Border Effects in European Public Procurement

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Abstract. We document border effects in the award of public contracts in the European Single Market. Cross-national border effects are very sizable, even after controlling for currency, cultural differences, and other variables: "local" bidders are over 900 times more likely to be awarded a contract than "foreign" bidders. More surprisingly, we find substantial cross-regional border effects *within* countries. Border effects exist for all types of goods and services. While we find evidence that already firms' bidding decisions are subject to border effects, we cannot exclude a home bias of contracting authorities in the award of public contracts.

JEL Classification: H57, F14, F15

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1 Introduction

While the dampening effect of borders on international trade has been widely documented, "border effects" have not yet been empirically quantified for the case of public procurement. This is surprising since in most industrialized countries public procurement accounts for a substantial share of GDP.[1] Moreover, the detrimental welfare effects of border effects in the award of public contracts can be substantial, especially if they are due to a "home bias," i.e., a tendency of governments to award procurement contracts to domestic firms relative to foreign competitors.[2] The liberalization of procurement practices, in particular, with the aim of increasing cross-border procurement, has therefore been on the agenda of policy makers for a long time.[3]

In this paper we fill this gap in the literature by documenting and quantifying border effects in public procurement in the European Single Market. Our empirical analysis is based on 1.8 million European public procurement contracts awarded from 2010 to 2014 and published in the EU's Tenders Electronic Daily database (TED). We match geo-locations to the address information in the data and then assign Eurostat's NUTS3 regions to tenderers and winning bidders to create a data set that consists of $1{,}361 \times 1{,}361$ bilateral public procurement flows between NUTS3 region pairs. Following the seminal work of McCallum (1995), we then use this data set to estimate a gravity model of bilateral procurement flows with border effects.[4]

Despite accounting for NUTS3 origin and destination fixed effects, geographic and cultural distance, and common currency and language, we document evidence of very substantial intra- and international border effects in European public procurement. We find the most sizable effect for cross-national borders: a local firm, that is, a firm located in the same NUTS3 region as the contracting authority, is more than 900 times more likely to be awarded a contract compared to a foreign firm. Cross-regional border effects *within* countries are quantitatively less important but still of substantial magnitude. A local firm is about twice as likely to win a contract compared to a firm located in a different NUTS3 within the same NUTS2 and over seven times more likely to win compared to a firm in the same country but in a different NUTS1 region

Our results hold for goods, services, and construction procurement and for different types of public procurement procedures and award criteria. We also show that cultural differences across countries, to the degree to which they can be quantitatively captured, can only explain a relatively small part of the border effect. However, our findings point to a decrease of border effects over time during our sample period.

We then try to better understand the underlying causes of border effects. Firstly, we find that international border effects are decreasing in the value of the public contract. This finding is consistent with the interpretation that foreign firms face a fixed cost to bid for public contracts tendered in other EU Member States.

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[1] For example, the estimate of total general government public procurement expenditure, excluding utilities and defense, was 1931.5 billion euros in 2014, or about 13% of EU GDP (European Commission, 2016).

[2] See, for example, Mattoo (1996) and Trionfetti (2000) for a discussion on the welfare effects in the case of discriminatory public procurement.

[3] Early efforts to bring government procurement under internationally agreed trade rules were undertaken in the OECD framework. The matter was then brought into the Tokyo Round of Trade Negotiations within GATT in 1976. The revised GPA entered into force on 6 April 2014. More recently, tackling the barriers to cross-border procurement has again been identified as a policy priority in a very recent Commission Staff Working Document (accessible at http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52015SC0202).

[4] See Head and Mayer (2014) for a review on the border effect and the gravity equation in international trade.

Secondly, we try to understand whether border effects arise exclusively at the stage when contracts are selected by the contracting authority or whether already the bidding decisions of firms could be subject to border effects. Unfortunately, the TED data records only the firms winning a contract and all the non-winning bidders are not identified. We therefore address this issue by focusing on the special case of awards with only one bidder. Despite the caveats of using this subsample of our data, our estimates strongly suggest that border effects already affect the participation decisions of firms.

The extent of the border effects we find is surprising since formal trade barriers have been abolished in the European Single Market by 1968. At least since the mid-1980s the EU also increasingly abolished non-tariff barriers, such as differences in standards or technical regulations that are imposed by national governments for health and safety reasons. Moreover, there have been substantial efforts to also reduce informal barriers, for example, by standardizing various elements of public procurement procedures[5] and by moving towards procurement digitalization. In any case, national differences cannot explain the very substantial cross-regional border effects that exist *within* countries.

While there are several alternative explanations for border effects, we cannot exclude a potential home bias of contracting authorities in the award of public contracts. Since rational bidding firms would incorporate any potential home bias at the selection stage in their expectations, the border effects that we find in the participation decision of firms are not inconsistent with this explanation.

The remainder of this paper is structured as follows. We relate our paper to the relevant existing literature in the next section. In Section 3 we discuss the data that we use in this article. In Section 4 we present our estimation strategy. We discuss our results in Section 5. In the final section we summarize, discuss policy implications, and argue that our findings are important from a welfare perspective.

2 Related Literature

This paper is related to a strand of literature that documents the negative impact of borders on the volume of trade using the gravity equation. McCallum (1995) initiated this literature by showing that the US-Canadian border had an unexpectedly strong effect: controlling for numerous variables, trade between the Canadian provinces was about 22 times higher than their trade with US states.[6] An obvious explanation for border effects in trade is that formal or informal national barriers to trade such as tariffs, quotas, or regulatory differences must be responsible for this finding. More recently, however, it became clear that there must be additional reasons because sizable border effects were also found to exist in the supposedly highly integrated EU single market (Nitsch, 2000; Chen, 2004), on the subnational in the US (Wolf, 2000, Hillberry and Hummels, 2003, Coughlin and Novy, 2013, Crafts and Klein, 2015), and even on the zip-code level (Hillberry and Hummels, 2008).

[5] Examples are the standardization of procurement-specific nomenclature by creating the Common Procurement Vocabulary (CPV) and the introduction of standard forms for publication.
[6] We refer the reader to Head and Mayer (2014) for more recent estimates of the border effect in trade.

This paper is also related to a descriptive literature that documents the extent of cross-national public procurement. A study carried out for the European Commission reports that in the European Union only 1.6% of contracts awarded under the rules of the EU procurement Directives (or 3.5% of their value) were won by non-domestic bidders (European Commission, 2011).[7] Using Eurostat input-output data, the same study concluded that import penetration differs significantly between the public and private sectors (7.5% to 19.1% respectively), stating that this difference is largely due to differences in the kinds of goods, services and works procured (i.e. that the public sector tends to relatively purchase more services, which are usually less tradable than goods).

Similarly, Trionfetti (2000) and Brülhart and Trionfetti (2001) show that the import share of private sector purchases is substantially higher than the import share of government purchases and interpret this as home bias in public procurement. The most recent paper in this literature is Shingal (2015) who explores several explanations for the relatively low share of foreign procurement in Switzerland and Japan for the years 1990-2003.

The present paper adds to this literature in several ways. Methodologically, this paper is the first that follows the trade literature and quantifies border effects by estimating bilateral procurement flows using a gravity equation. This approach has several advantages. Firstly, it allows us to quantify border effects while controlling for other explanatory variables, in particular geographical distance, origin and destination fixed effects as well as year and product category fixed effects. Secondly, unlike in the existing descriptive literature where border effects are often simply documented by a "relatively" low share of public vs. private import propensity, a formal test is straightforward in our estimation framework: border effects exist in case of a significant border coefficient in the estimated gravity equation. Thirdly, using micro-data allows us to gain more insights into the underlying causes of border effects, for example, by restricting the sample to awards that received only one bid and by distinguishing border effects by award value. Finally, unlike most trade data, our data set includes information on inter- as well was as *intra*-national transactions. This allows us to explore border effects not only across but also *within* countries.

3 Data Description

This study is based on European public procurement contract awards published on the European Union's Tenders Electronic Daily (TED) website. We use the address information of the contracting authority or entity (CAE) and the winning firm of each award to construct a data set that consists of bilateral procurement flows between NUTS3 (and NUTS2) region pairs. The data is then used to estimate gravity equations with border effects.

3.1 Institutional Background and Tenders Electronic Daily

[7] This is referred to in the study as "direct" cross-border procurement. Alternatively, they define a broader category of "indirect" cross-border procurement that includes for example, awards won by local subsidiaries of foreign companies and by consortia of foreign and local firms. In our paper we consider only "direct" cross-border procurement.

TED is an online supplement[8] to the Official Journal of the EU containing the details of public procurement notices published under the coverage of the EU public procurement Directives.[9] These Directives are relevant for and transposed by the EU member states and Norway, Iceland, and Lichtenstein (altogether the European Economic Area, EEA).

TED contains information about different types of procurement notices[10] that reflect the various administrative stages of the public procurement process followed by the CAEs[11] subject to the Directives. A "contract notice" announces the call for tenders for the provision of works, goods, or services. From it, firms are able to learn relevant information for their bids, like technical specifications, deadlines, award criteria, and other procedural aspects. Then, the CAE assesses the offers and decides who to award the procurement contract to. It is often the case that the procurement requested in a single contract notice is awarded to several firms. This may happen for instance when the contract notice is structured in different lots for which it is possible to bid separately. A single contract notice can therefore lead to one or more contract awards.[12] In this paper we use information at the contract award level.

The contract awards contain, amongst others, information regarding

- the name and address of the contracting authority or entity,
- the name and address of the winning firm,
- the number of bids (however, not the identity of the non-winning bidders),
- the value of the tender initially expected by the CAE,
- the final value of the award,
- the date of the award,
- the specific award criterion used in the tender,
- and the Common Procurement Vocabulary (CPV) code[13] which serves to identify the type of good, service, or work to be procured.[14]

[8] The supplement is available online at http://ted.europa.eu/TED/.
[9] Currently the Directive 2014/24/EU of the European Parliament and of the Council of 26 February 2014 on public procurement and repealing Directive 2004/18/EC, the Directive 2014/25/EU of the European Parliament and of the Council of 26 February 2014 on procurement by entities operating in the water, energy, transport and postal services sectors and repealing Directive 2004/17/EC, the Directive 2014/23/EU of the European Parliament and of the Council of 26 February 2014 on the award of concession contracts, and Directive 2009/81/EC on the coordination of procedures for the award of certain works contracts, supply contracts and service contracts by contracting authorities or entities in the fields of defense and security.
[10] A complete list of the different public procurement standard forms can be found in the TED website at http://simap.ted.europa.eu/standard-forms-for-public-procurement.
[11] A contracting authority would be for example a ministry or a city council, whereas a contracting entity would be a publicly owned firm.
[12] More precisely, the award decisions stemming from the contract notice are published through one or more "contract award notices." For example, one single contract notice can be followed by just one contract award notice which includes various contract awards. However, it can also be the case that there are several contract award notices, each including a single contract award. Any combination of these two situations is also possible, depending on the specificities of each procurement process. From a formal point of view, a contract award notice is a standard form, whereas a contract award (or award decision) is a specific section within the standard form for a contract award notice.
[13] See https://simap.ted.europa.eu/cpv for details regarding the CPV classification.

The data has two important shortcomings. Firstly, information is sometimes missing, especially regarding the number of bids as well as the final value of an award. Secondly, it is important to note that while the data contains information on the total number of bidders, it only identifies the winning bidder, but not the other bidding firms. By definition, "all" bidders are therefore only identified if there is only a single offer, a special case that we exploit in Section 5.2.1.

All contract notices whose value exceeds a certain amount are subject to the public procurement Directives and must be published in TED because they are presumed to be of "cross-border interest." These thresholds are set in the Directives and updated every two years.[15] The thresholds apply to the (expected) total value of the contract notice and not separately to each of the contract award notices and contract awards that stem from it. It is not unusual that a contract notice of large value translates into many contract awards of smaller values that in some cases are below the corresponding threshold. In practice, this implies that many of the contract awards in our sample have values below the thresholds of the Directives. Moreover, another reason to observe below-threshold contract awards in our dataset is that publication in TED is often perceived as a sign of openness and many CAEs decide to publish in TED on a voluntary basis. Therefore, although the TED data base does not include all European public procurement activity, it does include the most of it in terms of value.

3.2 Construction of the Data Sets

We use a subset of the TED data that consists of 1,792,217 contract awards published between 2010 and 2014. Based on the address information in the data, we assign the NUTS3 region[16] of the CAE and the winning firm to each contract award.[17]

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[14] The finest classification that we use in this paper consists of 45 so-called CPV divisions (Section 6.1). Due to computational reasons we mostly aggregate these 45 CPV divisions to seven broader categories. Finally, sometimes we merely differentiate between goods, services, and construction works. We refer the reader to Table A4 for an overview.

[15] The complete list of current thresholds is available at https://ec.europa.eu/growth/single-market/public-procurement/rules-implementation/thresholds_en. As an illustration, in the context of the general procurement covered by Directive 2014/24/EU (i.e., procurement not related to the defense sector, specific utilities sectors or concessions) the procurement of supplies and services by central government authorities has a threshold of 135,000 Euros, although subsidized services or certain services specifically listed have higher thresholds. Works contracts have a threshold of 5,225,000 Euros.

[16] European NUTS regions are territorial nomenclatures based primarily on the current institutional divisions of the respective country, following national regional classifications of generic nature (as opposed to specific regional classifications such as mining regions or rail traffic regions, for example). The NUTS classification has three levels, with NUTS1 and NUTS2 roughly corresponding to, respectively, regions and provinces within a country (the NUTS0 level). The NUTS3 level corresponds to a less important administrative structure that should have an average population between 150.000 and 800.000 inhabitants. NUTS regions can change over time following the needs of the respective countries. In this paper we follow the NUTS 2013 classification. The respective shape file can be found at http://ec.europa.eu/eurostat/web/gisco/geodata/reference-data/administrative-units-statistical-units.

[17] There are 239,728 *distinct* town/postal code combinations in our data. For each of these distinct town/postal code combinations, we obtain the latitude and longitude using the Google Maps API. By combining this data with the Eurostat shape file on NUTS3 regions in Europe, we then assign a NUTS3 region to each CAE and to each winning firm in our dataset.

3.2.1 Pooled Data Set on NUTS3 Level

We first construct a data set that consists of bilateral procurement flows tendered by CAEs located in NUTS3 region i and awarded to firms located in NUTS3 region j. Hereafter, we refer to these as the "origin NUTS3" and the "destination NUTS3," respectively. We limit our sample to origin and destination regions within the EU plus Norway. Since there are such 1,361 NUTS3 regions, the data set has $1{,}361 \times 1{,}361 = 1{,}852{,}321$ observations where each observation represents a NUTS3 region pair. We add NUTS3 level information on population figures from Eurostat.[18]

In our empirical analysis we use two variables capturing the extent of procurement flows between pairs of regions. Firstly, we use the variable $value_{i,j}$ that we define as the total value of projects tendered by CAEs in NUTS3 region i and won by firms located in region j.[19] Given that the information on final values of awarded contracts is sometimes missing, we also use the variable $projects_{i,j}$ that is defined as the number of total contracts (i.e. not weighted by their value) published by CAEs located in NUTS3 region i and awarded to firms in region j. Additionally, we split these variables according to a broadly defined categorization of the subject of the procurement contract, i.e., we construct the variables $value_{i,j}$ and $projects_{i,j}$ distinguishing between goods, services or construction works. More information regarding the main variables used in this study is presented in Appendix Table A1.

3.2.2 Data Set Including Time and Product Dimension on NUTS2 Level

To explore border effects in more detail, we create a second data set that also takes into account differences in the subject of the procurement contract, that is, what exact good or service is procured, as well as in the year of publication of a notice in TED.

Firstly, based on the CPV code provided in the data, we assign each award to one of seven broadly defined categories (see Appendix Table A4). While, for convenience, we refer to these as *product categories* it is important to note that in our context "product" refers not only to goods but also to services and construction works. Secondly, we distinguish between tenders published in 2010, 2011, 2012, 2013, and 2014.

Due to computational reasons, this data set is based on bilateral procurement flows between 283 NUTS2 regions instead of the finer 1,361 NUTS3 regions and therefore consists of $283 \times 283 \times 7 \times 5 = 2{,}803{,}115$ observations.[20] Descriptive statistics are reported in Appendix Table A2.

3.3 Cross-Border Procurement: Descriptive Statistics

[18] Note that we ignore public contracts won by countries outside of the EEA since the share is negligible.

[19] The award value reported in the data is sometimes subject to mistakes, for example, due to typos. In order to prevent outliers to affect our results, we drop observations with values below the 5 percentile and above the 99 percentile when using $value_{i,j}$ as the dependent variable.

[20] Using NUTS3 region pairs would result in a data set with $1{,}361 \times 1{,}361 \times 7 \times 5 = 64{,}831{,}235$ observations.

Before turning to the estimation of the gravity equations, we report some descriptive statistics. Table 1 provides an overview of cross-region and cross-border procurement. Column (2) of Panel A documents that of all projects that were tendered in one of the 1,361 NUTS3 regions in our data set, 31.31% were won by a firm in the same NUTS3 region. 16.77% were won by firms located in other NUTS3 regions within the same NUTS2. 50.59% (10.86%+39.73%) came from the rest of the country and, finally, 1.32% were awarded to firms located outside of the country, that is, in a different NUTS0. Columns (4), (6), and (8) show that at both the NUTS0 and NUTS3 levels the share of cross-border procurement is highest for goods and smaller for services and construction works. Panel B differentiates awards according to their value. It is apparent that international procurement takes place more often for high-value awards. Only about 0.49% of awards in the 1st quartile are awarded to a different country but about 2.27% of awards in the 4th quartile. A similar tendency is visible when projects are weighted by their total final value in panel C.

Figure 1 visualizes the share of awards by CAEs located in a NUTS3 region that are awarded to firms located in other countries (a different NUTS0). While in general the share of cross-border procurement in the whole EU is low, the map shows that it is not driven by any specific region or Member State. Scandinavian and Baltic countries have a relatively higher cross-border share. The map also suggests that in (geographically) larger countries, like France or Spain, NUTS3 regions closer to the border show higher rates compared to regions in the interior. This effect is particularly apparent is smaller countries like the Benelux and the central-eastern EU area.

It is important to note that, despite being highly suggestive, the evidence reported in in Figure 1 and Table 1 cannot be unambiguously interpreted as evidence of border effects in public procurement. The fact that only few cross-region and cross-border awards take place might be simply because trade costs increase with distance. For instance, the raw data for the procurement of construction works and services display stronger border effects than the data for goods procurement, since the former are more costly to trade over large distance than the latter.

Figure 2, however, presents more descriptive evidence that the border effects we document are indeed not just driven by trade costs. The map in the upper left visualizes the geographic distribution of contracts awarded published by authorities located in the NUTS2 region around Frankfurt am Main (DEA2) (marked in green). It is clearly visible that the probability that firms in a given region win an award is decreasing in the distance to the DEA2 NUTS2. Almost no trade across national borders is visible. However, this might be just due to the distance effect. The upper right panel shows a similar map for contracts published by authorities located the NUTS2 region Cologne (DEA2) which is adjacent to Germany's national border with Belgium and the Netherlands and close to the border with Luxembourg. This map now provides very clear evidence that the national border matters greatly for procurement: it is apparent that firms based in German NUTS3 regions of equal distance to Cologne have a much higher probability of being awarded a contract than equivalent firms in the Netherlands, Belgium, or Luxembourg.

Figure 2 shows another example. The two Mediterranean islands Corsica and Sardinia are located next to each other; however, the first is part of France while the second is part of Italy. The contract awards clearly reflect this: in spite of similar distance to Italy and France, 99.8% and 99.5% of contracts published by authorities located in Corsica and Sardinia are awarded to France and Italy, respectively.

In the next section, we present a formal way of quantifying border effects in European public procurement based on the gravity model following the methodology proposed in the seminal paper by McCallum (1995).

4 Estimation Strategy

Our estimation strategy is based on the popular gravity model that is widely used in the analysis of international trade and more recently in other fields, such as migration and even innovation policy.[21]

We propose a constant-elasticity model of the form

$$projects\_won_{i,j} = \exp\left(\boldsymbol{X}_{i,j}\boldsymbol{\beta}\right) + \varepsilon_{i,j}$$

with $projects\_won_{i,j} \geq 0$, $E\left[\varepsilon_{i,j}|\boldsymbol{X}_{i,j}\right] = 0$, and

$$\begin{aligned}\boldsymbol{X}_{i,j}\boldsymbol{\beta} = projects\_total_i + \beta_1 \ln pop_i + \beta_2 \ln pop_j + \beta_3 \ln distance_{i,j} \\ + \beta_4 same\_NUTS0_{i,j} + \beta_5 same\_NUTS1_{i,j} + \beta_6 same\_NUTS2_{i,j} \\ + \beta_7 same\_NUTS3_{i,j}\end{aligned} \quad (1)$$

The dependent variable $projects\_won_{i,j}$ is the number of tenders awarded to firms in NUTS3 region j tendered by CAEs located in NUTS3 region i. Since by construction the probability to win a tender from a NUTS3 region that launches more tenders is higher, we use the total projects tendered by CAEs located in region i $projects\_total_i$ as an offset variable.[22]

We expect tenders awarded by a NUTS3 region to rise proportionally to the economic activity of the origin NUTS3 region and tenders awarded to a NUTS3 region rise proportionally to the size of the destination NUTS3 region. We therefore include log-population of region i and j (pop_i and pop_j) as control variables.

We also expect that the distance between two NUTS3 regions ($distance_{i,j}$) and the bilateral procurement flow between these two regions have a negative relationship. Distance captures transportation cost due to physical distance but might also be a proxy for transaction and

[21] See Section 2.4 in Head and Mayer (2014).

[22] One obtains the same results by using the ratio $\frac{projects\_won_{i,j}}{projects\_total_i}$ as the dependent variable and weighting the regression by $projects\_total_i$.

information cost more generally (Portes and Rey, 2005)). As proposed by Leamer (1997) and Nitsch (2000), we calculate intra-NUTS3 distances based on land area.[23]

Our main estimates of interest are the coefficients on the dummy variables $same\_NUTSX_{i,j}$ that capture the border effects we want to estimate. We measure border effects at the NUTS0, i.e., the country-level, the NUTS1, NUTS2, and the NUTS3 level. The dummies take the value 1 when i and j are in the same NUTSX.

A potential problem of specification (1) is that coefficient estimates might be biased due to omitted variable bias. We address this problem in specification (2) by including fixed effects for both the destination and the origin NUTS3 regions:[24]

$$\boldsymbol{X}_{i,j}\boldsymbol{\Gamma} = orig_i + dest_j + \gamma_1 \ln distance_{i,j} + \gamma_2 same\_NUTS0_{i,j} + \gamma_3 same\_NUTS1_{i,j} + \gamma_4 same\_NUTS2_{i,j} + \gamma_5 same\_NUTS3_{i,j} \quad (2)$$

The fixed effects $orig_i$ and $dest_j$ capture unobserved characteristics of the origin NUTS3 and the destination NUTS3.[25]

To further explore the role of omitted variables for border effects, we also include dummy variables indicating whether two regions have the same language or use the same currency (the Euro) as well as control variables capturing differences in cultural values across EU member states.

Finally, based on the data set described in Section 3.2.2, we estimate an extended specification (3) that also takes into that the probability of an award might vary over time and by the type of product or service that is procured:

$$projects\_won_{i,j,k,t} = \exp\left(\boldsymbol{X}_{i,j,k,t}\boldsymbol{\Theta}\right) + \varepsilon_{i,j,k,t}$$

with $projects\_won_{i,j,k,t} \geq 0$, $E\left[\varepsilon_{i,j,k,t}|\boldsymbol{X}_{i,j,k,t}\right] = 0$, and

$$\boldsymbol{X}_{i,j,k,t}\boldsymbol{\Theta} = orig_i + dest_j + \_category_k + year_t + \theta_1 \ln distance_{i,j} + \theta_2 same\_NUTS0_{i,j} + \theta_3 same\_NUTS1_{i,j} + \theta_4 same\_NUTS2_{i,j} \quad (3)$$

$projects\_won_{i,j,k,t}$ refers to the number of tenders of product category k published in year t awarded to firms in region j tendered by CAEs located in region i. This specification allows us to estimate fixed effects $product\_catgory_k$ and $year_t$ and therefore further alleviates

[23] We follow Head and Mayer (2000) and calculate the intra-NUTS3 distance as $distance_{i,i} = \left[\frac{2}{3}\left(\frac{area_i}{\pi}\right)^{0.5}\right]$.

[24] Anderson and van Wincoop (2003) show that the "traditional" gravity equation leads to biased estimates due to neglected exporter- and importer-specific multilateral resistance variables. One way of theory-consistent estimation of the gravity equation is to use importer and exporter fixed effects. See, for example, Harrigan (1996), Hilberry and Hummels (2003), Coughlin and Novy (2013), and Section 3.3 in Head and Mayer (2014).

[25] Gravity factors (pop_i and pop_j) are not part of this specification because they are captured by the origin and destination region fixed effects.

concerns regarding biased estimates due to unobserved heterogeneity.[26] As discussed in Section 3.2.2, for computational reasons specification (3) is estimated on a data set based on NUTS2 instead of the finer NUTS3 region pairs.

As described in Table 1, there is a strong concentration of awards to nearby regions in our data. This implies that in all three specifications the dependent variable is characterized by a large count of zeros and a long right tail. To address this issue and to avoid inconsistent estimates in the presence of heteroskedasticity, we follow Silva and Tenreyro (2006) and estimate specifications (1), (2), and (3) by using Poisson (pseudo)-maximum likelihood (PPML) with Eicker-White robust standard errors.[27]

5 Results

We begin by documenting border effects using the baseline specification and by exploring the role of common currency, language, and cultural values. We then estimate the model separately for goods, services, and construction procurement. In Section 5.2 we proceed by showing results based on the extended specification (3) that also takes into account heterogeneity over time and by the type of the good or service that is procured. In Section 5.2.1 we analyze the special case of awards with only one bidder to better understand to what extent border effects are driven by limited participation of non-local firms. We then document that border effects exist even for very high value awards and we present some evidence that border effects seem to be decreasing towards the end of our sample period. In Section 5.2.4 we document substantial differences in border effects across finely disaggregated goods and service categories. Finally, we analyze the effect of the award criteria and the type of procedure that is used in the procurement process.

5.1 Baseline Results

Columns (1) and (2) of Table 2 report PPML estimates of, respectively, regression equations (1) and (2) when the number of projects $projects_{ij}$ is the dependent variable. Column (1) shows results based on the traditional gravity equation. Column (2) reports estimates when fixed effects for the NUTS3 region of origin and destination are included.

In both specifications we find that distance has a strong negative impact on the likelihood of winning a tender. According to our baseline specification in column (2), when the distance between the contracting authority's NUTS3 region and a given firm's NUTS3 regions doubles, the probability of that firm winning a tender decreases by about 32% (1-exp(-0.385)).

[26] Our results remain qualitatively unchanged when we include interactions to allow origin and destination region fixed effects to vary by year.

[27] Our data is clearly "over-dispersed," that is, the variance exceeds the mean. As advised by Head and Mayer (2014), we do not follow the recommendation by De Benedictis and Taglioni (2011) to use a negative binomial estimator in this case. Firstly, the PPML estimator remains consistent under over-dispersion. Secondly, as pointed out by Boulhol and Bosquet (2014), negative binomial PML estimates depend on the units of measurement of the dependent variable.

We find evidence of substantial border effects at both the international and intra-national level in both specifications. According to the baseline specification in column (2), firms located in the same NUTS3 as the contracting authority (hereafter "local firms") are two times (exp(0.718)) more likely to win a tender than firms located in a different NUTS3 within the same NUTS2 of the contracting authority. Firms located in a different NUTS2, but still within the same NUTS1 than the CAE are 4.6 times (exp(0.718+0.811)) less likely to win than a local firm. Firms located in a different NUTS1 than the CAE are 7.2 times (exp(0.718+0.811+0.447)) less likely to win compared to local firms. The most substantial border effect is the international one: a local firm is 2268 times (exp(0.718+0.811+0.447+5.751)) more likely to win than a foreign firm.

Columns (3) and (4) of Table 3 document that results are qualitatively similar when projects are weighted by their value, that is, $value_{ij}$ is the dependent variable. Comparing columns (2) and (4) we find that distance becomes more important while border effects become overall slightly less important.

One needs to be careful to not interpret these sizable border effects as trade barriers. As we discuss in more detail below, theory shows that the border effect is identical to the product of the elasticity of substitution between "local" and "non-local" goods, services, and works, and the tariff-equivalent of any border barrier (e.g., Anderson and van Wincoop, 2003). If goods, services, and works provided by "local" and "non-local" firms are very similar and therefore highly substitutable, a minor trade barrier or home bias can result in a very substantial border effect.

5.1.1 Currency, Language, and Cultural Values

Research in international trade suggests that differences in currency, language, and cultural values more generally might explain some of the border effects in public procurement.[28] The effect of currency and language can be easily estimated by adding dummy variables to regression equation (2) that indicate whether the same currency (the Euro) or the same language is used in the origin and destination NUTS3 region.

Operationalizing the concept of cultural values is more challenging. We follow Ahern et al. (2015) and use respondents' answers in the 2008 and 2009[29] waves of the European Values Study to three questions capturing the attitude regarding the following aspects: [30]

[28] Rose and van Wincoop (2001), for example, find that having a common currency is an important determinant of trade flows. Similarly, there is ample evidence that sharing the same language and, more generally, having similar cultural values, is an important determinant of economic exchange. In a standard gravity model, Felbermayr and Toubal (2010) and Tadesse and White (2010) find that measures of cultural proximity positively affect trade volumes for Europe and the US, even after controlling for fixed effects and other covariates. Guiso et al. (2009) document that bilateral trust, as a reflection of cultural biases, has an important impact on trade, portfolio investments, and FDI between European countries. Other research finds that cultural differences affect interest rates in international syndicated bank loans (Gianetti and Yafeh, 2012), venture-capital flows (Bottazzi et al., 2016), cross-regional migration flows (Falck et al., 2012), and the volume of cross-border mergers (Ahern et al., 2015).

[29] We use the latest waves available. Belgium, Finland, Italy, Sweden, and Great Britain were surveyed in 2009, the rest of countries in our sample and Northern Ireland were surveyed in 2008.

1. Trust versus distrust: "Generally speaking, would you say that most people can be trusted or that you can't be too careful in dealing with people?"

2. Hierarchy versus egalitarianism: "People have different ideas about following instruction at work. Some say that one should follow instructions of one's superiors even when one does not fully agree with them. Others say that one should follow one's superior's instructions only when is convinced that they are right. Which of these two opinions do you agree with?"

3. Individualism versus collectivism: "Income equality. How would you place your views on this scale?" (From 1 "Incomes should be made more equal" to 10 "We need larger income differences as incentives").

We then operationalize cultural differences between country i and j by including $\ln(1+|\Delta trust_{i,j}|)$, $\ln(1+|\Delta hierarchy_{i,j}|)$, and $\ln(1+|\Delta individualism_{i,j}|)$ [31] as control variables in regression equation (2). [32]

Column (1) of Table 3 shows that having the same language and the same currency indeed increases the likelihood of winning a tender by about 159% (exp(0.954)-1) and 94% (exp(0.667)-1), respectively. [33] Column (2) reports results when controls for cultural differences are also included. The bilateral distance between two countries in terms of trust is highly significant and has a negative impact on the number of cross-border procurement projects. Cultural distance as measured by hierarchy and individualism, on the other hand, is not significantly different from zero.

The results show that currency, language, and culture can explain part of the international border effect.[34] When comparing column (2) of Table 2 with column (1) and (2) of Table 3, it is apparent that the estimated coefficient on the *same_NUTS0* dummy becomes substantially smaller: when controlling for currency and language, residing in the same country as the CAE (but in a different NUTS1) increases the likelihood of winning 176 fold (exp(5.171)) instead of 314 fold (exp(5.751)). Controlling for cultural distance decreases this further to 127 fold (exp(4.846)). Overall, estimates in column (2) of Table 3 imply that, compared to a

[30] The most well-known approaches to construct measures of cultural values are the European Values Study and the World Values Survey, the five-dimension classification system of Hofstede (1980, 2001), the three-dimension system of Schwartz (1994), the seven-dimension system of Trompenaars and Hampden-Turner (2011), and the four-dimension system of Fiske (1991). In this paper we follow Ahern et al. (2015) because the importance of trust for economic exchange is well documented, and since measures of "hierarchy" and "individualism" are shared by all of the above classification systems.

[31] Note that unlike for example the trust matrix used in Guiso et al. (2009), these measures are symmetric, i.e., the distance from country i to country j is the same as the distance from j to i.

[32] Note that the dummy variables capturing same currency and language as well as the variables capturing cultural values only vary at the NUTS0 level.

[33] This finding is in line with Rose and van Wincoop (2001) who quantify the effect of different currencies on barriers to international trade.

[34] Since our measures of common currency, language, and cultural differences only vary across but not within countries, coefficients on the *same_NUTS1*, *same_NUTS2,* and *same_NUTS3* are virtually not affected by the inclusion of the these variables.

firm located in a different country, a local firm residing in the same NUTS3 as the CAE is about 930 times exp(0.724+0.816+0.452+4.846) more likely to win an award.

The relative importance of sharing the same currency and having similar cultural values becomes much smaller, however, when projects are weighted by their value in columns (3) and (4) of Table 3. Currency and cultural differences therefore seem to work as an implicit barrier to the cross-national award of public contracts, however, more so for relatively low-value public procurement.

5.1.2 Goods, Services, and Construction Works Procurement

Apart from goods procurement, services and construction works procurement comprises a large share of projects in our data: Between 2010 and 2014 around 45% of awards referred to service or works contracts, equaling about 68% of the value of all awards (Table 1). While the baseline results reported in Tables 2 and 3 are based on all contract awards in our data set, there are several reasons to expect that the determinants of goods procurement and of services and works procurement might differ, in particular regarding border and distance effects.[35]

Firstly, the provision of works and most services, with the exception of, e.g., electronically delivered business services, requires physical contact between producers and consumers. Works and services are also more likely to be "tailored" to the customer and therefore potentially require monitoring and quality control (e.g., Freund and Weinhold, 2002). Their provision to distant locations is therefore often infeasible or very costly. Secondly, due to the higher requirement for personal interaction and communication, language and cultural issues might be relatively more important for the provision of services and construction than for the provision of goods. Finally, national regulations regarding the provision of services and works are widespread and potentially act as implicit barriers to trade.[36]

Table 4 presents the results of estimating equation (2) using the subsamples of procurement of goods, services and construction works, both in terms of number of projects and of total final value of the projects. All regressions also include controls for common currency, language, and cultural values. We find that distance is a much stronger deterrent of procurement flows for services, especially for construction works, than for goods. More precisely, when the distance between the CAE and the firm doubles, the likelihood of winning a tender for goods decreases by 26% (1-exp(-0.309)), whereas it reduces by almost 40% (1-exp(-0.512)) in the case of services procurement and by more than 65% (1-exp(-1.071)) in the case of construction. These results, based on the number of projects, are also confirmed in the sample weighted by the total final value of the projects (columns (4) to (6)).

[35] This is confirmed in the empirical trade literature. Using a gravity model, Kimura and Lee (2006) and Head et al. (2009) find that services trade is subject to stronger distance effects than goods trade. Similarly, using a structural gravity model, Anderson et al. (2015) find important differences in the determinants of goods and services trade. They document large border effects in services trade that vary widely by sector in an intuitive way. Importantly, they also show that border effects in services trade have been falling in the last years. This is line with the view that the emergence of the internet greatly facilitated the trade of certain services (Freund and Weinhold, 2002, 2004). See also Tharakan et al. (2005) who, using gravity framework, finds no distance effect of Indian software (services) exports.

[36] See, for example, Nordås and Rouzet (2015) and Nordås (2016).

Combined border dummy variables play a more important role in the procurement of services than in goods or construction works. For instance, in services a local firm is 1610 times (exp(0.981+1.038+0.727+4.638)) more likely to win than a foreign firm, while just 380 times more (exp(0.798+0.726+0.725+3.692)) in the case of construction works and 441 times more (exp(0.221+0.480+0.193+5.197)) in the case of goods. However, intra-national border effects are clearly higher in the case of services and construction works. For example, compared to a national firm located in a different NUTS1 than the CAE, a local firm is 15 times (exp(0.981+1.038+0.727)) more likely to win a service contract and 9.5 times (exp(0.798+0.726+0.725)) more likely to win a construction works contract. For the procurement of goods the local firm is only 2.4 (exp(0.221+0.480+0.193)) times more likely to win.[37]

We also find support for the hypothesis that services and construction works require relatively more personal interaction and communication and that having the same language is therefore more important. For construction works and services, having the same language increases the likelihood of an award by about 600% and 200%, respectively, while this figure is only 60% for goods.[38] Sharing the same currency, on the other hand, is most important for goods procurement and least important for construction works.

In summary, while we find important differences between border effect of public procurement of goods, services, and construction works, border effects are sizable for all three types of procurement.

5.2 Results of the Extended Specification

We showed in Section 5.1.2 that the determinants of the award of a public tender vary substantially by the subject of the procurement contract. A potential concern is therefore that some of the border effects we documented above might be due to composition effects. In this section we address this issue by presenting estimates of the extended gravity equation (3) that allows for the inclusion of both time and product category fixed effects.[39]

The results are reported in Table 5. We find substantial border effects that are quantitatively similar to the baseline results in Tables 2 and 3. Language, currency, and cultural values again account for a part of the international border effects. The relatively stronger negative effect of distance on the likelihood of an award compared to the baseline results can be explained by the less fine spatial aggregation regression equation (3) is estimated on: since the specification does not allow for the inclusion of NUTS3 border effects, these are implicitly attributed to distance.

[37] This mixed effect of intra- and international border effects is consistent with Coughlin and Novy (2016). In their model, higher internal trade frictions imply lower (national) border effects.
[38] Respectively, exp(1.907)-1, exp(1.126)-1, and exp(0.452)-1.
[39] As mentioned above, we use the term "product" here for convenience. Technically, we are capturing the "subject of the procurement contract" which can include goods but also services and construction, see Appendix Table A4.

A remaining concern is that the transportation cost captured by geographical distance might substantially differ across for different goods or services and that this might result in biased estimates. In column (4), we take this into account by including interactions that allow the effect of distance to vary by the subject of the procurement contract. In line with Section 5.1.2, we find that distance is generally least important for goods, e.g., for medical products (which consists mostly of pharmaceuticals) and most important for services and construction works. However, most importantly, while we find important differences in the effect of distances, the border effects estimated by this specification remain remarkably similar to the ones reported in column (3). As before, our findings are qualitatively similar when projects are weighted by the value of the award in columns (5) to (8).

5.2.1 Awards with One and Multiple Offers

Border effects might exist because CAEs might have a tendency to select offers of local firms over other bids, i.e., CAEs might be subject to a home bias.[40] An alternative hypothesis is that for many tenders only local bidders apply. Border effects might therefore not be due to selection but might be a consequence of firms' bidding behavior for public contracts. These two scenarios have substantially different policy implications.

Unfortunately, it is not straightforward to empirically disentangle these two cases since, as mentioned in Section 3.1, our data does not contain information on all bidders (but only on the winning bidder). We can, however, make some progress by analyzing the special case of awards that received only a single offer since, by definition, for this subset of awards border effects cannot result from a potential tendency of the CAE to select local firms.

As can be seen in Figure 3, about 22% of awards received only a single bid.[41] Columns (1) to (4) of Table 6 compare estimates of regression equation (3) for the subset of awards that received one and multiple offers. Columns (1) and (2) report similar border dummies for both subsamples, except for the NUTS1 level, suggesting that already the participation decision of firms is subject to border effects. Adding controls for common language, currency, and cultural values in columns (3) and (4) leads to a relatively stronger decrease of the NUTS0 border coefficient for sample with multiple offers (column (4)). These variables therefore seem to be relatively more important for the selection of offers than for the participation decision of firms. This is also consistent with the finding that having the same language is not significant different from zero for the sample of single bids (column (3)). The results are qualitatively similar when awards are weighted by value in columns (5) to (8).

While these results point towards border effects already existing in the participation decision of firms to bid for public contracts, an important caveat is that we cannot exclude the possibility that a (perceived) home bias, that is, a tendency of CAEs to favor of local

[40] Home bias has been documented in many other contexts such as, for example, asset holdings (French and Poterba, 1991; Lewis, 1999; Ahearne et al., 2004), the wind turbine industry (Coşar et al., 2015), online products markets (Hortaçsu et al., 2009), online crowdfunding markets (Lin and Viswanathan, 2015).

[41] For about 12% of awards information on the number of offers is missing in the data. The figures presented here refer to the subsample with non-missing information.

providers in the award of contracts, is incorporated into the bidding firms' expectations.[42] The mere expectation of such a tendency in the selection process --whether justified or not-- might then result in border effects due to limited participation of non-local firms, in particular if bidding is subject to a cost.

5.2.2 Award Value

There is substantial variation in the value of awards. As reported in Table 7, the median award in our data set has a value of only 33,238 Euros while the 95 percentile is almost 2 Million and the 99 percentile and 11 Million. For example, some big awards by the UK government, mostly in the transport sector, have values of up to 11 Billion Euros.

The descriptive statistics in panel B of Table 1 shows that cross-border procurement is increasing in the value of a contract: the share of cross-border awards is 0.49% for the 1st quartile but 2.27% for the 4th quartile. Somewhat surprisingly, however, the extent of cross-regional procurement is decreasing in value: for example, for the 1st quartile 23.4% of awards went to the same NUTS3 of the CAE while it was 37.28% for the 4th quartile.

Table 8 reports results when regression equation (3) is estimated separately by quartile in columns (1) to (4) and for awards above the 95 percentile in column (5). The results confirm the pattern we found in the descriptive statistics. The NUTS0 border effect decreases with value: a firm located in the same country (but in a different NUTS1 region) is 189 times (exp(5.243)) more likely to be awarded a low-value contract (1st quartile) than a firm located in a different country. For a high value contract (4th quartile), it is only 88 times (exp(4.483)) more likely. The results remain qualitatively unchanged when border effects by quartile are jointly estimated (column (6)) and when the sample is constrained to awards with only one bidder (column (7)). Also consistent with the descriptive statistics, we find that intra-national border effects are increasing with the award value.

One interpretation of the decreasing national border effects with value is that firms face a fixed cost to participate in cross-national procurement transactions (e.g., dealing with an unfamiliar legal context and differences in technical specifications, preparing documents in a different language). Since these costs are not one-to-one related to the award value, it becomes relatively more profitable for foreign firms to bid for high value projects. This interpretation is also consistent with, firstly, the finding that also in the one bidder case (column (7)) national border effects are decreasing with the value of the award, suggesting that border effects already exist in the participation decision of firms (Section 5.2.1), and secondly, that the importance of common language, currency and cultural values as explanatory variables decreases as the value of the award increases across columns (1) to (5). Finally, this interpretation would be consistent with models of international trade that

[42] For example, according to a recent study by the European Commission 77% of 1,011 surveyed companies with experience in dealing with public procurement in the EU stated that the perceived preference among CAEs for local bidders constitutes a relevant barrier to cross-border public procurement (European Commission, 2017).

incorporate heterogeneous firms and fixed cost of exporting (e.g., Chaney, 2008 and Helpman et al., 2008).

The finding that that intra-national border effects are slightly *increasing* in the award value is surprising. A potential explanation is that this finding is an artefact of composition effects that are not fully captured by our fixed effects: higher value projects are more likely to be tendered in NUTS regions with higher GDP and population. However, in these economically more important regions also the also the number of potential local providers is likely to be higher.[43]

5.2.3 Border Effects over Time

We assess the evolution of border effects over time by interacting the three $sam\_NUTSX_{i,j}$ dummies in equation (3) with variables that indicate whether a notice was published in 2011, 2012, 2013, or 2014. The inclusion of these interactions allows us to estimate border effects relative to tenders published in the year 2010, the beginning of our sample. The results are reported in Appendix Table A3 and for convenience visualized in Figure 4. The upper and middle graphs show the evolution of the NUTS2 and the sum of the NUTS1 and NUTS2 border effects, respectively (the intra-national border effects). The bottom graph shows the sum of all three border effects (i.e., including the international effect). To ease interpretation, we always show the exponentials of the coefficient estimates reported in Table A3.

Although the coefficients on the interactions tend to be imprecisely estimated, there is nevertheless a tendency towards decreased border effects that is visible in all three graphs. While this tendency also exists on the intra-national level, it is more pronounced on the international level (the bottom graph), i.e., especially the NUTS0 border effect is becoming smaller in value. According to the bottom graph, for example, the total border effects in 2013 and 2014 are statistically significantly lower than in 2010. The difference is quantitatively important: in 2014, the level of the total border effect is about 70% of its 2010 level.

5.2.4 Border Effects by Type of Product

In Section 5.1.2 we documented that border effects vary substantially by goods, services, and construction works procurement. In this section we explore this further by estimating gravity equations separately for 45 CPV divisions that provide a more disaggregated classification of goods and services, see Section 3.2.2 and Table A4.[44] The results are shown in Table 9. For convenience, only the border and distance effects are reported. The categories are ranked according to the total international border effect, that is, the sum of the coefficients on the three border dummies.

While the estimates show very substantial differences in border effects across CPV divisions, it is important to note that the NUTS0 border effect remains significantly different from zero

[43] To capture this, one would have to include a full set of 283×283 interacted origin and destination NUTS2 region fixed effects.

[44] In order to prevent an excessive high number of zeros, we use a simplified cross-sectional version of equation (3) that does not include year fixed effects. Since there are 283 NUTS2 regions the number of observations used to estimate each of the 45 regressions is $283 \times 283 = 80{,}089$.

in all cases and so do the intra-national border effects in almost all cases. An important insight is therefore that even on a relatively fine level of disaggregation, virtually all types of goods and services are subject to both inter- and intra-national border effects.

In line with the results reported in Table 4, we find that border effects are more important for services than for goods. For example, out of the CPV divisions ranked in the top 10 according to the total international border effect, 8 are services. To the contrary, among the bottom 10 CPV divisions in the rank, 9 correspond to goods. The two good categories with relatively high border effects consist of highly substitutable products (e.g., fuel and water). This is consistent with what has been documented in the international trade literature (e.g., Chen, 2004).

5.2.5 Award Criteria and Type of Procedure

The border effects we document above could result from the choice of certain administrative procedures. We analyze the effect of the award criterion used in a tender and whether a tender is published under an "open" or "restricted" procedure.

Award Criteria

The public procurement Directives[45] provide that the CAE shall base the award of public contracts either on the lowest price only or on the so-called "most economically advantageous tender" (MEAT). Under the MEAT criterion, other factors than price (like quality, cost-effectiveness, after-sales service, etc.) are taken into account for the award.[46] In our sample 46% and 43% of the contracts have been awarded following the lowest price and MEAT criterion, respectively (Appendix Table A1).[47]

The price-only criterion is directly comparable and in principle less subject to product differentiation effects that can soften competition. Therefore, it could be the case that regions where MEAT is more prevalent show lower rates of cross-border procurement because foreign firms may find it more difficult to bid competitively taking into account factors other than price that can be linked to local preferences or specificities.

Table 10 reports for estimates of regression equation (3) for tenders using MEAT and lowest price criterion. Tenders using the MEAT criterion seem to be subject to substantially higher intra-national border effects: the coefficients on *same_NUTS1* and *same_NUTS2* are both substantially higher for the MEAT subsample. Also, having a common language and currency are more important determinants in the case of MEAT than lowest price. On the other hand, the international border effect is higher for the subsample using the lowest price criterion. As discussed previously, this is in line with Coughlin and Novy (2016).

Type of Procedure

[45] See Directive 2004/18/EC and Directive 2004/17/EC for the relevant legal provisions concerning EU public procurement in our sample period.
[46] The new Directives 2014/24/EC and 2014/25/EC set, without prejudice to national legislations, MEAT as the preferential award mechanism.
[47] For the remaining awards information on the award criterion used is missing.

The public procurement Directives[48] establish the general obligation of CAEs to award public contracts by using so-called "open" or "restricted" procedures. In an open procedure any interested firm can submit a tender whereas in a restricted procedure any firm can request to participate in the tendering process but only those firms invited by the CAE will be able to submit a tender.

Under specific circumstances other procedures can be used. These are for instance the "negotiated" procedure, which can take place with or without the publication of a previous contract notice, and the "competitive dialogue." In a negotiated procedure the CAE consults the firms of its choice and negotiates the terms of the contract with them. In a competitive dialogue the CAE usually has a specific procurement need, i.e., a need for which a suitable solution is not readily available in the market. Any firm can request to participate in the process, but the CAE can select those with which to discuss the manners to satisfy its need and following those discussions the CAE is allowed to narrow down further the list of firms allowed to submit a tender.[49]

The open and restricted procedures may be regarded as the more competitive ones in nature. They are also the most commonly used: About 90% of projects in our data sets are tendered either according to the "open" or "restricted" procedure (see Appendix Table A1).

Columns (3) and (6) of Table 10 reports estimates of equation (3) when only projects that use the "open" or "restricted" procedure are considered. The estimates are very similar to our results reported in columns (3) and (7) of Table 5. The border effects that we document above are therefore not a result of the tendering procedure.

6 Conclusions

In this paper, we use data on 1.8 million public contract award decisions to empirically quantify border effects in public procurement in the European Single Market. We match the address information in the data to geo-locations to construct a data set of bilateral public procurement flows between NUTS3 region pairs. Following a methodology first proposed by McCallum (1995), we then estimate a gravity model with border effects. We document very sizable inter- as well as intra-national border effects despite controlling for numerous variables, such as origin- and destination fixed effects, physical distance, common language, currency, and cultural similarity.

In our baseline results we find that a local firm is about twice as likely to win a contract as a non-local firm in the same NUTS2 region and about seven times more likely to be awarded compared to a firm in a different NUTS1 region. We document the most sizable border effects on the international level: a local firm is over 900 times more likely to be awarded a contract than a foreign firm. While border effects are weaker for goods procurement and

[48] Ibid. footnote 45.

[49] There exists also a variant of the negotiated and restricted procedures called "accelerated," where deadlines are shortened if additional conditions are met.

larger for construction works and services procurement, they are substantial even for finely defined product categories. We also document that border effects are becoming smaller towards the more recent years.

We find that cultural differences across European Member States can only explain a part of border effects. Moreover, we find that the award criterion used has an impact on the border effects: intra-national border effects are larger when the "most economically advantageous tender" instead of the "lowest price" criterion is used. The latter is of some policy importance, because since recently the former is now the preferential award mechanism.

Interestingly, international border effects are decreasing with the value of an award. In line with international trade models that assume a fixed cost of exporting, this finding suggests that firms wanting to bid for public contracts awarded in another EU Member State may still face important obstacles that are worth dealing with only for high value projects. Consistent with this interpretation, estimates based on the subsample of awards with only one bidder suggest that already the decision of firms to bid for public contracts is subject to border effects.

These findings are surprising since customs duties and quantitative restrictions were progressively abolished in the European Single Market by 1968. We can therefore exclude that formal trade barriers are the reason for the border effects we document in this paper. Moreover, above-threshold European public procurement legislation is explicitly aimed at promoting cross-border procurement. In particular, tendering procedures have been harmonized in order to prevent the administrative burden of cross-border transactions. Also, the requirement that all above-threshold contracts must be publicized at the EU-level has been in place for long time. This implies that information asymmetries, that is, the fact that firms are simply unaware of ongoing tenders in other countries are unlikely to be the reason for the border effects.

At least since the mid-1980s, the EU also focused on abolishing non-tariff barriers, such as differences in standards or technical regulations that are imposed by national governments for health and safety reasons.[50] Moreover, there have been efforts to reduce "hidden" trade costs, such as the (real or perceived) relative difficulty in enforcing contracts across jurisdictions.[51] In any case, while the remaining non-tariff barriers and "hidden" trade costs between countries might have some importance for international border effects, they cannot explain the substantial *within*-country border effects that we document in this paper.

The underlying reasons for border effects in the award of public contracts, in particular on the intra-national level, remain therefore unclear. On the one hand, our results based on the

[50] See, for example, the 1985 White Paper COM(85) 310 final "Completing the Internal Market" (Commission of the European Communities, 1985). We refer the reader to Head and Mayer (2000) for an economic evaluation of the "Single European Act" that was implementing some of the issues that were raised. Recent evidence that technical barriers diminish the trade volume of goods can be found in Chen (2004) and Essaji (2008).

[51] For example, Anderson and Marcouiller (2002) show evidence that such "hidden" trade costs might reduce the volume of trade.

subsample of awards with only one bidder suggest that border effects already exist in the participation decision of firms bidding for public contracts. While limited participation is consistent with, for example, tacit collusion based on the home-market principle (e.g., Roux et al., 2016), the fact that we find border effects for *all* product categories, however, makes this explanation less probable. An alternative explanation is that public procurement is subject to some degree of home bias, that is, contracting authorities might have a preference for consuming locally provided goods and services. Such a home bias would also be consistent with the observed limited participation of firms and recent survey evidence on firms' expectations regarding the chances of succeeding in cross-border procurement. The very expectation of a home bias in the selection process would have an impact on the bidding behavior of firms in the first place, in particular if bidding is costly. Since the policy implications substantially differ between these scenarios, more research into the causes of border effects in the award of public contracts is necessary.

From a policy perspective, the welfare losses due to border effects and the need for policy action differs by the specific goods or services that are the subject of the public contract. Policies should focus on goods and services for which the substitutability of locally and non-locally varieties is lowest since theory shows that in these cases welfare losses are highest.[52] Since we document border effects for a wide range of finely defined good and service categories the overall welfare loss due to border effects in European public procurement is likely to be substantial.

[52] Theory shows that the border effect is identical to the product of the elasticity of substitution between "local" and "non-local" goods, services, and works, and the tariff-equivalent of any border barrier (e.g., Anderson and van Wincoop, 2003). If goods, services, and works provided by "local" and "non-local" firms are very similar and therefore highly substitutable, a minor trade barrier or home bias can result in a very substantial border effect. In this case, the consequences for welfare, however, would be minor and scope for policy action would be smaller. If, on the other hand, the substitutability is low and border effects are primarily driven by trade barriers, adverse welfare effects might be substantial (Evans, 2003).

7 References

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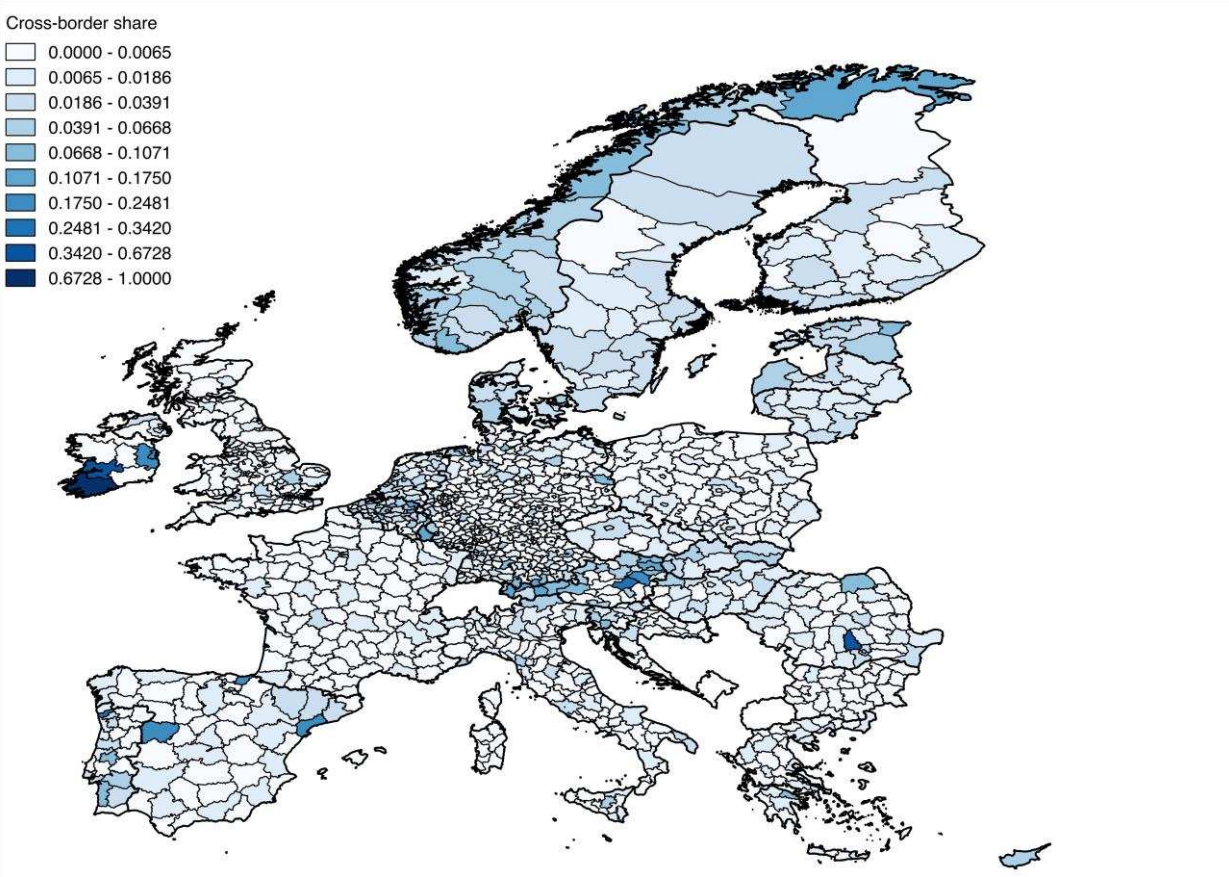
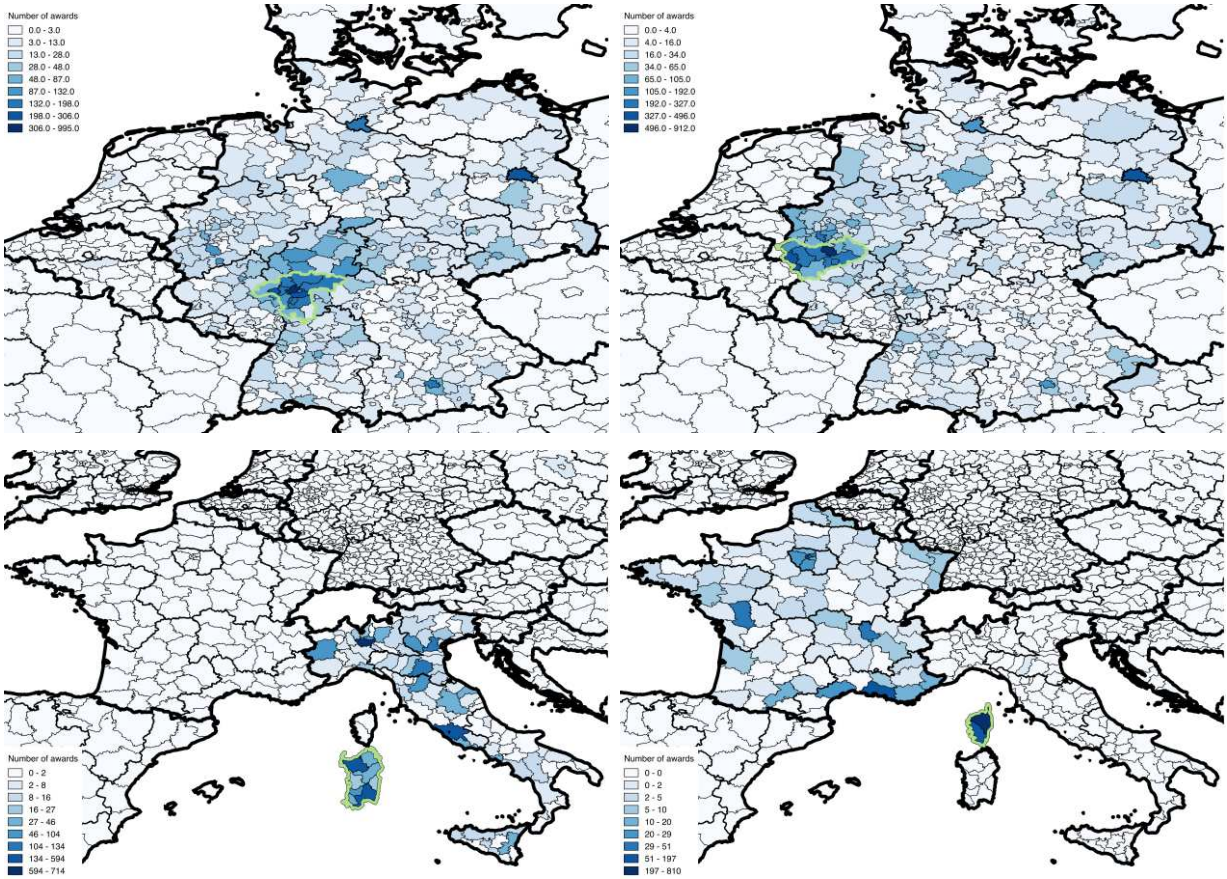
Figure 1: Share of cross-border by NUTS3 region



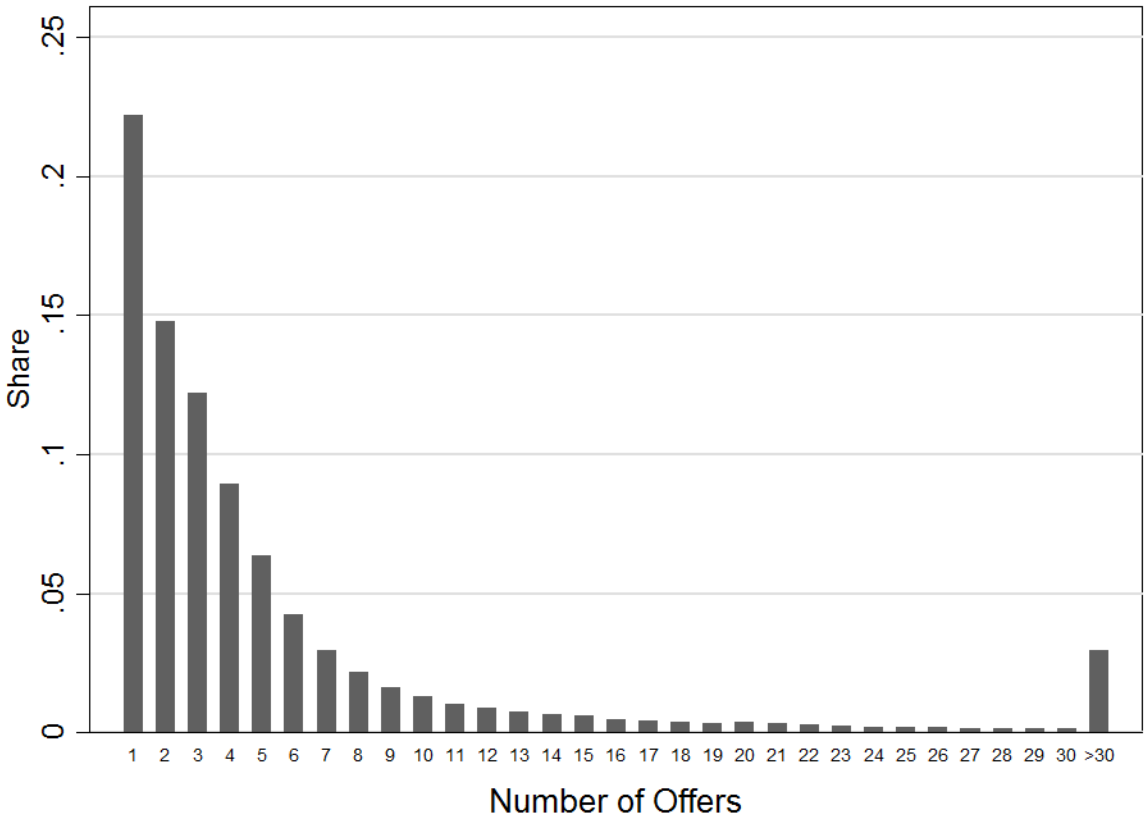
Notes: The figure shows the share of cross-border (NUTS0) procurement share by origin NUTS3 region.

Figure 2: Example of the geographic distribution of awards



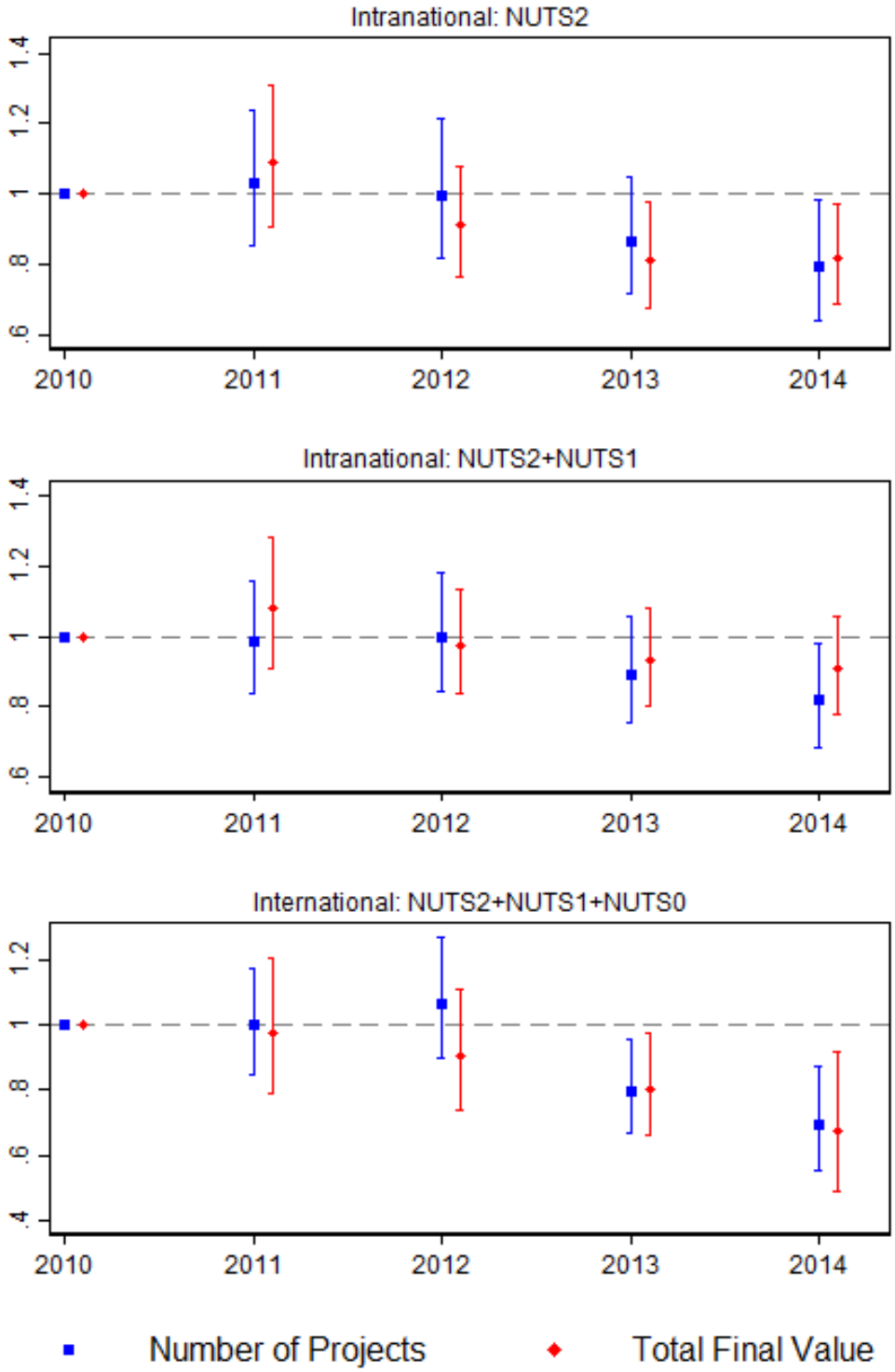
Notes: Clockwise from the top left, the figure shows the geographic distribution of contract awards by contracting authorities or entities (CAE) located in NUTS2 regions Darmstadt/Frankfurt am Main (DE71), Cologne (DEA2), Sardinia (ITG2) and Corsica (FR83).

Figure 3: Distribution of Number of Offers



Notes: The figure shows the distribution of the number of offers received.

Figure 4: Border Effects over Time



Notes: The figure visualizes the evolution of border effects relative to 2010. Exponentials of the coefficients reported in Appendix Table A3 are shown. The dependent variable is the number of projects (blue) or total final value (red). The lines indicate 95% confidence intervals.

Table 1: Cross-Border Procurement

Panel A: Number of Projects

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	All		Goods		Services		Construction Works	
	Number	Share	Number	Share	Number	Share	Number	Share
Same NUTS3	561141	31.31%	213969	21.72%	260322	42.49%	86066	44.75%
Same NUTS2	300609	16.77%	135359	13.74%	124581	20.34%	40371	20.99%
Same NUTS1	194707	10.86%	108418	11.00%	64565	10.54%	21481	11.17%
Same Country	712017	39.73%	511303	51.89%	157236	25.67%	42890	22.30%
Different Country	23743	1.32%	16259	1.65%	5938	0.97%	1536	0.80%
Total	1792217	100.00%	985308	100.00%	612642	100.00%	192344	100.00%

Panel B: Projects by Quartiles of Total Final Value

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	1st Quartile		2nd Quartile		3rd Quartile		4th Quartile	
	Number	Share	Number	Share	Number	Share	Number	Share
Same NUTS3	74750	23.40%	90587	28.36%	115873	36.28%	119077	37.28%
Same NUTS2	54989	17.22%	50365	15.77%	53307	16.69%	55875	17.49%
Same NUTS1	28150	8.81%	29812	9.33%	32733	10.25%	37723	11.81%
Same Country	159943	50.08%	146148	45.76%	113582	35.56%	99458	31.14%
Different Country	1561	0.49%	2481	0.78%	3898	1.22%	7260	2.27%
Total	319393	100.00%	319393	100.00%	319393	100.00%	319393	100.00%

Panel C: Total Final Value in Euros (in Millions)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	All		Goods		Services		Construction Works	
	Value	Share	Value	Share	Value	Share	Value	Share
Same NUTS3	150214.2	36.71%	36547.8	28.02%	63246.2	42.07%	49689.5	39.07%
Same NUTS2	71764.8	17.54%	17011.6	13.04%	28431.4	18.91%	26248.8	20.64%
Same NUTS1	49424.3	12.08%	16629.4	12.75%	16146.2	10.74%	16576.3	13.03%
Same Country	128303.0	31.35%	54877.5	42.07%	40253.6	26.78%	32795.3	25.79%
Different Country	9511.8	2.32%	5388.7	4.13%	2249.0	1.50%	1867.6	1.47%
Total	409218.1	100.00%	130454.9	100.00%	150326.3	100.00%	127177.5	100.00%

Notes: Panel A documents the number of projects that were won by firms located in the the same NUTS3, NUTS2, NUTS1, or country as the contracting authority. Panel B differentiates projects depending on the the total final value of the award. In panel C projects are weighted by their total final value.

Table 2: Baseline Results

	(1)	(2)	(3)	(4)
	Projects (Share)	Number of Projects	Total Final Value (Share)	Total Final Value (in Euros)
same_NUTS0	5.618***	5.751***	4.867***	5.126***
	(0.0702)	(0.0708)	(0.0850)	(0.0611)
same_NUTS1	0.714***	0.447***	0.938***	0.499***
	(0.0611)	(0.0386)	(0.0694)	(0.0411)
same_NUTS2	0.739***	0.811***	0.765***	0.741***
	(0.0735)	(0.0504)	(0.0784)	(0.0426)
same_NUTS3	1.243***	0.718***	1.206***	0.445***
	(0.0743)	(0.0716)	(0.0849)	(0.0586)
Distance (log)	-0.288***	-0.385***	-0.281***	-0.549***
	(0.0449)	(0.0340)	(0.0575)	(0.0274)
Origin Pop. (log)	-0.403***		-0.395***	
	(0.0229)		(0.0244)	
Destination Pop. (log)	1.189***		1.114***	
	(0.0309)		(0.0306)	
Observations	1,841,440	1,842,794	1,837,360	1,837,360
R-squared	0.373	0.795	0.306	0.906
Origin NUTS3 FE	NO	YES	NO	YES
Destination NUTS3 FE	NO	YES	NO	YES

Notes: The table shows estimates of regression equations (1) and (2). The dependent variable is the number of projects in columns (1) and (2) and the total final value in million Euros in columns (3) to (4). Columns (1) and (3) include the total projects tendered by authority i as an offset variable. Columns (2) and (4) contain origin and destination NUTS3 region fixed effects. The method of estimation is Poisson pseudo-maximum likelihood (PPML). Eicker-White robust standard errors are shown in parantheses.

Table 3: Currency, Language, and Cultural Values

	(1)	(2)	(3)	(4)
	Number of Projects		Total Final Value (in Euros)	
same_NUTS0	5.171***	4.846***	4.637***	4.560***
	(0.0869)	(0.135)	(0.0862)	(0.137)
same_NUTS1	0.452***	0.452***	0.507***	0.507***
	(0.0386)	(0.0386)	(0.0412)	(0.0412)
same_NUTS2	0.813***	0.816***	0.745***	0.747***
	(0.0504)	(0.0504)	(0.0426)	(0.0427)
same_NUTS3	0.722***	0.724***	0.453***	0.454***
	(0.0715)	(0.0715)	(0.0586)	(0.0585)
Distance (log)	-0.382***	-0.380***	-0.544***	-0.542***
	(0.0339)	(0.0339)	(0.0275)	(0.0275)
Origin Pop. (log)				
Destination Pop. (log)				
Same Language	0.954***	0.930***	1.019***	1.013***
	(0.126)	(0.102)	(0.140)	(0.126)
Same Currency	0.667***	0.734***	0.115	0.0707
	(0.154)	(0.169)	(0.157)	(0.172)
Trust		-2.169***		-1.571***
		(0.364)		(0.462)
Hierarchy		0.0386		-0.657
		(0.875)		(0.812)
Individualism		-0.807		1.225
		(1.016)		(1.014)
Observations	1,842,794	1,842,794	1,837,360	1,837,360
R-squared	0.795	0.795	0.906	0.906
Origin NUTS3 FE	YES	YES	YES	YES
Destination NUTS3 FE	YES	YES	YES	YES

Notes: The table shows estimates of regression equations (2). The dependent variable is the number of projects in columns (1) and (2) and the total final value in million Euros in columns (3) and (4). All specifications include origin and destination NUTS3 region fixed effects. The method of estimation is Poisson pseudo-maximum likelihood (PPML). Eicker-White robust standard errors are shown in parantheses.

Table 4: Goods, Services, and Construction Works

	(1)	(2)	(3)	(4)	(5)	(6)
	Number of Projects			Total Final Value (in Euros)		
	Goods	Services	Construction	Goods	Services	Construction
same_NUTS0	5.197***	4.638***	3.692***	5.014***	5.025***	4.072***
	(0.183)	(0.163)	(0.117)	(0.237)	(0.182)	(0.186)
same_NUTS1	0.193***	0.727***	0.725***	0.203***	0.508***	0.674***
	(0.0355)	(0.0402)	(0.0334)	(0.0426)	(0.0536)	(0.0468)
same_NUTS2	0.480***	1.038***	0.726***	0.374***	1.019***	0.687***
	(0.0513)	(0.0472)	(0.0381)	(0.0543)	(0.0529)	(0.0453)
same_NUTS3	0.221***	0.981***	0.798***	-0.0809	0.643***	0.524***
	(0.0842)	(0.0601)	(0.0502)	(0.0705)	(0.0674)	(0.0603)
Distance (log)	-0.309***	-0.512***	-1.071***	-0.417***	-0.501***	-0.890***
	(0.0339)	(0.0290)	(0.0207)	(0.0278)	(0.0330)	(0.0315)
Same Language	0.452***	1.126***	1.907***	0.318**	0.647***	2.268***
	(0.109)	(0.133)	(0.169)	(0.134)	(0.216)	(0.292)
Same Currency	0.876***	0.391*	0.0389	0.105	0.0221	-0.0658
	(0.205)	(0.218)	(0.194)	(0.228)	(0.245)	(0.332)
Trust	-2.114***	-1.453***	-1.579***	-1.911***	-0.435	-0.445
	(0.427)	(0.457)	(0.515)	(0.575)	(0.525)	(0.760)
Hierarchy	-0.289	-1.305	0.636	-0.283	-3.412***	-0.704
	(1.012)	(1.227)	(0.828)	(1.154)	(0.946)	(1.355)
Individualism	-1.948	0.874	1.170	1.761	1.118	-1.241
	(1.284)	(1.035)	(0.739)	(1.186)	(1.229)	(0.985)
Observations	1,823,844	1,827,855	1,701,168	1,790,195	1,790,144	1,610,370
R-squared	0.874	0.874	0.928	0.948	0.931	0.837
Origin NUTS3 FE	YES	YES	YES	YES	YES	YES
Destination NUTS3 FE	YES	YES	YES	YES	YES	YES

Notes: The table shows estimates of regression equations (2). The dependent variable is the number of projects involving goods, services, and construction works procurement in columns (1) to (3). In columns (4) to (6) the dependent variable is the total final value in million Euros. All specifications include origin and destination NUTS3 region fixed effects. The method of estimation is Poisson pseudo-maximum likelihood (PPML). Eicker-White robust standard errors are shown in parantheses.

Table 5: Results of the Extended Specification

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Number of Projects				Total Final Value (in Euros)			
same_NUTS0	5.367***	4.892***	4.618***	4.682***	4.977***	4.545***	4.488***	4.506***
	(0.0426)	(0.0536)	(0.0785)	(0.0794)	(0.0428)	(0.0646)	(0.106)	(0.107)
same_NUTS1	0.244***	0.249***	0.250***	0.258***	0.481***	0.488***	0.489***	0.492***
	(0.0331)	(0.0332)	(0.0332)	(0.0317)	(0.0286)	(0.0286)	(0.0286)	(0.0285)
same_NUTS2	0.916***	0.921***	0.924***	0.826***	0.964***	0.972***	0.977***	0.950***
	(0.0452)	(0.0452)	(0.0453)	(0.0441)	(0.0384)	(0.0384)	(0.0384)	(0.0382)
Distance (log)	-0.716***	-0.712***	-0.709***		-0.672***	-0.665***	-0.662***	
	(0.0228)	(0.0228)	(0.0228)		(0.0199)	(0.0198)	(0.0199)	
Same Language		0.787***	0.760***	0.792***		0.924***	0.922***	0.929***
		(0.0781)	(0.0628)	(0.0636)		(0.106)	(0.0962)	(0.0965)
Same Currency		0.595***	0.650***	0.693***		0.0871	0.0467	0.0602
		(0.0962)	(0.103)	(0.102)		(0.118)	(0.131)	(0.130)
Trust			-1.699***	-1.831***			-1.249***	-1.291***
			(0.249)	(0.254)			(0.372)	(0.375)
Hierarchy			0.0541	-0.129			-0.683	-0.733
			(0.674)	(0.678)			(0.658)	(0.658)
Individualism			-0.916	-0.927			1.090	1.084
			(0.602)	(0.600)			(0.764)	(0.764)
				-0.879***				-0.649***
Distance by product category (log)				(0.0317)				(0.0273)
Commodities, food, fuels, and construction materials				-0.687***				-0.465***
				(0.0270)				(0.0283)
Machinery and equipment				-0.320***				-0.308***
				(0.0311)				(0.0418)
Medical products				-0.643***				-0.542***
				(0.0296)				(0.0324)
Other manufacturing				-1.109***				-0.782***
				(0.0353)				(0.0269)
Construction				-0.963***				-0.764***
				(0.0306)				(0.0290)
Business, real estate, engineering, IT, and research services				-1.129***				-0.772***
				(0.0324)				(0.0260)
Other services				-1.093***				-0.814***
				(0.0394)				(0.0322)
Observations	2,763,495	2,763,495	2,763,495	2,763,495	2,763,495	2,763,495	2,763,495	2,763,495
R-squared	0.567	0.566	0.566	0.588	0.548	0.548	0.548	0.541
Origin NUTS2 FE	YES	YES	YES	YES	YES	YES	YES	YES
Destination NUTS2 FE	YES	YES	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES	YES	YES
Product Category FE	YES	YES	YES	YES	YES	YES	YES	YES

Notes: The table shows estimates of regression equation (3). The dependent variable is the number of projects in columns (1) to (4) and the total final value in million Euros in columns (5) to (8). All specifications include origin and destination NUTS2 region fixed effects as well as year and product category fixed effects. The method of estimation is Poisson pseudo-maximum likelihood (PPML). Eicker-White robust standard errors are shown in parantheses.

Table 6: Awards with One and Multiple Offers

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Number of Projects				Total Final Value (in Euros)			
	1 offer	>1 offer	1 offer	>1 offer	1 offer	>1 offer	1 offer	>1 offer
same_NUTS0	5.343***	5.443***	4.933***	4.590***	5.172***	4.998***	4.986***	4.417***
	(0.0662)	(0.0453)	(0.101)	(0.104)	(0.0785)	(0.0473)	(0.160)	(0.143)
same_NUTS1	0.0247	0.297***	0.0251	0.305***	0.384***	0.495***	0.386***	0.505***
	(0.0557)	(0.0323)	(0.0557)	(0.0323)	(0.0485)	(0.0290)	(0.0485)	(0.0289)
same_NUTS2	1.130***	0.791***	1.131***	0.802***	1.399***	0.808***	1.403***	0.822***
	(0.0846)	(0.0421)	(0.0847)	(0.0422)	(0.0649)	(0.0376)	(0.0650)	(0.0377)
Distance (log)	-0.666***	-0.730***	-0.665***	-0.720***	-0.391***	-0.737***	-0.388***	-0.725***
	(0.0416)	(0.0223)	(0.0417)	(0.0223)	(0.0374)	(0.0201)	(0.0375)	(0.0201)
Same Language			0.0534	0.911***			0.323*	1.092***
			(0.0877)	(0.0752)			(0.177)	(0.116)
Same Currency			0.588***	0.575***			-0.0969	-0.0137
			(0.0972)	(0.144)			(0.172)	(0.176)
Trust			0.186	-2.258***			-0.538	-1.426***
			(0.255)	(0.297)			(0.533)	(0.434)
Hierarchy			-1.211**	0.482			-1.296	-0.808
			(0.554)	(0.833)			(0.999)	(0.796)
Individualism			-1.724***	-1.183			0.500	1.147
			(0.345)	(0.794)			(0.672)	(0.930)
Observations	2,743,685	2,763,495	2,743,685	2,763,495	2,733,990	2,763,495	2,733,990	2,763,495
R-squared	0.620	0.540	0.620	0.540	0.582	0.504	0.582	0.504
Origin NUTS2 FE	YES	YES	YES	YES	YES	YES	YES	YES
Destination NUTS2 FE	YES	YES	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES	YES	YES
Product Category FE	YES	YES	YES	YES	YES	YES	YES	YES

Notes: The table shows estimates of regression equation (3). The dependent variable is the number of projects in columns (1) to (4) and the total final value in million Euros in columns (5) to (8). All specifications include origin and destination NUTS2 region fixed effects as well as year and product category fixed effects. The method of estimation is Poisson pseudo-maximum likelihood (PPML). Eicker-White robust standard errors are shown in parantheses.

Table 7: Award Values

Percentile	Value (in Euros)
25	4,337.0
50	33,238.1
75	200,340.4
95	1,879,134.5
99	11,074,326.0

Notes: Distribution of award values in the data set.

Table 8: Border Effects by Total Final Value of the Award

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Number of Projects						
	1st Quartile	2nd Quartile	3rd Quartile	4th Quartile	>=95 Percentile		One Bidder
same_NUTS0	5.243***	5.098***	4.784***	4.483***	4.396***		
	(0.247)	(0.177)	(0.138)	(0.127)	(0.0992)		
same_NUTS1	0.0232	-0.0184	0.218***	0.503***	0.507***		
	(0.0650)	(0.0453)	(0.0344)	(0.0269)	(0.0324)		
same_NUTS2	0.985***	0.838***	1.072***	1.044***	0.905***		
	(0.119)	(0.0616)	(0.0478)	(0.0403)	(0.0408)		
same_NUTS0							
1st Quartile						6.162***	6.129***
						(0.134)	(0.138)
2nd Quartile						5.608***	5.692***
						(0.115)	(0.114)
3rd Quartile						4.904***	4.933***
						(0.100)	(0.0967)
4th Quartile						4.148***	3.946***
						(0.0783)	(0.0887)
same_NUTS1							
1st Quartile						-0.213***	-0.277***
						(0.0808)	(0.101)
2nd Quartile						-0.0663	-0.214***
						(0.0528)	(0.0794)
3rd Quartile						0.278***	0.0447
						(0.0338)	(0.0580)
4th Quartile						0.555***	0.496***
						(0.0345)	(0.0532)
same_NUTS2							
1st Quartile						0.908***	1.276***
						(0.104)	(0.156)
2nd Quartile						0.933***	1.016***
						(0.0588)	(0.0873)
3rd Quartile						1.023***	1.192***
						(0.0497)	(0.0743)
4th Quartile						0.913***	1.111***
						(0.0547)	(0.0807)
Distance (log)	-0.391***	-0.688***	-0.801***	-0.668***	-0.601***	-0.696***	-0.659***
	(0.0588)	(0.0386)	(0.0260)	(0.0189)	(0.0222)	(0.0219)	(0.0331)
Same Language	1.793***	1.478***	1.084***	0.862***	0.843***	0.727***	0.241***
	(0.365)	(0.177)	(0.0992)	(0.0725)	(0.105)	(0.0588)	(0.0927)
Same Currency	1.939***	0.727***	0.260*	0.116	-0.0328	0.567***	0.436***
	(0.250)	(0.225)	(0.150)	(0.133)	(0.124)	(0.106)	(0.0892)
Trust	-4.040***	-3.286***	-1.165***	-1.026***	-0.972***	-1.011***	0.632**
	(1.377)	(0.824)	(0.426)	(0.377)	(0.308)	(0.255)	(0.306)
Hierarchy	0.661	1.001	0.550	-0.529	-2.148***	0.291	-1.203***
	(1.349)	(1.013)	(0.768)	(0.765)	(0.557)	(0.494)	(0.457)
Individualism	-12.30***	-3.735***	-0.159	1.512*	0.322	-0.969	-2.285***
	(2.029)	(1.409)	(0.791)	(0.826)	(0.431)	(0.659)	(0.335)
Observations	2,532,075	2,685,200	2,763,495	2,763,495	2,753,590	11,053,980	10,935,960
R-squared	0.636	0.652	0.515	0.562	0.523	0.373	0.422
Origin NUTS2 FE	YES	YES	YES	YES	YES	YES	YES
Destination NUTS2 FE	YES	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES	YES
Product Category FE	YES	YES	YES	YES	YES	YES	YES

Notes: Columns (1) to (5) show estimates of regression equation (3). The dependent variable is, respectively, the number of projects in the 1st, 2nd, 3rd, and 4th quartile and above the 95 percentile of the distribution of the total final value of awards. Column (6) shows jointly estimated quartile-specific border effects. In column (7) estimates for the subsample of awards with only one bidder are shown. All specifications include origin and destination NUTS2 region fixed effects as well as year and product category fixed effects. Column (6) and (7) also include quartile fixed effects. The method of estimation is Poisson pseudo-maximum likelihood (PPML). Eicker-White robust standard errors are shown in parantheses.

Table 9: Border Effects by Type of Procurement

CPV Division	same_NUTS0	same_NUTS1	same_NUTS2	Distance (log)
77. Agricultural, forestry, horticultural, aquacultural and apicultural services	7.416	1.009	1.964	-1.039
	(1.092)	(0.159)	-0.225	(0.169)
80. Education and training services	6.211	0.485	2.555	-0.755
	(0.651)	(0.156)	-0.193	(0.111)
70. Real estate services	6.136	0.625	2.086	-0.716
	(1.419)	(0.208)	-0.234	(0.145)
85. Health and social work services	5.448	1.027	2.334	-0.542
	(0.583)	(0.114)	-0.134	(0.085)
41. Collected and purified water	6.308	0.370	1.73	-1.013
	(1.385)	(0.319)	-0.389	(0.266)
9. Petroleum products, fuel, electricity and other sources of energy	6.909	0.630	0.762	-0.740
	(0.365)	(0.094)	-0.1	(0.066)
65. Public utilities	5.621	1.374	1.162	-0.572
	(0.640)	(0.169)	-0.162	(0.123)
55. Hotel, restaurant and retail trade services	6.084	0.494	1.365	-0.828
	(0.906)	(0.157)	-0.121	(0.110)
75. Administration, defence and social security services	4.653	1.222	1.876	-0.191
	(0.523)	(0.159)	-0.182	(0.120)
60. Transport services (excl. Waste transport)	5.113	0.515	1.881	-1.356
	(0.662)	(0.126)	-0.123	(0.092)
30. Office and computing machinery, equipment and supplies except furniture and software packages	5.006	0.481	1.588	-0.428
	(0.340)	(0.095)	-0.132	(0.068)
63. Supporting and auxiliary transport services; travel agencies services	4.860	0.628	1.57	-0.586
	(0.835)	(0.118)	-0.148	(0.092)
66. Financial and insurance services	5.329	0.211	1.417	-0.445
	(0.619)	(0.101)	-0.123	(0.057)
64. Postal and telecommunications services	6.116	0.611	0.199	-0.753
	(0.764)	(0.178)	-0.221	(0.119)
14. Mining, basic metals and related products	4.487	0.645	1.267	-0.955
	(0.592)	(0.175)	-0.184	(0.137)
50. Repair and maintenance services	4.699	0.355	1.332	-0.787
	(0.677)	(0.079)	-0.096	(0.060)
22. Printed matter and related products	4.655	0.386	1.313	-0.369
	(0.391)	(0.104)	-0.14	(0.060)
33. Medical equipments, pharmaceuticals and personal care products	6.063	0.002	0.243	-0.229
	(0.776)	(0.047)	-0.069	(0.045)
98. Other community, social and personal services	4.558	0.553	1.103	-0.874
	(0.609)	(0.107)	-0.106	(0.082)
16. Agricultural machinery	4.233	0.883	1.032	-0.962
	(0.679)	(0.161)	-0.18	(0.132)
90. Sewage-, refuse-, cleaning-, and environmental services	4.351	0.662	1.12	-1.083
	(0.486)	(0.064)	-0.078	(0.051)
32. Radio, television, communication, telecommunication and related equipment	4.558	0.627	0.794	-0.502
	(0.310)	(0.070)	-0.097	(0.055)
3. Agricultural, farming, fishing, forestry and related products	4.670	0.399	0.822	-1.116
	(0.656)	(0.131)	-0.146	(0.082)
51. Installation services (except software)	4.551	0.544	0.749	-0.753
	(0.761)	(0.121)	-0.137	(0.077)
79. Business services: law, marketing, consulting, recruitment, printing and security	4.254	0.583	0.972	-0.545
	(0.217)	(0.067)	-0.088	(0.053)
48. Software package and information systems	4.632	0.331	0.787	-0.281
	(0.226)	(0.063)	-0.093	(0.044)
24. Chemical products	4.824	0.284	0.511	-0.468
	(0.452)	(0.099)	-0.139	(0.075)
92. Recreational, cultural and sporting services	3.960	0.172	1.479	-0.712
	(0.533)	(0.113)	-0.142	(0.103)
45. Construction work	3.688	0.729	1.166	-1.162
	(0.151)	(0.067)	-0.083	(0.049)
73. Research and development services and related consultancy services	4.222	0.846	0.469	-0.333
	(0.337)	(0.127)	-0.141	(0.089)
72. IT services: consulting, software development, Internet and support	4.479	0.555	0.479	-0.490
	(0.196)	(0.064)	-0.082	(0.043)
15. Food, beverages, tobacco and related products	4.800	0.582	-0.012	-1.349
	(0.598)	(0.118)	-0.189	(0.084)
31. Electrical machinery, apparatus, equipment and consumables; Lighting	4.276	0.420	0.645	-0.616
	(0.218)	(0.077)	-0.095	(0.051)
18. Clothing, footwear, luggage articles and accessories	4.332	0.262	0.742	-0.561
	(0.364)	(0.090)	-0.135	(0.067)
71. Architectural, construction, engineering and inspection services	3.692	0.756	0.751	-0.863
	(0.190)	(0.061)	-0.074	(0.044)
38. Laboratory, optical and precision equipments (excl. glasses)	5.006	0.087	0.057	-0.460
	(0.188)	(0.076)	-0.113	(0.047)
44. Construction structures and materials; auxiliary products to construction (excepts electric apparatus)	3.588	0.536	0.982	-0.756
	(0.227)	(0.067)	-0.096	(0.047)
39. Furniture (incl. office furniture), furnishings, domestic appliances (excl. lighting) and cleaning products	3.624	0.436	0.808	-0.661
	(0.202)	(0.056)	-0.084	(0.040)
37. Musical instruments, sport goods, games, toys, handicraft, art materials and accessories	3.705	0.427	0.678	-0.473
	(0.492)	(0.114)	-0.161	(0.080)
35. Security, fire-fighting, police and defence equipment	3.870	0.026	0.804	-0.533
	(0.340)	(0.091)	-0.133	(0.065)
34. Transport equipment and auxiliary products to transportation	3.324	0.367	0.804	-0.730
	(0.169)	(0.065)	-0.098	(0.046)
76. Services related to the oil and gas industry	4.141	-1.563	1.796	-0.916
	(0.614)	(0.341)	-0.456	(0.184)
42. Industrial machinery	3.606	0.289	0.47	-0.693
	(0.208)	(0.073)	-0.098	(0.049)
43. Machinery for mining, quarrying, construction equipment	2.911	0.440	0.66	-0.995
	(0.500)	(0.113)	-0.122	(0.088)
19. Leather and textile fabrics, plastic and rubber materials	2.957	0.188	0.597	-0.466
	(0.568)	(0.137)	-0.16	(0.089)

Notes: The table shows estimates of regression equations (3) for 45 CPV divisions which are sorted according to the total international border effect (i.e., the sum of the coefficients on the three border dummies). The dependent variable is the number of projects. The regressions include origin and destination NUTS2 region fixed effects as well as year fixed effects. Controls for same language, same currency, and cultural distance are included but not shown. The method of estimation is Poisson pseudo-maximum likelihood (PPML). Eicker-White robust standard errors are shown in parantheses.

Table 10: Award Criteria and Type of Procedure

	(1)	(2)	(3)	(4)	(5)	(6)
	Number of Projects			Total Final Value		
	Lowest Price	MEAT	Open/Restr	Lowest Price	MEAT	Open/Restr
same_NUTS0	5.344***	3.930***	4.677***	4.784***	4.257***	4.555***
	(0.180)	(0.0656)	(0.102)	(0.208)	(0.111)	(0.149)
same_NUTS1	0.0620	0.464***	0.213***	0.419***	0.494***	0.472***
	(0.0450)	(0.0258)	(0.0349)	(0.0399)	(0.0341)	(0.0303)
same_NUTS2	0.761***	1.148***	0.897***	0.674***	1.224***	0.950***
	(0.0691)	(0.0391)	(0.0474)	(0.0507)	(0.0484)	(0.0401)
Distance (log)	-0.612***	-0.689***	-0.739***	-0.632***	-0.668***	-0.729***
	(0.0400)	(0.0186)	(0.0244)	(0.0287)	(0.0244)	(0.0212)
Same Language	0.589***	1.148***	0.905***	0.804***	0.848***	1.232***
	(0.110)	(0.0608)	(0.0708)	(0.157)	(0.117)	(0.105)
Same Currency	0.268	0.639***	0.696***	-0.272	0.354**	-0.116
	(0.204)	(0.0922)	(0.127)	(0.223)	(0.146)	(0.163)
Trust	-2.914***	-1.285***	-2.091***	-2.506***	-0.314	-1.494***
	(0.360)	(0.243)	(0.307)	(0.569)	(0.370)	(0.445)
Hierarchy	1.406	-1.566***	0.716	-0.254	-1.553**	-0.289
	(0.941)	(0.604)	(0.806)	(0.986)	(0.705)	(0.821)
Individualism	-0.878	-0.654**	-1.474*	1.276	0.432	1.499*
	(1.172)	(0.297)	(0.757)	(1.189)	(0.533)	(0.868)
Observations	2,734,130	2,763,495	2,763,495	2,724,400	2,763,495	2,763,495
R-squared	0.696	0.652	0.550	0.431	0.641	0.547
Origin NUTS2 FE	YES	YES	YES	YES	YES	YES
Destination NUTS2 FE	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES
Product Category FE	YES	YES	YES	YES	YES	YES

Notes: The table shows estimates of regression equation (3). In columns (1) to (3) the dependent variable is the number of projects that were tendered according to the "lowest price" and "MEAT" criterion and projects for which the "open" or "restricted" procedure was used. In columns (4) to (6) projects are weighted by their total final value in million Euros. All specifications include origin and destination NUTS2 region fixed effects as well as year and product category fixed effects. The method of estimation is Poisson pseudo-maximum likelihood (PPML). Eicker-White robust standard errors are shown in parantheses.

Table A1: Data Set on NUTS3 Level

Panel A: Number of Projects

	(1)	(2)	(3)	(4)
	mean	sd	min	max
All	0.97	49.30	0.00	28,388.00
Goods	0.53	32.85	0.00	18,964.00
Services	0.33	17.58	0.00	10,438.00
Construction Works	0.10	6.82	0.00	4,364.00
By Award Value				
1st Quartile	0.17	14.25	0.00	8,022.00
2nd Quartile	0.17	11.96	0.00	8,028.00
3rd Quartile	0.17	10.33	0.00	7,004.00
4th Quartile	0.17	10.64	0.00	7,001.00
By Number of Offers				
Only One Bidder	0.21	17.02	0.00	14,232.00
More than One Bidder	0.63	32.20	0.00	18,273.00
By Award Criterion				
Lowest Price	0.46	34.23	0.00	20,978.00
MEAT	0.43	21.20	0.00	10,579.00
By Type of Procedure				
Open/Restricted	0.86	44.27	0.00	26,058.00

Panel B: Total Final Value, in Million Euros

	(1)	(2)	(3)	(4)
	mean	sd	min	max
All	0.22	13.88	0.00	8,152.11
Goods	0.07	5.54	0.00	3,184.01
Services	0.08	6.23	0.00	4,198.79
Construction Works	0.07	3.64	0.00	1,686.94
By Number of Offers				
Only One Bidder	0.04	4.05	0.00	3,126.81
More than One Bidder	0.16	9.73	0.00	5,214.83
By Award Criterion				
Lowest Price	0.10	8.28	0.00	5,219.63
MEAT	0.11	6.68	0.00	4,762.93
By Type of Procedure				
Open/Restricted	0.18	10.62	0.00	6,387.70

Panel C: Other Variables

	(1)	(2)	(3)	(4)
	mean	sd	min	max
same_NUTS0	0.13	0.33	0.00	1.00
same_NUTS1	0.02	0.13	0.00	1.00
same_NUTS2	0.01	0.07	0.00	1.00
same_NUTS3	0.00	0.03	0.00	1.00
Distance, in 1000km	1.14	0.89	0.00	13.42
Distance (log)	-0.13	0.79	-6.60	2.60
Same Language	0.14	0.35	0.00	1.00
Same Currency	0.48	0.50	0.00	1.00
Cultural values				
Trust	0.11	0.10	0.00	0.51
Hierarchy	0.06	0.06	0.00	0.39
Individualism	0.10	0.08	0.00	0.37

Notes: Descriptive statistics are shown. The number of observations is 1,792,217.

Table A2: Data Set on NUTS2 Level

Panel A: Number of Projects

	(1)	(2)	(3)	(4)
	mean	sd	min	max
All	0.64	20.94	0.00	5,990.00
Goods	0.35	16.16	0.00	5,990.00
Services	0.22	11.86	0.00	5,572.00
Construction Works	0.07	6.06	0.00	2,853.00
By Award Value				
1st Quartile	0.11	8.38	0.00	4,159.00
2nd Quartile	0.11	5.25	0.00	1,816.00
3rd Quartile	0.11	3.99	0.00	970.00
4th Quartile	0.11	3.68	0.00	1,097.00
By Number of Offers				
Only One Bidder	0.14	7.97	0.00	3,916.00
More than One Bidder	0.42	13.43	0.00	5,047.00
By Award Criterion				
Lowest Price	0.31	15.36	0.00	5,964.00
MEAT	0.29	9.73	0.00	3,469.00
By Type of Procedure				
Open/Restricted	0.57	19.23	0.00	5,987.00

Panel B: Total Final Value, in Million Euros

	(1)	(2)	(3)	(4)
	mean	sd	min	max
All	0.15	4.93	0.00	2,828.71
Goods	0.05	1.88	0.00	537.06
Services	0.05	3.35	0.00	2,828.71
Construction Works	0.05	3.09	0.00	1,869.09
By Number of Offers				
Only One Bidder	0.03	1.18	0.00	496.01
More than One Bidder	0.11	3.80	0.00	2,789.91
By Award Criterion				
Lowest Price	0.06	2.69	0.00	2,415.62
MEAT	0.07	3.21	0.00	1,707.75
By Type of Procedure				
Open/Restricted	0.12	3.94	0.00	1,614.38

Panel C: Other Variables

	(1)	(2)	(3)	(4)
	mean	sd	min	max
same_NUTS0	0.07	0.26	0.00	1.00
same_NUTS1	0.01	0.11	0.00	1.00
same_NUTS2	0.00	0.06	0.00	1.00
Distance, in 1000km	1.47	1.42	0.00	13.42
Distance (log)	0.07	0.82	-6.60	2.60
Same Language	0.08	0.28	0.00	1.00
Same Currency	0.39	0.49	0.00	1.00
Cultural values				
Trust	0.13	0.12	0.00	0.51
Hierarchy	0.07	0.06	0.00	0.39
Individualism	0.09	0.07	0.00	0.37

Notes: Descriptive statistics are shown. The number of observations is 2,803,115.

Table A3: Border Effects Over Time

	(1)	(2)
	Number of Projects	Total Final Value
same_NUTS0	4.654***	4.607***
	(0.0975)	(0.133)
Year 2011	0.0162	-0.101
	(0.0708)	(0.0804)
Year 2012	0.0671	-0.0714
	(0.0730)	(0.0856)
Year 2013	-0.114	-0.147*
	(0.0823)	(0.0822)
Year 2014	-0.169	-0.303**
	(0.111)	(0.151)
same_NUTS1	0.247***	0.432***
	(0.0651)	(0.0473)
Year 2011	-0.0442	-0.0107
	(0.0840)	(0.0584)
Year 2012	0.000324	0.0661
	(0.0870)	(0.0639)
Year 2013	0.0284	0.132*
	(0.0893)	(0.0757)
Year 2014	0.0343	0.107
	(0.101)	(0.0692)
same_NUTS2	0.983***	1.051***
	(0.0790)	(0.0645)
Year 2011	0.0287	0.0860
	(0.0950)	(0.0933)
Year 2012	-0.00193	-0.0935
	(0.100)	(0.0875)
Year 2013	-0.142	-0.204**
	(0.0979)	(0.0934)
Year 2014	-0.233**	-0.203**
	(0.109)	(0.0888)
Distance (log)	-0.709***	-0.662***
	(0.0228)	(0.0199)
Same Language	0.760***	0.922***
	(0.0628)	(0.0962)
Same Currency	0.650***	0.0467
	(0.103)	(0.131)
Trust	-1.699***	-1.249***
	(0.249)	(0.372)
Hierarchy	0.0541	-0.683
	(0.674)	(0.658)
Individualism	-0.916	1.090
	(0.602)	(0.763)
Observations	2,763,495	2,763,495
R-squared	0.567	0.551
Origin NUTS2 FE	YES	YES
Destination NUTS2 FE	YES	YES
Year FE	YES	YES
Product Category FE	YES	YES

Notes: The table shows estimates of regression equation (3) that has been extended to include additional interactions to allow border effects to vary by year. The dependent variable is the number of projects in column (1) and the total final value in million Euros in column (2). All specifications include origin and destination NUTS2 region fixed effects as well as year and product category fixed effects. The method of estimation is Poisson pseudo-maximum likelihood (PPML). Eicker-White robust standard errors are shown in parantheses.

Table A4: CPV Divisions

	CPV Division (45)	Product Categories (7)	Goods, Services, Construction works (3)
3	Agricultural, farming, fishing, forestry and related products	Commodities, food, fuels, and construction materials	Goods
9	Petroleum products, fuel, electricity and other sources of energy		
14	Mining, basic metals and related products		
15	Food, beverages, tobacco and related products		
24	Chemical products		
41	Collected and purified water		
44	Construction structures and materials; auxiliary products to construction (excepts electric apparatus)		
16	Agricultural machinery	Machinery and equipment	
30	Office and computing machinery, equipment and supplies except furniture and software packages		
31	Electrical machinery, apparatus, equipment and consumables; Lighting		
32	Radio, television, communication, telecommunication and related equipment		
34	Transport equipment and auxiliary products to transportation		
35	Security, fire-fighting, police and defence equipment		
38	Laboratory, optical and precision equipments (excl. glasses)		
42	Industrial machinery		
43	Machinery for mining, quarrying, construction equipment		
33	Medical equipments, pharmaceuticals and personal care products	Medical products	
18	Clothing, footwear, luggage articles and accessories	Other manufacturing	
19	Leather and textile fabrics, plastic and rubber materials		
22	Printed matter and related products		
37	Musical instruments, sport goods, games, toys, handicraft, art materials and accessories		
39	Furniture (incl. office furniture), furnishings, domestic appliances (excl. lighting) and cleaning products		
48	Software package and information systems		
45	Construction work	Construction	Construction works
66	Financial and insurance services	Business, real estate, engineering, IT, and research services	Services
70	Real estate services		
71	Architectural, construction, engineering and inspection services		
72	IT services: consulting, software development, Internet and support		
73	Research and development services and related consultancy services		
79	Business services: law, marketing, consulting, recruitment, printing and security		
50	Repair and maintenance services	Other services	
51	Installation services (except software)		
55	Hotel, restaurant and retail trade services		
60	Transport services (excl. Waste transport)		
63	Supporting and auxiliary transport services; travel agencies services		
64	Postal and telecommunications services		
65	Public utilities		
75	Administration, defence and social security services		
76	Services related to the oil and gas industry		
77	Agricultural, forestry, horticultural, aquacultural and apicultural services		
80	Education and training services		
85	Health and social work services		
90	Sewage-, refuse-, cleaning-, and environmental services		
92	Recreational, cultural and sporting services		
98	Other community, social and personal services		

Notes: The table compares the three classifications that we use for the type of procurement in the paper: i) 45 CPV Divisions, ii) seven broad product categories, iii) goods, services, and construction works.