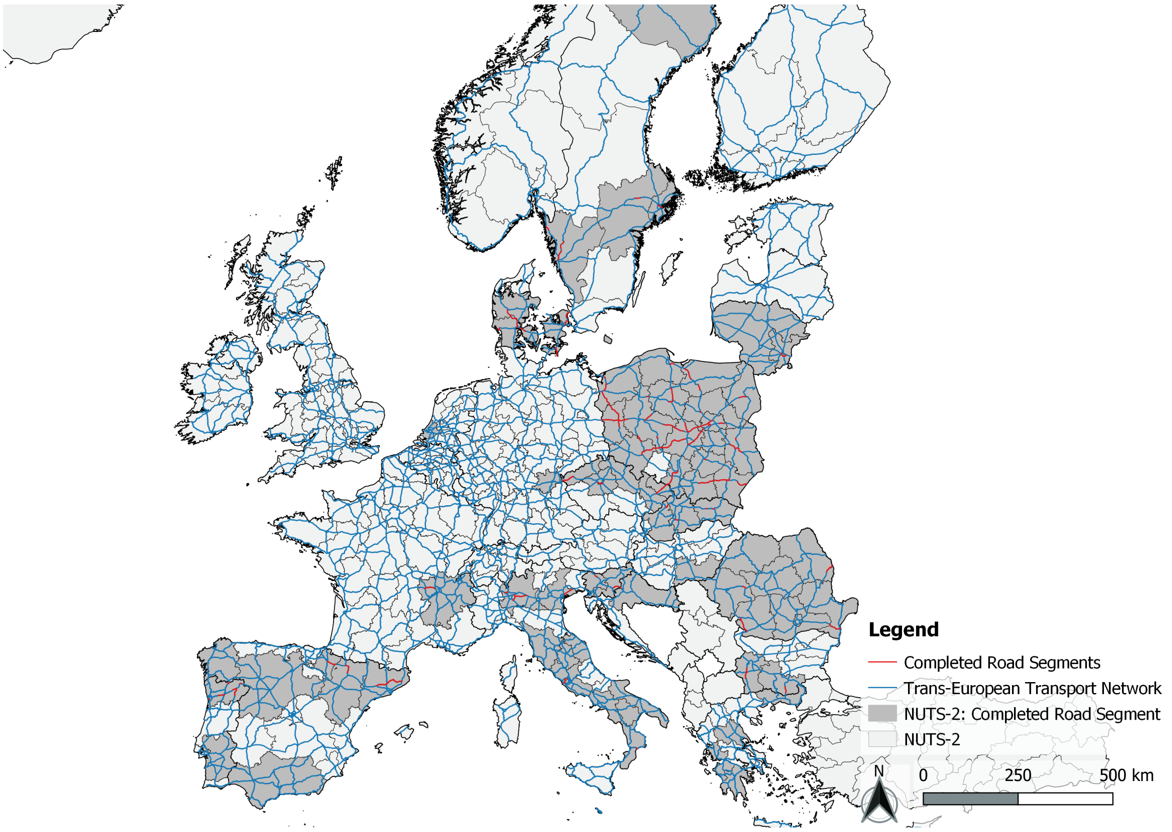
Figure 3.1 shows the road network of the TEN-T in blue and highlights the road segments which were completed in the period 2011 to 2019 in red. The NUTS-2 regions colored in darker gray are hence those in which at least one completed road segment is located. Figure 3.1 shows that most roads are built in countries which are at the south-east border of the European Union with the majority of completed roads in Eastern European countries. This spatial distribution of completed road segments will build the basis for exploiting effect heterogeneity in the later analysis.

[10]The data provided by the Directorate-General Mobility and Transport of the European Commission records the progress until 2016. For the type of measure the options “no measure”, “upgrade” and “new construction” and for the information on the status of construction the options“planned”, “under construction” or “completed” are available. Information for the infrastructure network in the United Kingdom except the location of the segment is not included since the UK left the European Union on 24^{th} of January 2020. The United Kingdom is hence omitted from the later analysis.

[11]Figure A3.1 provides a map of the EU-wide road network considered in this paper.

[12]As the data provided by the Directorate-General Mobility and Transport of the European Commission reports the status of the TEN-T of 2016, I consider segments which are “under construction” in order to depict a comprehensive picture of road construction in the EU. If the road was completed in the first three month of the respective current year was used.

Figure 3.1: Completed Road Network of the Trans-European Transport Network



Note: The map presented in Figure 3.1 shows the TEN-T. The roads colored in red are those that were upgraded or newly built and were completed between 2011 and 2019. The NUTS-2 regions colored in grsy are those directly affected by a completed road segment. Data on Sweden and Finland is available but cropped from the picture. The map is produced with the data provided by the Directorate-General Mobility and Transport of the European Commission and based on administrative boundaries from European Commission – Eurostat/GISCO (2016).

It is not surprising that roads are predominantly built in Southern and Eastern European regions as the majority of the TEN-T as described in Section 3.2 is funded by the European Structural and Investment Funds. A large part of the European Structural and Investment Funds thereby focuses on regional cohesion and investment into relatively less developed regions and countries. It follows, that the location of road construction projects is unlikely to be random which will be the starting point for the identification strategy.

3.3 Improvements in Road Network and Travel Times

The main objective of building a EU-wide TEN-T is, as described in Section 3.2, to improve connectivity and remove bottlenecks. One natural consequence of the road construction is that there are changes in bilateral connectivity which here is measured by durations and distances of bilateral travel routes between regions in the EU. In order to link the data on road construction in the EU (Section 3.2) to bilateral travel routes, I generate a customized dataset which consists of year-specific travel times and distances between the largest cities of the EU NUTS-2 regions. The year-specific travel times and distances between each NUTS-2 pair are computed using the year specific infrastructure network from OpenStreetMap covering all European NUTS-2 regions in the years 2013 to 2019.[13] The travel time and distance between a NUTS-2 pair thereby corresponds to the optimal route between the largest, measured by population size in 2017, Local Administrative Unit (LAU) of the respective NUTS-2 region and are allowed to be asymmetric.[14] For intra-NUTS-2 travel times the population weighted travel times and distances of the ten largest LAUs in a NUTS-2 region are computed.[15] Before using the data in the analysis I account for outliers.[16]

Combes and Lafourcade (2005) establish that bilateral travel times are a good approximation of transportation costs as they highly correlate with the Generalized Transport Cost Matrix which allows to remain agnostic about further factors to transportation costs, i.e. fuel, labor costs, tolls and taxes. Following, an increasing number of studies uses bilateral travel times as the proxy for transportation and trade costs instead of the traditional great circle distance (e.g. Heiland et al., 2019; Coşar et al., 2021; Allen and Atkin, 2022; Allen and Arkolakis, 2022). The travel times and distances computed in this study likewise correlate highly with traditional measures of distance metrics, i.e. time-(in)variant great circle and population weighted distances, and are negatively correlated with bilateral trade flows.[17] Moreover, the year-specific travel times also correlate with the reported traveled distances in

[13]The OpenStreetMap project started in 2004 and is a crowd-sourced database of infrastructure, i.e. roads, buildings and amenities. Data availability differs by country, region and year; with with increasing data availability over time. There are vast literatures on routing algorithms using the OpenStreetMap data (e.g. Protaziuk et al., 2019) and assessments of heterogeneity across countries in e.g. road density (Meijer et al., 2018). Barrington-Leigh and Millard-Ball (2017) provide an assessment of the OpenStreetMap's completeness with respect to roads and find that overall OpenStreetMap covers more than 80% of roads in 2016 and that coverage in Europe is above average. Figure A3.4 depicts the data availability bias of the OpenStreetMap data. The European countries are thereby characterized by completeness of approximately 90%. Moreover, main roads and especially highways are likely to be 100% available for all countries and regions. However, before 2013 parts of the road network is not available for some European regions which results in 2013 being the first year with reliable information on all EU NUTS-2 regions.

[14]For a list of all NUTS-2 regions and the LAU regions see Table A3.11.

[15]Among others Chen (2004); Rauch (2016) showed that the weighted harmonic average shall be used in order to calculate distances in a setting where relatively large spatial units are considered and information on distances between local units on a finer spatial scale are available. Vienna, Hamburg, Berlin and Prague only consist out of one LAU, the NUTS-2 itself. I hence in line with Mayer and Zignago (2011) compute the internal distance as $0.667 \times \sqrt{(area/\pi)}$ and assume that the infrastructure improvement is equal to the average improvement in the respective year of all other LAU combinations.

[16]Outliers, i.e. upward jumps with a following downward jump in similar size, are mainly in NUTS-2 pairs with a ferry connection, i.e. Finland, Greece, Ireland, Italy, the United Kingdom. However, these outliers are assumed to be the average of the year before and after. Finally, the changes are winsorized at the 1^{st} and 99^{th} percentile and distances and durations are adjusted accordingly. In total 3.37% of the sample are corrected for measurement error and outliers. And the correlation coefficient between the raw and cleaned data is 0.99 for the analysis sample.

[17]The correlation coefficients of travel time and time invariant and population weighted great circle distance are 0.65 and 0.85, respectively. See Table A3.12 in Appendix A3.2. Figure A3.7 in Appendix A3.2 compares

the European Road Freight Transport Survey which creates confidence that the travel times and distances approximate transportation costs of intra-EU road freight well.[18]

The travel times and distances used in this study feature two advantages compared to traditional distance metrics. First, by using year-specific infrastructure maps travel times and distances vary over time due to changes in the infrastructure and accessibility instead of changes in population size or economic activity (e.g. Mayer and Head, 2002; Hinz, 2017). Especially when examining road construction projects it is important to control for changes in infrastructure irrespective of the TEN-T. Further, along with the travel times and distances the routing algorithm allows to retrieve a GPX path, i.e. a geocoded line of the optimal route. This GPX path allows to match a road construction project to the NUTS-2 pair specific routes and to examine whether a NUTS-2 pair is affected by an infrastructure improvement or not.[19] The mapping of a completed road segment with NUTS-2 pair travel routes relies on the assumption that trucks will chose the optimal and cost-minimizing route between two NUTS-2 regions. The presented high correlation between reported traveled distances in the European Road Freight Transport Survey and the computed travel times and distances can be interpreted as descriptive evidence for the computed bilateral year-specific travel times to be a very good approximation of the traveled route and transportation costs in general.

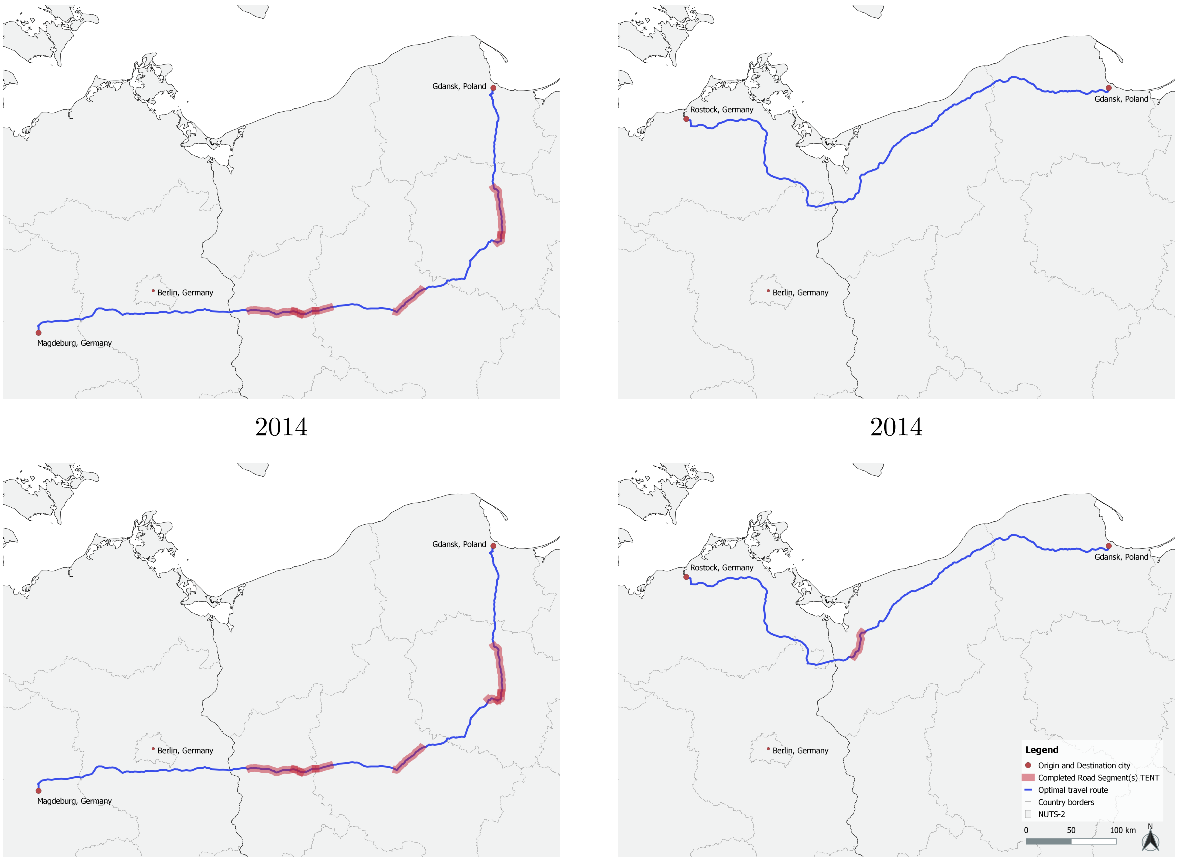
Figure 3.2 illustrates the definition of the variable identifying whether a NUTS-2 pair is affected by completed road segments and displays two examples. Panel (a) shows the route between Magdeburg, Germany and Gdansk, Poland and Panel (b) depicts the route between Rostock (Germany) and Gdansk (Poland).

the relationship of bilateral time-invariant distance as well as the year-specific travel times with bilateral trade flows in a binned scatter plot.

[18] The European Road Freight Transport Survey serves as the data source for trade flows on NUTS-2 level in the EU and will be described in more detail in Section 3.4.1. The correlation coefficient is equal to 0.92 for travel times and 0.91 for travel distances. See Table A3.12 in Appendix A3.2. Unfortunately, the traveled distance is not available for all observations in the Road Freight Transport Survey making the average traveled distance an imperfect proxy.

[19] For intra-regional routes a population weighted average of bilateral routes between the ten largest LAUs is used which does not allow a one-to-one map of road construction projects to NUTS-2 pairs.

Figure 3.2: Illustration of Routes Affected by Road Construction



(a) Route between Magdeburg and Gdansk — 2014, 2015

(b) Route between Rostock and Gdansk — 2014, 2015

Note: Figure 3.2 displays two examples of routes (blue) affected by a road segment which was newly constructed or upgraded (red). Panel (a) shows the route between Magdeburg, Germany and Gdansk, Poland and Panel (b) depicts the route between Rostock (Germany) and Gdansk (Poland). Own illustration for which the map is sourced from European Commission – Eurostat/GISCO (2016), the road segments from the Directorate-General Mobility and Transport of the European Commission.

Figure 3.2 shows that matching the GPX path of the optimal travel routes (in blue) with the location of the completed road segments (in red), allows to define a variable $ROAD_{dot}$ which assesses whether a NUTS-2 pair is affected by a completed road segment or not. The variable $ROAD_{dot}$ is defined for all inter-regional NUTS-2 pairs. For intra-regional NUTS-2 pairs this variable is not defined because there is no one-to-one match of a travel route to completed road segments. I define two versions of the main explanatory variable $ROAD_{dot}$: a binary, $ROAD_{dot}$ (0/1), and a continuous variable, $ROAD_{dot}$ (%).[20] The binary variable takes

[20] In order to prevent that routes only cross a completed road segment a minimum threshold of one kilometer or one percent of the total route is set. In a robustness check other thresholds as well as other definitions of the road treatment are tested.

the value one when a route uses at least one of the completed road segments after completion and stays one until the end of the observation period. The continuous variable is equal to the fraction of the road using a completed road segment and remains equal to that percentage until the optimal route's percentage on a completed road segment changes. Implicitly, road construction is assumed to be permanent.

The exemplary routes shown in Figure 3.2 are both affected by road construction. The route between Magdeburg and Gdansk (Panel a) is mainly affected by newly constructed road segments in 2012 such that the binary variable $ROAD_{dot}(0/1)$ for this NUTS-2 pair switches one in 2012 and stays one until 2019, the continuous variable $ROAD_{dot}(\%)$ is positive in this period respectively. The route between Rostock and Gdansk (Panel b) is only affected by one road upgrade completed in 2015. The dummy variable $ROAD_{dot}$ for this NUTS-2 pair therefore switches to one in 2015 and stays one until 2019. Moreover, both routes start in Germany and end in the same NUTS-2 region in Poland, visualizing that there is variation between NUTS-2 pairs of the same countries in the intensity and the timing of being affected.[21]

The difference in these two variables is the underlying assumption on the weighting of completed road segments. The binary $ROAD_{dot}$ (0/1) variable weighs all road segments used by a NUTS-2 pair specific route equally irrespective of the length. This uniform weighting comes with the advantage that the improvement in connectivity is not evaluated by the length of the road segment used. The length of a segment is probably not indicative of the relevance of the segment to the TEN-T. Additionally, road construction can affect accessibility by an improved connection but also by reducing congestion on a route through more alternatives. Moreover, the binary $ROAD_{dot}$ (0/1) variable ignores heterogeneity in the importance of a new road segment for a NUTS-2-pair-specific route, i.e. longer routes in terms of kilometers are less dependent on one specific link because of more potential alternatives. Considering the fraction of a route using a completed road segment hence better approximates the importance of a road segment for a NUTS-2 pair.[22] Furthermore, the continuous variable allows to track changes in the intensity over time, whereas the binary variable does not allow to examine the effect of a marginal road being built.

The EU's cohesion and structural policies target to promote NUTS-2 regions not NUTS-2 pairs. The bilateral definition of the $ROAD_{dot}$ variable hence enables to reduce the concern of the non-random location of completed road segments (Section 3.2). Following Coşar et al. (2021), I argue that because of the high number of NUTS-2 pairs ($45,369$) it is unlikely that policymakers target specific NUTS-2 pairs. To dispel the remaining concern that economic

[21] Figure A3.5 in Appendix A3.2 shows the number of completed road segments per year.

[22] A negative correlation of -0.3535 between the travel distance and the continuous $ROAD_{dot}$ (%) variable supports this statement.

centers, e.g. capitals, might be targeted by policymakers with a higher probability these pairs are excluded in a robustness check.[23]

The aim of improving road infrastructure is to improve the accessibility and connectivity of regions. The summary statistics of the relative change in travel times reveal that travel times decreased on average by 2.7% over the observation period for EU NUTS-2 pairs.[24] Related studies examining the trade effect of road construction use this change in bilateral travel times in order to examine the trade effect (cf. Donaubauer et al., 2018; Gibbons et al., 2019; Coşar et al., 2021). Focusing on the TEN-T and not observing the full universe of road segments in the EU requires to define the bilateral $ROAD_{dot}$ variable identifying whether a NUTS-2 pair's optimal route is affected by a completed road segment. Considering a naive regression explaining the relative change in travel times by the binary $ROAD_{dot}$ variable indicates that NUTS-2 pairs affected by a completed road segment experience a significantly larger decline in travel times than NUTS-2 regions not affected by a completed road segment.[25] This is first suggestive evidence of the constructed roads as part of the TEN-T having a road network improving effect.

3.4 Regional Trade Integration and Road Construction

3.4.1 Data

This paper is the first to combine three individual panel datasets to estimate the effect of newly and upgraded road segments on regional trade integration in the EU. The first dataset, described in Section 3.2, entails information on the location and timing of road construction as part of the TEN-T in the EU. The second set of data which is described in Section 3.3, is a customized dataset on year-specific optimal travel routes. The combination of the data on road construction and optimal travel routes allows to identify which NUTS-2 pairs are affected by completed road segments. Finally, the third dataset, the European Road Freight Transport Survey, records trade flows on a regional (here: NUTS-2) level.

[23]Performing an auxiliary regression examining NUTS-2 pair specific predictors helps to understanding where roads are built in order to account for potential endogeneity of location and timing. This auxiliary is presented in Table A3.15 and reveals that the distance between NUTS-2 regions, local highway density in the region of origin and destination, whether a road segment was completed in the region of origin or destination, and whether the region of origin or destination is eligible to cohesion funds of the EU, are significant predictors for the probability of being affected by a completed road segment. Thereby the local highway density, the indicator of whether in the region of origin or destination a road segment was completed and whether one of the NUTS-2 regions is eligible to the cohesion funds are suggestive evidence for the location of completed road segments to be prone to NUTS-2 regions which are lagging behind in terms of road infrastructure or regional development. Bilateral distance is a significant predictor, in more technical terms, because longer routes have more route kilometers, making it more likely that a closed road section will be used. Importantly, average trade growth in the years from 2000 to 2010 does not seem to be a significant determinant as the coefficient estimate is very small in magnitude and not distinguishable from zero. Hence, reverse causality does not seem to be a concern in the estimation.

[24]The summary statistics are presented in Table A3.14 of the Appendix A3.2.

[25]The results are summarized in Table A3.2.

The European Road Freight Transport Survey is a representative commodity flow survey resulting in an anonymized micro-dataset on freight transport in the EU. Each EU member state collects information on goods shipments from stratified samples of their national register of road freight vehicles. The survey is performed at the vehicle level. The operators of sampled vehicles are surveyed over a period of a few (generally seven) days and are asked to provide information on the vehicle, the journeys and the goods transported within this period (Eurostat, 2021). By covering all EU countries plus Norway and Switzerland, the European Road Freight Transport Survey is unique in the sense that it allows to look at regional trade in a multi-region, multiple-country setting in the period from 2011 to 2019.

In order to obtain sub-national trade flows from the shipment-level data the following steps were taken: First, in line with the literature using commodity flow surveys I exclude distribution journeys, goods types unrelated to goods trade, Islands and NUTS-2 regions which do not majorly trade by road due to geography (cf. Hillberry and Hummels, 2008; Bemrose et al., 2020; Santamaría et al., 2020). Excluding distribution journeys, i.e. journeys which mainly operate between producers and intermediaries and not producers and consumers reduces the bias of spatially clustered hub and spoke distribution networks (Hillberry and Hummels, 2008; Bemrose et al., 2020). Restricting the goods to those which are related to international trade guarantees that the obtained trade flows are comparable with trade flows of international trade databases. Excluding remote NUTS-2 regions and islands helps to depict a realistic picture of inter- and intra-regional road freight in the European Union. Second, the individual shipments are aggregated by the region of loading and unloading and thereby onto the smallest possible regional level, i.e. NUTS-2 pairs. Thereby, all goods were summed to an aggregate trade flow for each NUTS-2 pair. Aggregating the data reduces biases due to sample selection or non-response as well as minimizes the number of zero value trade flows but comes at the cost of losing level of detail.[26] The final dataset consists of 33,124 NUTS-2 pairs located in mainland EU for which I observe trade flows for the years 2011 to 2019.[27] Trade flows are given in 100 kilograms.[28] The studies by Santamaría et al. (2020, 2023) also use the European Road Freight Transport Survey demonstrate that trade

[26]See Table A3.13 in Appendix A3.2 for the selection of goods types. Sampling weights are applied to further minimize the bias of sample selection bias.

[27]The dataset is strongly balanced as I fill missing pair observations with zeroes and linearly interpolate the pair specific time series. Interpolating the data serves the goal of reducing the bias of sample selection in the Trans-European Transport Survey. The dataset covers 33.124 ($N^2 = 182^2$) NUTS-2 pair-year observations, excluding the United Kingdom, Ireland, Malta, Cyprus, Balearic Islands (ES), Canary Islands (ES), Ceuta (ES), Melilla (ES), French overseas Islands, Corse (FR), Sardinia (IT), Mardeira (PT), Acores (PT), Crete (EL), The Aegean (EL), Thrace (EL), Ionian Islands (EL), Åland Islands (FI). I further excluded all ex- and imports from non-EU countries. By using intra-mainland-EU trade data does not allow to examine trade effects beyond the EU borders.

[28]As shown by Duranton et al. (2014) using weights instead of values generates very similar results in gravity estimation.

flows from the European Road Freight Transport Survey are well suited data for analyzing regional trade flows in the EU.[29]

Data on control variables used in the estimation are based on the CEPII dataset on gravity variables and filled with further information on the NUTS-2 level or constructed manually using GIS software as well as the ESPON database.[30]

3.4.2 Gravity Estimation & Identification

The baseline estimation identifying the effect of completed road segments on regional trade flows builds on the gravity model of trade. I specify a structural gravity equation controlling for multilateral resistance terms and time invariant NUTS-2 pair specific factors (cf. Anderson and Van Wincoop, 2003)

$$X_{dot} = \exp\left[\eta_{dt} + \theta_{ot} + \gamma_{do} + \zeta_{DOt} + \beta_1 ROAD_{dot} + \beta_2 \ln(TIME_{dot})\right] \times \varepsilon_{dot}. \tag{3.1}$$

Thus, NUTS-2 level trade flows X_{dot} between origin region o and destination region d at time t are explained by the outward and inward multilateral resistance terms captured by origin-time and destination-time fixed effects, η_{dt} and θ_{ot}, respectively, pair fixed effects γ_{do}, country-pair-time fixed effects ζ_{DOt}, the main explanatory variable $ROAD_{dot}$, bilateral travel times $\ln(TIME_{dot})$ and an idiosyncratic error term ε_{dot}. The variable of interest $ROAD_{dot}$ captures the inter-regional trade effect of being affected by a completed road segment as well as the TEN-T-specific effect of improved road infrastructure. Depending on the specification the binary $ROAD_{dot}$ (0/1) or the continuous variable $ROAD_{dot}$ (%) enters the regression equation.

Moreover, year-specific travel times are included in the regression model to adequately control for any back-door paths and to get an unbiased estimates (Cinelli et al., 0). Controlling for bilateral travel time changes is in light of the descriptive statistics which show that NUTS-2 pairs using a completed road segment exhibit relatively larger reductions in travel times than those not using a complete road segment. Logarithmic year-specific travel times are captured by $\ln(TIME_{dot})$ in order to estimate the effect of changes in bilateral time as well as general improvements in the road network. This gravity equation intuitively answers the question of how much more or less a NUTS-2 pair trades after being affected by a road

[29]Figure A3.6 in Appendix A3.2 shows the correlations of the customized dataset aggregated onto country-pair level constructed from the micro-level data of the ERFT and (a) aggregate trade data from the International Trade and Production Database for Estimation (ITPD-E) as well as (b) with aggregate trade flows published by Eurostat. The correlation coefficients are 0.87 and 0.91, respectively. The Figure also indicates that the aggregate of the commodity flow survey can well capture aggregate trade flows of the EU countries. Using trade flows from road freight only hence seem to capture intra-EU trade well which might be due to the fact that road freight accounts for more then half of intra EU trade. In 2019 approximately 53% of total freight transport has been conducted via road (e.g. Eurostat, 2022).

[30]See Table A3.1 for the full list of data sources and a detailed description and Table A3.14 for summary statistics of all relevant variables.

segment, i.e. trucks being able to use a newly constructed road segment on the optimal route.

In terms of identification, the restrictive set of fixed effects, i.e. origin- and destination-time fixed effects, NUTS-2 pair fixed effects and country-pair-time fixed effects control for most observable and unobservable factors; origin- and destination-time fixed effects control for the multilateral resistance terms. The NUTS-2 pair-specific fixed effects account for time-invariant NUTS-2 pair-specific characteristics so that the coefficient of interest β_1 identifies infrastructure improvements only through time variation. Moreover, the NUTS-pair fixed effects account for time-invariant (cross-sectional) endogeneity, partialling out NUTS-2 pairs trading relatively more in levels (Baier and Bergstrand, 2007). Standard control variables, e.g. bilateral distance, common border, common language, contiguity or common colonial history, are absorbed by these fixed effects and hence do not enter the regression equation individually. Finally, the country-pair-time fixed effects control for any macro-trends on country level, i.e. country-pair specific time trends including the standard gravity control variable of common currency. In sum, the above empirical set-up encompassing NUTS-2 pair fixed effects together with country-pair-time fixed effects - albeit only to some extend - control for the selection into being affected by a completed road segment.

3.4.3 Results

The baseline estimation identifies the trade effects of infrastructure improvements in general and completed road segments of the Trans-European Transportation Network, in particular, for intra-mainland-EU NUTS-2 level trade flows in the years 2013-2019.

Table 3.1 presents the baseline results of Eq. 3.1 estimated by PPML including time-varying exporter and importer fixed effects, NUTS-2 pair fixed effects as well as country-pair-time fixed effects.[31] These time-varying fixed effects control for observable and unobserved time- and region-specific factors potentially correlated with a completed road segment's effect on regional trade flows. By controlling for these determinants I rule out that pre-road construction characteristics - such as the initial road endowment - are driving the results and I truly capture the impact of newly gained access to the EU-wide road network.

[31] PPML estimates are presented as baseline results to account for heteroskedasticity. OLS results as well as PPML results with the OLS sample are in line with the baseline result with respect to the sign. Results of this exercise are presented in Table A3.3. Table A3.16 shows PPML results with a reduced set of fixed effects, i.e. omitting the country-pair-time fixed effects. The results are consistent with the baseline results.

Table 3.1: The Trade-enhancing Effect of Completed Road Segments

Dependent Variable: Trade between origin o and destination d in year t					
Model:	PPML				
Specification:	(1)	(2)	(3)	(4)	(5)
$\ln(TIME_{dot})$	-0.2566^{***}	-0.2379^{***}	-0.2271^{***}	-0.1720^{**}	-0.1744^{**}
	(.0723)	(.0724)	(.0721)	(.0777)	(.0776)
Binary variable:					
$ROAD_{dot}$ (0/1)		0.0362^{**}	0.1831^{*}		
		(.0156)	(.1068)		
Continuous variable:					
$ROAD_{dot}$ (%)				0.2422^{***}	0.2213^{***}
				(.0801)	(.0855)
Control variables:					
$ROAD_{dot} \times \ln(TIME_{dot})$			-0.0269		0.0021
			(.0183)		(.0028)
Fixed Effects:					
Origin-time	✓	✓	✓	✓	✓
Destination-time	✓	✓	✓	✓	✓
NUTS-2-pair	✓	✓	✓	✓	✓
Country-pair-time	✓	✓	✓	✓	✓
Summary Statistics:					
Observations	234,564	234,564	234,564	234,564	234,564
(Pseudo-)R^2	0.9954	0.9954	0.9954	0.9954	0.9954

Note: Standard errors in parentheses and clustered at NUTS-2-pair-level. Significance: * $p < 0.10$, ** $p < .05$, *** $p < .01$.

Column (1) includes logarithmic time-varying travel times as the only explanatory variable revealing the general trade-enhancing effect of improved connectivity between NUTS-2 regions. Applying these time-varying destination- and origin fixed effects as well as NUTS-2 pair fixed effects the effect is exclusively identified through variation over time. With an observed average decline in travel times the statistically significant and negative coefficient estimate implies that NUTS-2 pairs with relatively higher reductions in travel times experience relatively higher increases in trade. Seeing that the average decline in travel time was 25 minutes - or 2.6 percentage - between NUTS-2 regions the respective trade effect is 0.27 percentage. That is, a 1 percentage decline in travel time (approx. 10 minutes) increases trade by 0.27 percentage.

In Columns (2) and (5) the binary or continuous version of the $ROAD_{dot}$ variable are added. These capture the trade effect of new and upgraded road segments as part of TEN-T. As described in 3.4.2 the variable $ROAD_{dot}$ isolates the effect of a completed road segment on inter-regional trade. The coefficient estimates for the binary $ROAD_{dot}$ (0/1) variable in Column (2) as well as the continuous $ROAD_{dot}$ (%) variable in Column (5) are positive and statistically significant. This finding implies that NUTS-2 pairs using a completed road segment trade significantly more than those not using a completed road segment. In terms of magnitude, Column (3) - including the binary $ROAD_{dot}$ variable and country-pair-time fixed effects - suggests that optimal routes using a road segment after completion increases trade for inter-regional pairs on average by approximately 20%.[32] By definition $ROAD_{dot}$ captures the total accumulated effect of a completed road segment from first switching on in the first period and remaining one until the end of the observation period. Column (5) including the continuous measure of the $ROAD_{dot}$ variable indicates that an increase of one percentage point in the fraction the total route uses a completed road segment increases trade by 0.22 percentage. The average NUTS-2 experiences an increase in the optimal route using a completed route segment by 5 percentage points (approximately 85km) which corresponds to an estimated trade effect of 1.1 percent. Adding the $ROAD_{dot}$ variables reduces the coefficient estimate of the year-specific travel time, indicating that part of the variation in the year-specific travel time indeed comes from completed road segments in the TEN-T.

In Columns (3) and (4) an interaction term of the $ROAD_{dot}$ variable and the time-varying travel time is introduced, $ROAD_{dot} \times \ln(TIME_{dot})$. This interaction term aims at capturing the dependency of changes in the optimal route's travel time and whether the optimal route is affected by a completed road segment. The coefficient estimate has the expected negative sign, i.e. NUTS-2 pair specific optimal routes using a road segment are associated with relatively lower travel times. However, the coefficient estimate is statistically insignificant in Column (5).

3.4.4 Robustness

A set of robustness checks ensures that the baseline results are not driven by (1) the location of completed road or rail segments of the TEN-T, (2) the level of spatial aggregation, (3) the definition of the $ROAD_{dot}$ variable, (4) unobserved heterogeneity varying at the NUTS-2-pair-time level and (5) sample selection.

First, in order to control for the location of the completed road segments and shocks to the EU-wide railway network binary control variables for the location of railway and road construction enter the regression equation. First, Table A3.4 summarizes the results. Columns (1) and (4) includes the additional variable for whether a completed road segment is located in the NUTS-2 region of origin or destination ($Location\,of\,ROAD_{dot}$). I find a small negative and statistically significant effect for routes where a completed road segment is located in the region of origin or destination. Columns (2) and (5) show the results when adding an indicator variable for whether a completed rail segment is located in a NUTS-2 region crossed by an optimal of a NUTS-2 pair. The coefficient estimate for NUTS-2 pairs whose route is crossing a NUTS-2 region affected by a completed railway section ($RAIL_{dot}$) indicates significantly

[32] The elasticity is calculated by $(exp(.1831) - 1) * 100 = 20.09$.

positive trade effects. This trade effect across different modes of transportation is suggestive evidence for a potential complementarity between railway and road infrastructure. Columns (3) and (6) include both control variables simultaneously finding similar results. Importantly, the coefficient estimate of the $ROAD_{dot}$ identifying the trade effect of improvements in bilateral road connectivity does not change significantly suggesting that the location of infrastructure construction does not bias the estimation of the bilateral trade effect.

Second, in order to rule out that the results are biased by the spatial aggregation to the NUTS-2 level, I repeat the baseline estimation on NUTS-1 level (Gallego and Llano, 2015); Table A3.5 presents the results of this exercise. While all coefficients retain their sign and significance level the estimates are slightly larger in magnitude compared to the baseline estimation. This slight increase in coefficients might be due to the calculation of the $ROAD_{dot}$ and $\ln(TIME_{dot})$ and thus indicative of the baseline underestimating the effect rather than overestimating it. Thus, the level of spatial aggregation does not seem to bias the results.

Third, to exclude that the definition of the $ROAD_{dot}$ variables drives the result I perform four exercises: (a) using different thresholds on $ROAD_{dot}$, (b) using an indirect definition similar to the $RAIL_{dot}$ variable, (c) relaxing the assumption that road construction is permanent and using the year-specific percentage of the route which lies on a completed road segment and (d) performing a placebo test. For exercise (a) looser and stricter definitions of the baseline $ROAD_{dot}$ variable are used. In the baseline a minimum of one kilometer or one percentage of the route on one of the completed road segments is required in order to be affected by a completed road segment. For robustness, alternative thresholds of 250, 1000[33], 2500 and 5000 meters are considered.

In exercise (b), a more indirect definition of being affected by a completed road segment is computed. Equivalent to the $RAIL_{dot}$ variable all NUTS-2 regions crossed by a route of a NUTS-2 pair are taken into account and a NUTS-2 pair is considered affected if within any of these NUTS-2 regions a road segments was completed. The results of (a), (b) and (c) are summarized in Table A3.6; they show that the coefficient estimates do not change significantly compared to the baseline results. Hence, the definition of $ROAD_{dot}$ does not seem to affect the coefficient estimates. Moreover, the placebo test (d) also validates the definition of $ROAD_{dot}$. Figure A3.2 shows the distribution of 500 placebo regressions assigning the variable $ROAD_{dot}$ randomly. As expected, the estimated coefficient estimates center around the null, indicating that the baseline $ROAD_{dot}$ variables indeed identify NUTS-2 pairs affected by road construction. However, this also suggests that it is not entirely random whether a NUTS-2 pair benefits from a completed road segment. I argue that my identification strategy of looking at NUTS-2 pairs instead of directly targeted NUTS-2 regions, and the application of a restrictive set of fixed effects, address this endogeneity well.

Fourth, controlling for potentially omitted variables with variation at NUTS-2 time level

[33]In the baseline additionally to a 1000m threshold a minimum of one percent of the optimal route is applied.

allows to rule out that omitted confounding factors bias the baseline results. All time-invariant and NUTS-pair specific factors are absorbed by NUTS-2 fixed effects as included in our baseline estimation. Further, all country-pair specific trends are captured by the country-pair-time fixed effects in the baseline estimation. Thus, the only source of unobserved heterogeneity and hence a potential endogeneity concern comes from NUTS-2 pair specific time trends, such as bilateral migration or FDI flows. In addition to the free movement of goods, the European Single Market also incorporates the free movement of people, capital and services. These four freedoms are likely to be interdependent. Including lagged migration when estimating the effect of road completion on regional trade hence allows to control for these dependencies. In addition, using lagged flows of migration also allows to account for potential reverse causality (cf. Aizenman and Noy, 2006; Felbermayr et al., 2015; Head and Ries, 1998) Table A3.7 presents the results of these regressions. The coefficient estimates of the variable of interest $ROAD_{dot}$ remain statistically significant and positive. Moreover, also in terms of magnitude the coefficient estimates do not change significantly implying that the results are not suffering from omitted variable bias.

Finally, in order to rule out results bring driven by potential sample selection, I perform two robustness checks: (a) excluding the NUTS-2 region in which the capital is located, (b) re-estimating the baseline estimation with different (random) samples. Excluding the capital's NUTS-2 region in (a) allows to eliminate concerns that road segments are more likely to be built to connect the EU's economic centers. The results are summarized in Table A3.8 and show that the coefficient estimate doubles when excluding economic centers. The increase in the coefficient estimate's magnitude indicates that the baseline estimation rather underestimates the effect of centers. Re-estimating the baseline model in exercise (b) with 500 random sub-samples corresponding to 50% of the full sample ensures that the result is not driven by potential sample selection. Figure A3.3 illustrates that the coefficient estimates are well centered around the estimated coefficient of the baseline regressions.

3.5 Effect Heterogeneity of the Trade-enhancing Effect

NUTS-2 pairs affected by completed road segments on average benefit from their bilateral trade increasing. In this section I exploit effect heterogeneity along an important political dimension: who exactly is benefiting and how? To this end, two sets of exercises are performed: (1) differentiating between NUTS-2 pairs directly and indirectly affected, (2) distinguishing between geographic and economic groups.

The first set of tests examines whether road construction primarily affects NUTS-2 regions locally, i.e. NUTS-2 regions directly affected by a new road segment within their region or those NUTS-2 regions which the route happens to cross and which therefore are indirectly affected.[34] In order to examine this, an interaction term for indirectly affected NUTS-2 pairs is added to the estimation equation. Table A3.9 presents the results. Statistically the effect for NUTS-2 pairs indirectly affected by road construction is no different from the effect of NUTS-2 pairs with direct road work; thus, both directly and indirectly affected NUTS-2 pairs benefit from improved accessibility.[35] That there is no differential effect for directly and indirectly affected NUS-2 pairs matches the above finding that there is both a local and global effect. Performing a sample split, i.e. only considering NUTS-2 pairs indirectly affected by a completed road segment - which is comparable to the inconsequential units approach (Redding and Turner, 2015; Chandra and Thompson, 2000; Michaels, 2008) - allows to clear concerns of endogeneity that some of the selection criteria of the policy leads to differential effects. Table A3.9 shows that the effect of a completed road segment on inter-regional trade remains statistically significant when using the binary $ROAD_{dot}$ variable. However, it becomes insignificant when using the continuous measure. Hence, the positive effect of completed road segments on inter-regional trade operates both locally and globally.

The second set of regressions exploiting heterogeneity investigates whether the construction of roads has differential effects on region groups or countries. TEN-T is, as described in Section 3.2, part of the EU cohesion policy. I hence first exploit whether NUTS-2 regions eligible for cohesion funds and targeted by the policy are affected differently than NUTS-2 regions which are not eligible. Columns (1) and (3) show the regression results when including an interaction term for eligible NUTS-2 regions.[36] The effect is negative and statistically significant when using the continuous $ROAD_{dot}$ variable and insignificantly negative when using the binary variable. If anything NUTS-2 pairs where at least one of the regions is eligible for cohesion funds in the observation period experience a smaller increase in trade compared to NUTS-2 pairs where neither region is eligible.

Similarly, I differentiate between NUTS-2 pairs where at least one region is located in an Eastern European country by introducing an interaction term to the regression equation. Columns (2) and (3) in Table A3.10 summarize the results and support the previous finding that economically weaker NUTS-2 regions experience a smaller increase in trade than economically stronger NUTS-2 regions. Both definitions of region groups are very hetero-

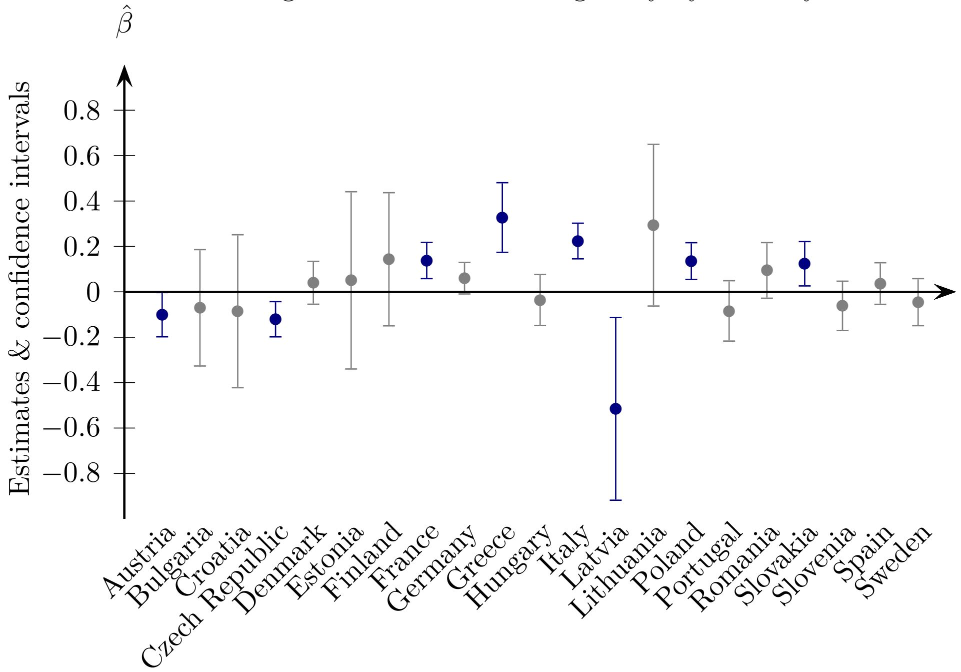
[34]Panel A in Table A3.17 in Appendix A3.2 shows the number of “affected” versus “non-affected” NUTS-2 pairs. Roughly 50% of the NUTS-2 region pairs are affected by a road segment in at least one year of the sample period. Differentiating between directly and indirectly affected NUTS-2 pairs, Table A3.17 shows that there is a large number of NUTS-2 pairs which are - according to the definition above - affected by a road segment which is not in the region of origin or destination. Panel B in Table A3.17 reveals that in the majority of NUTS-2 pairs one of the NUTS-2 regions is located in an Eastern European country.

[35]Estimating the differential effect of road completion by distance bins of the travel route provides similar results. Focusing on the results in Column (2) of Table A3.18 indicates weak suggestive evidence for the effect decreasing with distance but the differential effects are statistically zero. Considering the continuous $ROAD_{dot}$ variable when looking at distance bins allows to examine the differential effect of distance bins which is the opposite to the binary variable. As described in Section A3.2 the binary $ROAD_{dot}$ variable shuts down heterogeneity in the importance of a road segment for pair-specific routes.

[36]Each region being eligible for cohesion funds in the period 2013-2019 is considered.

geneous within groups. Hence, I consider country-specific effects in order to identify which NUTS-2 regions and countries gained most by improved accessibility in the EU. Therefore the $ROAD_{dot}$ variable is interacted with a country-specific border dummy.[37] The country-specific differential effects are displayed in Figure 3.3 with the Benelux countries serving as the baseline group.[38] For the majority of countries the differential effect is not statistically significant different from zero. For Austria, the Czech Republic and Latvia the differential effect is negative and significant at conventional levels of significance. The total effect remains negative for Austria and the Czech Republic while it becomes negative for Latvia. At the same time, France, Greece, Italy, Poland and Slovakia are associated with significantly positive differential effects indicating that these countries experience relatively higher increases in trade.

Figure 3.3: Effect Heterogeneity by Country



Note: Figure 3.3 displays the coefficient estimates of the country-specific interaction term of the $ROAD_{dot}$ variable. The estimates originate from Column (2)'s specification in Table A3.19. Belgium, Luxembourg and the Netherlands are omitted as these form the baseline group. Coefficients statistically different from zero are colored in blue, insignificant coefficient estimates are colored in gray.

[37] Two definitions are considered: (1) the exporting country determines to which country a border is assigned and (2) a border is assigned both to the exporting and importing country.

[38] The baseline effect remains positive and statistically significant. The regression results are presented in Table A3.19.

3.6 Conclusion

The EU allocates large fractions of its budget on economic, social and territorial cohesion. Investments into road infrastructure are a popular instrument to improve regions' accessibility and promoting economic integration. This paper aims to provide novel evidence of the effectiveness of road construction projects in the EU and its effects on intra-EU trade integration. In order to assess the question whether road construction and improved access to the EU-wide TEN-T enhances trade within the EU this study combines three novel datasets. First, data on road segments of TEN-T serving as the source of information on EU road construction. Second, a customized dataset on bilateral and year-specific travel times which allows to observe general trends in regions' connectivity and its link to road construction. Third, the European Road Freight Survey provides data on inter- and intra-regional trade flows between EU NUTS-2 regions.

The contribution of this paper in terms of data lies both in the novel data collected as well as in combining these data for a tailored identification strategy for the research question and the setting. The data contribution is thereby threefold: First, I use customized and manually collected data on the year of completion of road segments co-funded by the EU, building on the work by Goldmann and Wessel (2020). Second, I generate and use year-specific travel times between EU NUTS-2 regions providing a simple time-varying measure of bilateral transportation costs (e.g. Hinz, 2017); this approach helps to match road construction to connectivity on NUTS-2 level. Third, using the EU's commodity flow survey (European Road Freight Transport Survey) allows to examine trade flows between EU NUTS-2 regions and to examine trade integration in the EU Single Market on a regional level (e.g. Coughlin and Novy, 2021). In sum, this paper is the first to apply cross-country and regional level trade data to analyze infrastructure investments' trade effects. Taken together,this paper provides novel empirical evidence of a trade-enhancing effect across intra-national as well as international borders for mainland EU NUTS-2 regions and contributes to the scientific debate on the trade effects of infrastructure investments (e.g. Donaldson, 2018; Heiland et al., 2019; Coşar et al., 2021).

The empirical analysis builds on the workhorse model of international trade: the gravity equation. Using a theory-consistent gravity estimation on the effect of a completed road segment on trade integration reveals that NUTS-2 pairs affected by a completed road segment trade significantly more with other NUTS-2 regions than they trade intra-regionally. The baseline results are estimated with PPML and controlling for a restrictive set of fixed effects. These baseline results using the continuous $ROAD_{dot}$ suggest that an increase in the optimal route's path on completed road segments by one percent increases trade with other NUTS-2 regions by roughly 0.22% after completion of the road segment. This effect is in line with the literature on trade effects of road infrastructure investments (Coşar et al., 2021; Shevtsova et al., 2021). The effect of improved access to the EU-wide road network is robust to several re-specifications, namely, controlling for the location of rail and road contraction, the spatial level of aggregation, the definition of the $ROAD_{dot}$ variable, accounting for unobserved time-varying heterogeneity and sample selection. Interestingly, we find this positive average effect of completed road segments on inter-regional NUTS-2 trade in mainland EU for both directly and indirectly affected NUTS-2 regions as well as close and distant NUTS-2-pairs. Further, exploiting country-specific effects reveals that some countries benefit more than others in terms of trade with only Latvia losing in terms of trade by improved accessibility to the EU.

Location and timing of the construction of new road segments is unlikely to be random. Hence, I control for a restrictive set of fixed effect, particularly the country-pair-time fixed effects which absorb all macro trends; I argue that these are capable of controlling for possible selection effects to a large extend. This is in addition to defining the relevant variables at NUTS-2 pair level; evaluating whether the optimal route uses one of the new road segments should be less endogenous seeing that cohesion policy targets NUTS-2 regions and not NUTS-2 pairs. One might be concerned that NUTS-2 regions which are eligible for Cohesion Funds are affected differently by road completion. Examining any such differential effects for eligible NUTS-2 regions I differentiate between regions located in Eastern and Western European countries as well as between regions eligible and not eligible for cohesion funds. This exercise reveals that, if anything, there is evidence for these regions to be less affected by completed road segments. Moreover, building on the inconsequential units approach and differentiating by directly and indirectly affected NUTS-2 regions helps to clear concerns of endogeneity that some of the selection criteria of the policy region leads to differential effects.

Concluding, the results presented in this paper provide promising evidence of a trade-enhancing effect of improved access to the EU-wide road network for the EU. Thus, TEN-T construction of road segments has both local and global effects as well as benefits beyond the targeted NUTS-2 regions.

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Concluding Remarks

This thesis explores various dimensions of international trade within the EU and examines the influence of converging political preferences, environmental policies, and infrastructure investments on trade flows at both country and regional levels. By exploiting the unique setting of the EU Single Market, it deepens the understanding of factors determining and promoting trade integration in the EU and provides policy recommendations to enhance the EU's integration process.

The first chapter studies how changes in the similarity in political preferences with the EU mainstream impact intra-EU trade flows. A novel measure of similarity in political preferences is created based on European Parliament voting outcomes. This measure of the similarity in political preferences informs economic actors about a member state's likelihood to align with EU policies in the future, thus offering insights into its future relations with the EU. The study evaluates the effects of changes in the similarity of political preferences by utilizing a theory-consistent gravity estimation and finds that member states aligning more closely with the EU's political mainstream witness a reduction in home bias of trade, resulting in intensified trade with fellow EU member states. According to our preferred estimate a member states would experience a 14.87% increase in its bilateral trade with the rest of the EU, when moving from the 25^{th} to the 75^{th} percentile in the 2016 distribution of the similarity of political preferences across EU member states. When focusing on observed changes in the similarity of political preferences with the rest of the EU from 2007 to 2013, we find that the impact on member states' trade with the remainder of the EU from 2010 to 2016 ranges from a loss of 2.4% for Malta to a gain of 1.4% for Romania. The chapter concludes that a high voting similarity with the EU mainstream signals long-term alignment with the EU strengthening long-lasting trade partnerships by mitigating policy-related uncertainties.

The second chapter focuses on differences in EU member state environmental policy preferences and examines whether these create "pollution havens" within the EU. Utilizing European Parliament voting records on environmental policies allows to infer revealed environmental policy preferences of EU member states. To assess if these differences in revealed environmental policy preferences lead to intra-EU "pollution havens" a gravity model analyses carbon-related trade flows. Results indicate that binding multilateral environmental agreements successfully overrule national preferences and prevent benefits for emissions-intensive industries.

In the final chapter, the focus shifts to the impact of cohesion policy through infrastructure investment. It examines how investments in new and upgraded roads of the Trans-European Transport Network shape trade patterns within EU regions. Utilizing trade flows at the NUTS-2 regional level for mainland EU from 2011 to 2019, data on completed road segments and year-specific travel times, the chapter employs a theory-consistent gravity model of trade. The estimations reveal a significantly positive effect of improved connectivity on trade. NUTS-2 pairs benefiting from completed road segments see an average trade increase of 20 percent, demonstrating that enhanced infrastructure facilitates trade and strengthens economic ties between EU regions. Moreover, an one percent increase in the NUTS-2 pair's optimal route on a completed road segment is expected to increase bilateral trade by 0.22 percent.

Taken together, these chapters' findings have an overarching policy implication: The path to further deepening and improving trade integration within the EU requires a combination of policy efforts by the EU and its member states. The alignment of policy preferences not only promotes deepening of trade relations but also highlights the downside of disintegration. The divergence of individual member states or even the dissolution of the Union would endanger existing trade relations and diminish prosperity. Harmonizing environmental policies at EU level seems to be a successful strategy in implementing policies aiming at internalizing environmental external effects without creating comparative advantages in emission-intensive production. The imperative to address environmental concerns hence requires comprehensive multilateral agreements complemented by border adjustment mechanisms to resolve differences between countries within and outside an agreement. Finally, exploiting the full potential of European integration demands a complete Europe-wide infrastructure network. The Trans-European Transport Network provides the basis for this, as better connected regions are more intensively involved in inter-regional trade. Infrastructure investments are therefore regarded as a key element in expanding trade, improving the connectivity of regions and reducing regional disparities.

In sum, this thesis contributes to a broader understanding of how political, environmental, and infrastructural factors shape bilateral trade relations in the EU. As the EU continues to strive for deeper integration, these insights provide guidance for policymakers, enabling them to lead the EU towards sustained economic growth, seamless cross-border interactions, and higher welfare for its citizens.

List of Appendix Figures

List of Appendix Tables

CHAPTER A1

Appendix for Chapter 1

A1.1 Appendix

Table A1.1: Datasets, Variables & Sources

Name	Description	Variables	Years	Source
ITPD-E	International Trade and Production Database for Estimation	$X_{dos,t}$	2000-2016	USITC
EP RCVs	Roll Call Votes of the European Parliament are used to construct the political similarity of EU member states. Includes information on the Member State, National Party and European Group of each MEP.	$SPP_{do,t}$ MS NP EPG	1995-2016	Simon Hix & VoteWatch
CEPII	Gravity Variables	$DIST_{do}$ $CONTG_{do}$ $LANG_{do}$ $COLNY_{do}$ $CRRY_{do,t}$ $GDP_{d/o,t}$	2000-2016	CEPII
ESC	Bilateral Point Scores in the Eurovision Song Contest which serves as an index for cultural similarity.	$CULT\_SIM_{do,t}$	2000-2016	data.world
Migration	Bilateral migration flows between EU countries	$MIGR_{do,t}$	1995-2016	United Nations
Eurobarometer	The Eurobarometer is a survey by the EU conducted multiple times a year. The question of interest "Generally speaking, do you think that (OUR COUNTRY'S) membership of the European Union is ...?" is thereby included in one survey a year. We utilise the surveys 44.0, 46.0, 48.0, 50.0, 53.0, 54.1, 56.2, 58.1, 60.1, 62.0, 64.2, 66.1, 68.1, 70.1, 72.4, 73.4, 75.3, 77.4, 79.5, 82.4, 84.1, 86.1 to construct the share of respondents in favour of the EU varying between 0 and 1.	$EURO\_BAR_{o,t-3}$	1995-2016	GESIS
Uncertainty Index	Sourced from Ahir et al. (2022): "The World Uncertainty Index is a measure that tracks uncertainty across the globe by text mining the country reports of the Economist Intelligence Unit. The index is available for 143 countries."	$WUI_{d/o,t}$	2011-2019	World Uncertainty Index
ERFT	European Road Freight Transport (Commodity Flow Survey) is used to construct NUTS-2 level intra-EU trade flows.	$X_{dos,t}$	2011-2019	Eurostat
NUTS-2 geofigurey	Populated weighted distances and the contiguity variable were calculated with GIS software using NUTS-2 shapefiles and the location of the ten (population wise) largest cities.	$DIST_{do}$ $CONTG_{do}$	2011-2019	Eurostat GISCO
NUTS-2 language	Building on the CEPII variable of common language plus manually collecting official languages at the NUTS-2 level.	$LANG_{do}$	2011-2019	CEPII Wikipedia

Table A1.2: Inter- and Intra-national Trade between the NUTS-2 Regions of the EU

Dep. Var.: Exports from o to d at time t		
Data:	ERFT	
Unit:	Volumes	
Years:	2011-2019	
Model:	OLS	PPML
Specification:	(1)	(2)
Variable of interest:		
$BRD_{do} \times SPP_{o,t-3}$	6.4368***	0.7462***
	(.1202)	(.1186)
Control Variables:		
$\ln(DIST_{do})$	−1.2391***	−1.1784***
	(.0052)	(.0103)
BRD_{do}	−3.4642***	−4.9819***
	(.0799)	(.0820)
REG_BRD_{do}	−2.1915***	−2.1263***
	(.0266)	(.0228)
$CONTG_{do}$	1.1149***	0.9644***
	(.0133)	(.0136)
$LANG_{do}$	0.4350***	1.0404***
	(.0096)	(.0152)
$CRRY_{dot}$	0.3838***	0.8642***
	(.0122)	(.0224)
Fixed Effects:		
Origin-time	✓	✓
Destination-time	✓	✓
Summary Statistics:		
Observations	232,175	569.528
(Pseudo-)R^2	0.7237	0.9679

Note: Robust standard errors in parentheses; clustered at country-pair level. Significance: * $p < 0.10$, ** $p < .05$, *** $p < .01$.

Table A1.3: Balanced Panel Analysis

Dependent variable: Sectoral/aggregate exports from origin o to destination d at time t								
Sample Composition:	EU-15 only				EU-28 in 2010 to 2016			
Model:	OLS		PPML		OLS		PPML	
Data:	Sectoral	Aggregate	Sectoral	Aggregate	Sectoral	Aggregate	Sectoral	Aggregate
Specification:	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Variable of interest:								
$BRD_{do} \times SPP_{o,t-3}$	1.7415***	2.0789**	2.0785***	2.9793***	0.9813*	1.1899**	1.2427***	1.0811***
	(.4859)	(.9365)	(.2615)	(.4439)	(.5743)	(.4837)	(.1532)	(.1230)
Controls:								
$CRRY_{dot}$	0.1143	0.0904	0.0876	0.0561	0.1352***	0.0578	−0.0008	−0.0214
	(.0788)	(.1338)	(.0636)	(.0937)	(.0435)	(.0484)	(.0490)	(.0450)
Fixed effects:								
Origin-sector-time	✓		✓		✓		✓	
Destination-sector-time	✓		✓		✓		✓	
Origin-time		✓		✓		✓		✓
Destination-time		✓		✓		✓		✓
Country-pair	✓	✓	✓	✓	✓	✓	✓	✓
Summary statistics:								
Observations	421,955	3,790	438,123	3,790	539,691	5,263	595,756	5,265
(Pseudo-)R^2	0.8657	0.9931	0.9590	0.9971	0.8074	0.9901	0.9542	0.9989

Note: Robust standard errors in parentheses are clustered at the country-pair level. Significance: * $p < 0.10$, ** $p < .05$, *** $p < .01$.

Table A1.4: Controlling for Unobserved Time-variant Heterogeneity

Dependent variable: Sectoral exports from origin o to destination d at time t								
Model:	OLS	PPML	OLS	PPML	OLS	PPML	OLS	PPML
Specification:	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Variable of interest:								
$BRD_{do} \times SPP_{o,t-3}$	1.0995***	1.4887***	1.1299***	1.4607***	1.4298***	1.5522***	1.3485***	1.6330***
	(0.1215)	(0.2014)	(0.1050)	(0.1642)	(0.2863)	(0.1420)	(0.3828)	(0.2068)
Controls:								
$CRRY_{dot}$	0.1700***	−0.0217	0.1337***	0.0303	0.1251***	0.0157	0.2030***	−0.0103
	(0.0334)	(0.0552)	(0.0329)	(0.0297)	(0.0267)	(0.0280)	(0.0446)	(0.0690)
$CULT\_SIM_{do,t}$	−0.0102	0.0037					−0.0044	0.0027
	(0.0129)	(0.0126)					(0.0134)	(0.0126)
$BRD_{do} \times WUI_{o,t-3}$			−0.0435	0.1747***			0.0426	0.1668**
			(0.1471)	(0.0516)			(0.1807)	(0.0777)
$BRD_{do} \times EURO\_BAR_{o,t-3}$					−0.2881	−0.4226***	−0.2456	−0.2816**
					(0.2333)	(0.0916)	(0.3131)	(0.1192)
Fixed effects:								
Origin-sector-time	✓	✓	✓	✓	✓	✓	✓	✓
Destination-sector-time	✓	✓	✓	✓	✓	✓	✓	✓
Country-pair	✓	✓	✓	✓	✓	✓	✓	✓
Summary statistics:								
Observations	556,267	606,548	860,486	933,680	979,150	1,076,466	500,094	540,000
(Pseudo-)R^2	0.8357	0.9626	0.8241	0.9572	0.8210	0.9580	0.8374	0.9626

Notes: Robust standard errors in parentheses are clustered at the country-pair level. Significance: * $p < 0.10$, ** $p < .05$, *** $p < .01$.

A1.2 Supplementary Material

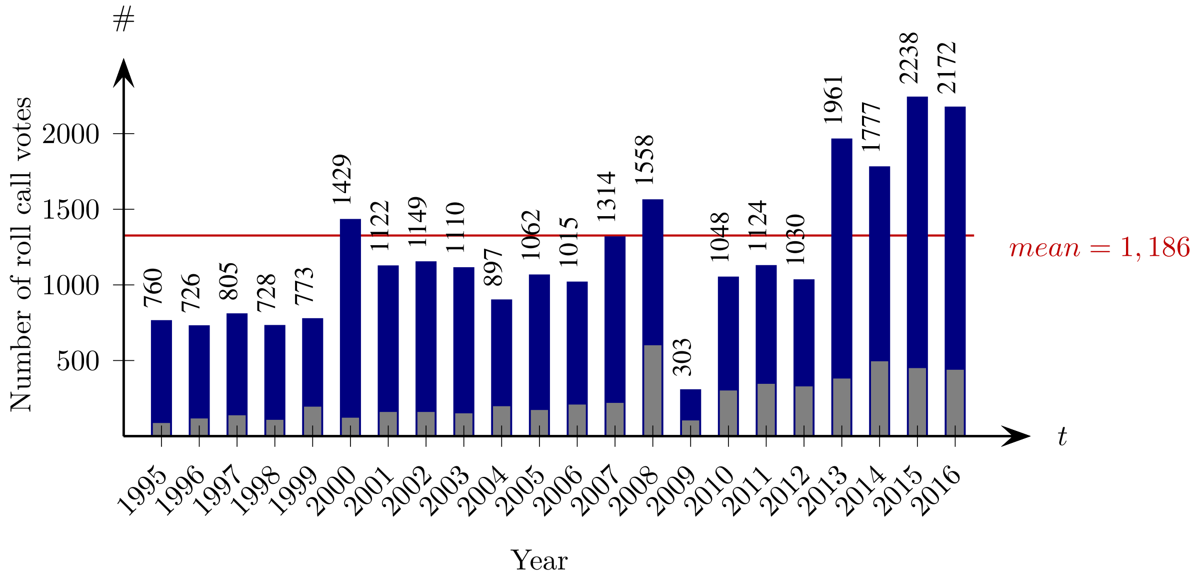
A1.2.1 Data

Table A1.5: Number of Member State Delegates in the European Parliament

	Entry	06/2004	07/2007	06/2009	12/2011	07/2013
Austria	01.01.1995	18	18	17	19	18
Belgium	01.01.1958	24	24	22	22	21
Bulgaria	01.01.2007		18	17	18	17
Croatia	01.07.2013					11
Cyprus	01.05.2004	6	6	6	6	6
Czech Republic	01.05.2004	24	24	22	22	21
Denmark	01.01.1973	14	14	13	13	13
Estonia	01.05.2004	6	6	6	6	6
Finland	01.01.1995	14	14	13	13	13
France	01.01.1958	78	78	72	74	74
Germany	01.01.1958	99	99	99	99	96
Greece	01.01.1981	24	24	22	22	21
Hungary	01.05.2004	24	24	22	22	21
Ireland	01.01.1973	13	13	12	12	11
Italy	01.01.1958	78	78	72	73	73
Latvia	01.05.2004	9	9	8	9	8
Lithuania	01.05.2004	13	13	12	12	11
Luxembourg	01.01.1958	6	6	6	6	6
Malta	01.05.2004	5	5	5	6	6
Netherlands	01.01.1958	27	27	25	26	26
Poland	01.05.2004	54	54	50	51	51
Portugal	01.01.1986	24	24	22	22	21
Romania	01.01.2007		35	33	33	32
Slovakia	01.05.2004	14	14	13	13	13
Slovenia	01.05.2004	7	7	7	8	8
Spain	01.01.1986	54	54	50	54	54
Sweden	01.01.1995	19	19	18	20	20
United Kingdom	01.01.1973	78	78	72	73	73

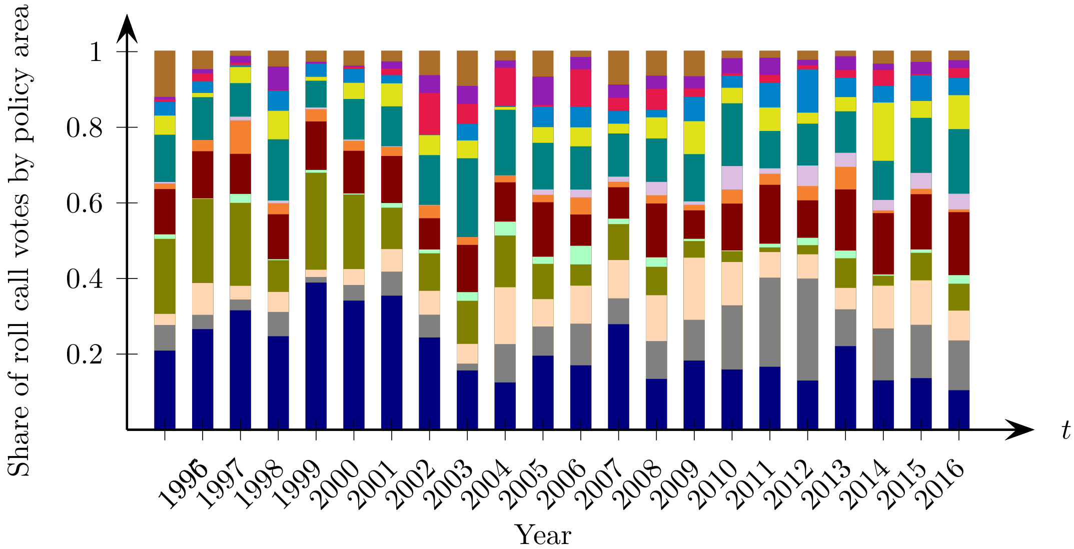
Note: Table A1.5 reports the number of member state delegates in the European Parliament from 1995 to 2016, which was adjusted in 2004, 2007, 2009, 2011, and 2013.

Figure A1.1: Number of Roll Call Votes in the European Parliament from 1995 to 2016



Note: Figure A1.1 reports the number of roll call votes per year from 1995 to 2016. The share of final votes is indicated through gray bars.

Figure A1.2: Share of Roll Call Votes by Policy Area from 1995 to 2016



Note: Figure A1.2 plots the share of roll call votes by policy area from 1995 to 2016. Policy areas from top to bottom: "Transport & Tourism", "Regional & International Development", "Internal Market & Consumer Protection", "Internal & External Trade", "Industry, Research & Energy", "Human Rights, Security Policy & Foreign Affairs", "Gender Equality", "Fisheries", "Economic & Social Affairs", "Culture & Education", "Constitutional and Inter-Institutional Affairs", "Civil Liberties, Justice & Home Affairs", "Budget", and "Agriculture, Environment & Public Health".

Table A1.6: National Parties in the European Parliament from 1995 to 2016

Austria	Die Grünen - Die Grüne Alternative, Die Liberalen (2004 - 2008), Die Reformkonservativen – REKOS (2011 - 2014), Freiheitliche Partei Österreichs, Liberales Forum (1995 - 1999), Liste 'Dr. Martin - für Demokratie, Kontrolle, Gerechtigkeit' (2009 - 2014), Liste Dr. Hans-Peter Martin - Für echte Kontrolle in Brüssel (2004 - 2008), NEOS – Das Neue Österreich (2014 - 2016), Sozialdemokratische Partei Österreichs, Österreichische Volkspartei, Österreichische Volkspartei - Liste Ursula Stenzel (2004 - 2008)
Belgium	Anders gaan arbeiden, leven en vrijen (1995 - 2004), Centre Démocrate Humaniste (2004 - 2016), Christelijke Volkspartij / Christen-Democratisch & Vlaams (1995 - 2004), Christen-Democratisch & Vlaams (2009 - 2016), Christen-Democratisch & Vlaams - Nieuw-Vlaamse Alliantie (2004 - 2008), Christlich Soziale Partei (2004 - 2016), Christlische Soziale Partei: Europäische Volkspartei (1995 - 2004), Ecolo, Front démocratique des francophones / Mouvement des Citoyens pour le Changement (1995 - 2004), Groen (2004 - 2016), Lijst Dedecker (2009 - 2014), Mouvement Réformateur (2004 - 2016), Nieuw-Vlaamse Alliantie (2009 - 2016), Onafhankelijk (2009 - 2014), Open VLD (2004 - 2008), Open Vlaamse Liberalen en Democraten (2009 - 2016), Parti Socialiste, Parti réformateur libéral (1995 - 2004), Parti social-chrétien (1995 - 2004), Parti socialiste, Socialistische Partij, Socialistische Partij.Anders (2004 - 2016), Vlaams Belang (2004 - 2016), Vlaams Blok (1995 - 2004), Vlaamse liberalen en democraten(1995 - 2008), Volskunie / België Spirit (1995 - 2004)
Bulgaria(2007-2016)	Attack (2007 - 2008), BANU-PU (2007 - 2008), Blue Coalition (2009 - 2014), Bulgarian People's Union (2007 - 2007), Bulgarian Socialist Party (2014 - 2016), Citizens for European Development of Bulgaria (2007 - 2016), Coalition for Bulgaria (2007 - 2014), Democrats for Strong Bulgaria (2007 - 2016), Movement for Rights and Freedoms (2007 - 2016), National Front for the Salvation of Bulgaria (2009 - 2014), National Movement Simeon II (2007 - 2008), National Movement for Stability and Progress (2009 - 2014), National-Democratic Party (2009 - 2014), Platform European Socialists (2007 - 2008), Reload Bulgaria Party (2014 - 2016), United Democratic Forces (2007 - 2007), VMRO (2014 - 2016)
Croatia(2013-2016)	Građansko-liberalni savez (2014 - 2016), Hrvatska demokratska zajednica (2013 - 2016), Hrvatska konzervativna stranka (2014 - 2016), Hrvatska stranka prava dr. Ante Starčević (2013 - 2014), Hrvatski laburisti - stranka rada (2013 - 2014), Istarski demokratski sabor - Dieta democratica istriana (2014 - 2016), Socijaldemokratska partija Hrvatske (2013 - 2016), Anorthotiko Komma Ergazomenou Laou - Aristera - Nees Dynameis (2004 - 2008), Democratic Party (2009 - 2016), Democratic Rally (2009 - 2016), Dimokratiko Komma (2004 - 2008), Dimokratikos Synagermos (2004 - 2008), Gia tin Evropi (2004 - 2008), Movement for Social Democracy EDEK (2009 - 2016), Progressive Party of Working People - Left - New Forces (2009 - 2016)

Table A1.6: National Parties in the European Parliament from 1995 to 2016 (continued)

Czech Republic(2004-2016)	Ano 2011 (2014 - 2016), Evropští demokraté (2004 - 2008), Komunistická strana Čech a Moravy (2004 - 2016), Křesťanská a demokratická unie - Československá strana lidová (2004 - 2016), NEZÁVISLÍ (2004 - 2008), NEZÁVISLÍ/DEMOKRATÉ (2004 - 2008), Občanská demokratická strana (2004 - 2016), SNK sdruženi nezávislých a Evropští demokraté (2004 - 2008), Starostové a nezávisli (2014 - 2016), Strana svobodných občanů (2014 - 2016), TOP 09 a Starostové (2014 - 2016), Česká strana sociálně demokratická (2004 - 2016)
Denmark(2004-2016)	Dansk Folkeparti (1999 - 2016), Det Konservative Folkeparti, Det Radikale Venstre, Folkebevægelsen mod EF - Unionen (1995 - 2004), Folkebevægelsen mod EU (2004 - 2016), JuniBevægelsen (1995 - 2004), JuniBevægelsen - Mod Unionen (2004 - 2008), Miljøpartiet Fokus (2009 - 2014), Ny Alliance (2004 - 2007), Socialdemokratiet, Socialistisk Folkeparti, Venstre
Estonia(2004-2016)	Eesti Keskerakond (2004 - 2016), Eesti Reformierakond (2004 - 2016), Erakond Isamaa ja Res Publica Liit (2009 - 2014), Isamaa (2014 - 2016), Isamaa ja Res Publica Liit (2004 - 2008), Sotsiaaldemokraatlik Erakond (2004 - 2016), Sõltumatu (2009 - 2016)
Finland	Kansallinen Kokoomus, Perussuomalaiset (2011 - 2016), Soumen Kristillinen Liitto (1999 - 2004), Suomen Keskusta, Suomen Sosialidemkraattinen Poulue, Suomen kristillisdemokraatit (2009 - 2014), Svenska folkpartiet, Vasemmistoliitto, Vihreät
France	Agir - La Droite constructive (2014 - 2016), Avenir Démocrate (2004 - 2008), Centre Démocrates Sociaux (1995 - 1999), Centre national des indépendants et paysans (1995 - 1999), Chasse, Pêche, Nature, Traditions (1999 - 2004), Citoyenneté Action Participation pour le 21ème siècle (2009 - 2014), Debout la France (2014 - 2016), Energie Radicale / Mouvement Radicaux de Gauche / Parti radical de gauche (1995 - 2004), Europe Écologie (2009 - 2016), Front de Gauche (2014 - 2016), Front de gauche pour changer d'Europe (2009 - 2014), Front national, Génération Citoyens (2014 - 2016), Génération.s, le mouvement (2014 - 2016), L'union pour les Outremer (2014 - 2016), La Maison de la Vie (2004 - 2008), Les Français Libres (2014 - 2016), Les Patriotes (2014 - 2016), Les Républicains (2014 - 2016), Les Verts (1999 - 2008), Les Verts-Europe-Ecologie (2004 - 2008), Les radicaux de Gauche (2014 - 2016), Liste 'Alliance des Outre-Mers' (2012 - 2014), Lutte ouvrière / Ligue Communiste Révolutionnaire (1999 - 2004), Mouvement Démocrate (2004 - 2016), Mouvement Radical Social-Libéral (2014 - 2016), Mouvement des citoyens (1999 - 2004), Mouvement pour l'Autre Europe / Rassemblement pour la France / Mouvement pour la France (1995 - 2004), Mouvement pour la France (2004 - 2014), Mouvement pour la France - Rassemblement pour l'Indépendance et la Souveraineté de la France (2004 - 2008), Nouveau Centre (2008 - 2014), Parti Radical (2009 - 2014), Parti Radical / Union des Démocrates et Indépendants (2009 - 2014), Parti Socialiste, Parti communiste français (2004 - 2008), Parti communiste française / Gauche unitaire / Parti communiste réunionnais (1995 - 2004)

Table A1.6: National Parties in the European Parliament from 1995 to 2016 (continued)

	Parti communiste réunionnais (2009 - 2011), Parti de la France (2004 - 2008), Parti radical (1995 - 2004), Parti radical socialiste (1995 - 1999), Parti républicain / Démocratie libérale (1995 - 2004), Parti socialiste, Partitu di a Nazione Corsa (2009 - 2014), Rassemblement Démocratique de la Martinique (2007 - 2008), Rassemblement bleu Marine (2014 - 2016), Rassemblement national (2014 - 2016), Rassemblement pour la République / Défence des intérêts de la France en Europe (1995 - 2004), Sans étiquette (2014 - 2016) Union des Démocrates et Indépendants (2009 - 2016), Union pour la Majorité Présidentielle / Union pour un Mouvement Populaire (2002 - 2004), Union pour la démocratie française (2004 - 2007), Union pour la démocratie française / Union pour la démocratie française - Force démocrate / Union pour la démocratie française - Parti populaire pour la démocratie française / Union pour la France en Europe (1995 - 2004), Union pour un Mouvement Populaire (2004 - 2014)
Germany	Alternative für Deutschland (2014 - 2016), Bündnis 90/Die Grünen, Christlich Demokratische Union, Christlich-Soziale Union, DIE LINKE. (2004 - 2016), Die PARTEI (2014 - 2016), Die blaue Partei (2014 - 2016), Freie Demokratische Partei (2004 - 2016), Freie Wähler (2014 - 2016), Liberal-Conservative Refomists (2014 - 2016), Nationaldemokratische Partei Deutschlands (2014 - 2016), Partei des Demokratischen Sozialismus (1999 - 2004), Piratenpartei Deutschland (2014 - 2016), Sozialdemokratische Partei Deutschlands, Ökologisch-Demokratische Partei (2014 - 2016)
Greece	Coalition of the Radical Left (2009 - 2016), Communist Party of Greece (2009 - 2016), Dimogratiki Anaeossi / Politiki Anixi (1995 - 1999), Dimokratiko Kinoniko Kinima (1999 - 2004), Drassi (2009 - 2014), Ecologist Greens (2009 - 2014), Greece-The Alternative Road (2014 - 2016), Kommounistiko Komma Elladas (1995 - 2008), Laikos Orthodoxos Synagermos - G. Karatzaferis (2004 - 2008), Nea Dimokratia, Panellinio Socialistiko Kinima (1995 - 2008), Panhellenic Socialist Movement (2009 - 2014), Panhellenic Socialist Movement - Olive Tree (2014 - 2016), Patriotic Radical Union (PAT.RI.E.) (2014 - 2016), Popular Association – Golden Dawn (2014 - 2016), Popular Orthodox Rally - G. Karatzaferis (2009 - 2014), Popular Unity (2015 - 2016), Synaspismos tis Aristeras kai tis Proodou / Neo Aristero Revma (1995 - 2004), Synaspismos tis Aristeras ton Kinimaton kai tis Oikologias (2004 - 2008), The River (2014 - 2016)
Hungary (2004-2016)	Demokratikus Koalíció (2014 - 2016), Együtt 2014 - Párbeszéd Magyarországért (2014 - 2016), Fidesz-Magyar Polgári Szövetség (2004 - 2008), Fidesz-Magyar Polgári Szövetség-Keresztény Demokrata Néppárt (2009 - 2016), Jobbik Magyarországért Mozgalom (2009 - 2016), Kereszténydemokrata Néppárt (2014 - 2016), Lehet Más A Politika (2014 - 2016), Magyar Demokrata Fórum (2004 - 2008), Magyar Szocialista Párt (2004 - 2016), Modern Magyarország Mozgalom (2009 - 2014), Szabad Demokraták Szövetsége (2004 - 2008)

Table A1.6: National Parties in the European Parliament from 1995 to 2016 (continued)

Ireland	Fianna Fáil, Fine Gael, Green Party, Labour Party, Sinn Féin (2004 - 2016), Socialist Party (2011 - 2014)
Italy	Alleanza Popolare - Unione Democratici per l'Europa (2004 - 2006), Alleanza nazionale (2004 - 2008), Alternativa Popolare (2014 - 2016), Alternativa sociale: Lista Mussolini (2004 - 2008), Articolo UNO – Movimento Democratico e Progressista (2014 - 2016), Centro cristiano democratico (1995 - 2004), Conservatori e Riformisti (2014 - 2016), Conservatori e Social Riformatori (2009 - 2014), Cristiani democratici uniti (1995 - 2004), Democratici di Sinistra (2004 - 2007), Democratico Cristiana / Partito populare italiano (1995 - 2004), Democrazia proletaria / Partito democratico di unità proletaria / Comunisti unitari (1995 - 1999), Federazione dei Verdi (2004 - 2008), Forza Italia, Forza Nuova (2008 - 2008), Fratelli d'Italia - Alleanza Nazionale (2009 - 2014), Futuro e Libertà per l'Italia (2009 - 2014), I Democratici (1995 - 2004), Il Popolo della Libertà (2009 - 2013), Indipendenti di sinistra (1995 - 1999), Io Cambio (2009 - 2014), Italia dei Valori (2004 - 2006), Italia dei Valori - Lista Di Pietro (2009 - 2014), La Destra - Alleanza Siciliana (2004 - 2008), La Margherita (2004 - 2006), La Rete movimento democratico (1995 - 1999), Lega Nord, Lista Emma Bonino (2004 - 2008), Lista Tsipras-L'Altra Europa (2014 - 2016), Movimento 5 Stelle (2014 - 2016), Movimento Repubblicani Europei (2004 - 2008), Movimento sociale fiamma tricolore (1999 - 2008), Movimento soziale italiano / Alleanza nazionale (1995 - 2004), Nuovo Centrodestra (2009 - 2014), Partito Communista Italiano / Partito Democratico della Sinistra / Democratici di Sinistra (1995 - 2004), Partito Democratico (2004 - 2016), Partito Pensionati (2004 - 2008), Partito Socialista (2004 - 2008), Partito dei Comunisti Italiani (2004 - 2008), Partito dei Comunisti Italiani / Rifondazione Communista / Partito della rifondazione comunista (1995 - 2004), Partito del Sud (2007 - 2008), Partito della Rifondazione Comunista - Sinistra Europea (2004 - 2008), Partito radicale / Pannella-Riformatori / Lista Bonino / Lega antiproibizionisti droga (1995 - 2004), Partito reppublicano italiano (1995 - 2004), Partito socialista italiano / Socialisti democratici italiani (1995 - 2004), Patto Segni (1995 - 2004), Pensionati (1999 - 2004), Popolari per l'Europa (2009 - 2014), Rinnovamento italiano - Dini (1999 - 2004), Sinistra Democratica (2004 - 2008), Sinistra Italiana (2014 - 2016), Socialisti democratici italiani (2004 - 2005), Südtiroler Volkspartei, Union Valdostana (2000 - 2004), Unione Democratici per l'Europa (1999 - 2014), Unione dei Democratici cristiani e dei Democratici di Centro (2004 - 2014), Unione di Centro (2014 - 2016), Uniti nell'Ulivo (2005 - 2008), Verdi Arcobaleno / Federazione dei Verdi / Verdi Europa (1995 - 2004)

Table A1.6: National Parties in the European Parliament from 1995 to 2016 (continued)

Latvia(2004 - 2016)	'Saskaņa' sociāldemokrātiskā partija (2014 - 2016), Jaunais laiks (2004 - 2008), Latvijas Krievu savienība (2014 - 2016), Latvijas Pirmā Partija/Latvijas Ceļš (2009 - 2014), Nacionālā apvienība 'Visu Latvijai!'-'Tēvzemei un Brīvībai/LNNK' (2014 - 2016), Par cilvēka tiesībām vienotā Latvijā (2009 - 2014), Partija 'VIENOTĪBA' (2009 - 2016), Pilsoniskā Savienība (2004 - 2008), Politisko organizāciju savienība "Par cilvēka tiesībām vienotā Latvijā" (2004 - 2008), Politisko partiju apvienība 'Saskaņas centrs' (2009 - 2014), Politiskā Partija 'Alternative' (2009 - 2014), Tautas partija (2004 - 2008), Tēvzemei un Brīvībai/LNNK (2004 - 2014), Zaļo un Zemnieku savienība (2014 - 2016)
Lithuania(2004 - 2016)	Darbo partija (2004 - 2016), Liberalų demokratų partija (2004 - 2008), Liberalų ir centro sąjunga (2004 - 2008), Lietuvos Respublikos liberalų sąjūdis (2004 - 2016), Lietuvos lenkų rinkimų akcija (2009 - 2014), Lietuvos lenkų rinkimų akcija – Krikščioniškų šeimų sąjunga (2014 - 2016), Lietuvos socialdemokratų partija (2004 - 2016), Lietuvos valstiečių ir žaliųjų sąjunga (2014 - 2016), Lietuvos valstiečių liaudininkų sąjunga (2004 - 2008), Partija Tvarka ir teisingumas (2009 - 2016), Tėvynės sąjunga (2004 - 2016)
Luxembourg	Déi Gréng (1995 - 2004), Déi Gréng - Les Verts (2009 - 2016), Les Verts (1999 - 2008), Parti chrétien social, Parti démcratique , Parti ouvrier socialiste luxembourgeois
Malta(2004 - 2016)	Partit Laburista (2004 - 2016), Partit Nazzjonalista (2004 - 2016)
Netherlands	Artikel 50 (2009 - 2014), Christen Democratisch Appèl, ChristenUnie (2009 - 2016), ChristenUnie - Staatkundig Gereformeerde Parti (2004 - 2008), Democraten 66, Europa Transparant (2004 - 2008), GroenLinks, Onafhankelijk lid (2009 - 2014), Partij van de Arbeid, Partij voor de Dieren (2014 - 2016), Partij voor de Vrijheid (2009 - 2016), Socialistische Partij, Staatkundig Gereformeerde Partij (2009 - 2016), Staatkundig Gereformeerde Partij-Gereformeerd Politiek Verbond-Reformatorisch Politieke Federatie (1995 - 2004), Volkspartij voor Vrijheid en Democratie
Poland(2004 - 2016)	Bezpartyjny (2014 - 2016), Kongres Nowej Prawicy (2014 - 2016), Liga Polskich Rodzin (2004 - 2008), Naprzód Polsko (2004 - 2008), Partia Demokratyczna (2008 - 2008), Platforma Obywatelska (2004 - 2016), Polska Razem Jarosława Gowina (2009 - 2014), Polskie Stronnictwo Ludowe (2004 - 2016), Polskie Stronnictwo Ludowe "PIAST" (2004 - 2008), Prawica Rzeczypospolitej (2014 - 2016), Prawo i Sprawiedliwość (2004 - 2016), Samoobrona RP (2004 - 2008), Socjaldemokracja Polska (2004 - 2008), Sojusz Lewicy Demokratycznej (2009 - 2016), Sojusz Lewicy Demokratycznej - Unia Pracy (2004 - 2016), Solidarna Polska (2009 - 2014), Srtonnictwo Demokratyczne (2004 - 2008), Stronnictwo Piast (2004 - 2008), Unia Pracy (2004 - 2016), Unia Wolnosci/Partia Demokratyczna - demokraci.pl (2004 - 2008), Wolność (2014 - 2016)

Table A1.6: National Parties in the European Parliament from 1995 to 2016 (continued)

Portugal	Bloco de Esquerda (2004 - 2016), Coligação Democrática Unitária (PCP-PEV) (1995 - 2011), Partido Comunista Português (2005 - 2016), Partido Democrático Republicano (2014 - 2016), Partido Social Democrata, Partido Socialista, Partido da Terra (2014 - 2016), Partido do Centro Democrático e Social / Partido do Centro Democrático e Social-Partido Popular (1995 - 2004)
Romania(2007 - 2016)	ALDE Romania (2014 - 2016), Forumul Democrat al Germanitor din România (2007 - 2007), Partidul Conservator (2007 - 2014), Partidul Democrat (2007 - 2007), Partidul Democrat-Liberal (2007 - 2014), Partidul Mișcarea Populară (2009 - 2014), Partidul Naţional Liberal (2007 - 2016), Partidul Național Țărănesc Creștin Democrat (2009 - 2014), Partidul Puterii Umaniste (2014 - 2016), Partidul România Mare (2007 - 2014), Partidul Social Democrat (2007 - 2016), Romániai Magyar Demokrata Szövetség (2007 - 2008), Uniunea Democrată Maghiară din România (2007 - 2016)
Slovakia(2004 - 2016)	Hnutie za demokratické Slovensko (2004 - 2008), Kresťanskodemokratické hnutie (2004 - 2016), MOST - HÍD (2014 - 2016), NOVA (2014 - 2016), OBYČAJNÍ ĽUDIA (2014 - 2016), SMER-Sociálna demokracia (2004 - 2016), Sloboda a Solidarita (2014 - 2016), Slovenská demokratická a kresťanská únia (2004 - 2014), Slovenská národná strana (2009 - 2014), Smer (2004 - 2008), Strana Demokratického Slovenska (2009 - 2014), Strana mad'arskej koalície - Magyar Koalíció Pártja (2004 - 2008), Strana mad'arskej komunity- Magyar Közösség Pártja (2009 - 2016)
Slovenia(2004 - 2016)	DeSUS - Demokratična Stranka Upokojencev Slovenije (2014 - 2016), Liberalna Demokracija Slovenije (2004 - 2014), Lista dr. Igorja Šoltesa (2014 - 2016), Nova Slovenija (2004 - 2016), Slovenska demokratska stranka (2004 - 2016), Slovenska ljudska stranka (2014 - 2016), Socialni demokrati (2004 - 2016), ZARES-Nova Politika (2009 - 2014)
Spain	Alternativa galega de esquerda en Europa (2014 - 2016), Aralar (2013 - 2014), Bloque Nacionalista Gallego (1999 - 2013), COMPROMIS (2014 - 2016), Ciudadanos – Partido de la Ciudadanía (2014 - 2016), Coalición Canaria (1995 - 2004), Coalición por la Europa de los Pueblos: Esquerra Republicana de Catalunya (2001 - 2004), Convergència Democràtica Catalunya (1995 - 2014), Delegación Ciudadanos Europeos (2014 - 2015), EH BILDU (2014 - 2016), EQUO (2016 - 2016), Esquerra Republicana de Catalunya (2009 - 2016), Europa de los Pueblos (2004 - 2007), Eusko Alkartasuna (1999 - 2008), Herri Battasuna / Euskal Herritarrok (1999 - 2004), Iniciativa Per Catalunya Verds - Esquerra Unida í Alternativa (2004 - 2008), Iniciativa per Catalunya Verds (2009 - 2016), Izquierda Unida (2004 - 2016), Izquierda Unida / Izquierda Unida-Iniciativa per Catalunya (1995 - 2004), Izquierda Xunida (2014 - 2016), Los Verdes (2004 - 2008), Nova Esquerra Catalana (2014 - 2016), PODEMOS (2014 - 2016), Partido Andalucista (1999 - 2004),

Table A1.6: National Parties in the European Parliament from 1995 to 2016 (continued)

	Partido Nacionalista Vasco, Partido Popular , Partido Socialista Obrero Español, Partit Demòcrata Europeu i Català (2014 - 2016), Partit dels Socialistes de Catalunya (1999 - 2016), Unió Democràtica de Catalunya (1995 - 2014), Unió Valenciana (2003 - 2004), Unión, Progreso y Democracia (2009 - 2016), Vox (2009 - 2014)
Sweden	Arbetarepartiet- Socialdemokraterna (2004 - 2016), Centerpartiet, Feministiskt initiativ (2004 - 2016), Folkpartiet liberalerna (1995 - 2015), Junilistan (2004 - 2008), Kristdemokraterna, Liberalerna (2014 - 2016), Miljöpartiet, Moderata Samlingspartiet (1995 - 2014), Moderaterna (2014 - 2016), Piratpartiet (2009 - 2014), Socialdemokratiska arbetarepartiet (1995 - 2004), Sverigedemokraterna (2014 - 2016), Vänsterpartiet
United Kingdom	AN INDEPENDENCE FROM EUROPE (2009 - 2014), British Democratic Party (2009 - 2014), British National Party (2009 - 2014), Conservative Party (2009 - 2016), Conservative and Unionist Party (1995 - 2008), Democratic Unionist Party, Democratic Unionist Party (Northern Ireland) (2009 - 2014), Green Party, Labour Party, Labour and the Gibraltar Socialist Labour Party (2004 - 2008), Liberal Democrat Party, Official Unionist Party / Ulster Unionist Party (1995 - 2004), Plaid Cymru - Party of Wales (1999 - 2016), Scottish Conservative and Unionist Party (2004 - 2008), Scottish Liberal Democrats (2004 - 2008), Scottish National Party, Sinn Féin (2004 - 2016), Social Democratic and Labour Party (1995 - 2004), Traditional Unionist (2004 - 2008), UK Independence Party (2004 - 2008), Ulster Conservatives and Unionists-New Force (2009 - 2014), Ulster Unionist Party (2004 - 2016), United Kingdom Independence Party (1999 - 2016), We Demand a Referendum (2009 - 2014)

Table A1.7: European party groups in the European Parliament from 1995 to 2016

Alliance of Liberals and Democrats for Europe (2004 - 2016),
Confederation of Socialist Parties,
Europe of Democracies and Diversities (1995 - 2004),
Europe of Freedom and Democracies (2009 - 2016),
Europe of Nations and Freedom (2014 - 2016),
European Conservatives and Reformists (2004 - 2016),
European Democratic Alliance (1995 - 1999),
European Liberal Democrat and Reform Party (1995 - 2004),
European People's Party (2009 - 2016),
European People's Party - European Democrats,
European Radical Alliance (1995 - 1999),
European United Left - Nordic Green Left,
Green Group (1995 - 1999),
Greens - European Free Alliance (1999 - 2016),
Independence and Democracy (2004 - 2008),
Non-Inscrits,
Progressive Alliance of Socialists and Democrats (2009 - 2016),
Regionalist Group (2014 - 2015),
Union for Europe of the Nations (1999 - 2008)

A1.2.2 Results

Table A1.8: Changes in Member States' Trade with the EU Predicted by Changes in $SPP_{o,t-3}$

Country	$(SPP_{o,2013} - SPP_{o,2007})/SPP_{o,2007}$	$(\sum_{d\neq o} X_{do,2016} - \sum_{d\neq o} X_{do,2010})/\sum_{d\neq o} X_{do,2010}$
Malta	−0.0670	−2.4239
United Kingdom	−0.0424	−0.6383
Netherlands	−0.0363	−0.5293
Austria	−0.0326	−0.5367
Lithuania	−0.0280	−0.6434
Cyprus	−0.0092	−0.3244
Estonia	−0.0029	−0.0795
Denmark	0.0012	0.0225
Portugal	0.0068	0.1413
Czech Republic	0.0083	0.1401
Greece	0.0114	0.2571
Hungary	0.0136	0.2368
Germany	0.0168	0.2115
Luxembourg	0.0195	0.4702
Belgium	0.0201	0.3072
Finland	0.0217	0.4136
Latvia	0.0218	0.5978
Spain	0.0255	0.4081
Bulgaria	0.0297	0.6902
Slovenia	0.0330	0.7122
Sweden	0.0349	0.5884
France	0.0360	0.5208
Poland	0.0399	0.6240
Italy	0.0433	0.6175
Ireland	0.0467	0.8736
Slovakia	0.0683	1.2586
Romania	0.0706	1.3755

Note: Table A1.8 plots the observed changes in the lagged similarity of political preferences from 2007 to 2013 together with the predicted changes in the bilateral trade with the rest of the EU for 27 member states between 2010 and 2016 (excluding Croatia, which did not join before 2013).

Table A1.9: Timing of the Trade-Creating Effect of Converging to the EU's Political Mainstream

Dependent variable: Aggregate exports from origin o to destination d at time t						
Timing:	$k=0$	$k=1$	$k=2$	$k=3$	$k=4$	$k=5$
Model:			OLS			
$BRD_{do} \times SPP_{do,t-k}$	-2.6413	1.5692	2.2645***	2.5290***	2.5023***	2.1300***
	(2.7754)	(1.2073)	(0.7370)	(0.5805)	(0.5904)	(0.4846)
Model:			PPML			
$BRD_{do} \times SPP_{do,t-k}$	-0.7500	0.6874	1.5436***	1.9996***	1.9424***	1.6790***
	(0.9113)	(0.6425)	(0.4525)	(0.3807)	(0.3751)	(0.3664)
Fixed Effects:						
Origin-time	✓	✓	✓	✓	✓	✓
Destination-time	✓	✓	✓	✓	✓	✓
Model:			OLS			
$BRD_{do} \times SPP_{do,t-k}$	0.9137	1.0313***	1.1641***	1.1705***	0.9728***	0.6234***
	(0.9402)	(0.2353)	(0.2296)	(0.2058)	(0.1967)	(0.1654)
Model:			PPML			
$BRD_{do} \times SPP_{do,t-k}$	1.5614***	1.9286***	1.9550***	1.8832***	1.4056***	0.7144***
	(.4998)	(.3119)	(.2700)	(.2560)	(.2185)	(.2040)
Fixed Effects:						
Origin-time	✓	✓	✓	✓	✓	✓
Destination-time	✓	✓	✓	✓	✓	✓
Country-pair	✓	✓	✓	✓	✓	✓

Note: Robust standard errors in parentheses; clustered at country-pair level. Significance: * $p < 0.10$, ** $p < .05$, *** $p < .01$.

Table A1.10: Alternative Computation Methods for the Similarity of Political Preferences

Dependent variable: Sectoral/aggregate exports from origin o to destination d at time t								
Model:	OLS				PPML			
Data:	Sectoral		Aggregate		Sectoral		Aggregate	
Specification:	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Final votes only								
BRD_{do}	−2.4511***		−2.1258***		−2.5545***		−2.4379***	
	(0.4680)		(0.4145)		(0.1699)		(0.1959)	
$BRD_{do} \times SPP_{o,t-3}$	1.4065**	0.9691***	1.6993***	1.0698***	1.2724***	0.9316***	1.2709***	1.4606***
	(0.6225)	(0.0896)	(0.5406)	(0.2045)	(0.1985)	(0.0932)	(0.2078)	(0.1741)
Votes on economic matters only								
BRD_{do}	−2.9670***		−2.5282***		−3.1674***		−2.7122***	
	(0.3729)		(0.3902)		(0.2272)		(0.2692)	
$BRD_{do} \times SPP_{o,t-3}$	2.3820***	1.0661***	2.5320***	1.0822***	2.3791***	1.1599***	1.8407***	1.5585***
	(0.5594)	(0.0908)	(0.5739)	(0.1605)	(0.3303)	(0.1385)	(0.3472)	(0.1988)
Excluding votes in the field: "Agriculture, Environment & Public Health"								
BRD_{do}	−2.9995***		−2.5394***		−3.3606***		−2.7592***	
	(0.3714)		(0.3820)		(0.2633)		(0.2936)	
$BRD_{do} \times SPP_{o,t-3}$	2.3971***	1.1008***	2.5126***	1.1577***	2.6255***	1.3052***	1.8712***	1.6905***
	(0.5470)	(0.0992)	(0.5692)	(0.2092)	(0.3837)	(0.1493)	(0.3802)	(0.2388)
Excluding votes in the field: "Budget"								
BRD_{do}	−3.0946***		−2.6172***		−3.5319***		−2.9320***	
	(0.3472)		(0.3693)		(0.2780)		(0.3003)	
$BRD_{do} \times SPP_{o,t-3}$	2.5823***	1.1219***	2.6717***	1.1860***	2.9254***	1.4060***	2.1628***	1.8452***
	(0.5268)	(0.0998)	(0.5741)	(0.2141)	(0.4151)	(0.1670)	(0.3998)	(0.2630)
Excluding votes in the field: "Civil Liberties, Justice & Home Affairs"								
BRD_{do}	−3.0010***		−2.5463***		−3.3854***		−2.8065***	
	(0.3714)		(0.3850)		(0.2646)		(0.2954)	
$BRD_{do} \times SPP_{o,t-3}$	2.4253***	1.1141***	2.5502***	1.1421***	2.6961***	1.4010***	1.9686***	1.8138***
	(0.5563)	(0.0991)	(0.5785)	(0.1928)	(0.3914)	(0.1621)	(0.3876)	(0.2537)
Excluding votes in the field: "Constitutional & Inter-Institutional Affairs"								
BRD_{do}	−3.0054***		−2.5373***		−3.3393***		−2.7827***	
	(0.3681)		(0.3813)		(0.2563)		(0.2889)	
$BRD_{do} \times SPP_{o,t-3}$	2.4230***	1.1123***	2.5259***	1.1598***	2.6126***	1.3749***	1.9232***	1.8030***
	(0.5488)	(0.0991)	(0.5704)	(0.2003)	(0.3750)	(0.1542)	(0.3759)	(0.2453)
Excluding votes in the field: "Culture & Education"								
BRD_{do}	−2.9978***		−2.5489***		−3.3875***		−2.8321***	
	(0.3714)		(0.3841)		(0.2649)		(0.2950)	
$BRD_{do} \times SPP_{o,t-3}$	2.4147***	1.1170***	2.5482***	1.1623***	2.6925***	1.4090***	2.0030***	1.8517***
	(0.5558)	(0.1005)	(0.5785)	(0.2029)	(0.3914)	(0.1606)	(0.3884)	(0.2580)
Excluding votes in the field: "Economic & Social Affairs"								
BRD_{do}	−2.9727***		−2.5208***		−3.3605***		−2.8484***	
	(0.3745)		(0.3855)		(0.2563)		(0.2883)	
$BRD_{do} \times SPP_{o,t-3}$	2.3624***	1.1206***	2.4896***	1.1579***	2.6356***	1.4590***	2.0175***	1.9283***
	(0.5590)	(0.1035)	(0.5743)	(0.1998)	(0.3757)	(0.1574)	(0.3771)	(0.2571)
Excluding votes in the field: "Fisheries"								
BRD_{do}	−3.0000***		−2.5574***		−3.4110***		−2.8594***	
	(0.3712)		(0.3832)		(0.2675)		(0.2960)	
$BRD_{do} \times SPP_{o,t-3}$	2.4188***	1.1221***	2.5621***	1.1700***	2.7291***	1.4529***	2.0455***	1.8922***
	(0.5568)	(0.1022)	(0.5803)	(0.2061)	(0.3963)	(0.1643)	(0.3912)	(0.2638)

Table A1.10: Alternative Computation Methods for the Similarity of Political Preferences (continued)

Dependent variable: Sectoral/aggregate exports from origin o to destination d at time t								
Model:	OLS				PPML			
Data:	Sectoral		Aggregate		Sectoral		Aggregate	
Specification:	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Excluding votes in the field: "Gender Equality"								
BRD_{do}	−2.9891***		−2.5479***		−3.3790***		−2.8282***	
	(0.3731)		(0.3862)		(0.2633)		(0.2937)	
$BRD_{do} \times SPP_{o,t-3}$	2.3963***	1.1156***	2.5418***	1.1671***	2.6737***	1.4158***	1.9929***	1.8550***
	(0.5570)	(0.1009)	(0.5799)	(0.2062)	(0.3878)	(0.1596)	(0.3854)	(0.2560)
Excluding votes in the field: "Human Rights, Security Policy & Foreign Affairs"								
BRD_{do}	−2.9041***		−2.4961***		−3.2560***		−2.7451***	
	(0.3979)		(0.4076)		(0.2536)		(0.2911)	
$BRD_{do} \times SPP_{o,t-3}$	2.2515***	1.0859***	2.4480***	1.1018***	2.4842***	1.3377***	1.8668***	1.7569***
	(0.5902)	(0.0949)	(0.5947)	(0.1754)	(0.3724)	(0.1516)	(0.3808)	(0.2445)
Excluding votes in the field: "Industry, Research & Energy"								
BRD_{do}	−2.9879***		−2.5425***		−3.4077***		−2.8479***	
	(0.3752)		(0.3848)		(0.2695)		(0.2978)	
$BRD_{do} \times SPP_{o,t-3}$	2.3965***	1.1230***	2.5355***	1.1683***	2.7203***	1.4591***	2.0250***	1.9101***
	(0.5607)	(0.1026)	(0.5801)	(0.2049)	(0.3991)	(0.1646)	(0.3934)	(0.2679)
Excluding votes in the field: "Internal & External Trade"								
BRD_{do}	−3.0061***		−2.5493***		−3.4149***		−2.8265***	
	(0.3716)		(0.3829)		(0.2717)		(0.3000)	
$BRD_{do} \times SPP_{o,t-3}$	2.4266***	1.1156***	2.5478***	1.1494***	2.7322***	1.4247***	1.9924***	1.8488***
	(0.5560)	(0.0999)	(0.5776)	(0.1969)	(0.4019)	(0.1643)	(0.3953)	(0.2640)
Excluding votes in the field: "Internal Market & Consumer Protection"								
BRD_{do}	−3.0052***		−2.5412***		−3.4103***		−2.7955***	
	(0.3726)		(0.3846)		(0.2725)		(0.3015)	
$BRD_{do} \times SPP_{o,t-3}$	2.4203***	1.1107***	2.5300***	1.1362***	2.7186***	1.3996***	1.9396***	1.8007***
	(0.5556)	(0.0986)	(0.5786)	(0.1924)	(0.4025)	(0.1610)	(0.3961)	(0.2593)
Excluding votes in the field: "Regional & International Development"								
BRD_{do}	−2.9933***		−2.5471***		−3.3624***		−2.8087***	
	(0.3728)		(0.3870)		(0.2622)		(0.2939)	
$BRD_{do} \times SPP_{o,t-3}$	2.4083***	1.1082***	2.5464***	1.1528***	2.6546***	1.3722***	1.9675***	1.8155***
	(0.5572)	(0.0984)	(0.5823)	(0.1998)	(0.3864)	(0.1573)	(0.3858)	(0.2529)
Excluding votes in the field: "Transport & Tourism"								
BRD_{do}	−2.9922***		−2.5515***		−3.3901***		−2.8309***	
	(0.3733)		(0.3874)		(0.2660)		(0.2966)	
$BRD_{do} \times SPP_{o,t-3}$	2.4068***	1.1202***	2.5536***	1.1611***	2.6971***	1.4269***	2.0020***	1.8655***
	(0.5594)	(0.1016)	(0.5842)	(0.2030)	(0.3930)	(0.1631)	(0.3908)	(0.2631)
Re-weighted by voting turn								
BRD_{do}	−2.9269***		−2.5611***		−3.2425***		−2.8124***	
	(0.3872)		(0.4035)		(0.2449)		(0.2797)	
$BRD_{do} \times SPP_{o,t-3}$	2.3108***	1.1358***	2.5750***	1.2162***	2.4876***	1.4255***	1.9909***	1.9211***
	(0.5793)	(0.1095)	(0.6024)	(0.2258)	(0.3611)	(0.1555)	(0.3697)	(0.2520)
Fixed effects:								
Origin-sector-time	✓	✓			✓	✓		
Destination-sector-time	✓	✓			✓	✓		
Origin-time			✓	✓			✓	✓
Destination-time			✓	✓			✓	✓
Country-pair		✓		✓		✓		✓

Note: Standard errors in parentheses and clustered at country-pair level. Significance: * $p < 0.10$, ** $p < .05$, *** $p < .01$. Policy areas that relate to economic matters are: "Agriculture, Environment & Public Health"; "Economic & Social Affairs"; "Fisheries"; "Industry, Research & Energy"; "Internal & External Trade"; "Internal Market & Consumer Protection"; "Regional & International Development"; "Transport & Tourism".

Table A1.11: Controlling for Potential Outliers

Dependent variable: Sectoral/aggregate exports from origin o to destination d at time t								
Sample Composition:	Excluding Netherlands and UK				Excluding Greece			
Model:	OLS		PPML		OLS		PPML	
Data:	Sectoral	Aggregate	Sectoral	Aggregate	Sectoral	Aggregate	Sectoral	Aggregate
Specification:	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Variable of interest:								
$BRD_{do} \times SPP_{o,t-3}$	1.1256***	1.1912***	1.3375***	1.9266***	1.1242***	1.1905***	1.4252***	1.8986***
	(0.1056)	(0.2190)	(0.1543)	(0.2481)	(0.1076)	(0.2074)	(0.1599)	(0.2576)
Controls:								
$CRRY_{dot}$	0.1360***	0.0396	0.0207	−0.0260	0.1212***	0.0344	0.0171	−0.0342
	(0.0280)	(0.0462)	(0.0298)	(0.0385)	(0.0271)	(0.0444)	(0.0282)	(0.0366)
Fixed effects:								
Origin-sector-time	✓		✓		✓		✓	
Destination-sector-time	✓		✓		✓		✓	
Origin-time		✓		✓		✓		✓
Destination-time		✓		✓		✓		✓
Country-pair	✓	✓	✓	✓	✓	✓	✓	✓
Summary statistics:								
Observations	887,396	8,657	984,170	8,659	940,448	9,067	1,033,032	9,069
(Pseudo-)R^2	0.8138	0.9874	0.9620	0.9986	0.8240	0.9880	0.9580	0.9974

Note: Robust standard errors in parentheses are clustered at the country-pair level. Significance: * $p < 0.10$, ** $p < .05$, *** $p < .01$.

Table A1.12: Alternative Measures for the Similarity of Political Preferences

Dependent variable: Sectoral/aggregate exports from origin o to destination d at time t								
Model:	OLS				PPML			
Data:	Sectoral		Aggregate		Sectoral		Aggregate	
Specification:	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Euclidean Distance								
BRD_{do}	−0.8330***		−0.3547		−1.1801***		−1.1733***	
	(0.2452)		(0.3680)		(0.1254)		(0.1445)	
$BRD_{do} \times SPP_{o,t-3}$	−3.0422***	−1.1363***	−2.7507***	−1.3254***	−2.6868***	−1.3534***	−2.1451***	−1.7120***
	(0.6538)	(0.1025)	(0.8865)	(0.2621)	(0.4761)	(0.1741)	(0.5024)	(0.3009)
Pearson Correlation								
BRD_{do}	0.0015		−1.0730		−3.9026***		−3.0862***	
	(1.9861)		(1.6957)		(0.6984)		(0.7496)	
$BRD_{do} \times SPP_{o,t-3}$	−1.5639	1.0362**	0.1864	2.3847***	2.4424***	1.6090***	1.6701**	2.1216***
	(2.2076)	(0.4158)	(1.9893)	(0.7291)	(0.7468)	(0.2285)	(0.7772)	(0.5641)
Cosine Similarity								
BRD_{do}	1.4496		−2.1286		−6.2768***		−4.8251***	
	(4.6132)		(4.3415)		(1.5643)		(1.6638)	
$BRD_{do} \times SPP_{o,t-3}$	−3.0042	2.3312**	1.2834	5.9887***	4.8120***	3.4787***	3.4116**	4.6324***
	(4.8523)	(1.0042)	(4.6745)	(1.7608)	(1.6212)	(0.5406)	(1.7065)	(1.2252)
Jaccard Index								
BRD_{do}	−3.6690***		−2.1708***		−2.5435***		−2.0577***	
	(0.4035)		(0.6905)		(0.2628)		(0.3302)	
$BRD_{do} \times SPP_{o,t-3}$	4.5378***	1.0595***	2.5744	1.3255***	1.6100***	0.3361*	0.9229	0.5177*
	(0.8285)	(0.3553)	(1.6575)	(0.2847)	(0.4250)	(0.1903)	(0.5724)	(0.2728)
Fixed effects:								
Origin-sector-time	✓	✓			✓	✓		
Destination-sector-time	✓	✓			✓	✓		
Origin-time			✓	✓			✓	✓
Destination-time			✓	✓			✓	✓
Country-pair		✓		✓		✓		✓

Note: Robust standard errors in parentheses are clustered at the country-pair level. Significance: * $p < 0.10$, ** $p < .05$, *** $p < .01$. Instead of using the sum of the products of shares for the construction of the Similarity of Political Preferences $SPP_{o,t-3}$, we rely on the Euclidean distance, the Pearson Correlation coefficient, the Cosine similarity and the Jaccard index as alternative similarity measures.

Table A1.13: Controlling for Unobserved Time-variant Heterogeneity (Aggregate Trade)

Dependent variable: Aggregate exports from origin o to destination d at time t										
Variable:	Migration		Cultural Similarity		World Uncertainty Index		Eurobarometer		All	
Model:	OLS	PPML	OLS	PPML	OLS	PPML	OLS	PPML	OLS	PPML
Specification:	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Variable of interest:										
$BRD_{do} \times SPP_{o,t-3}$	1.0802***	1.6094***	1.1495***	2.1034***	0.3114	2.0011***	2.6700***	2.8977***	−5.3671	3.1125***
	(0.1753)	(0.2281)	(0.1825)	(0.3212)	(0.9544)	(0.2694)	(0.6702)	(0.3574)	(5.7203)	(0.5181)
$\ln(MIGR_{do,t-1})$	0.0143*	0.0369***							−0.0386	0.0717***
	(0.0078)	(0.0139)							(0.1101)	(0.0166)
$CS_{do,t}$			−0.0021	0.0122					−0.0224	0.0080
			(0.0219)	(0.0239)					(0.2696)	(0.0194)
$BRD_{do} \times WUI_{o,t-3}$					1.6143	0.5662***			2.7835	0.9865***
					(1.3737)	(0.1474)			(1.7593)	(0.2502)
$BRD_{do} \times EUROBAROMETER_{o,t-3}$							−0.8396	−0.6049***	−2.5856	0.0218
							(0.5188)	(0.2214)	(3.7731)	(0.2036)
Controls:										
$CRRY_{dot}$	−0.0280	−0.0361	0.1136	−0.0478	0.1387	−0.0210	0.0278	−0.0487	−0.3989	−0.2001
	(0.0532)	(0.0431)	(0.0720)	(0.0650)	(0.2957)	(0.0376)	(0.0436)	(0.0374)	(0.7002)	(0.1458)
Fixed effects:										
Origin-sector-time	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Destination-sector-time	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Country-pair	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Summary statistics:										
Observations	6,109	6,109	5,283	5,283	7,411	8,146	9,199	9,201	3,090	3,377
(Pseudo-)R^2	0.9913	0.9978	0.9899	0.9975	0.5935	0.9974	0.9884	0.9975	0.6821	0.9980

Note: Robust standard errors in parentheses are clustered at the country-pair level. Significance: * $p < 0.10$, ** $p < .05$, *** $p < .01$. The results using industry level trade flows are presented in Table A1.4.

Bibliography

Ahir, H., N. Bloom, and D. Furceri (2022): "The World Uncertainty Index," Working Paper 29763, National Bureau of Economic Research.

CHAPTER A2

Appendix for Chapter 2

A2.1 Data

Table A2.1: Data and Variables

Variables	Description	Source
$Trade_{ijs,t}$ $Imports_{ijs,t}$	Trade and Import flows calculated from the Wold Input Output Tables at basic current prices (44 countries*65 sectors)	Timmer et al. (2015)
$CO_{2\ is,t}$	Environmental Accounts incl. Gross energy use and CO_2 emissions modeled by sector and energy commodity	Corsatea et al. (2019)
$REPP_{is,t}$	Member of Parliament level voting decision on European Parliament roll call votes constructed and aggregated to measure the member state specific revealed environmental policy preference	Hix et al. (2022)
Gravity control variables		
$DIST_{ij}$	bilateral distance	Conte et al. (2022)
$CONTG_{ij}$	indicating whether the importer and exporter share a common border	Conte et al. (2022)
$LANG_{ij}$	indicating whether the importer and exporter share a common official language	Conte et al. (2022)
$COLNY_{ij}$	indicating whether the importer and exporter share a colonial history	Conte et al. (2022)
$CRRY_{ij,t}$	indicating whether the importer and exporter share a common official currency	Conte et al. (2022)
$HOME_{ij}$	differentiating international and intranational carbon trade	own calculation
$ETS_{ij,t}$	indicating whether the sector is subject to the Emission Trading System, the EU's market based approach to limit emissions via a "cap and trade" mechanism	European Commission (2023a)
$TRGT_{ij,t}$	indicating whether importer and exporter both committed to reduce emissions	European Parliament (2009, 2018) European Commission (2023b) UNCC (2023)
$EPS_{i,t}$	OECD Environmental Policy Stringency	OECD (2022)

Note: The Table lists all variables, which are used in the analysis, and for each variable a description and its data source.

Table A2.2: WIOD Data Release 2016 - Countries

EU-Countries	Non-EU-Countries
Austria	Australia
Belgium	Brazil
Bulgaria	Canada
Cyprus	Switzerland
Czech Republic	China
Germany	India
Denmark	Indonesia
Spain	Japan
Estonia	South Korea
Finland	Mexico
France	Norway
United Kingdom	Russia
Greece	Turkey
Croatia	Taiwan
Hungary	United States
Ireland	Rest of the World
Italy	
Lithuania	
Luxembourg	
Latvia	
Malta	
Netherlands	
Poland	
Portugal	
Romania	
Slovakia	
Slovenia	
Sweden	

Note: The Table lists all countries included in the WIOD 2016 Release.

Table A2.3: WIOD Data Release 2016 - Sectors

Sector		Broad Sector	
Abbr.	Description	Abbr.	Description
A01	Crop and animal production, hunting and related service activities	A	Agriculture, forestry and fishing
A02	Forestry and logging		
A03	Fishing and aquaculture		
B	Mining and quarrying	B	Mining and quarrying
C10-C12	Manufacture of food products, beverages and tobacco products	C	Manufacturing
C13-C15	Manufacture of textiles, wearing apparel and leather products		
C16	Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials		
C17	Manufacture of paper and paper products		
C18	Printing and reproduction of recorded media		
C19	Manufacture of coke and refined petroleum products		
C20	Manufacture of chemicals and chemical products		
C21	Manufacture of basic pharmaceutical products and pharmaceutical preparations		
C22	Manufacture of rubber and plastic products		
C23	Manufacture of other non-metallic mineral products		
C24	Manufacture of basic metals		
C25	Manufacture of fabricated metal products, except machinery and equipment		
C26	Manufacture of computer, electronic and optical products		
C27	Manufacture of electrical equipment		
C28	Manufacture of machinery and equipment n.e.c.		
C29	Manufacture of motor vehicles, trailers and semi-trailers		
C30	Manufacture of other transport equipment		
C31_C32	Manufacture of furniture; other manufacturing		
C33	Repair and installation of machinery and equipment		
D35	Electricity, gas, steam and air conditioning supply	D	Electricity, gas, steam and air conditioning supply
E36	Water collection, treatment and supply	E	Water supply; sewerage, waste management and remediation activities
E37-E39	Sewerage; waste collection, treatment and disposal activities; materials recovery;remediation activities and other waste management services		
F	Construction	F	Construction
G45	Wholesale and retail trade and repair of motor vehicles and motorcycle	G	Wholesale and retail trade; repair of motor vehicles and motorcycles
G46	Wholesale trade, except of motor vehicles and motorcycles		
G47	Retail trade, except of motor vehicles and motorcycles		

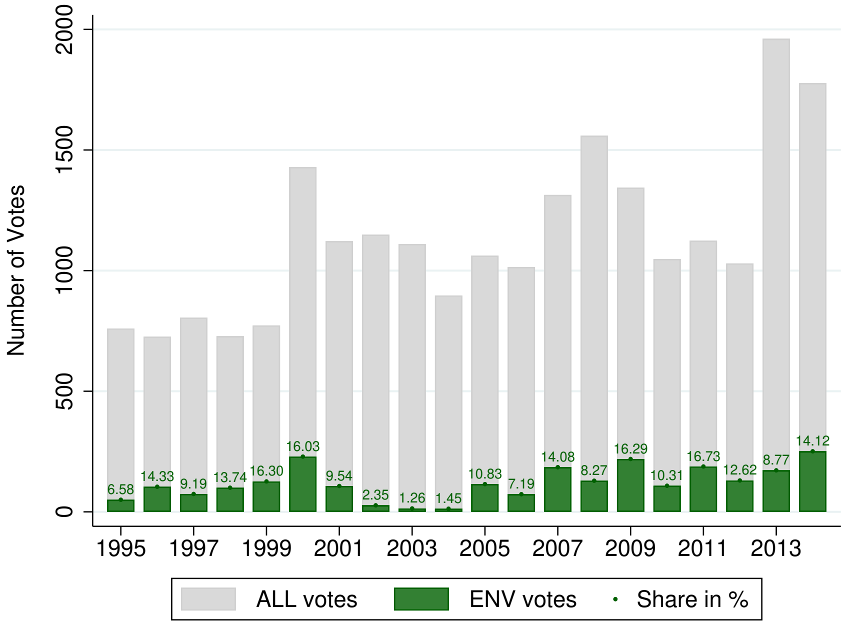
Note: The Table lists all sectors included in the WIOD 2016 Release.

Table A2.3: WIOD data release 2016 - sectors (continued)

Sector		Broad Sector	
Abbr.	Description	Abbr.	Description
H49	Land transport and transport via pipelines	H	Transportation and storage
H50	Water transport		
H51	Air transport		
H52	Warehousing and support activities for transportation		
H53	Postal and courier activities		
I	Accommodation and food service activities	I	Accommodation and food service activities
J58	Publishing activities	J	Information and communication
J59_J60	Motion picture, video and television programme production, sound recording and music publishing activities; programming and broadcasting activities		
J61	Telecommunications		
J62_J63	Computer programming, consultancy and related activities; information service activities		
K64	Financial service activities, except insurance and pension funding	K	Financial and insurance activities
K65	Insurance, reinsurance and pension funding, except compulsory social security		
K66	Activities auxiliary to financial services and insurance activities		
L68	Real estate activities	L	Real estate activities
M69_-M70	Legal and accounting activities; activities of head offices; management consultancy activities	M	Professional, scientific and technical activities
M71	Architectural and engineering activities; technical testing and analysis		
M72	Scientific research and development		
M73	Advertising and market research		
M74_-M75	Other professional, scientific and technical activities; veterinary activities		
N	Administrative and support service activities	N	Administrative and support service activities
O84	Public administration and defence; compulsory social security	O	Public administration and defence; compulsory social security
P85	Education	P	Education
Q	Human health and social work activities	Q	Human health and social work activities
R_S	Other service activities	R_S	Arts, entertainment and recreation & Other services activities
T	Activities of households as employers; undifferentiated goods- and services-producing activities of households for own use	T	Activities of households as employers; undifferentiated goods- and services-producing activities of households for own use
U	Activities of extraterritorial organizations and bodies	U	Activities of extraterritorial organisations and bodies

Note: The Table lists all sectors included in the WIOD 2016 Release.

Figure A2.1: Number and Share of Votes per Year



Note: The Figure depicts the number of all roll call votes conducted in the European Parliament in the years 1995–2014 by the gray bars. The green bars display the share of environmental roll call votes in the European Parliament in %. The definition of an environmental vote described in Section 2 is applied. The Figure is based on the data on the roll call votes in the European Parliament and on own calculations.

Table A2.4: Policy Areas in the European Parliament

Policy Area
Agriculture, Environment & Public Health
Budget
Civil Liberties, Justice & Home Affairs
Constitutional and Inter-Institutional Affairs
Culture & Education
Economic & Social Affairs
Fisheries
Gender Equality
Human Rights, Security Policy & Foreign Affairs
Industry, Research & Energy
Internal & External Trade
Internal Market & Consumer Protection
Regional & International Development
Transport & Tourism

Note: The Table lists all policy areas included in the data on roll call votes in the European Parliament.

Table A2.5: Variation in the Revealed Environmental Policy Support by Sector

	Broad Sector	Mean	Sd.	Min.	Max.
	$REPP_{ist}$	0.3615	0.2076	0.0152	1.0000
A:	Agriculture, forestry and fishing	0.3957	0.1585	0.0677	1.0000
B:	Mining and quarrying	0.4666	0.1136	0.2590	1.0000
C:	Manufacturing	0.5407	0.1223	0.2903	1.0000
D:	Electricity, gas, steam and air conditioning supply	0.4502	0.1362	0.1334	1.0000
E:	Water supply sewerage, water management and remediation activities	0.3644	0.1645	0.0337	1.0000
F:	Construction	0.3551	0.1551	0.0357	1.0000
G:	Wholesale and retail trade, repair of motor vehicles and motorcycles	0.2587	0.1679	0.0146	1.0000
H:	Transportation & storage	0.2991	0.1554	0.0480	1.0000
I-S:	Services	0.1987	0.1598	0.0146	1.0000

Note: The Table summarizes the measure of revealed environmental policy preferences $REPP_{ist}$ by sector s which is calculated based on the data of roll call votes in the European Parliament and as described in Section 2.2.

Table A2.6: Variation in the Revealed Environmental Preference by Country

Country	Mean	Std. Dev.	Minimum	Maximum
AUT	0.3835	0.2179	0.0175	0.5777
BEL	0.2726	0.1406	0.0717	0.5068
BGR	0.2701	0.2396	0.0184	0.6093
CYP	0.3863	0.3549	0.0163	1.0000
CZE	0.3734	0.1313	0.1155	0.5363
DEU	0.3545	0.1995	0.0455	0.6531
DNK	0.2828	0.2041	0.0187	0.6419
ESP	0.2517	0.1559	0.0335	0.5487
EST	0.4574	0.3064	0.0345	1.0000
FIN	0.4782	0.1303	0.3134	0.6216
FRA	0.3399	0.1324	0.1485	0.4944
GBR	0.2125	0.1873	0.0152	0.6178
GRC	0.2843	0.1741	0.1040	0.5837
HUN	0.5003	0.2579	0.2221	1.0000
IRL	0.3596	0.1723	0.1327	0.7487
ITA	0.3566	0.1966	0.0185	0.5971
LTU	0.3748	0.1810	0.0346	0.5293
LUX	0.3749	0.2256	0.0747	0.6413
LVA	0.5111	0.1098	0.3858	0.6961
MLT	0.3006	0.2075	0.0339	0.5583
NLD	0.2908	0.1353	0.1381	0.5187
POL	0.3195	0.1727	0.0972	0.5313
PRT	0.2603	0.2277	0.0200	0.5837
ROU	0.3663	0.2478	0.0724	0.7442
SVK	0.2595	0.1691	0.0427	0.4330
SVN	0.4215	0.2443	0.0818	0.7457
SWE	0.4226	0.1350	0.2249	0.7032
Total	0.6230	0.0936	0.3937	1.0000

Note: The Table summarizes the measure of revealed environmental policy preferences $REPP_{ist}$ by EU member state i which is calculated based on the data of roll call votes in the European Parliament and as described in Section 2.2.

A2.2 Calculation of Carbon Embodied Trade Flows

A2.2.1 Multi-regional Input-Output Model

The multi-regional input-output (MRIO) framework based on a non-competitive IO-model divides the world into N countries indexed by i and j and S economic sectors indexed by r and s. The N countries are linked via trade in intermediate (x_{ij}^{rs}) and final goods (y_{ij}^{rs}) between each of the $N \times S$ country-sector combinations. Input-Output tables are constructed symmetrically such that the sum of intermediate and final goods supplied (x_i^r) equals total use (x_j^s). Each producing sector adds value to the used intermediate goods (v_j^s). During the production of intermediate and final goods CO_2 is emitted. CO_2 emissions are observable on sector level using the energy consumption of the respective sector and weighting the energy use by an coefficient for CO_2 intensity of the energy source which gives total sectoral emissions (c_i^r).

Table A2.7: Environmentally-extended Multi-Regional Input-Output Table

	Intermediate Use			Final Use			Total Output	CO_2
	Country 1	...	Country n	Country 1	...	Country n		
Input								
Country 1	x_{11}^{rs}	...	x_{1n}^{rs}	y_{11}^{rs}	...	y_{1n}^{rs}	x_1^r	c_1^r
$\vdots$	$\vdots$	x_{ij}^{rs}	$\vdots$	$\vdots$	y_{ij}^{rs}	$\vdots$	x_i^r	c_i^r
Country n	x_{n1}^{rs}	...	x_{nn}^{rs}	y_{n1}^{rs}	...	y_{nn}^{rs}	x_n^r	c_n^r
Value Added	v_1^s	v_j^s	v_n^s					
Total Input	x_1^s	x_j^s	x_n^s					

The MRIO is the standard framework to incorporate global value chains and in particular to include upstream emissions (emission produced in previous production steps). Starting with the seminal work by Leontief (1970) total output can be formulated as

$$\boldsymbol{x} = \boldsymbol{A}\boldsymbol{x} + \boldsymbol{y}, \tag{A2.1}$$

which expresses total output as the sum of intermediate consumption ($\boldsymbol{A}\boldsymbol{x}$) and final consumption ($\boldsymbol{y}$). $\boldsymbol{A}$ thereby represents the direct inter-sector requirement matrix, where each element $a_{ij}^{rs} = x_{ij}^{rs}/x_j^s$ expresses the intermediate demand of country j's sector s from country i's sector r in the production of x_j^s. Solving for total output yields

$$\boldsymbol{x} = (\boldsymbol{I} - \boldsymbol{A})^{-1}\boldsymbol{y}, \tag{A2.2}$$

with $(\boldsymbol{I} - \boldsymbol{A})^{-1} = L$ being the Leontief inverse matrix[1] and $\boldsymbol{I}$ the identity matrix. The Leontief inverse hence expresses the required quantity of gross output of country j's sector s in order to produce final goods consumed in i's sector r. By using this approach we are able to trace intermediate input flows across borders and assign these flows to the original source country. As Johnson and Noguera (2012) highlight it is important to note that the here constructed bilateral output transfers are different from the observed bilateral trade flows as bilateral trade flows only report gross output transfers but do not reveal the embodied

[1]The Leontief inverse can also be expresses as a geometric series $(\boldsymbol{I} - \boldsymbol{A})^{-1} = \sum_{k=0}^{\infty} \boldsymbol{A}^k$ which highlights the iterative pattern of intermediate inputs in the production of (infinite) many sequences in global value chains.

intermediate goods which potentially are produced in a third or fourth country. In order to calculate the CO_2 emission which are embodied in trade flows first a sectoral emission intensity is calculated which reports the average amount of CO_2 emitted in the production of goods in a specific sector. Therefore total CO_2 emissions are divided by a measure of economic activity/output.

$$e_i^r = c_i^r / x_i^r, \tag{A2.3}$$

where the amount per value of total output is calculated and which represents the standard approach in the emissions embodied in trade literature. Alternatively one can use value added as the reference which is more similar to the approach of the emission intensity literature which uses GDP as the denominator. Using value added as the denominator and thereby directly account for fragmented value chains.

$$f_i^r = c_i^r / v_i^r, \tag{A2.4}$$

Both intensity measures give the direct amount of CO_2 emitted in order to produce one dollar of output. The main difference is that Eq. A2.3 measures CO_2 per USD of the produced goods and thereby also includes the value of foreign intermediate goods. Whereas Eq.A2.4 measures CO_2 per USD of domestically produced value. e_i^r and f_i^r both only measure the direct emission intensity of production. In order to also include upstream emissions, i.e. emissions embodied in intermediate inputs the measure of emission intensity needs to be combined with the final demand structure implied by the input-output logic:

$$E_i^r = e_i^r (\boldsymbol{I} - \boldsymbol{A})^{-1}, \tag{A2.5}$$

and

$$F_i^r = f_i^r (\boldsymbol{I} - \boldsymbol{A})^{-1}, \tag{A2.6}$$

respectively. Now any cross-border flow can be weighted with the upstream emission intensity in order to receive a measure for emissions embodied in the respective value flow. In the following intermediate input flows and final demand flows are considered. Intermediate input flows/intermediate exports from country i sector r to country j are equal to

$$EXM_{ij}^r = \sum_s x_{ij}^{rs}, \tag{A2.7}$$

and final good[2] value flows from country i sector r to country j are equal to

$$EXF_{ij}^r = \sum_s y_{ij}^{rs}. \tag{A2.8}$$

Total exports can hence be defined as the sum of intermediate and final goods export flows

$$EXT_{ij}^r = EXM_{ij}^r + EXF_{ij}^r \tag{A2.9}$$

[2]When using the WIOD final consumption = final goods, hence we consider household final consumption, government final consumption and non-government organizations' final consumption. Investments = GFCF and Inventories are not considered.

Emissions embodied in these flows are hence obtained by weighting the flows by the upstream emission intensities (E_i^r and F_i^r)

$$CO_2EXM_{ij}^r = F_i^r \times EXM_{ij}^r \tag{A2.10}$$

$$CO_2EXF_{ij}^r = F_i^r \times EXF_{ij}^r \tag{A2.11}$$

$$CO_2EXT_{ij}^r = CO_2EXM_{ij}^r + CO_2EXF_{ij}^r \tag{A2.12}$$

respectively.

A2.2.2 Input-Output Corrections

Following Costinot and Rodríguez-Clare (2014) and Shapiro (2020) in correcting the WIOD data for negative inventory values. Intuitively, negative values of inventory changes mean that output was produced in the prior period and is consumed in the current period. However, we treat this as output produced and consumed in the current period. Note that inventory changes can take positive and negative values. Positive values are directly added to final consumption. Final consumption is thereby defined as:

$$X_{ij,F} = X_{ij,H} + X_{ij,G} + X_{ij,NP} + X_{ij,I} + X_{ij,Inv}^{+} \tag{A2.13}$$

where the vector $X_{ij,F}$ indicates final consumption which is composed of consumption by households $X_{ij,H}$, governments $X_{ij,G}$ and non-profit organizations $X_{ij,N}$, by investment $X_{ij,I}$ (in WIOD GFCF) and by positive values of inventory changes $X_{ij,Inv}^{+}$. Negative values of inventory changes $X_{ij,Inv}^{-}$ are treated as output produced in the current period, hence we need to adjust the data on total output. The consumption balance is given by

$$X = AX + F + Inv$$

where X is a vector of total output, A is the input coefficient matrix, F is a vector of final demand as defined in Eq. A2.13 and Inv is the vector of negative inventory changes. Rearranging total output (current period) yields

$$X = (I - A)^{-1}(F + Inv)$$

When now setting the negative inventory changes to zero this becomes

$$\tilde{X} = (I - A)^{-1}F$$

where $\tilde{X}$ is the vector of adjusted total output. Note that the input coefficient matrix and the final demand vector remain unchanged. Given the unchanged input coefficient matrix and a previously calculated share of value added[3] in total output we can adjust the intermediate flows and value added as well. Intermediate flows are now $A\tilde{X}$ according to

$$\tilde{X} = A\tilde{X} + F.$$

[3]Value added was not allowed to exceed gross output.

A2.3 Results

Table A2.8: Baseline Results with Carbon Exports

Dependent Variable: Carbon Exports				
Model:	OLS		PPML	
Specification:	(1)	(2)	(3)	(4)
$\Delta REPP_{ijs,t-1}$	-0.1296^{***}		-0.0398	
	(.0472)		(.1341)	
$D_s \times \Delta REPP_{ijs,t-1}$				
Agriculture, forestry and fishing (A)		-0.0949		0.1322
		(.0612)		(.1089)
Mining & quarrying (B)		-0.0863		0.1084
		(.0790)		(.3644)
Manufacturing (C)		-0.1620^{***}		-0.1187
		(.0602)		(.1920)
Electricity, gas, steam and air conditioning supply (D)		-0.0786		0.4920^{**}
		(.0737)		(.2237)
Water supply; sewerage, waste management and remediation activities (E)		0.0008		-0.1378
		(.0789)		(.1496)
Construction (F)		-0.1023^{**}		0.1056
		(.0508)		(.1164)
Wholesale and retail trade; repair of motor vehicles and motorcycles (G)		-0.0923^{*}		-0.2090^{**}
		(.0511)		(.1054)
Transportation and storage (H)		-0.1002^{*}		-0.0697
		(.0586)		(.1616)
Services (I-S)		-0.1421^{***}		0.0387
		(.0464)		(.0617)
Controls:	✓	✓	✓	✓
Fixed Effects:				
Origin-Time	✓	✓	✓	✓
Destination-Time	✓	✓	✓	✓
Origin-Destination-Sector	✓	✓	✓	✓
Summary Statistics:				
Observations	428,049	436,152	428,178	436,281
(Pseudo-)R^2	0.9723	0.9723	0.9902	0.9902

Note: Standard errors in parentheses and clustered at country-pair level. Significance: * $p < 0.10$, ** $p < .05$, *** $p < .01$. The Table presents regression results of . The specifications correspond to the specifications of the baseline results in Table 2.1. The regressions in Table A2.8 differ in that it uses carbon exports instead of carbon imports.

Table A2.9: OLS Estimates with Reduced Set of Fixed Effects

Dependent Variable: Carbon Imports						
Model:	OLS					
Variable:	OECD Environmental Policy Stringency		$REPP_{ij,t}$ w/o sector variation		$REPP_{ijs,t}$ w/ sector variation	
Specification:	(1)	(2)	(3)	(4)	(5)	(6)
$\Delta EPS_{ij,t}$	-0.0528^{***}	-0.0499^{***}				
	(.0158)	(.0142)				
$\Delta REPP_{ij,t}$			-0.1226^{*}	-0.1333^{*}		
			(.0742)	(.0773)		
$\Delta REPP_{ijs,t}$					-0.1669^{***}	-0.1629^{***}
					(.0515)	(.0546)
Controls:						
$\ln(DIST_{ij})$	-1.2533^{***}		-1.2728^{***}		-1.2774^{***}	
	(.0882)		(.0922)		(.0915)	
$CNTG_{ij}$	0.2966^{***}		0.3977^{***}		0.3969^{***}	
	(.1047)		(.1166)		(.1164)	
$COLNY_{ij}$	0.3071^{**}		0.4965^{***}		0.4949^{***}	
	(.1335)		(.1472)		(.1471)	
$LANG_{ij}$	-0.0847		-0.0888		-0.0905	
	(.1529)		(.1345)		(.1346)	
$CRRY_{ij,t}$	0.1977^{**}		0.3298^{***}		0.3297^{***}	
	(.0829)		(.0546)		(.0545)	
$HOME_{ij}$	3.2516^{***}		3.1851^{***}		3.1550^{***}	
	(.2203)		(.2261)		(.2262)	
$TRGT_{ij,t}$	-0.0731^{*}	-0.0699^{***}	-0.1436^{***}	-0.1243^{***}	-0.1437^{***}	-0.1252^{***}
	(.0404)	(.0177)	(.0268)	(.0155)	(.0267)	(.0154)
$ETS_{ijs,t}$	0.1626^{***}	0.2133^{***}	0.2239^{***}	0.2882^{***}	0.2237^{***}	0.2881^{***}
	(.0196)	(.0166)	(.0237)	(.0183)	(.0237)	(.0183)
Fixed Effects:						
Origin-Sector	✓	✓	✓	✓	✓	✓
Destination-Sector	✓	✓	✓	✓	✓	✓
Origin-Destination		✓		✓		✓
Summary Statistics:						
Observations	211,295	211,295	469,235	469,235	460,518	460,518
(Pseudo-) R^2	0.9353	0.9556	0.9141	0.9439	0.9145	0.9441

Note: Standard errors in parentheses and clustered at country-pair level. Significance: * $p < 0.10$, ** $p < .05$, *** $p < .01$. The regressions presented in the Table above include OLS estimates with a reduced set of fixed effects compared to the baseline estimates in Table 2.1. Columns (1) and (2) show regression results including the differential OECD Environmental Policy Stringency between the exporter and importer. Columns (3) and (4) include the differential revealed environmental policy preference $\Delta REPP_{ij,t}$ not varying on sector level. Finally, Columns (5) and (6) includes the sector specific measure for differential revealed environmental policy preference $\Delta REPP_{ijs,t}$. All Columns include origin-sector and destination-sector fixed effects instead of origin-time and destination-time fixed effects as in the baseline regressions. Further Columns (2), (4) and (6) include origin-destination fixed effects, where the baseline regression included origin-destination-sector fixed effects.

Table A2.10: PPML Estimates with Reduced Set of Fixed Effects

Dependent Variable: Carbon Imports						
Model:	PPML					
Variable:	OECD Environmental Policy Stringency		$REPP_{ij,t}$ w/o sector variation		$REPP_{ijs,t}$ w/ sector variation	
Specification:	(1)	(2)	(3)	(4)	(5)	(6)
$\Delta EPS_{ij,t}$	−0.0478	−0.0422				
	(.0306)	(.0312)				
$\Delta REPP_{ij,t}$			−0.0663	−0.0775		
			(.2244)	(.2360)		
$\Delta REPP_{ijs,t}$					−0.0927	−0.0998
					(.1556)	(.1702)
Controls:						
$\ln(DIST_{ij})$	-1.3116^{***}		-1.2788^{***}		-1.2786^{***}	
	(.0748)		(.0677)		(.0678)	
CNT_{ij}	0.0591		0.1061		0.1061	
	(.1138)		(.1189)		(.1190)	
$COLNY_{ij}$	−0.0571		0.0667		0.0658	
	(.1306)		(.1143)		(.1145)	
$LANG_{ij}$	0.8045^{***}		0.7413^{***}		0.7384^{***}	
	(.1063)		(.1146)		(.1148)	
$CRRY_{ij,t}$	0.1706^{***}		0.2904^{***}		0.2907^{***}	
	(.0644)		(.0684)		(.0684)	
$HOME_{ij}$	2.4681^{***}		2.4650^{***}		2.4476^{***}	
	(.1268)		(.1243)		(.1244)	
$TRGT_{ij,t}$	0.0385	−0.0020	0.0716^{**}	0.0415	0.0830^{***}	0.0536^{**}
	(.0279)	(.0159)	(.0332)	(.0287)	(.0318)	(.0270)
$ETS_{ijs,t}$	0.1470^{***}	0.1530^{***}	0.2022^{***}	0.2088^{***}		
	(.0485)	(.0486)	(.0542)	(.0548)		
Fixed Effects:						
Origin-Sector	✓	✓	✓	✓	✓	✓
Destination-Sector	✓	✓	✓	✓	✓	✓
Origin-Destination		✓		✓		✓
Summary Statistics:						
Observations	211,295	211,295	469,366	469,366	460,649	460,649
(Pseudo-) R^2	0.9742	0.9780	0.9700	0.9749	0.9698	0.9747

Note: Standard errors in parentheses and clustered at country-pair level. Significance: * $p < 0.10$, ** $p < .05$, *** $p < .01$. The regressions presented in the Table above include PPML estimates with a reduced set of fixed effects compared to the baseline estimates in Table 2.1. Columns (1) and (2) show regression results including the differential OECD Environmental Policy Stringency between the exporter and importer. Columns (3) and (4) include the differential revealed environmental policy preference $\Delta REPP_{ij,t}$ not varying on sector level. Finally, Columns (5) and (6) includes the sector specific measure for differential revealed environmental policy preference $\Delta REPP_{ijs,t}$. All Columns include origin-sector and destination-sector fixed effects instead of origin-time and destination-time fixed effects as in the baseline regressions. Further Columns (2), (4) and (6) include origin-destination fixed effects, where the baseline regression included origin-destination-sector fixed effects.

Table A2.11: Baseline Results of Environmental Policy Preferences and Carbon Imports with Control Variables

Dependent Variable: Carbon Imports								
Model:	OLS				PPML			
Specification:	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$\Delta ES\_ijs,t-1$	-3.5517^{***}	-0.3632^{***}			-2.4861^{***}	-0.1132		
	(.1927)	(.0501)			(.4588)	(.1657)		
$D_s \times \Delta REPP_{ijs,t-1}$								
Agriculture, forestry and fishing (A)			-4.0252^{***}	-0.4120^{***}			-2.1369^{***}	-0.2086^{*}
			(.2280)	(.0644)			(.3004)	(.1232)
Mining & quarrying (B)			-4.4092^{***}	-0.4875^{***}			-2.0513^{***}	-0.1723
			(.2378)	(.0816)			(.3175)	(.3661)
Manufacturing (C)			-4.6315^{***}	-0.5031^{***}			-3.6719^{***}	-0.1130
			(.3301)	(.0656)			(.9271)	(.2232)
Electricity, gas, steam and air conditioning supply (D)			-4.3761^{***}	-0.4395^{***}			-3.7668^{**}	-0.5450^{*}
			(.4077)	(.0768)			(1.7820)	(.2854)
Water supply; sewerage, waste management and remediation activities (E)			-5.2614^{***}	-0.6530^{***}			-2.7496^{***}	0.0044
			(.2657)	(.0827)			(.3363)	(.1554)
Construction (F)			-3.2400^{***}	-0.3376^{***}			-2.4067^{***}	-0.1312
			(.2778)	(.0520)			(.4375)	(.1079)
Wholesale and retail trade; repair of motor vehicles and motorcycles (G)			-3.0060^{***}	-0.3589^{***}			-1.5611^{***}	0.2354^{**}
			(.1701)	(.0547)			(.2091)	(.0953)
Transportation and storage (H)			-3.1478^{***}	-0.3540^{***}			-2.3865^{***}	0.0968
			(.1909)	(.0583)			(.3878)	(.1289)
Services (I-S)			-3.0593^{***}	-0.3032^{***}			-1.4959^{***}	-0.0353
			(.1735)	(.0486)			(.1827)	(.0582)
Controls:								
$\ln(DIST_{ij})$	-1.0982^{***}		-1.0923^{***}		0.1993		0.2037	
	(.1332)		(.1333)		(.1413)		(.1395)	
$CNTG_{ij}$	0.9027^{***}		0.9026^{***}		1.5114^{***}		1.5121^{***}	
	(.1970)		(.1967)		(.2688)		(.2673)	
$COLNY_{ij}$	0.4209		0.4209		0.0420		0.0473	
	(.2925)		(.2909)		(.3072)		(.3085)	
$LANG_{ij}$	-0.0870		-0.0816		0.0342		0.0422	
	(.2720)		(.2714)		(.2980)		(.2974)	
$CRRY_{ij,t}$	0.5518^{***}	0.0657^{**}	0.5571^{***}	0.0647^{**}	0.2109	0.0896^{***}	0.2096	0.0935^{***}
	(.1132)	(.0298)	(.1127)	(.0298)	(.1630)	(.0239)	(.1620)	(.0242)
$HOME_{ij}$	3.3263^{***}		3.3567^{***}		5.1754^{***}		5.1963^{***}	
	(.3494)		(.3484)		(.3167)		(.3141)	
$TRGT_{ij,t}$	0.3020^{***}	-0.1454^{***}	0.2991^{***}	-0.1453^{***}	0.6051^{***}	-0.0272	0.6015^{***}	-0.0276
	(.0993)	(.0177)	(.0991)	(.0178)	(.1408)	(.0268)	(.1402)	(.0267)
$ETS_{ijs,t}$	1.8168^{***}	0.0402^{***}	1.8146^{***}	0.0408^{***}	0.9401^{***}	0.0836^{*}	0.9427^{***}	0.0832^{*}
	(.0327)	(.0152)	(.0335)	(.0153)	(.0933)	(.0448)	(.0923)	(.0446)
Fixed Effects:								
Origin-Time	✓	✓	✓	✓				
Destination-Time	✓	✓	✓	✓				
Origin-Destination-Sector		✓		✓				
Summary Statistics:								
Observations	430,960	428,049	439,118	436,152	432,374	428,178	440,532	436,281
(Pseudo-) R^2	0.4914	0.9735	0.4928	0.9735	0.7579	0.9906	0.7603	0.9907

Note: Standard errors in parentheses and clustered at country-pair level. Significance: * $p < 0.10$, ** $p < .05$, *** $p < .01$. The regression estimates in the above's Table show the regression results of Table 2.1 plus the coefficient estimates of the control variables plus regressions with a reduced set of fixed effects.. Specifications (1) and (3) of the baseline results in Table 2.1 are equivalent to the Columns (2) and (6) of Table A2.11. Specifications (2) and (4) of the baseline results in Table 2.1 are equivalent to Columns (4) and (8) in Table A2.11. Further, Columns (1), (3), (5) and (7) show specifications where the origin-destination fixed effects.

Table A2.12: OLS Estimation Results of Lagged Revealed Environmental Policy Preferences

Dependent Variable: Carbon Imports												
Model:	OLS											
Lag:	t		t-1		t-2		t-3		t-4		t-5	
Specification:	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Panel A: Differential environmental policy preference												
$\Delta REPP_{ijs,t-1}$	−3.6279***	−0.3959***	−3.5517***	−0.3632***	−3.3912***	−0.2535***	−3.2669***	−0.1418***	−3.1903***	−0.1074***	−3.1817***	−0.1370***
	(.1995)	(.0491)	(.1927)	(.0501)	(.1786)	(.0362)	(.1678)	(.0350)	(.1577)	(.0369)	(.1558)	(.0341)
Observations	460,518	460,518	430,960	428,049	401,425	401,425	374,803	374,803	348,181	348,181	321,532	321,532
(Pseudo-)R^2	0.4881	0.9721	0.4914	0.9735	0.4954	0.9754	0.5000	0.9771	0.5070	0.9783	0.5158	0.9795
Panel B: Differential environmental policy preference by sector												
$D_s \times \Delta REPP\_ijs, t-1$												
A	−4.2199***	−0.5917***	−4.0252***	−0.4120***	−3.8386***	−0.2967***	−3.7687***	−0.2890***	−3.6379***	−0.2401***	−3.5735***	−0.1906***
	(.2289)	(.0616)	(.2280)	(.0644)	(.2232)	(.0539)	(.2204)	(.0534)	(.2147)	(.0527)	(.2119)	(.0490)
B	−4.4696***	−0.5352***	−4.4092***	−0.4875***	−4.2887***	−0.4383***	−4.0699***	−0.2944***	−3.9909***	−0.2895***	−3.7806***	−0.0825
	(.2375)	(.0793)	(.2378)	(.0816)	(.2226)	(.0635)	(.2066)	(.0661)	(.1980)	(.0628)	(.1999)	(.0632)
C	−4.6667***	−0.4603***	−4.6315***	−0.5031***	−4.3034***	−0.2888***	−4.1873***	−0.1969***	−3.9691***	−0.0845	−4.0257***	−0.2078***
	(.3436)	(.0622)	(.3301)	(.0656)	(.2997)	(.0519)	(.2779)	(.0493)	(.2648)	(.0514)	(.2565)	(.0482)
D	−4.3864***	−0.4012***	−4.3761***	−0.4395***	−4.2932***	−0.2985***	−4.1381***	−0.2064***	−4.0542***	−0.2178***	−4.0056***	−0.2897***
	(.4239)	(.0776)	(.4077)	(.0768)	(.3890)	(.0670)	(.3650)	(.0590)	(.3550)	(.0644)	(.3322)	(.0612)
E	−5.3708***	−0.6875***	−5.2614***	−0.6530***	−4.9343***	−0.4294***	−4.5169***	−0.0804	−4.3230***	−0.0370	−4.4677***	−0.2813***
	(.2705)	(.0880)	(.2657)	(.0827)	(.2615)	(.0651)	(.2556)	(.0691)	(.2499)	(.0688)	(.2487)	(.0725)
F	−3.2405***	−0.3310***	−3.2400***	−0.3376***	−3.0419***	−0.2434***	−2.9369***	−0.1911***	−2.8513***	−0.1684***	−2.8112***	−0.1956***
	(.2785)	(.0501)	(.2778)	(.0520)	(.2632)	(.0404)	(.2565)	(.0399)	(.2488)	(.0422)	(.2393)	(.0407)
G	−3.0510***	−0.3874***	−3.0060***	−0.3589***	−2.8537***	−0.2323***	−2.7614***	−0.1449***	−2.7655***	−0.1963***	−2.6847***	−0.1654***
	(.1717)	(.0544)	(.1701)	(.0547)	(.1592)	(.0419)	(.1509)	(.0387)	(.1427)	(.0424)	(.1399)	(.0371)
H	−3.1981***	−0.3859***	−3.1478***	−0.3540***	−3.0287***	−0.2635***	−2.8780***	−0.1343***	−2.8177***	−0.0974**	−2.7738***	−0.0985**
	(.1969)	(.0597)	(.1909)	(.0583)	(.1791)	(.0481)	(.1723)	(.0489)	(.1616)	(.0471)	(.1607)	(.0432)
Services (I-S)	−3.1060***	−0.3436***	−3.0593***	−0.3032***	−2.9554***	−0.2243***	−2.8483***	−0.1059***	−2.8146***	−0.0744**	−2.8179***	−0.1006***
	(.1760)	(.0486)	(.1735)	(.0486)	(.1669)	(.0363)	(.1631)	(.0358)	(.1569)	(.0370)	(.1579)	(.0342)
Observations	469,235	469,235	439,118	436,152	409,024	409,024	381,898	381,898	354,772	354,772	327,619	327,619
(Pseudo-)R^2	0.4895	0.9721	0.4928	0.9735	0.4968	0.9754	0.5014	0.9771	0.5084	0.9783	0.5174	0.9795
Control Variables:	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Fixed Effects:												
Origin-Time	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Destination-Time	✓	✓	✓	✓	✓	✓	✓	✓	✓	Yes	✓	✓
Origin-Destination-Sector		✓		✓		✓		✓		✓		✓

Note: Standard errors in parentheses and clustered at country-pair level. Significance: * $p < 0.10$, ** $p < .05$, *** $p < .01$. The regression estimates in the above's Table show regression results of OLS estimations which include the difference in revealed environmental policy preference lagged by zero to five years. Panel A includes the revealed environmental policy preference not interacted with the respective sector indicator. Panel B shows the regression results of the sector-specific effects of the revealed environmental policy preference. The Table includes both regression estimates with origin-destination-sector fixed effects (in the odd Columns) and without origin-destination-sector fixed effects (in the even Columns).

Table A2.13: PPML Estimation Results of Lagged Revealed Environmental Policy Preferences

Dependent Variable: Carbon Imports												
Model:	PPML											
Lag:	t		t-1		t-2		t-3		t-4		t-5	
Specification:	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
$\Delta REPP_{ijs,t-1}$	−2.4203***	−0.1569	−2.3862***	−0.1178	−2.3260***	−0.1336	−2.2524***	−0.1187	−2.1357***	−0.0072	−2.0913***	0.0304
	(.5150)	(.1695)	(.4550)	(.1688)	(.3801)	(.1561)	(.3215)	(.1631)	(.2816)	(.1275)	(.2799)	(.1074)
Observations	462,001	462,001	432,374	428,178	402,747	401,529	376,035	374,880	349,323	348,231	322,611	321,582
(Pseudo-)R^2	0.7439	0.9905	0.7425	0.9906	0.7409	0.9906	0.7394	0.9906	0.7378	0.9906	0.7359	0.9906
$D_s \times \Delta REPP_{ijs,t-1}$												
A	−2.0139***	−0.2300*	−2.0846***	−0.2084*	−2.0833***	−0.2108*	−2.0553***	−0.1565	−2.0998***	−0.1997*	−2.1426***	−0.0996
	(.2918)	(.1296)	(.2818)	(.1241)	(.2491)	(.1131)	(.2341)	(.1219)	(.2177)	(.1129)	(.2308)	(.1308)
B	−1.9015***	−0.2821	−2.0645***	−0.1727	−2.1380***	−0.4625**	−2.2118***	−0.4527**	−2.2282***	−0.3380**	−2.2375***	−0.1818
	(.3201)	(.2528)	(.2992)	(.3667)	(.2613)	(.1998)	(.2571)	(.2059)	(.2505)	(.1406)	(.2682)	(.1909)
C	−4.0325***	−0.1648	−4.0166***	−0.1218	−3.8712***	−0.1495	−3.6799***	−0.1258	−3.3140***	−0.0358	−3.2278***	−0.0069
	(1.2931)	(.2339)	(1.1769)	(.2288)	(.9612)	(.2160)	(.8102)	(.2215)	(.7163)	(.1765)	(.6943)	(.1505)
D	−3.4361*	−0.4989**	−3.5217**	−0.5421*	−3.3649**	−0.4533*	−3.4906***	−0.4915*	−2.8657**	−0.2020	−1.9897	0.0505
	(1.8048)	(.2174)	(1.6330)	(.2832)	(1.5392)	(.2456)	(1.1921)	(.2770)	(1.3476)	(.2362)	(1.4262)	(.1984)
E	−2.6611***	−0.1942	−2.6930***	0.0163	−2.7069***	−0.0333	−2.5768***	0.1127	−2.6364***	0.0778	−2.6371***	0.1269
	(.3327)	(.1514)	(.3282)	(.1525)	(.3079)	(.1535)	(.3009)	(.1704)	(.2975)	(.1673)	(.3157)	(.1701)
F	−2.2639***	−0.1464	−2.2938***	−0.1298	−2.1259***	−0.1108	−1.9810***	−0.1004	−1.8253***	−0.0425	−1.8429***	−0.0402
	(.4182)	(.1173)	(.3951)	(.1076)	(.3156)	(.0789)	(.2725)	(.0673)	(.2612)	(.0689)	(.2604)	(.0754)
G	−1.5548***	0.1430	−1.5570***	0.2349**	−1.5902***	0.1931**	−1.5915***	0.1829**	−1.6104***	0.1659*	−1.6406***	0.0960
	(.2100)	(.0889)	(.2045)	(.0952)	(.1874)	(.0898)	(.1749)	(.0831)	(.1689)	(.0866)	(.1708)	(.0633)
H	−2.3169***	0.0598	−2.2755***	0.0997	−2.1916***	0.0721	−2.1616***	0.0662	−2.0416***	0.2717*	−1.9016***	0.2852*
	(.3747)	(.0952)	(.3566)	(.1289)	(.3044)	(.1332)	(.2894)	(.1656)	(.2635)	(.1399)	(.2667)	(.1589)
Services (I-S)	−1.4691***	−0.1037*	−1.4869***	−0.0360	−1.4931***	−0.0979**	−1.4742***	−0.0222	−1.4851***	0.0593	−1.4540***	−0.0259
Control Variables:	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Fixed Effects:												
Origin-Time	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Destination-Time	✓	✓	✓	✓	✓	✓	✓	✓	✓	Yes	✓	✓
Origin-Destination-Sector		✓		✓		✓		✓		✓		✓
Observations	470,718	469,366	440,532	436,281	410,346	409,128	383,130	381,975	355,914	354,822	328,698	327,669
(Pseudo-)R^2	0.7463	0.9906	0.7449	0.9906	0.7434	0.9907	0.7419	0.9907	0.7402	0.9907	0.7384	0.9906

Note: Standard errors in parentheses and clustered at country-pair level. Significance: * $p < 0.10$, ** $p < .05$, *** $p < .01$. The regression estimates in the above's Table show regression results of PPML estimations which include the difference in revealed environmental policy preference lagged by zero to five years. Panel A includes the revealed environmental policy preference not interacted with the respective sector indicator. Panel B shows the regression results of the sector-specific effects of the revealed environmental policy preference. The Table includes both regression estimates with origin-destination-sector fixed effects (in the odd Columns) and without origin-destination-sector fixed effects (in the even Columns).

Table A2.14: Estimation Results of Sample Split Eastern & Western European Countries

Dependent Variable: Carbon Imports				
Sample:	Eastern EU imports		Western EU imports	
Model:	OLS	PPML	OLS	PPML
Specification:	(1)	(2)	(3)	(4)
$D_A \times \Delta REPP_{ijA,t-1}$	-0.2458^{**}	0.2749^{***}	-0.5218^{***}	-0.7144^{***}
	(.1182)	(.0750)	(.0774)	(.2069)
$D_B \times \Delta REPP_{ijB,t-1}$	-0.4875^{***}	-0.2718	-0.4360^{***}	0.1764
	(.1363)	(.2098)	(.1097)	(1.0036)
$D_C \times \Delta REPP_{ijC,t-1}$	-0.6553^{***}	0.3611^{***}	-0.3123^{***}	-0.4283
	(.1424)	(.0764)	(.0625)	(.3673)
$D_D \times \Delta REPP_{ijD,t-1}$	-0.3579^{***}	-0.0944	-0.4705^{***}	-1.3562
	(.1371)	(.1015)	(.0916)	(.9602)
$D_E \times \Delta REPP_{ijE,t-1}$	-0.4699^{***}	0.5356^{***}	-0.7659^{***}	-0.3259
	(.1467)	(.1390)	(.1048)	(.2198)
$D_F \times \Delta REPP_{ijF,t-1}$	-0.4908^{***}	0.1768	-0.1479^{**}	-0.4655^{***}
	(.0972)	(.1311)	(.0610)	(.0964)
$D_G \times \Delta REPP_{ijG,t-1}$	-0.1853^{*}	0.5234^{***}	-0.4908^{***}	-0.1190
	(.0976)	(.0868)	(.0671)	(.1266)
$D_H \times \Delta REPP_{ijH,t-1}$	-0.3048^{***}	0.4266^{***}	-0.3619^{***}	-0.1986
	(.1086)	(.0906)	(.0663)	(.2681)
$D_{(I-S)} \times \Delta REPP_{ij(I-S),t-1}$	-0.2373^{**}	0.1445^{**}	-0.3278^{***}	-0.3151^{***}
	(.0954)	(.0570)	(.0530)	(.1160)
Control Variables:	✓	✓	✓	✓
Fixed Effects:				
Origin-Sector	✓	✓	✓	✓
Destination-Sector	✓	✓	✓	✓
Origin-Destination	✓	✓	✓	✓
Summary Statistics:				
Observations	162,579	162,708	273,573	273,573
(Pseudo-) R^2	0.9650	0.9891	0.9760	0.9904

Note: Standard errors in parentheses and clustered at country-pair level. Significance: * $p < 0.10$, ** $p < .05$, *** $p < .01$. The regression estimates in the above's Table show regression results of OLS as well as PPML estimations of specifications (2) and (4) of the baseline results in Table 2.1 separately estimated by Eastern and Western European countries.

Table A2.15: Estimation Results Adding Political Similarity

Dependent Variable: Carbon Imports				
Model:	OLS		PPML	
Specification:	(1)	(2)	(3)	(4)
$\Delta REPP_{ijs,t-1}$	-0.3983^{***}		-0.0783	
	(.0508)		(.1254)	
$\Delta REPP_{ijA,t-1}$		-0.4527^{***}		-0.1796
		(.0650)		(.1182)
$\Delta REPP_{ijB,t-1}$		-0.5325^{***}		-0.1620
		(.0820)		(.3681)
$\Delta REPP_{ijC,t-1}$		-0.5615^{***}		-0.0656
		(.0666)		(.1684)
$\Delta REPP_{ijD,t-1}$		-0.4797^{***}		-0.5287^{**}
		(.0774)		(.2695)
$\Delta REPP_{ijE,t-1}$		-0.7053^{***}		0.0563
		(.0836)		(.1676)
$\Delta REPP_{ijF,t-1}$		-0.3690^{***}		-0.1223
		(.0525)		(.1045)
$\Delta REPP_{ijG,t-1}$		-0.3893^{***}		0.2386^{***}
		(.0553)		(.0926)
$\Delta REPP_{ijH,t-1}$		-0.3851^{***}		0.1146
		(.0589)		(.1273)
$\Delta REPP_{ij(I-S),t-1}$		-0.3322^{***}		-0.0292
		(.0491)		(.0577)
$POLIT\_SIM_{ij,t-1}$	1.0591^{***}	1.0798^{***}	-0.5348	-0.5303
	(.2579)	(.2580)	(.8017)	(.7917)
Control Variables:	✓	✓	✓	✓
Fixed Effects:				
Origin-Time	✓	✓	✓	✓
Destination-Time	✓	✓	✓	✓
Origin-Destination-Sector	✓	✓	✓	✓
Summary Statistics:				
Observations	428,049	436,152	428,178	436,281
(Pseudo-) R^2	0.9735	0.9735	0.9906	0.9907

Note: Standard errors in parentheses and clustered at country-pair level. Significance: * $p < 0.10$, ** $p < .05$, *** $p < .01$. The specifications in Tables A2.15 are equivalent to the specifications in Table 2.1 of the baseline results, whereby a measure for political similarity is added. The measure of political similarity ($POLIT\_SIM_{ij,t-1}$) is measured as the sum product of shares of the voting outcomes in the European Parliament (cf. Hellmanzik et al., 2023).

Table A2.16: Estimation Results Using the OECD Environmental Stringency

Dependent Variable: Carbon Imports								
Sample:	EU				EU & non-EU countries			
Model:	OLS		PPML		OLS		PPML	
Specification:	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$\Delta EPS_{ij,t}$	−0.0528***	−0.0499***	−0.0478	−0.0422	−0.0458***	−0.0443***	0.0400	0.0361
	(.0158)	(.0142)	(.0306)	(.0312)	(.0130)	(.0129)	(.0445)	(.0434)
Controls:								
$\ln(DIST\_ij)$	−1.2533***		−1.3116***		−1.2070***		−1.0702***	
	(.0882)		(.0748)		(.0438)		(.0568)	
$CNTG_{ij}$	0.2966***		0.0591		0.2702***		−0.0693	
	(.1047)		(.1138)		(.1034)		(.1274)	
$COLNY_{ij}$	0.3071**		−0.0571		0.3686***		0.3015***	
	(.1335)		(.1306)		(.1137)		(.0920)	
$LANG_{ij}$	−0.0847		0.8045***		0.1179		0.5397***	
	(.1529)		(.1063)		(.0910)		(.1046)	
$CRRY_{ij,t}$	0.1977**		0.1706***		0.1307**		0.6186***	
	(.0829)		(.0644)		(.0640)		(.0853)	
$HOME_{ij}$	3.2516***		2.4681***		3.6313***		2.6863***	
	(.2203)		(.1268)		(.2263)		(.1291)	
$TRGT_{ij,t}$	−0.0731*	−0.0699***	0.0385	−0.0020	−0.1082**	−0.0826***	−0.1572***	−0.1287***
	(.0404)	(.0177)	(.0279)	(.0159)	(.0430)	(.0137)	(.0233)	(.0295)
$ETS_{ijs,t}$	0.1626***	0.2133***	0.1470***	0.1530***	0.3814***	0.3792***	0.6933***	0.6935***
	(.0196)	(.0166)	(.0485)	(.0486)	(.0142)	(.0141)	(.2126)	(.2126)
Fixed Effects:								
Origin-Sector	✓	✓	✓	✓	✓	✓	✓	✓
Destination-Sector	✓	✓	✓	✓	✓	✓	✓	✓
Origin-Destination		✓		✓		✓		✓
Summary Statistics:								
Observations	211,295	211,295	211,295	211,295	681,525	681,525	681,948	681,948
(Pseudo-) R^2	0.9353	0.9556	0.9742	0.9780	0.9051	0.9381	0.9799	0.9826

Note: Standard errors in parentheses and clustered at country-pair level. Significance: * $p < 0.10$, ** $p < .05$, *** $p < .01$. Table A2.16 shows regression results of specifications including the measure of the OECD Environmental Policy Stringency estimated with both OLS and PPML. The regression is estimated with EU countries only in Columns (1) to (4), which are equivalent to the Columns (1) and (2) in Tables A2.9 and A2.10 , and with EU and non-EU countries in Columns (5) to (8). The EU sample includes: Austria, Belgium, Czechia, Denmark, Finland, France, Germany, Great Britain, Greece, Hungary, Ireland, Italy, Netherlands, Poland, Portugal, Slovakia, Slovenia, Spain, Sweden. The EU&non-EU sample additionally includes: Australia, Brazil, Canada, China, Indonesia, India, Japan, Korea, Norway, Russia, Switzerland, Turkey, USA. Odd Columns include origin-sector and destination-sector fixed effects and even Columns additionally include origin-destination fixed effects.

Table A2.17: Estimation Results Excluding the Year of Accession

Dependent Variable: Carbon Imports				
Model:	OLS		PPML	
Specification:	(1)	(2)	(3)	(4)
$\Delta REPP_{ijs,t-1}$	-0.0599		-0.4547	
	(.0904)		(.4948)	
$\Delta REPP_{ijA,t-1}$		-0.1970		-0.6956^{**}
		(.1511)		(.3437)
$\Delta REPP_{ijB,t-1}$		-0.7728^{***}		-1.8376^{***}
		(.1982)		(.5272)
$\Delta REPP_{ijC,t-1}$		-0.0887		-0.3808
		(.0847)		(.5146)
$\Delta REPP_{ijD,t-1}$		-0.1165		-2.4547^{*}
		(.1699)		(1.2913)
$\Delta REPP_{ijE,t-1}$		-0.2138		-0.3609
		(.1368)		(.2921)
$\Delta REPP_{ijF,t-1}$		-0.0560		-0.5336^{**}
		(.1385)		(.2232)
$\Delta REPP_{ijG,t-1}$		0.3167		1.0781^{**}
		(.2042)		(.4495)
$\Delta REPP_{ijH,t-1}$		0.3675^{*}		0.6530
		(.2011)		(.9676)
$\Delta REPP_{ij(I-S),t-1}$		0.0549		-0.1861
		(.2250)		(.4636)
Control Variables:	✓	✓	✓	✓
Fixed Effects:				
Origin-Time	✓	✓	✓	✓
Destination-Time	✓	✓	✓	✓
Origin-Destination-Sector	✓	✓	✓	✓
Summary Statistics:				
Observations	389,545	397,648	389,649	397,752
(Pseudo-) R^2	0.9756	0.9755	0.9907	0.9908

Note: Standard errors in parentheses and clustered at country-pair level. Significance: * $p < 0.10$, ** $p < .05$, *** $p < .01$. The specifications presented in Table A2.17 are equivalent to the regressions of the baseline results in Table 2.1 excluding the year of accession of each EU member state.

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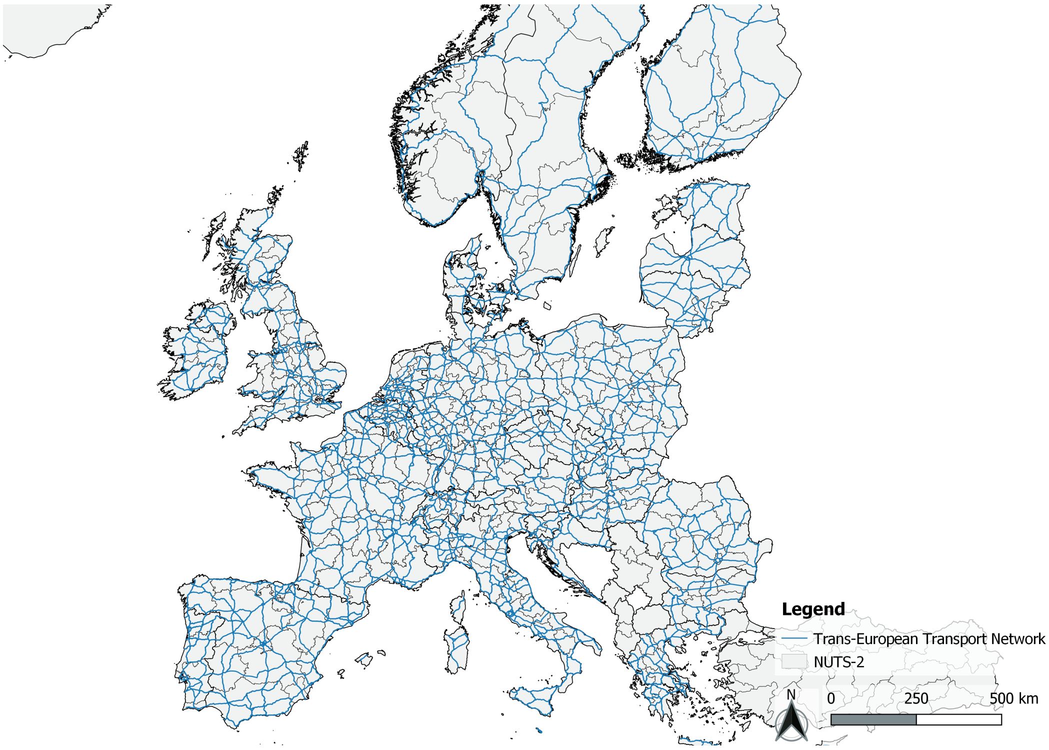
CHAPTER A3

Appendix for Chapter 3

A3.1 Appendix

Figure A3.1: Road Network of the Trans-European Transport Network



Note: The map displayed in Figure A3.1 shoes the EU-wide road network of the Trans-European Transport Network. The map is produced with the data provided by the Directorate-General Mobility and Transport of the European Commission and based on administrative boundaries from European Commission – Eurostat/GISCO (2016).

Table A3.1: Datasets, Variables & Sources

Name	Description	Variables	Years	Source
European Road Freight Transport Survey	European Road Freight Transport Survey (Commodity Flow Survey) used to construct NUTS-2 level intra-EU trade flows.	X^s_{dot}	2011-2019	Eurostat
TEN-T	The Directorate-General Mobility and Transport of the European Commission provided geocoded information on the Trans-Euorpean Transport Network including information on the status of completion of each road segment. Building on Goldmann and Wessel (2020) I completed the information on the year of completion of each completed road segment.	$ROAD_{dot}$	2011-2019	Directorate-General Mobility and Transport of the European Commission
Time Varying Travel Times	Based on historic Open Street Map (OSM) obtained from Geofabrik GmbH files, I retrieved the year specific road network for the years 2011 to 2019. By using a local OSM server, I then calculated travel times and travel distances between each of the ten largest cities in each NUTS-2 region. Manually cleaning and organizing the asymmetric bilateral travel times and distances results in a customized and unique dataset. For internal distances the ten distances are weighted with the 2017 population share within the NUTS-2 region. Because of computational limits for know for inter-NUTS-2 distances only one city per NUTS-2 region was used.	$TIME_{dot}$	2011-2019	Geofabrik GmbH
NUTS-2 geography	Populated weighted distances and the contiguity variable were calculated with GIS software using NUTS-2 shapefiles and the location of the ten largest cities (population-wise).	$DIST_{do}$ $CONTG_{do}$	2011-2019	Eurostat GISCO
NUTS-2 language	Building on the "common language" variable incl. in the CEPII dataset plus manually collecting official languages at the NUTS-2 level.	$LANG_{do}$	2011-2019	CEPII Wikipedia
NUTS-2 common currency	Building on the "common currency" variable incl. in the CEPII dataset plus correcting the variable for EU member states that joined the Euro zone.	$CRRY_{dot}$	2000-2019	CEPII
NUTS-2 distances	Time-invariant population weighted distances are calculated using GIS software. The great circle distance between each of the population largest cities is calculated and weighted with the 2017 population share within the NUTS-2 region.	$DIST_{do}$	2011-2019	
NUTS-2 flow variables	Data on bilateral NUTS-2 flows of people (migration) varying over time are sourced from the ESPON database.	$MIGR_{dot}$ FDI_{dot} $TOURISM_{dot}$ $KNOW_{dot}$	2010-2018	ESPON
ITPD-E	International Trade and Production Database for Estimation.		2011-2016	USITC
Eurostat Trade	EU trade since 1988 by BEC/rev.4 and CPA 2008 (DS-058397)		2011-2019	Eurostat

Table A3.2: The Effect of Completed Road Segments on Bilateral Travel Times

Dependent Variable: change in travel time from o to d in t				
Model:	OLS			
Specification:	(1)	(2)	(3)	(4)
Explanatory Variables:				
$ROAD_{dot}$ (0/1)	-0.0026^{***}	-0.0068^{***}		
	(.0001)	(.0004)		
$ROAD_{dot}$ (%)			-0.0330^{***}	-0.0842^{***}
			(.0009)	(.0040)
Fixed Effects:				
Year	✓	✓	✓	✓
NUTS-2-pair		✓		✓
Summary Statistics:				
Observations	317,574	317,574	317,574	317,574
(Pseudo-)R^2	0.6911	0.7380	0.6916	0.7385

Note: Standard errors in parentheses; clustered at country-pair level. Significance: * $p < 0.10$, ** $p < .05$, *** $p < .01$. Regressions are performed on the full sample.

Table A3.3: The trade-enhancing effect of completed road segments (OLS sample)

Dependent Variable: Trade between origin o and destination d in year t										
Model:	OLS					PPML				
Specification:	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
$\ln(TIME_{dot})$	0.0736	0.0771	0.0892	0.0939	0.0938	-0.2670^{***}	-0.2470^{***}	-0.2426^{***}	-0.1837^{**}	-0.1871^{**}
	(.1397)	(.1398)	(.1396)	(.1409)	(.1409)	(.0722)	(.0723)	(.0719)	(.0773)	(.0772)
Binary variable:										
$ROAD_{dot}$ (0/1)		0.0093	0.2618^{*}				0.0386^{**}	0.0994		
		(.0162)	(.1402)				(.0158)	(.1073)		
Continuous variable:										
$ROAD_{dot}$ (%)				0.1423	0.1366				0.2377^{***}	0.2076^{**}
				(.1345)	(.1422)				(.0808)	(.0858)
Control variables:										
$ROAD_{dot} \times \ln(TIME_{dot})$			-0.0393^{*}		0.0003			-0.0111		0.0030
			(.0217)		(.0026)			(.0185)		(.0029)
Fixed Effects:										
Origin-time	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Destination-time	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
NUTS-2-pair	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Country-pair-time	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Summary Statistics:										
Observations	177,716	177,716	177,716	177,716	177,716	177,716	177,716	177,716	177,716	177,716
(Pseudo-)R^2	0.8615	0.8615	0.8615	0.8615	0.8615	0.9961	0.9961	0.9961	0.9961	0.9961

Note: Standard errors in parentheses and clustered at NUTS-2-pair-level. Significance: * $p < 0.10$, ** $p < .05$, *** $p < .01$.

Table A3.4: Controlling for the Location of Railway and Road Segments

Dependent Variable: Trade between origin o and destination d in year t						
Model:	PPML					
Specification:	(1)	(2)	(3)	(4)	(5)	(6)
Binary variable:						
$ROAD_{dot}$ (0/1)	0.1790*	0.1835*	0.1797*			
	(.1063)	(.1048)	(.1045)			
Continuous variable:						
$ROAD_{dot}$ (%)				0.2157**	0.2175**	0.2123**
				(.0863)	(.0864)	(.0872)
Control variables:						
$\ln(TIME_{dot})$	−0.2229***	−0.2207***	−0.2169***	−0.1718**	−0.1693**	−0.1670**
	(.0722)	(.0707)	(.0709)	(.0777)	(.0766)	(.0767)
$ROAD_{dot} \times \ln(TIME_{dot})$	−0.0262	−0.0273	−0.0267	0.0021	0.0018	0.0018
	(.0182)	(.0179)	(.0179)	(.0028)	(.0028)	(.0028)
$Location\,of\,ROAD_{dot}$	−0.0329**		−0.0309*	−0.0311*		−0.0292*
	(.0162)		(.0162)	(.0163)		(.0163)
$RAIL_{dot}$		0.0576***	0.0563***		0.0565***	0.0552***
		(.0181)	(.0180)		(.0184)	(.0183)
Fixed Effects:						
Origin-time	✓	✓	✓	✓	✓	✓
Destination-time	✓	✓	✓	✓	✓	✓
NUTS-2-pair	✓	✓	✓	✓	✓	✓
Country-pair-time	✓	✓	✓	✓	✓	✓
Summary Statistics:						
Observations	234, 564	234, 564	234, 564	234, 564	234, 564	234, 564
(Pseudo-)R^2	0.9954	0.9954	0.9954	0.9954	0.9954	0.9954

Note: Standard errors in parentheses and clustered at NUTS-2-pair-level. Significance: * $p < 0.10$, ** $p < .05$, *** $p < .01$. $Location\,of\,ROAD_{dot}$ is a binary indicator taking the value of one if a completed road segment is located in the region of origin or destination and zero otherwise. $RAIL_{dot}$ is defined as a dummy variable taking the value of one if in any of the NUTS-2 regions the optimal travel route is crossing a rail segment is located and zero otherwise.

Table A3.5: Regional Trade Flows Aggregated to the NUTS-1-level

Dependent Variable: Trade between origin o and destination d in year t					
Model:			PPML		
Specification:	(1)	(2)	(3)	(4)	(5)
$\ln(TIME_{dot})$	-0.3959^{***}	-0.3540^{***}	-0.3094^{**}	-0.2247^{*}	-0.2311^{*}
	(.1321)	(.1299)	(.1307)	(.1292)	(.1284)
Binary variable:					
$ROAD_{dot}$ (0/1)		0.0537^{**}	0.5059^{**}		
		(.0233)	(.2495)		
Continuous variable:					
$ROAD_{dot}$ (%)				0.2883^{***}	0.2504^{**}
				(.0942)	(.1063)
Control variables:					
$ROAD_{dot} \times \ln(TIME_{dot})$			-0.0779^{*}		0.0041
			(.0416)		(.0042)
Fixed Effects:					
Origin-time	✓	✓	✓	✓	✓
Destination-time	✓	✓	✓	✓	✓
NUTS-2-pair	✓	✓	✓	✓	✓
Country-pair-time	✓	✓	✓	✓	✓
Summary Statistics:					
Observations	44,010	44,010	44,010	44,010	44,010
(Pseudo-)R^2	0.9986	0.9986	0.9986	0.9986	0.9986

Note: Standard errors in parentheses and clustered at NUTS-1-pair-level. Significance: * $p < 0.10$, ** $p < .05$, *** $p < .01$. The $ROAD_{dot}$ and the time varying travel time $\ln(TIME_{dot})$ are computed as the (populated weighted) average of the NUTS-2 regions. For intra-NUTS-1 variables the ten largest cities of the NUTS-1 or NUTS-2 regions are utilised.

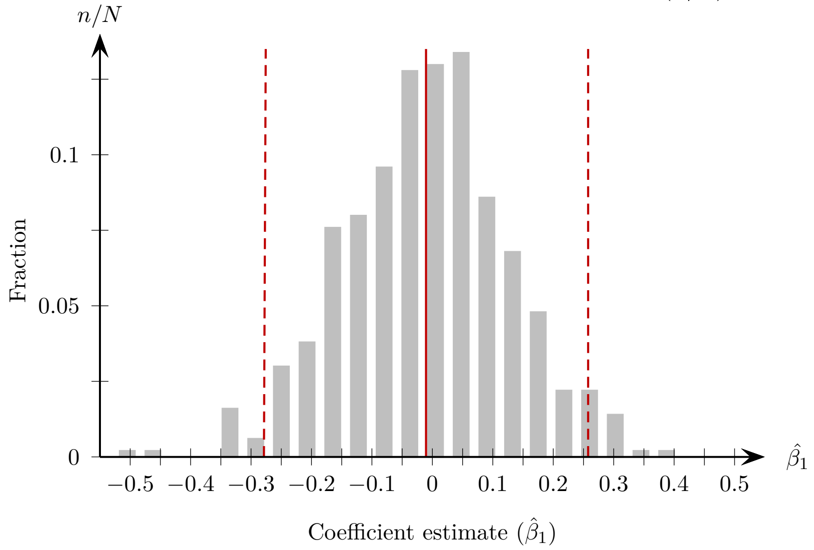
Table A3.6: Alternative definitions of the $ROAD_{dot}$ Variable

Dependent Variable: Trade between origin o and destination d in year t										
Model:	PPML									
$ROAD_{dot}$ Variable:	Binary					Continuous				
Threshold:	pooled	$\geq$ 250m	$\geq$ 1000m	$\geq$ 2500m	$\geq$ 5000m	$\geq$ 250m	$\geq$ 1000m	$\geq$ 2500m	$\geq$ 5000m	% on road
Specification:	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Binary variable:										
$ROAD_{dot}(0/1)$	0.2595***	0.2417**	0.1535	0.2164*	0.2701**					
	(.0678)	(.0941)	(.0960)	(.1152)	(.1219)					
Continuous variable:										
$ROAD_{dot}(\%)$						0.2086**	0.2335***	0.2383***	0.2375***	0.2284**
						(.0846)	(.0865)	(.0892)	(.0873)	(.0889)
Control Variables:										
$\ln(TIME_{dot})$	−0.2164***	−0.2256***	−0.2313***	−0.2256***	−0.2165***	−0.1765**	−0.1714**	−0.1715**	−0.1704**	−0.1825**
	(.0727)	(.0721)	(.0720)	(.0720)	(.0733)	(.0784)	(.0785)	(.0786)	(.0782)	(.0795)
$ROAD_{dot} \times \ln(TIME_{dot})$	−0.0395***	−0.0348**	−0.0222	−0.0335*	−0.0423**	0.0061**	0.0018	0.0010	0.0013	0.0023
	(.0124)	(.0160)	(.0161)	(.0193)	(.0203)	(.0028)	(.0026)	(.0027)	(.0028)	(.0028)
Fixed Effects:										
Origin-time	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Destination-time	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
NUTS-pair	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Country-pair-time	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Summary Statistics:										
Observations	234,564	234,564	234,564	234,564	234,564	234,564	234,564	234,564	234,564	234,536
(Pseudo-)R^2	0.9954	0.9954	0.9954	0.9954	0.9954	0.9954	0.9954	0.9954	0.9954	0.9953

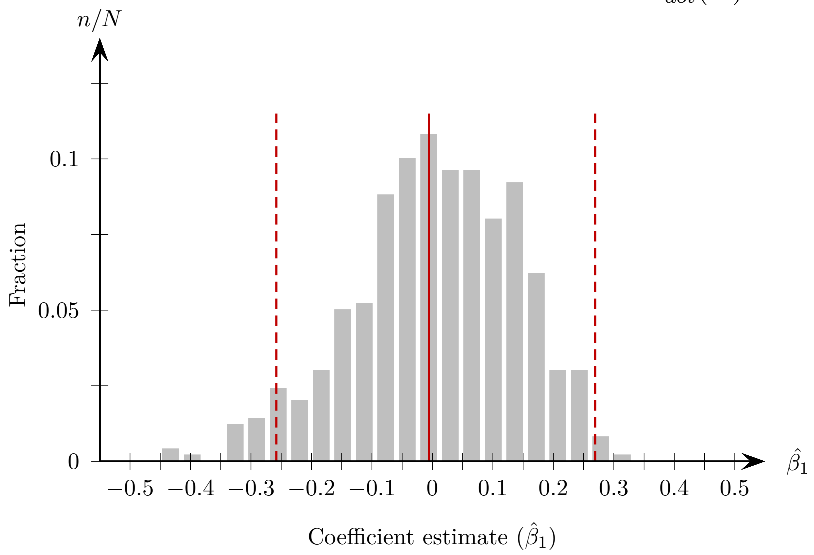
Note: Standard errors in parentheses and clustered at NUTS-2-pair-level. Significance: * $p < 0.10$, ** $p < .05$, *** $p < .01$.

Figure A3.2: Distribution of the Coefficient Estimate $\hat{\beta}_1$ after Randomizing $ROAD_{dot}$

Panel A: Randomization of the binary $ROAD_{dot}(0/1)$ variable



Panel B: Randomization of the continuous $ROAD_{dot}(\%)$ variable



Note: Bars in gray display the distribution of β_1 coefficient estimates resulting from $N = 500$ placebo regressions randomizing the assignment of the $ROAD_{dot}$ variable. The regressions performed for Figure A3.2 use specification (4) of Table 3.1. The red lines highlight the average coefficient estimate and the 95% confidence interval. For the estimations in Panel A specification (3) and for Panel B specification (5) of the baseline Table 3.1 is utilized. Following, the full set of fixed effects, i.e. origin-time, destination-time, NUTS-2-pair and country-pair-time, are applied as well as the interaction of the $ROAD_{dot}$ with bilateral travel times is included.

Table A3.7: Controlling for NUTS-2 Pair and Time-specific Heterogeneity

Dependent Variable: Trade between o and d in t		
Model:	PPML	
Specification:	(1)	(2)
Binary variable:		
$ROAD_{dot}$ (0/1)	0.1929*	
	(.1060)	
Continuous variable:		
$ROAD_{dot}$ (%)		0.2187**
		(.0855)
Control Variables:		
$\ln(TIME_{dot})$	−0.2324***	−0.1813**
	(.0723)	(.0778)
$ROAD_{dot} \times \ln(TIME_{dot})$	−0.0286	0.0021
	(.0181)	(.0028)
$\ln(MIGR_{do,t-1})$	−0.0530***	−0.0528***
	(.0170)	(.0170)
Fixed Effects:		
Origin-time	✓	✓
Destination-time	✓	✓
NUTS-2-pair	✓	✓
Country-pair-time	✓	✓
Summary Statistics:		
Observations	234,470	234,470
(Pseudo-)R^2	0.9953	0.9953

Note: Standard errors in parentheses and clustered at NUTS-2-pair-level. Significance: * $p < 0.10$, ** $p < .05$, *** $p < .01$. In order to obtain a sufficiently large panel, I add a one to the migration flows before logarithmizing.

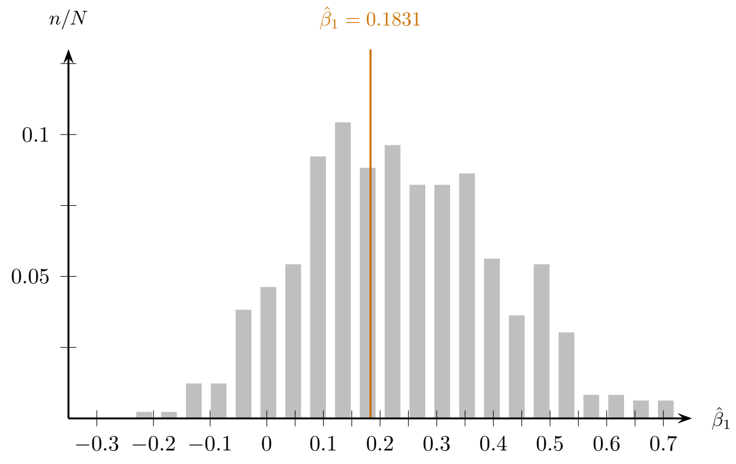
Table A3.8: Excluding the Capital's NUTS-2 Region

Dependent Variable: Trade between o and d in t		
Model:	PPML	
Specification:	(1)	(2)
Binary variable:		
$ROAD_{dot}$ (0/1)	0.3197***	
	(.1192)	
Continuous variable:		
$ROAD_{dot}$ (%)		0.3726***
		(.0794)
Control variables:		
$\ln(TIME_{dot})$	−0.2879***	−0.2138***
	(.0613)	(.0646)
$ROAD_{dot} \times \ln(TIME_{dot})$	−0.0495**	0.0006
	(.0206)	(.0030)
Fixed Effects:		
Origin-time	✓	✓
Destination-time	✓	✓
NUTS-2-pair	✓	✓
Country-pair-time	✓	✓
Summary Statistics:		
Observations	182,401	182,401
(Pseudo-)R^2	0.9958	0.9958

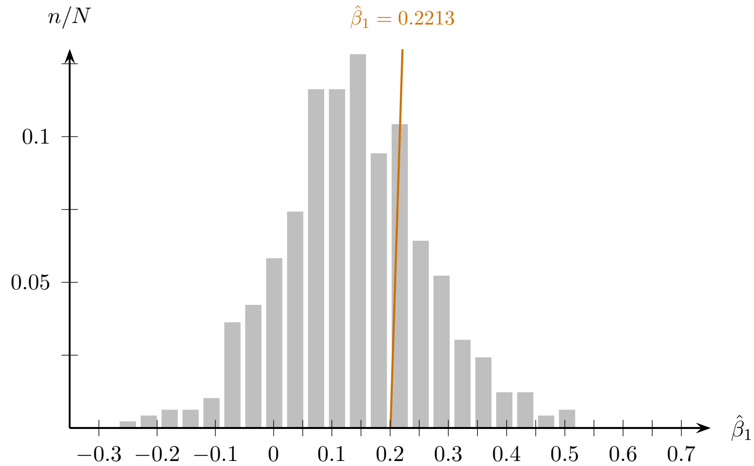
Note: Standard errors in parentheses and clustered at NUTS-2-pair-level. Significance: * $p < 0.10$, ** $p < .05$, *** $p < .01$.

Figure A3.3: Distribution of the Coefficient Estimate $\hat{\beta}_1$ after Randomizing Sub-samples

Panel A: Randomization of the binary variable $ROAD_{dot}(0/1)$



Panel B: Randomization of the continuous variable $ROAD_{dot}(\%)$



Note: The gray bars in Figure A3.3 display the distribution of β_1 coefficient estimates resulting from 500 random sub-samples which correspond to 50% of the total sample. The orange line highlights the baseline coefficient estimate of Table 3.1. For the estimations in Panel A specification (3) and for Panel B specification (5) of the baseline Table 3.1 is utilized. Following, the full set of fixed effects, i.e. origin-time, destination-time, NUTS-2-pair and country-pair-time, are applied as well as the interaction of the $ROAD_{dot}$ with bilateral travel times is included.

Table A3.9: Effect Heterogeneity between Directly and Indirectly Affected NUTS-2 Pairs

Dependent Variable: Trade between o and d in t				
Model:	PPML			
Sample:	Indirect	Full	Indirect	Full
Specification:	(1)	(2)	(3)	(4)
Binary variable:				
$ROAD_{dot}$ (0/1)	0.5035**	0.1586		
	(.2090)	(.1104)		
$ROAD_{dot}$ (0/1) $\not\subset do$		−0.0258		
		(.0282)		
Continuous variable:				
$ROAD_{dot}$ (%)			0.2672	0.2244***
			(.3197)	(.0860)
$ROAD_{dot}$ (%) $\not\subset do$				−0.2895
				(.2719)
Control variables:				
$\ln(TIME_{dot})$	−0.1828***	−0.2281***	−0.1837***	−0.1726**
	(.0633)	(.0720)	(.0633)	(.0777)
$ROAD_{dot} \times \ln(TIME_{dot})$	−0.0785**	−0.0216	0.0006	0.0026
	(.0330)	(.0195)	(.0041)	(.0029)
Fixed Effects:				
Origin-time	✓	✓	✓	✓
Destination-time	✓	✓	✓	✓
NUTS-2-pair	✓	✓	✓	✓
Country-pair-time	✓	✓	✓	✓
Summary Statistics:				
Observations	173,519	234,564	173,519	234,564
(Pseudo-)R^2	0.9958	0.9954	0.9958	0.9954

Note: Standard errors in parentheses and clustered at NUTS-2-pair-level. Significance: * $p < 0.10$, ** $p < .05$, *** $p < .01$. The sub-sample of indirectly affected NUTS-2 pairs refer to pairs where the completed road segment is not within the region of origin or destination.

Table A3.10: Effect Heterogeneity between Country Groups

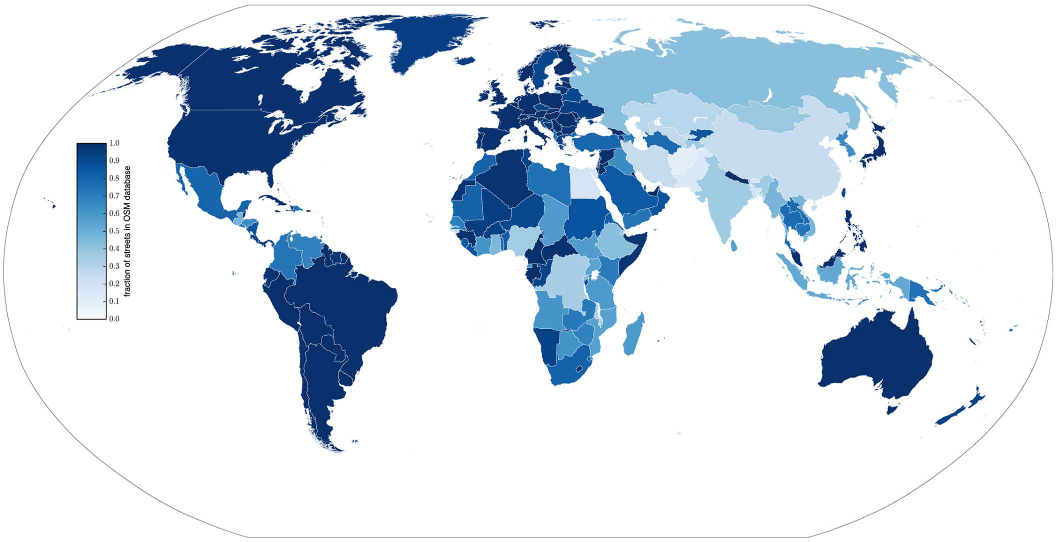
Dependent Variable: Trade between origin o and destination d in year t				
Model:	PPML			
Specification:	(1)	(2)	(3)	(4)
Binary variable:				
$ROAD_{dot}$ (0/1)	0.1944*	0.2462**		
	(.1049)	(.1066)		
$ROAD_{dot}$ (0/1)#$COHESION_{do}$	−0.0240			
	(.0298)			
$ROAD_{dot}$ (0/1)#$EAST_{do}$		−0.0616**		
		(.0305)		
Continuous variable:				
$ROAD_{dot}$ (%)			0.7188***	0.6484***
			(.1524)	(.1005)
$ROAD_{dot}$ (%)#$COHESION_{do}$			−0.5302***	
			(.1635)	
$ROAD_{dot}$ (%)#$EAST_{do}$				−0.5307***
				(.1322)
Control variables:				
$\ln(TIME_{dot})$	−0.2278***	−0.2292***	−0.1798**	−0.2004***
	(.0721)	(.0722)	(.0775)	(.0778)
$ROAD_{dot} \times \ln(TIME_{dot})$	−0.0258	−0.0331*	−0.0002	−0.0014
	(.0183)	(.0183)	(.0028)	(.0029)
Fixed Effects:				
Origin-time	✓	✓	✓	✓
Destination-time	✓	✓	✓	✓
NUTS-2-pair	✓	✓	✓	✓
Country-pair-time	✓	✓	✓	✓
Summary Statistics:				
Observations	234,564	234,564	234,564	234,564
(Pseudo-)R^2	0.9954	0.9954	0.9954	0.9954

Note: Standard errors in parentheses and clustered at NUTS-2-pair-level. Significance: * $p < 0.10$, ** $p < .05$, *** $p < .01$.

A3.2 Supplementary Material

A3.2.1 Data

Figure A3.4: Completeness of the OpenStreetMap Data



Note: Figure A3.4 is sourced from Barrington-Leigh and Millard-Ball (2017): and shows Figure 5 of their paper. The Figure shows the completeness of the OpenStreetMap data by country as of 2016.

Table A3.11: List of NUTS-2 Regions and Local Administrative Units

NUTS-2 region		LAU/ (city)
AT11	Burgenland	Eisenstadt, Neusiedl am See, Oberwart, Mattersburg, Pinkafeld, Parndorf, Neudörfl, Jennersdorf, Gols, Güssing
AT12	Niederösterreich	St. Pölten, Wiener Neustadt, Klosterneuburg, Baden, Krems an der Donau, Amstetten, Mödling, Traiskirchen, Schwechat, Stockerau
AT13	Wien	Wien
AT21	Kärnten	Klagenfurt am Wörthersee, Villach, Wolfsberg, Spittal an der Drau, Feldkirchen in Kärnten, St. Veit an der Glan, Völkermarkt, Sankt Andrä, Velden am Wörther See, Finkenstein am Faaker See
AT22	Steiermark	Graz, Leoben, Kapfenberg, Bruck an der Mur, Feldbach, Gratwein-Straßengel, Knittelfeld, Leibnitz, Deutschlandsberg, Weiz
AT31	Oberösterreich	Linz, Wels, Steyr, Leonding, Traun, Braunau am Inn, Ansfelden, Bad Ischl, Marchtrenk, Gmunden
AT32	Salzburg	Salzburg, Hallein, Saalfelden am Steinernen Meer, Wals-Siezenheim, Sankt Johann im Pongau, Seekirchen am Wallersee, Bischofshofen, Zell am See, Straßwalchen, Grödig
AT33	Tirol	Innsbruck, Kufstein, Telfs, Hall in Tirol, Schwaz, Wörgl, Lienz, Imst, St. Johann in Tirol, Rum
AT34	Vorarlberg	Dornbirn, Feldkirch, Bregenz, Lustenau, Hohenems, Bludenz, Hard, Rankweil, Götzis, Lauterach
BE10	Région de Bruxelles-Capitale	Brussel, Schaarbeek, Anderlecht, Sint-Jans-Molenbeek, Elsene, Ukkel, Vorst, Sint-Lambrechts-Woluwe, Jette, Sint-Gillis
BE21	Prov. Antwerpen	Anvers, Malines, Turnhout, Heist-op-den-Berg, Geel, Brasschaat, Mol, Lierre, Schoten, Brecht
BE22	Prov. Limburg (BE)	Hasselt, Genk, Beringen, Saint-Trond, Maasmechelen, Lommel, Heusden-Zolder, Bilzen, Houthalen-Helchteren, Tongres
BE23	Prov. Oost-Vlaanderen	Gand, Alost, Saint-Nicolas, Beveren, Termonde, Lokeren, Ninove, Evergem, Grammont, Audenarde
BE24	Prov. Vlaams-Brabant	Louvain, Vilvorde, Dilbeek, Hal, Grimbergen, Tirlemont, Sint-Pieters-Leeuw, Zaventem, Asse, Aarschot
BE25	Prov. West-Vlaanderen	Bruges, Courtrai, Ostende, Roulers, Waregem, Ypres, Menin, Knokke-Heist, Wevelgem, Harelbeke
BE31	Prov. Brabant Wallon	Eigenbrakel, Waver, Ottignies-Louvain-la-Neuve, Waterloo, Nijvel, Tubeke, Rixensart, Genepiën, Geldenaken, Lasne
BE32	Prov. Hainaut	Charleroi, Bergen, La Louvière, Doornik, Moeskroen, Châtelet, Binche, Courcelles, Aat, Zinnik
BE33	Prov. Liège	Luik, Seraing, Verviers, Herstal, Ans, Flémalle, Oupeye, Saint-Nicolas, Grâce-Hollogne, Hoei
BE34	Prov. Luxembourg (BE)	Aarlen, Marche-en-Famenne, Aubange, Bastenaken, Durbuy, Virton, Libramont-Chevigny, Bertrix, Habay, Messancy
BE35	Prov. Namur	Namen, Sambreville, Andenne, Gembloux, Jemeppe-sur-Sambre, Walcourt, Ciney, Eghezée, Couvin, Dinant

Table A3.11: List of NUTS-2 Regions and Local Administrative Units (continued)

NUTS-2 region		LAU/ (city)
BG31	Severozapaden	Pleven, Vratsa, Vidin, Montana, Lovech, Troyan, Lom, Cherven bryag, Byala Slatina, Kozloduy
BG32	Severen tsentralen	Ruse, Veliko Tarnovo, Gabrovo, Razgrad, Silistra, Gorna Oryahovitsa, Svishtov, Sevlievo, Dulovo, Pavlikeni
BG33	Severoiztochen	Varna, Shumen, Dobrich, Targovishte, Popovo, Provadia, Omurtag, Aksakovo, Balchik, Dolni chiflik
BG34	Yugoiztochen	Burgas, Stara Zagora, Sliven, Yambol, Kazanlak, Nova Zagora, Aytos, Ruen, Pomorie, Nesebar
BG41	Yugozapaden	Sofia, Pernik, Blagoevgrad, Kyustendil, Petrich, Dupnitsa, Sandanski, Samokov, Botevgrad, Gotse Delchev
BG42	Yuzhen tsentralen	Plovdiv, Pazardzhik, Haskovo, Kardzhali, Asenovgrad, Karlovo, Dimitrovgrad, Smolyan, Velingrad, Maritsa
CZ01	Praha	Praha
CZ02	Střední Čechy	Kladno, Mladá Boleslav, Příbram, Kolín, Kutná Hora, Beroun, Mělník, Brandýs nad Labem-Stará Boleslav, Kralupy nad Vltavou, Benešov
CZ03	Jihozápad	Plzeň, České Budějovice, Tábor, Písek, Strakonice, Klatovy, Jindřichův Hradec, Rokycany, Český Krumlov, Tachov
CZ04	Severozápad	Ústí nad Labem, Most, Teplice, Děčín, Karlovy Vary, Chomutov, Cheb, Litvínov, Litoměřice, Sokolov
CZ05	Severovýchod	Liberec, Hradec Králové, Pardubice, Jablonec nad Nisou, Česká Lípa, Trutnov, Chrudim, Náchod, Svitavy, Jičín
CZ06	Jihovýchod	Brno, Jihlava, Třebíč, Znojmo, Břeclav, Hodonín, Havlíčkův Brod, Žďár nad Sázavou, Vyškov, Blansko
CZ07	Střední Morava	Olomouc, Zlín, Prostějov, Přerov, Kroměříž, Šumperk, Vsetín, Uherské Hradiště, Valašské Meziříčí, Hranice
CZ08	Moravskoslezsko	Ostrava, Havířov, Opava, Frýdek-Místek, Karviná, Třinec, Orlová, Český Těšín, Krnov, Nový Jičín
DE11	Stuttgart	Stuttgart, Heilbronn, Ludwigsburg, Esslingen am Neckar, Aalen, Sindelfingen, Schwäbisch Gmünd, Göppingen, Waiblingen, Böblingen
DE12	Karlsruhe	Karlsruhe, Mannheim, Heidelberg, Pforzheim, Baden-Baden, Rastatt, Weinheim, Bruchsal, Ettlingen, Sinsheim
DE13	Freiburg	Freiburg im Breisgau, Villingen-Schwenningen, Konstanz, Offenburg, Lörrach, Singen (Hohentwiel), Lahr/Schwarzwald, Kehl, Tuttlingen, Rheinfelden (Baden)
DE14	Tübingen	Ulm, Reutlingen, Tübingen, Friedrichshafen, Ravensburg, Albstadt, Rottenburg am Neckar, Balingen, Biberach an der Riß, Wangen im Allgäu
DE21	Oberbayern	München, Ingolstadt, Rosenheim, Freising, Dachau, Germering, Fürstenfeldbruck, Erding, Neuburg a.d.Donau, Landsberg am Lech
DE22	Niederbayern	Landshut, Passau, Straubing, Deggendorf, Dingolfing, Kelheim, Vilshofen an der Donau, Pocking, Mainburg, Neustadt a.d.Donau

Table A3.11: List of NUTS-2 Regions and Local Administrative Units (continued)

NUTS-2 region	LAU/ (city)
DE23 Oberpfalz	Regensburg, Weiden i.d.OPf., Amberg, Neumarkt i.d.OPf., Schwandorf, Sulzbach-Rosenberg, Cham, Regenstauf, Neutraubling, Lappersdorf
DE24 Oberfranken	Bamberg, Bayreuth, Hof, Coburg, Forchheim, Kulmbach, Lichtenfels, Marktredwitz, Kronach, Neustadt b.Coburg
DE25 Mittelfranken	Nürnberg, Fürth, Erlangen, Ansbach, Schwabach, Lauf a.d.Pegnitz, Zirndorf, Roth, Herzogenaurach, Weißenburg i.Bay.
DE26 Unterfranken	Würzburg, Aschaffenburg, Schweinfurt, Bad Kissingen, Kitzingen, Alzenau, Großostheim, Bad Neustadt a.d.Saale, Lohr a.Main, Karlstadt
DE27 Schwaben	Augsburg, Kempten (Allgäu), Neu-Ulm, Memmingen, Kaufbeuren, Friedberg, Königsbrunn, Lindau (Bodensee), Senden, Gersthofen
DE30 Berlin	Berlin
DE40 Brandenburg	Potsdam, Cottbus, Brandenburg an der Havel, Frankfurt (Oder), Oranienburg, Falkensee, Eberswalde, Bernau bei Berlin, Königs Wusterhausen, Fürstenwalde/Spree
DE50 Bremen	Bremen, Bremerhaven
DE60 Hamburg	Hamburg
DE71 Darmstadt	Frankfurt am Main, Wiesbaden, Darmstadt, Offenbach am Main, Hanau, Rüsselsheim am Main, Bad Homburg v. d. Höhe, Oberursel (Taunus), Rodgau, Dreieich
DE72 Gießen	Gießen, Marburg, Wetzlar, Limburg a.d. Lahn, Dillenburg, Stadtallendorf, Herborn, Haiger, Pohlheim, Kirchhain
DE73 Kassel	Kassel, Fulda, Bad Hersfeld, Baunatal, Korbach, Eschwege, Schwalmstadt, Vellmar, Frankenberg (Eder), Bad Wildungen
DE80 Mecklenburg-Vorpommern	Rostock, Schwerin, Neubrandenburg, Stralsund, Greifswald, Wismar, Güstrow, Waren (Müritz), Neustrelitz, Parchim
DE91 Braunschweig	Braunschweig, Wolfsburg, Göttingen, Salzgitter, Wolfenbüttel, Goslar, Peine, Gifhorn, Einbeck, Northeim
DE92 Hannover	Hannover, Hildesheim, Garbsen, Hameln, Langenhagen, Neustadt am Rübenberge, Lehrte, Wunstorf, Laatzen, Barsinghausen
DE93 Lüneburg	Lüneburg, Celle, Cuxhaven, Stade, Seevetal, Buxtehude, Buchholz in der Nordheide, Winsen (Luhe), Uelzen, Achim
DE94 Weser-Ems	Oldenburg (Oldenburg), Osnabrück, Delmenhorst, Wilhelmshaven, Lingen (Ems), Nordhorn, Emden, Melle, Aurich, Papenburg
DEA1 Düsseldorf	Düsseldorf, Essen, Duisburg, Wuppertal, Mönchengladbach, Krefeld, Oberhausen, Mülheim an der Ruhr, Solingen, Neuss
DEA2 Köln	Köln, Bonn, Aachen, Leverkusen, Bergisch Gladbach, Düren, Troisdorf, Kerpen, Bergheim, Hürth
DEA3 Münster	Münster, Gelsenkirchen, Bottrop, Recklinghausen, Marl, Gladbeck, Rheine, Dorsten, Castrop-Rauxel, Bocholt
DEA4 Detmold	Bielefeld, Paderborn, Gütersloh, Minden, Detmold, Herford, Bad Salzuflen, Bad Oeynhausen, Rheda-Wiedenbrück, Bünde

Table A3.11: List of NUTS-2 Regions and Local Administrative Units (continued)

NUTS-2 region		LAU/ (city)
DEA5	Arnsberg	Dortmund, Bochum, Hagen, Hamm, Herne, Siegen, Witten, Iserlohn, Lünen, Arnsberg
DEB1	Koblenz	Koblenz, Neuwied, Bad Kreuznach, Andernach, Idar-Oberstein, Bad Neuenahr-Ahrweiler, Mayen, Lahnstein, Sinzig, Bendorf
DEB2	Trier	Trier, Wittlich, Konz, Bitburg, Morbach, Daun, Schweich, Gerolstein, Saarburg, Bernkastel-Kues
DEB3	Rheinhessen-Pfalz	Mainz, Ludwigshafen am Rhein, Kaiserslautern, Worms, Neustadt an der Weinstraße, Speyer, Frankenthal (Pfalz), Landau in der Pfalz, Pirmasens, Zweibrücken
DEC0	Saarland	Saarbrücken, Neunkirchen, Homburg, Völklingen, St. Ingbert, Saarlouis, Merzig, St. Wendel, Blieskastel, Dillingen/ Saar
DED2	Dresden	Dresden, Görlitz, Bautzen, Freital, Pirna, Radebeul, Hoyerswerda, Riesa, Meißen, Zittau
DED4	Chemnitz	Chemnitz, Zwickau, Plauen, Freiberg, Limbach-Oberfrohna, Döbeln, Glauchau, Reichenbach im Vogtland, Werdau, Annaberg-Buchholz
DED5	Leipzig	Leipzig, Grimma, Delitzsch, Markkleeberg, Torgau, Borna, Schkeuditz, Wurzen, Eilenburg, Markranstädt
DEE0	Sachsen-Anhalt	Magdeburg, Halle (Saale), Dessau-Roßlau, Wittenberg, Halberstadt, Weißenfels, Stendal, Bitterfeld-Wolfen, Merseburg, Bernburg (Saale)
DEF0	Schleswig-Holstein	Kiel, Lübeck, Flensburg, Neumünster, Norderstedt, Elmshorn, Pinneberg, Wedel, Ahrensburg, Itzehoe
DEG0	Thüringen	Erfurt, Jena, Gera, Weimar, Gotha, Eisenach, Nordhausen, Suhl, Mühlhausen/Thüringen, Altenburg
DK01	Hovedstaden	København, Frederiksberg, Gentofte, Gladsaxe, Helsingør, Rudersdal, Lyngby-Taarbæk, Hvidovre, Høje-Taastrup, Hillerød
DK02	Sjælland	Roskilde, Næstved, Slagelse, Holbæk, Guldborgsund, Køge, Greve, Kalundborg, Vordingborg, Lolland
DK03	Syddanmark	Odense, Esbjerg, Vejle, Kolding, Sønderborg, Aabenraa, Svendborg, Haderslev, Faaborg-Midtfyn, Fredericia
DK04	Midtjylland	Aarhus, Randers, Viborg, Silkeborg, Horsens, Herning, Skanderborg, Holstebro, Ringkøbing-Skjern, Favrskov
DK05	Nordjylland	Aalborg, Hjørring, Frederikshavn, Thisted, Mariagerfjord, Jammerbugt, Vesthimmerlands, Brønderslev, Rebild, Morsø
EE00	Eesti	Tallinn, Tartu, Narva, Pärnu, Kohtla-Järve, Viimsi, Viljandi, Rae, Rakvere, Maardu
EL30	Attiki	Athens, Pireaeus, Peristeri, Acharnes, Kallithea, Nikea, Glyfada, Ilio, Ilioupoli, Keratsini
EL51	Anatoliki Makedonia, Thraki	Alexandroupoli, Kavala, Xanthi, Komotini, Drama, Orestiada, Didymoticho, Chrysoupoli, Myki, Feres
EL52	Kentriki Makedonia	Thessaloniki, Kalamaria, Evosmos, Serres, Katerini, Stavroupoli, Veria, Polichni, Sykies, Ampelokipoi
EL53	Dytiki Makedonia	Kozani, Ptolemaida, Florina, Kastoria, Grevena, Argos Orestiko, Siatista, Amyndeo, Deskati, Servia

Table A3.11: List of NUTS-2 Regions and Local Administrative Units (continued)

NUTS-2 region		LAU/ (city)
EL54	Ipeiros	Ioannina, Arta, Preveza, Igoumenitsa, Anatoli, Marmara, Filippiada, Stavraki, Peta, Katsikas
EL61	Thessalia	Larisa, Volos, Trikala, Karditsa, Nea Ionia, Tyrnavos, Farsala, Kalabaka, Almyros, Elassona
EL63	Dytiki Ellada	Patra, Agrinio, Pyrgos, Aegio, Amaliada, Mesolongi, Nafpaktos, Gastouni, Kato Achaia, Aghios Konstantinos
EL64	Sterea Ellada	Chalkida, Lamia, Thiva, Levadia, Nea Artaki, Karpenisi, Schimatari, Amfissa, Vassiliko, Eretria
EL65	Peloponnisos	Kalamata, Tripoli, Korinthos, Argos, Sparti, Nafplio, Loutraki-Perachora, Sikyona (Kiato), Filiatra, Messini
ES11	Galicia	Vigo, A Coruña, Ourense, Lugo, Santiago de Compostela, Pontevedra, Ferrol, Narón, Vilagarcía de Arousa, Oleiros
ES12	Principado de Asturias	Gijón, Oviedo, Avilés, Siero, Langreo, Mieres, Castrillón, San Martín del Rey Aurelio, Corvera de Asturias, Villaviciosa
ES13	Cantabria	Santander, Torrelavega, Castro-Urdiales, Camargo, Piélagos, El Astillero, Santa Cruz de Bezana, Laredo, Santoña, Los Corrales de Buelna
ES21	País Vasco	Bilbao, Vitoria-Gasteiz, San Sebastián, Barakaldo, Getxo, Irun, Portugalete, Santurtzi, Basauri, Errenteria
ES22	Comunidad Foral de Navarra	Iruña, Tudela, Eguesibar, Barañain, Burlata, Zizur Nagusia, Estella-Lizarra, Antsoain, Tafalla, Aranguren
ES23	La Rioja	Logroño, Calahorra, Arnedo, Haro, Lardero, Alfaro, Nájera, Villamediana de Iregua, Santo Domingo de la Calzada, Autol
ES24	Aragón	Zaragoza, Huesca, Teruel, Calatayud, Utebo, Monzón, Barbastro, Ejea de los Caballeros, Alcañiz, Fraga
ES30	Comunidad de Madrid	Madrid, Móstoles, Fuenlabrada, Alcalá de Henares, Leganés, Getafe, Alcorcón, Torrejón de Ardoz, Parla, Alcobendas
ES41	Castilla y León	Valladolid, Burgos, Salamanca, León, Palencia, Ponferrada, Zamora, Ávila, Segovia, Soria
ES42	Castilla-La Mancha	Albacete, Guadalajara, Toledo, Talavera de la Reina, Ciudad Real, Cuenca, Puertollano, Tomelloso, Azuqueca de Henares, Alcázar de San Juan
ES43	Extremadura	Badajoz, Cáceres, Mérida, Plasencia, Don Benito, Almendralejo, Villanueva de la Serena, Navalmoral de la Mata, Zafra, Montijo
ES51	Cataluña	Barcelona, L' Hospitalet de Llobregat, Terrassa, Badalona, Sabadell, Lleida, Tarragona, Mataró, Santa Coloma de Gramenet, Reus
ES52	Comunidad Valenciana	Valencia, Alacant, Elx, Castelló de la Plana, Torrevieja, Torrent, Orihuela, Gandia, Paterna, Benidorm
ES61	Andalucía	Sevilla, Málaga, Córdoba, Granada, Jerez de la Frontera, Almería, Huelva, Marbella, Dos Hermanas, Algeciras
ES62	Región de Murcia	Murcia, Cartagena, Lorca, Molina de Segura, Alcantarilla, Torre-Pacheco, Cieza, Águilas, Yecla, San Javier

Table A3.11: List of NUTS-2 Regions and Local Administrative Units (continued)

NUTS-2 region		LAU/ (city)
FI18	Etelä-Suomi	Helsingfors, Esbo, Vanda, Åbo, Lahtis, Kouvola, Villmanstrand, Tavastehus, Kotka, Salo
FI19	Länsi-Suomi	Tammerfors, Jyväskylä, Björneborg, Vasa, Seinäjoki, Raumo, Nokia, Ylöjärvi, Kangasala, Sastamala
FI1D	Pohjois- ja Itä-Suomi	Uleåborg, Kuopio, Joensuu, Rovaniemi, S:t Michel, Karleby, Kajana, Nyslott, Brahestad, Torneå
FR10	Ile-de-France	Boulogne-Billancourt, Saint-Denis, Argenteuil, Montreuil, Nanterre, Vitry-sur-Seine, Créteil, Asnières-sur-Seine, Versailles, Paris
FRB0	Centre - Val de Loire	Tours, Orléans, Bourges, Blois, Châteauroux, Chartres, Joué-lès-Tours, Dreux, Vierzon, Olivet
FRC1	Bourgogne	Dijon, Chalon-sur-Saône, Auxerre, Nevers, Mâcon, Sens, Creusot, Beaune, Montceau-les-Mines, Chenôve
FRC2	Franche-Comté	Besançon, Belfort, Montbéliard, Dole, Lons-le-Saunier, Pontarlier, Vesoul, Audincourt, Valentigney, Héricourt
FRD1	Basse-Normandie	Caen, Cherbourg-en-Cotentin, Alençon, Hérouville-Saint-Clair, Lisieux, Saint-Lô, Vire Normandie, Flers, Argentan, Bayeux
FRD2	Haute-Normandie	Havre, Rouen, Évreux, Dieppe, Sotteville-lès-Rouen, Saint-Étienne-du-Rouvray, Grand-Quevilly, Vernon, Petit-Quevilly, Mont-Saint-Aignan
FRE1	Nord-Pas de Calais	Lille, Tourcoing, Roubaix, Dunkerque, Calais, Villeneuve-d'Ascq, Valenciennes, Boulogne-sur-Mer, Wattrelos, Arras
FRE2	Picardie	Amiens, Saint-Quentin, Beauvais, Compiègne, Creil, Soissons, Laon, Abbeville, Nogent-sur-Oise, Crépy-en-Valois
FRF1	Alsace	Strasbourg, Mulhouse, Colmar, Haguenau, Schiltigheim, Illkirch-Graffenstaden, Saint-Louis, Sélestat, Lingolsheim, Bischheim
FRF2	Champagne-Ardenne	Reims, Troyes, Charleville-Mézières, Châlons-en-Champagne, Saint-Dizier, Épernay, Chaumont, Sedan, Romilly-sur-Seine, Vitry-le-François
FRF3	Lorraine	Metz, Nancy, Thionville, Épinal, Vandœuvre-lès-Nancy, Forbach, Montigny-lès-Metz, Sarreguemines, Saint-Dié-des-Vosges, Lunéville
FRG0	Pays de la Loire	Nantes, Angers, Mans, Saint-Nazaire, Cholet, Roche-sur-Yon, Laval, Saint-Herblain, Rezé, Saumur
FRH0	Bretagne	Rennes, Brest, Quimper, Lorient, Vannes, Saint-Malo, Saint-Brieuc, Lanester, Fougères, Lannion
FRI1	Aquitaine	Bordeaux, Pau, Mérignac, Pessac, Bayonne, Talence, Anglet, Agen, Villenave-d'Ornon, Mont-de-Marsan
FRI2	Limousin	Limoges, Brive-la-Gaillarde, Tulle, Guéret, Saint-Junien, Panazol, Ussel, Couzeix, Malemort, Isle
FRI3	Poitou-Charentes	Poitiers, Rochelle, Niort, Angoulême, Châtellerault, Saintes, Rochefort, Bressuire, Cognac, Royan
FRJ1	Languedoc-Roussillon	Montpellier, Nîmes, Perpignan, Béziers, Narbonne, Carcassonne, Sète, Alès, Agde, Lunel
FRJ2	Midi-Pyrénées	Toulouse, Montauban, Albi, Castres, Tarbes, Colomiers, Tournefeuille, Muret, Rodez, Blagnac

Table A3.11: List of NUTS-2 Regions and Local Administrative Units (continued)

NUTS-2 region	LAU/ (city)
FRK1 Auvergne	Clermont-Ferrand, Montluçon, Aurillac, Vichy, Cournon-d'Auvergne, Moulins, Riom, Puy-en-Velay, Chamalières, Issoire
FRK2 Rhône-Alpes	Lyon, Saint-Étienne, Grenoble, Villeurbanne, Annecy, Vénissieux, Valence, Chambéry, Vaulx-en-Velin, Saint-Priest
FRL0 Provence-Alpes-Côte d'Azur	Marseille, Nice, Toulon, Aix-en-Provence, Avignon, Antibes, Cannes, Seyne-sur-Mer, Hyères, Fréjus
HR03 Jadranska Hrvatska	Split, Rijeka, Zadar, Pula - pola, Šibenik, Dubrovnik, Kaštela, Sinj, Solin, Metković
HR04 Kontinentalna Hrvatska	Grad zagreb, Osijek, Velika gorica, Slavonski brod, Karlovac, Sisak, Varaždin, Bjelovar, Samobor, Vinkovci
HU10 Pest	Budapest, Érd, Dunakeszi, Szigetszentmiklós, Cegléd, Vác, Gödöllő, Budaörs, Szentendre, Nagykőrös
HU21 Közép-Dunántúl	Székesfehérvár, Tatabánya, Veszprém, Dunaújváros, Pápa, Ajka, Esztergom, Tata, Várpalota, Komárom
HU22 Nyugat-Dunántúl	Győr, Szombathely, Sopron, Zalaegerszeg, Nagykanizsa, Mosonmagyaróvár, Keszthely, Sárvár, Kőszeg, Körmend
HU23 Dél-Dunántúl	Pécs, Kaposvár, Szekszárd, Siófok, Komló, Paks, Dombóvár, Mohács, Bonyhád, Marcali
HU31 Észak-Magyarország	Miskolc, Eger, Salgótarján, Ózd, Gyöngyös, Kazincbarcika, Hatvan, Mezőkövesd, Tiszaújváros, Balassagyarmat
HU32 Észak-Alföld	Debrecen, Nyíregyháza, Szolnok, Hajdúböszörmény, Jászberény, Hajdúszoboszló, Törökszentmiklós, Karcag, Balmazújváros, Hajdúnánás
HU33 Dél-Alföld	Szeged, Kecskemét, Békéscsaba, Hódmezővásárhely, Baja, Gyula, Kiskunfélegyháza, Orosháza, Kiskunhalas, Szentes
ITC1 Piemonte	Torino, Novara, Alessandria, Asti, Moncalieri, Cuneo, Collegno, Rivoli, Nichelino, Settimo Torinese
ITC2 Valle d'Aosta/Vallée d'Aoste	Aosta, Sarre, Châtillon, Saint-Vincent, Quart, Pont-Saint-Martin, Saint-Christophe, Gressan, Saint-Pierre, Nus
ITC3 Liguria	Genova, La Spezia, Savona, Sanremo, Imperia, Rapallo, Chiavari, Ventimiglia, Albenga, Sarzana
ITC4 Lombardia	Milano, Brescia, Monza, Bergamo, Como, Busto Arsizio, Sesto San Giovanni, Varese, Cinisello Balsamo, Pavia
ITF1 Abruzzo	Pescara, L'Aquila, Teramo, Montesilvano, Chieti, Avezzano, Vasto, Lanciano, Roseto degli Abruzzi, Francavilla al Mare
ITF2 Molise	Campobasso, Termoli, Isernia, Venafro, Bojano, Campomarino, Larino, Montenero di Bisaccia, Guglionesi, Riccia
ITF3 Campania	Napoli, Salerno, Giugliano in Campania, Torre del Greco, Pozzuoli, Casoria, Caserta, Castellammare di Stabia, Afragola, Benevento
ITF4 Puglia	Bari, Taranto, Foggia, Andria, Lecce, Barletta, Brindisi, Altamura, Molfetta, Cerignola
ITF5 Basilicata	Potenza, Matera, Melfi, Pisticci, Policoro, Lavello, Rionero in Vulture, Lauria, Bernalda, Venosa
ITF6 Calabria	Reggio di Calabria, Catanzaro, Lamezia Terme, Cosenza, Crotone, Corigliano Calabro, Rossano, Rende, Vibo Valentia, Castrovillari

Table A3.11: List of NUTS-2 Regions and Local Administrative Units (continued)

NUTS-2 region		LAU/ (city)
ITG1	Sicilia	Palermo, Catania, Messina, Siracusa, Marsala, Gela, Ragusa, Trapani, Vittoria, Caltanissetta
ITH1	Provincia Autonoma di Bolzano/Bozen	Bolzano, Merano, Bressanone, Laives, Brunico, Appiano sulla strada del vino, Lana, Caldaro sulla strada del vino, Renon, Sarentino
ITH2	Provincia Autonoma di Trento	Trento, Rovereto, Pergine Valsugana, Arco, Riva del Garda, Mori, Ala, Lavis, Levico Terme, Mezzolombardo
ITH3	Veneto	Venezia, Verona, Padova, Vicenza, Treviso, Rovigo, Chioggia, Bassano del Grappa, San Donà di Piave, Schio
ITH4	Friuli-Venezia Giulia	Trieste, Udine, Pordenone, Gorizia, Monfalcone, Sacile, Cordenons, Codroipo, Azzano Decimo, Porcia
ITH5	Emilia-Romagna	Bologna, Parma, Modena, Reggio nell'Emilia, Ravenna, Rimini, Ferrara, Forlì, Piacenza, Cesena
ITI1	Toscana	Firenze, Prato, Livorno, Arezzo, Pisa, Pistoia, Lucca, Grosseto, Massa, Carrara
ITI2	Umbria	Perugia, Terni, Foligno, Città di Castello, Spoleto, Gubbio, Assisi, Bastia Umbra, Corciano, Orvieto
ITI3	Marche	Ancona, Pesaro, Fano, Ascoli Piceno, San Benedetto del Tronto, Senigallia, Civitanova Marche, Macerata, Jesi, Fermo
ITI4	Lazio	Roma, Latina, Guidonia Montecelio, Fiumicino, Aprilia, Viterbo, Pomezia, Tivoli, Anzio, Velletri
LT00	Lietuvo	Vilniaus, Kauno, Klaipėda, Šiauliai, Panevėžys, Marijampolė, Mažeikiai
LU00	Luxembourg	Luxembourg, Esch-sur-Alzette, Differdange, Dudelange, Pétange, Sanem, Hesperange, Bettembourg, Schifflange, Käerjeng
LV00	Latvija	Riga, Daugavpils, Liepaja, Jelgava, Jurmala, Ventspils, Ogres, Talsu, Tukuma, Rezekne
NL11	Groningen	Groningen, Oldambt, Hoogezand-Sappemeer, Stadskanaal, Veendam, Delfzijl, Leek, Haren, Zuidhorn, Vlagtwedde
NL12	Friesland (NL)	Leeuwarden, Súdwest-Fryslân, Smallingerland, De Fryske Marren, Heerenveen, Tytsjerksteradiel, Opsterland, Achtkarspelen, Weststellingwerf, Ooststellingwerf
NL13	Drenthe	Emmen, Assen, Hoogeveen, Coevorden, Midden-Drenthe, Tynaarlo, Meppel, Noordenveld, Borger-Odoorn, Aa en Hunze
NL21	Overijssel	Enschede, Zwolle, Deventer, Hengelo, Almelo, Hardenberg, Kampen, Steenwijkerland, Rijssen-Holten, Raalte
NL22	Gelderland	Nijmegen, Apeldoorn, Arnhem, Ede, Doetinchem, Barneveld, Overbetuwe, Zutphen, Harderwijk, Lingewaard
NL23	Flevoland	Almere, Lelystad, Noordoostpolder, Dronten, Zeewolde, Urk, , , ,
NL31	Utrecht	Utrecht, Amersfoort, Stichtse Vecht, Veenendaal, Zeist, Nieuwegein, Woerden, Houten, Utrechtse Heuvelrug, Soest
NL32	Noord-Holland	Amsterdam, Haarlem, Zaanstad, Haarlemmermeer, Alkmaar, Amstelveen, Hilversum, Purmerend, Hoorn, Velsen
NL33	Zuid-Holland	Rotterdam, 's-Gravenhage, Zoetermeer, Leiden, Dordrecht, Alphen aan den Rijn, Westland, Delft, Nissewaard, Schiedam

Table A3.11: List of NUTS-2 Regions and Local Administrative Units (continued)

NUTS-2 region	LAU/ (city)
NL34 Zeeland	Terneuzen, Middelburg, Vlissingen, Goes, Schouwen-Duiveland, Hulst, Tholen, Sluis, Borsele, Reimerswaal
NL41 Noord-Brabant	Eindhoven, Tilburg, Breda, 's-Hertogenbosch, Helmond, Oss, Meierijstad, Roosendaal, Bergen op Zoom, Oosterhout
NL42 Limburg (NL)	Maastricht, Venlo, Sittard-Geleen, Heerlen, Roermond, Weert, Kerkrade, Venray, Peel en Maas, Horst aan de Maas
PL12 Warszawski stołeczny	Warszawa, Radom, Płock, Piaseczno, Siedlce, Pruszków, Legionowo, Ostrołęka, Wołomin, Grodzisk Mazowiecki
PL21 Małopolskie	Kraków, Tarnów, Nowy Sącz, Wieliczka, Olkusz, Chrzanów, Andrychów, Myślenice, Skawina, Oświęcim
PL22 Śląskie	Katowice, Częstochowa, Sosnowiec, Gliwice, Zabrze, Bielsko-Biała, Bytom, Ruda Śląska, Rybnik, Tychy
PL41 Wielkopolskie	Poznań, Kalisz, Konin, Piła, Ostrów Wielkopolski, Gniezno, Leszno, Swarzędz, Września, Jarocin
PL42 Zachodniopomorskie	Szczecin, Koszalin, Stargard, Kołobrzeg, Police, Świnoujście, Szczecinek, Goleniów, Gryfino, Wałcz
PL43 Lubuskie	Zielona Góra, Gorzów Wielkopolski, Nowa Sól, Żary, Świebodzin, Sulechów, Żagań, Międzyrzecz, Wschowa, Szprotawa
PL51 Dolnośląskie	Wrocław, Wałbrzych, Legnica, Jelenia Góra, Lubin, Głogów, Świdnica, Bolesławiec, Oleśnica, Dzierżoniów
PL52 Opolskie	Opole, Kędzierzyn-Koźle, Nysa, Brzeg, Kluczbork, Strzelce Opolskie, Prudnik, Namysłów, Głuchołazy, Krapkowice
PL61 Kujawsko-pomorskie	Bydgoszcz, Toruń, Włocławek, Grudziądz, Inowrocław, Świecie, Nakło nad Notecią, Brodnica, Mogilno, Szubin
PL62 Warmińsko-mazurskie	Olsztyn, Elbląg, Ełk, Ostróda, Iława, Giżycko, Pisz, Kętrzyn, Morąg, Bartoszyce
PL63 Pomorskie	Gdańsk, Gdynia, Słupsk, Tczew, Wejherowo, Starogard Gdański, Rumia, Chojnice, Malbork, Kwidzyn
PL71 Łódzkie	Łódź, Piotrków Trybunalski, Pabianice, Tomaszów Mazowiecki, Bełchatów, Zgierz, Skierniewice, Radomsko, Kutno, Sieradz
PL72 Świętokrzyskie	Kielce, Ostrowiec Świętokrzyski, Starachowice, Skarżysko-Kamienna, Końskie, Busko-Zdrój, Jędrzejów, Staszów, Sandomierz, Pińczów
PL81 Lubelskie	Lublin, Zamość, Chełm, Biała Podlaska, Puławy, Świdnik, Kraśnik, Łuków, Biłgoraj, Łęczna
PL82 Podkarpackie	Rzeszów, Stalowa Wola, Przemyśl, Mielec, Tarnobrzeg, Krosno, Dębica, Sanok, Jarosław, Jasło
PL84 Podlaskie	Białystok, Suwałki, Łomża, Augustów, Sokółka, Bielsk Podlaski, Łapy, Zambrów, Grajewo, Hajnówka
PT11 Norte	Tabuaço, Boticas, Penedono, Carrazeda de Ansiães, Freixo de Espada à Cinta, Murça, Sabrosa, Vimioso, Mesão Frio, Alfândega da Fé
PT15 Algarve	Monchique, Tavira, Vila Real de Santo António, Aljezur, Vila do Bispo, São Brás de Alportel, Lagos, Lagoa, Castro Marim, Alcoutim

Table A3.11: List of NUTS-2 Regions and Local Administrative Units (continued)

NUTS-2 region		LAU/ (city)
PT16	Centro (PT)	Pedrógão Grande, Vila Velha de Ródão, Góis, Manteigas, Castanheira de Pera, Sardoal, Pampilhosa da Serra, Fornos de Algodres, Vila de Rei, Constância
PT17	Área Metropolitana de Lisboa	Odivelas, Barreiro, Moita, Mafra, Montijo, Vila Franca de Xira, Alcochete, Setúbal, Palmela, Sesimbra
PT18	Alentejo	Arronches, Marvão, Alter do Chão, Mourão, Fronteira, Barrancos, Monforte, Castelo de Vide, Alvito, Crato
RO11	Nord-Vest	Cluj-Napoca, Oradea, Baia Mare, Satu Mare, Bistrita, Zalau, Turda, Sighetu Marmatiei, Dej, Floresti
RO12	Centru	Brasov, Sibiu, Targu Mures, Alba Iulia, Sfantul Gheorghe, Medias, Miercurea Ciuc, Fagaras, Odorheiu Secuiesc, Reghin
RO21	Nord-Est	Iasi, Bacau, Botosani, Suceava, Piatra Neamt, Vaslui, Birlad, Roman, Onesti, Pascani
RO22	Sud-Est	Constanta, Galati, Braila, Buzau, Focsani, Tulcea, Medgidia, Tecuci, Mangalia, Navodari
RO31	Sud - Muntenia	Ploiesti, Pitesti, Targoviste, Calarasi, Giurgiu, Slobozia, Alexandria, Campina, Campulung, Fetesti
RO32	Bucureşti - Ilfov	Bucuresti, Voluntari, Popesti Leordeni, Pantelimon, Buftea, Chiajna, Bragadiru, Otopeni, Chitila, Magurele
RO41	Sud-Vest Oltenia	Craiova, Ramnicu Valcea, Drobeta-Turnu Severin, Targu Jiu, Slatina, Caracal, Motru, Bals, Dragasani, Bailesti
RO42	Vest	Timisoara, Arad, Resita, Hunedoara, Deva, Lugoj, Petrosani, Caransebes, Vulcan, Lupeni
SE11	Stockholm	Stockholm, Huddinge, Nacka, Södertälje, Botkyrka, Haninge, Solna, Järfälla, Sollentuna, Täby
SE12	Östra Mellansverige	Uppsala, Linköping, Västerås, Örebro, Norrköping, Eskilstuna, Nyköping, Motala, Enköping, Strängnäs
SE21	Småland med öarna	Jönköping, Växjö, Kalmar, Gotland, Västervik, Värnamo, Nässjö, Gislaved, Ljungby, Vetlanda
SE22	Sydsverige	Malmö, Helsingborg, Lund, Kristianstad, Karlskrona, Hässleholm, Landskrona, Trelleborg, Ängelholm, Vellinge
SE23	Västsverige	Göteborg, Borås, Halmstad, Kungsbacka, Mölndal, Varberg, Trollhättan, Uddevalla, Skövde, Falkenberg
SE31	Norra Mellansverige	Gävle, Karlstad, Falun, Borlänge, Sandviken, Hudiksvall, Ludvika, Bollnäs, Arvika, Söderhamn
SE32	Mellersta Norrland	Sundsvall, Östersund, Örnsköldsvik, Härnösand, Sollefteå, Kramfors, Timrå, Krokom, Strömsund, Åre
SE33	Övre Norrland	Umeå, Luleå, Skellefteå, Piteå, Boden, Kiruna, Gällivare, Kalix, Lycksele, Haparanda
SI03	Vzhodna Slovenija	Maribor, Celje, Novo mesto, Velenje, Krško, Slovenska Bistrica, Brežice, Ptuj, Žalec, Šentjur
SI04	Zahodna Slovenija	Ljubljana, Kranj, Koper/Capodistria, Domžale, Nova Gorica, Kamnik, Škofja Loka, Jesenice, Grosuplje, Ajdovščina

Table A3.11: List of NUTS-2 Regions and Local Administrative Units (continued)

NUTS-2 region		LAU/ (city)
SK01	Bratislavský kraj	Bratislava, Pezinok, Senec, Malacky, Stupava, Modra, Bernolákovo, Ivanka pri Dunaji, Dunajská Lužná, Svätý Jur
SK02	Západné Slovensko	Nitra, Trnava, Trenčín, Prievidza, Považská Bystrica, Nové Zámky, Komárno, Levice, Piešťany, Topoľčany
SK03	Stredné Slovensko	Žilina, Banská Bystrica, Martin, Zvolen, Liptovský Mikuláš, Lučenec, Ružomberok, Čadca, Rimavská Sobota, Brezno
SK04	Východné Slovensko	Prešov, Poprad, Košice, Michalovce, Spišská Nová Ves, Humenné, Bardejov, Trebišov, Vranov nad Topľou, Snina

Table A3.12: Correlations of Duration and Distance Measures

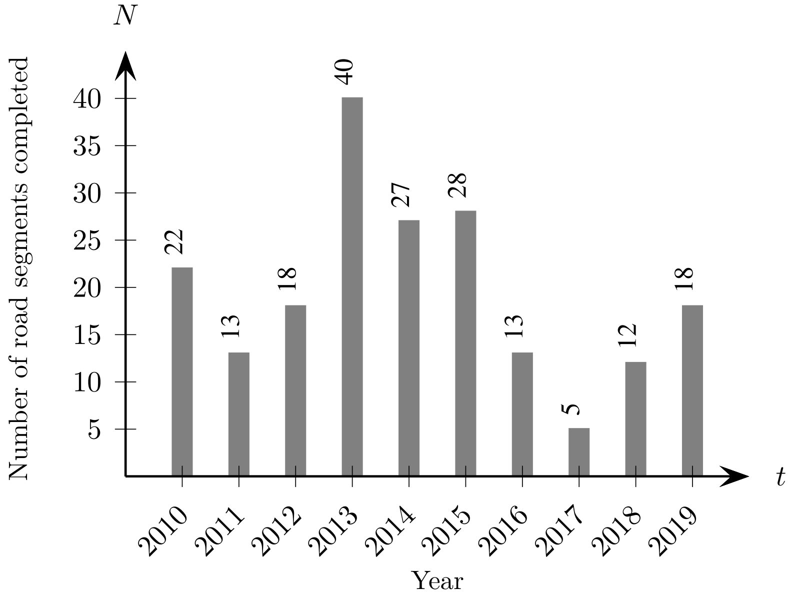
	$TIME_{dot}$	$TRVL\ DIST_{dot}$	$PW\ DIST_{do}$	$DIST_{do}$	$DIST\ TRVLD_{dot}$
$TIME_{dot}$	1				
$TRVL\ DIST_{dot}$	0.9878	1			
$PW\ DIST_{do}$	0.6566	0.6535	1		
$DIST_{do}$	0.8533	0.8604	0.5686	1	
$DIST\ TRVLD_{dot}$	0.9135	0.9288	0.6240	0.8297	1

Note: Based on the datasets described in Section 3.3. $TIME_{dot}$ and $TRVL\ DIST_{dot}$ are the travel time and distance computed from OSM, $PW\ DIST_{do}$ is a NUTS-2 level population weighted great circle distance, $DIST_{do}$ is a country level great circle distance and $DIST\ TRVLD_{dot}$ is the traveled distance as reported in the European Road Freight Survey.

Table A3.13: Goods Types in the European Road Freight Transport Survey

No.	Description	Included?
1	Products of agriculture, hunting, and forestry; fish and other fishing products	Yes
2	Coal and lignite; crude petroleum and natural gas	No
3	Metal ores and other mining and quarrying products; peat; uranium and thorium	Yes
4	Food products, beverages and tobacco	Yes
5	Textiles and textile products; leather and leather products	Yes
6	Wood and products of wood and cork (except furniture); articles of straw and plaiting materials; pulp, paper and paper products; printed matter and recorded media	Yes
7	Coke and refined petroleum products	Yes
8	Chemicals, chemical products, and man-made fibres; rubber and plastic products; nuclear fuel	Yes
9	Other non-metallic mineral products	Yes
10	Basic metals; fabricated metal products, except machinery and equipment	Yes
11	Machinery and equipment n.e.c.; office machinery and computers; electrical machinery and apparatus n.e.c.; radio, television and communication equipment and apparatus; medical, precision and optical instruments; watches and clocks	Yes
12	Transport equipment	Yes
13	Furniture; other manufactured goods n.e.c.	Yes
14	Secondary raw materials; municipal wastes and other wastes	No
15	Mail, parcels	No
16	Equipment and material utilised in the transport of goods	No
17	Goods moved in the course of household and office removals; baggage transported separately from passengers; motor vehicles being moved for repair; other non-market goods n.e.c.	No
18	Grouped goods: a mixture of types of goods which are transported together	No
19	Unidentifiable goods: goods which for any reason cannot be identified and therefore cannot be assigned to groups 01–16.	No
20	Other goods n.e.c.	No

Figure A3.5: Number of Completed Road Segments per Year



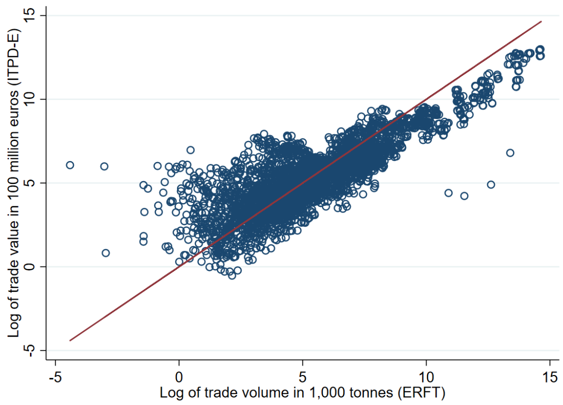
Note: The bars in Figure A3.5 display the number n of completed road segments of the Trans-European Transport Network within the given year t. Based on own calculations using the data of the Directorate-General Mobility and Transport of the European Commission and the manually collected year of completion.

Table A3.14: Summary Statistics of the Main Variables

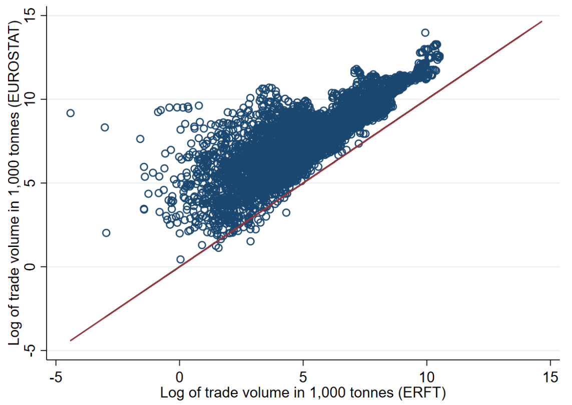
Variable	N	Mean	Std. Dev.	Minimum	Maximum
X_{dot}	317,583	2062243	2.59E+07	0	1.65E+09
$\ln(X_{dot})$	182,615	12.0394	1.8836	3.4334	21.2231
$\ln(TIME_{dot})$	317,583	6.6365	0.7360	1.9052	8.1392
$ROAD_{dot}(0/1)$	317,583	0.3760	0.4833	0	1
$ROAD_{dot}(\%)$	317,583	0.0259	0.0565	0	0.7681
$\ln(MIGR_{do,t-1})$	317,377	2.7730	1.9219	0	11.3282

Note: Based on the datasets described in Section 3.4.1.

Figure A3.6: Correlation between the Aggregate ERFT data , ITPD-E and Eurostat Data



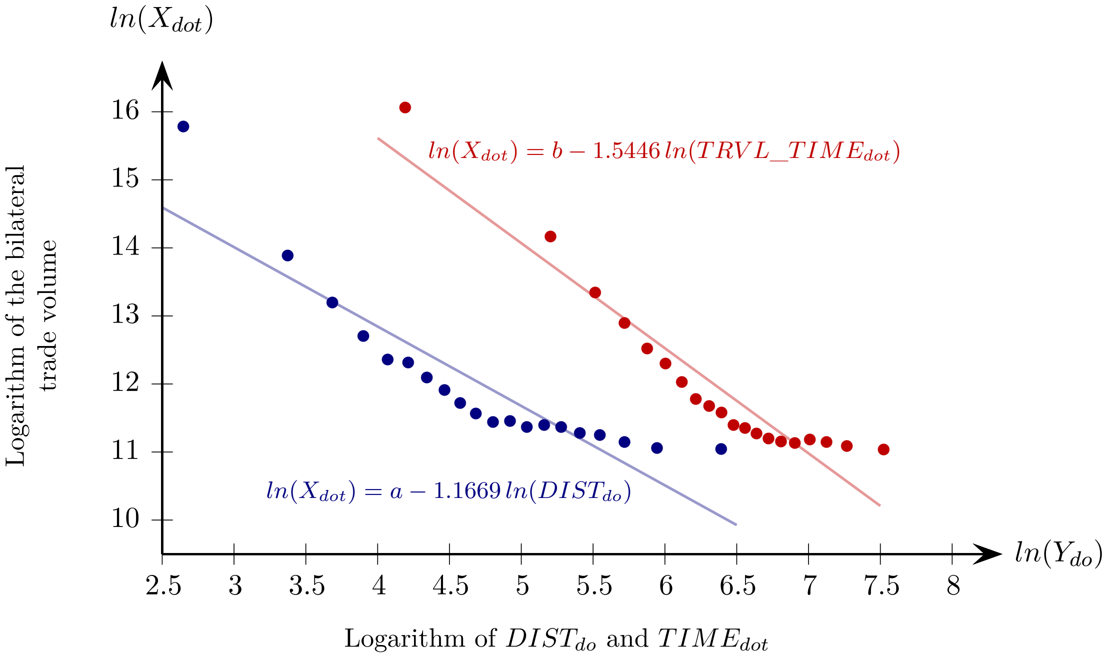
(a) Correlation with ITPD-E data



(b) Correlation with Eurostat data

Note: Figure A3.6 is based on own calculations using the ERFT, ITPD-E and Eurostat trade data and shows the correlation between the aggregated ERFT data and the ITPD-E data (Panel a) and the Eurostat data (Panel b).

Figure A3.7: Relationship between Bilateral Distances, Travel Times and Trade Volumes



Note: Figure A3.7 captures the relationship between the logarithms of bilateral distance as well time-varying bilateral travel times with the logarithm of trade volume. The dots thereby present the binned scattered relationship between the respective transportation cost metrics and trade volumes. Blue dots refer to the bilateral time-invariant distance and red dots refer to the time-varying travel times. The lines depict the linear relationship between the logarithms of the transportation cost metrics and trade volumes' logarithm obtained by regressing the respective metrics onto the logarithm of bilateral trade volumes. Both transportation metrics, bilateral distance and travel times, thereby reveal the by the gravity literature extensively discussed negative correlation with bilateral trade volumes.

A3.2.2 Results

Table A3.15: Determinants of a NUTS-2 Region Affected by a Completed Road Segment

Dependent variable: Indicator (0/1) for a NUTS-2 pair *do* using a completed road segment on its optimal route				
Model:	OLS		Probit	Logit
Specification:	(1)	(2)	(3)	(4)
Explanatory Variables:				
$\ln(DIST_{do})$	0.1476***	0.1094***	0.5445***	0.9240***
	(.0171)	(.0190)	(.0654)	(.1200)
$AVG\_TRADE\_GROWTH_{do,2000-2010}$	−0.0000***	0.0000	−0.0000	−0.0000
	(.0000)	(.0000)	(.0000)	(.0000)
$\ln(GDP_{o,2005})$	0.0571***	−0.0869***	0.1866***	0.3095***
	(.0206)	(.0195)	(.0647)	(.1100)
$\ln(GDP_{d,2005})$	0.0448**	−0.0863***	0.1443**	0.2400**
	(.0205)	(.0204)	(.0626)	(.1069)
$\ln(POP_{o,2010})$	−0.0181	0.0939***	−0.0296	−0.0438
	(.0219)	(.0184)	(.0694)	(.1184)
$\ln(POP_{d,2010})$	−0.0113	0.0869***	−0.0096	−0.0115
	(.0213)	(.0170)	(.0672)	(.1145)
$\ln(HW\_DENSITY_{o,1990})$	−3.2511***	−0.5322**	−12.6015***	−21.1602***
	(.5227)	(.2433)	(1.9340)	(3.4289)
$\ln(HW\_DENSITY_{d,1990})$	−3.3154***	−0.6601***	−12.8099***	−21.5636***
	(.5193)	(.2541)	(1.8725)	(3.3210)
$ROAD_o$	0.1411***	0.0677***	0.4148***	0.6996***
	(.0282)	(.0143)	(.0851)	(.1453)
$ROAD_d$	0.1472***	0.0773***	0.4370***	0.7353***
	(.0280)	(.0139)	(.0862)	(.1469)
$COHESION_{do}$	0.1127***	0.0368*	0.3554***	0.5836***
	(.0276)	(.0221)	(.0834)	(.1403)
Fixed Effects:				
Country-pair		✓		
Summary Statistics:				
Observations	32,558	32,542	32,558	32,558
(Pseudo-)R^2	0.2761	0.5683	0.2431	0.2417

Note: Standard errors in parentheses; clustered at country-pair level. Significance: * $p < 0.10$, ** $p < .05$, *** $p < .01$. The dependent variable is a binary indicator taking the value one if a NUTS-2 region i is ever affected by a completed road segment in the period 2011-2019, i.e. the binary $ROAD_{dot}$ variable takes the value of one in any of the years. The explanatory variables are: the great circle distance between the NUTS-2 regions ($\ln(DIST_{do})$, average trade growth between the NUTS-2 regions in the years 2000-2010, the level of GDP and population size of the NUTS-2 regions in 2005 and 2010 respectively (GDP and POP), the highway density in 1990 ($HW\_DENSITY$), whether any of the two NUTS-2 regions is by definition of the EU eligible to Cohesion Funds ($COHESIONdo$), and whether within the region of origin or destination has at least one completed road segment completed within it region. Bulgaria, parts of Denmark, Croatia, Romania and Slovenia are omitted due to data availability. The set of explanatory variables is composed of geographic, economic and infrastructure characteristics of a region or NUTS-2 pair in the 2000s or earlier as the decision to plan and construct a road is made in advance of the construction. See Virginia Department of Transportation (2023); Nova Scotia Canada (2023) for anecdotal evidence on the length of road construction projects.

Table A3.16: The Trade-enhancing Effect of Completed Road Segments (reduced set of fixed effects)

Dependent Variable: Trade between origin o and destination d in year t					
Model:	PPML				
Specification:	(1)	(2)	(3)	(4)	(5)
$\ln(TIME_{dot})$	-0.2688^{***}	-0.2626^{***}	-0.2482^{***}	-0.1960^{***}	-0.1935^{***}
	(.0668)	(.0666)	(.0662)	(.0700)	(.0701)
Binary variable:					
$ROAD_{dot}$ (0/1)		0.0118	0.2367^{**}		
		(.0147)	(.0962)		
Continuous variable:					
$ROAD_{dot}$ (%)				0.2219^{***}	0.2515^{***}
				(.0791)	(.0853)
Control variables:					
$ROAD_{dot} \times \ln(TIME_{dot})$			-0.0406^{**}		-0.0029
			(.0160)		(.0026)
$CRRY_{dot}$	0.0493	0.0505	0.0476	0.0470	0.0450
	(.0708)	(.0707)	(.0709)	(.0712)	(.0715)
Fixed Effects:					
Origin-time	✓	✓	✓	✓	✓
Destination-time	✓	✓	✓	✓	✓
NUTS-2-pair	✓	✓	✓	✓	✓
Country-pair-time	✓	✓	✓	✓	✓
Summary Statistics:					
Observations	235, 242	235, 242	235, 242	235, 242	235, 242
(Pseudo-)R^2	0.9952	0.9952	0.9952	0.9952	0.9952

Note: Standard errors in parentheses and clustered at NUTS-2-pair-level. Significance: * $p < 0.10$, ** $p < .05$, *** $p < .01$.

Table A3.17: Summary Statistics of Being Affected by a Completed Road Segment

Panel A: Road construction in directly and indirectly affected regions							
NUTS-2 pairs:		All		Direct		Indirect	
Statistic:		Count	Percent	Count	Percent	Count	Percent
$ROAD_{dot}$	0	21,998	48.4	2,046	17.5	19,933	59.2
	1	23,390	51.6	9.655	82.5	13,735	40.8
Total		45,388	100.0	11,701	100.0	33,668	100.0
Panel B: Road construction in Eastern and Western European regions							
NUTS-2 pairs:		West-West		East-West		East-East	
Statistic:		Count	Percent	Count	Percent	Count	Percent
$ROAD_{dot}$	0	16,926	60.7	4,558	29.7	495	23.4
	1	10,963	39.3	10,806	70.3	1,621	76.6
Total		27,889	100.0	15,364	100.0	2,080	100.0

Note: Based on Section 3.3's definition of being affected by a completed road segment. "Direct" refers to a completed road segment in the NUTS-2 region of origin or destination. "Indirect" hence refers to the case where neither in the NUTS-2 region of origin nor in the NUTS-2 region of destination a road segment was completed.

Table A3.18: Effect Heterogeneity by the Length of the NUTS-2 Pair-specific Travel Route

Dependent Variable: Trade between origin o and destination d in year t		
Model:	PPML	
Specification:	(1)	(2)
Binary variable:		
$ROAD_{dot}$ (0/1)	0.0525	
	(.1595)	
$ROAD_{dot}$ (0/1) # $\text{DIST}_{do,2013} \leq 1000$	−0.0574	
	(.0393)	
$ROAD_{dot}$ (0/1) # $\text{DIST}_{do,2013} \leq 2500$	−0.0315	
	(.0528)	
$ROAD_{dot}$ (0/1) # $\text{DIST}_{do,2013} \leq 5500$	−0.1149*	
	(.0627)	
Continuous variable:		
$ROAD_{dot}$ (%)		0.2103**
		(.0880)
$ROAD_{dot}$ (%) # $\text{DIST}_{do,2013} \leq 1000$		0.1996
		(.1554)
$ROAD_{dot}$ (%) # $\text{DIST}_{do,2013} \leq 2500$		−0.0014
		(.2677)
$ROAD_{dot}$ (%) # $\text{DIST}_{do,2013} \leq 5500$		−0.3671
		(.7557)
Control variables:		
$\ln(TIME_{dot})$	−0.2347***	−0.1752**
	(.0715)	(.0776)
$ROAD_{dot} \times \ln(TIME_{dot})$	−0.0005	0.0018
	(.0300)	(.0029)
Fixed Effects:		
Origin-time	✓	✓
Destination-time	✓	✓
NUTS-2-pair	✓	✓
Country-pair-time	✓	✓
Summary Statistics:		
Observations	234,564	234,564
(Pseudo-)R^2	0.9954	0.9954

Note: Standard errors in parentheses and clustered at NUTS-2-pair-level. Significance: * $p < 0.10$, ** $p < .05$, *** $p < .01$. The pair-specific distance bins are identified using the initial travel distance in 2013 and remains constant for all years.

Table A3.19: Effect Heterogeneity between Countries

Dependent Variable: Trade between origin o and destination d in year t		
Model:	PPML	
Specification:	(1)	(2)
Binary variable:		
$ROAD_{dot}$ (0/1)	0.2968***	0.2609***
	(.1100)	(.0932)
$ROAD_{dot}$#Austria	−0.1012	−0.1013**
	(.0820)	(.0512)
$ROAD_{dot}$#Bulgaria	−0.1925	−0.0709
	(.1698)	(.1323)
$ROAD_{dot}$#Croatia	−0.1975	−0.0860
	(.2575)	(.1734)
$ROAD_{dot}$#Czech Republic	−0.2348***	−0.1213***
	(.0660)	(.0411)
$ROAD_{dot}$#Denmark	−0.0860	0.0394
	(.0705)	(.0497)
$ROAD_{dot}$#Estonia	0.4624	0.0499
	(.2900)	(.2007)
$ROAD_{dot}$#Finland	0.3333	0.1429
	(.2270)	(.1511)
$ROAD_{dot}$#France	0.0628	0.1375***
	(.0653)	(.0422)
$ROAD_{dot}$#Germany	−0.0401	0.0596
	(.0675)	(.0370)
$ROAD_{dot}$#Greece	0.2400**	0.3269***
	(.0972)	(.0797)
$ROAD_{dot}$#Hungary	−0.0766	−0.0365
	(.0892)	(.0590)
$ROAD_{dot}$#Italy	0.1195**	0.2234***
	(.0604)	(.0416)
$ROAD_{dot}$#Latvia	−0.4907	−0.5162**
	(.3007)	(.2068)
$ROAD_{dot}$#Lithuania	0.3502	0.2931
	(.2520)	(.1832)
$ROAD_{dot}$#Poland	0.0175	0.1351***
	(.0651)	(.0427)
$ROAD_{dot}$#Portugal	−0.2479***	−0.0845
	(.0914)	(.0693)
$ROAD_{dot}$#Romania	−0.0146	0.0938
	(.0799)	(.0640)
$ROAD_{dot}$#Sweden	−0.1671**	−0.0461
	(.0733)	(.0544)
$ROAD_{dot}$#Slovenia	−0.1696*	−0.0623
	(.0866)	(.0569)
$ROAD_{dot}$#Slovakia	0.0900	0.1232**
	(.0733)	(.0513)
$ROAD_{dot}$#Spain	−0.0743	0.0360
	(.0634)	(.0482)
Control Variables:		
$\ln(TIME_{dot})$	−0.2130***	−0.2140***
	(.0720)	(.0719)
$ROAD_{dot} \times \ln(TIME_{dot})$	−0.0457***	−0.0583***
	(.0165)	(.0196)
Fixed Effects:		
Origin-time	✓	✓
Destination-time	✓	✓
NUTS-2-pair	✓	✓
Country-pair-time	✓	✓
Summary Statistics:		
Observations	234,564	234,564
(Pseudo-)R^2	0.9954	0.9954

Note: Standard errors in parentheses and clustered at NUTS-2-pair-level. Significance: * $p < 0.10$, ** $p < .05$, *** $p < .01$. The Benelux countries Belgium, Luxembourg and the Netherlands are captured in the baseline $ROAD_{dot}$ effect.

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