Border Effects in Public procurement: the Aggregate Effects of Governments' Home Bias*

Manuel García-Santana** Marta Santamaría§

UPF, CREi, BSE, CEPR University of Warwick

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Abstract

Using a dataset with information on more than one million public procurement contracts awarded across French and Spanish regions, we document the presence of substantial border effects both across countries and across regions within countries. We isolate the governments' role in explaining these border effects by applying a novel strategy that relies on observing the same establishment selling to several destinations and different government types within a destination. We find that governments' home-bias explains a big fraction of the observed border effects. Our results show that sub-national governments drive a large part of this effect: setting the estimated sub-national governments' home bias to their national governments' counterparts would decrease the total border effect by 29.5%. Both the intensive margin of home bias, i.e., awarding less value to participating non-local firms, and the extensive margin, i.e., higher entry barriers for non-local firms, are quantitatively important in accounting for the observed border effects. Our results point towards the existence of big inefficiencies in the allocation of government procurement expenditure across firms, regions, and countries within the European Union.

JEL codes: F10, F13, F14.

Keywords: Public procurement, border effects, productivity.

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**manuel.santana@upf.edu https://garciasantana.weebly.com/

§marta.santamaria@warwick.ac.uk https://sites.google.com/site/msantamariaupf/

1 Introduction

Modern economies are characterized by the presence of big governments that play a unique role as final producers of public goods and services. Throughout this production process, governments of all kinds (local, provincial, regional and national) actively buy from private firms operating in most industries, including some of the most tradable ones like machinery or transport equipment. Overall, the value of governments' purchases accounts for around 12% of global GDP.

A remarkable feature of government' purchases is the fact that they are much more locally concentrated, both across countries and across regions within countries, than purchases by private firms and households. In the year 2010, for instance, less than 5% of the value of procurement contracts were awarded to foreign firms in countries like Italy, France, Spain, Portugal, or the UK.[1] In the Spanish region of Catalonia, for example, around 70% of the value of procurement contracts was awarded to firms located within that region.[2]

In this paper we ask: *To what extent are governments responsible in explaining the low observed penetration rates in public procurement, both within and across countries?* The reason why answering this question is challenging is that, in principle, low penetration rates could also be driven by bilateral natural frictions that constraint governments' actions, at least in the short run. In particular, factors like geography, information frictions or lack of historical ties between regions and countries could prevent non-local firms from being competitive relative to local firms. A comparison of procurement sales across regions would hence be biased unless all these bilateral factors were accounted for.

To overcome this challenge, we take advantage of a detailed dataset of 1.2 million of procurement contracts awarded in France and Spain over the 2009-2019 period. In our dataset, we observe the winning establishment and the buying institution, as well as their geographic location and contract characteristics. We count more than 30,000 different government agencies buying goods and services from private firms in our sample. Our novel identification strategy relies on observing the same establishment selling to two different government agencies *within* a given destination. If the above-mentioned bilateral natural frictions are constant within a given firm-origin-destination across buyers, i.e., government agencies, then one can identify the relative home bias of the different government types.

Government agencies are heterogeneous in many aspects. To implement our empirical strategy, we focus on one specific dimension of government heterogeneity: the geographical area at which the government agency operates. Our hypothesis is that governments' home bias crucially depends on the geographical level at which it operates. In particular, we explore the hypothesis that regional governments will prefer to buy from firms located within the same region, whereas national governments will prefer to buy goods from firms located within the same country but will be

[1] See Herz and Varela-Irimia (2020). The authors estimate a gravity equation and find very sizable cross-national border effects for all types of goods and services, even after controlling for physical distance and other variables.

[2] In section 3, we show that import penetration rates in procurement are significantly lower than those in overall trade also when looking at narrowly defined sectors.

indifferent about buying from firms located in different regions within its own country.

To test our hypothesis, our analysis considers two government types: *national* agencies, which despite all being located in different regions belong to the same national government (i.e. central or federal administration), and *subnational* agencies, which belong to a government that exclusively operates locally (i.e. an individual region or territory within the country). The key of our empirical strategy is that, while there are several origin-destination factors that could explain the low import penetration rates, differences in observed relative purchases from "local" firms across government-types located in the same destination can be interpreted as differences in home biases across these government-types.

An important part of our data work therefore consists on correctly identifying the agencies' names and classifying them into "national government" or "sub-national government" categories. Let's consider again the case of the Catalonia region in Spain. In our data, we observe projects awarded in Catalonia by the Spanish Ministry of Finance (*Delegación Especial de la Agencia Estatal de Adminisistración Tributaria en Cataluña*), and by the Catalan health institute (*CatSalut*). Our governments classification procedure classifies the former as a national and the latter as a sub-national government.[3]

To guide our empirical analysis, we write a multi-country multi-region version of Melitz (2003). The main building blocks of our model are the same as Chaney (2008) or Breinlich and Cuñat (2016). Regions are asymmetric, firms' productivity is Pareto distributed, and there exists an homogeneous good sector that pins-down the equilibrium wage. In our version of the model, we include national and sub-national governments operating in each region. These governments produce final goods using intermediate inputs produced by heterogeneous firms located across all regions.

Governments are potentially biased towards local firms, i.e., firms located in their same region, and domestic firms, i.e., firms located in their same country. This home bias manifests in two ways: through an intensive margin – which we model as governments having a preference for goods produced by local and/or domestic firms, and through an extensive margin – which we model as governments imposing a higher entry cost to non-local/foreign firms. Crucially, we allow for these two types of home biases to vary across government types. Variation in procurement flows within the same firm across regions and government types allows us to estimate the intensive margin of home bias, whereas variation in firms' participation rates across regions and government types will discipline the extensive margin.

We start our analysis by documenting some novel empirical facts on government procurement flows. First, we show that the number of firms from a given region that sell to governments in another region is increasing in that region governments' total expenditure. That is, firms' participation in procurement markets increases with the size of the market. Second, firms participate disproportionally more in their own country. Third, within their country, firms participate dispro-

[3]In the case of the US, for example, an equivalent example would be any federal agency located in California (national government) vs. any agency that belongs to the Government of California (subnational government).

portionally more in their own region, particularly so when selling to subnational governments. And fourth, the firms' sales distribution within an origin has a remarkably similar shape across destinations, and the shape of this distribution is well approximated by a Pareto. The first, second, and fourth facts are remarkably similar to their counterparts related to export markets participation in France documented by Eaton, Kortum, and Kramarz (2011). This similarity is what motivates us to use the canonical model of international trade with firm heterogeneity for our quantitative analysis.

We parametrize the model to Spain and France, where around 76 region-government types (38 regions and two government types) are active in public procurement. We follow a two-step strategy to estimate governments' home bias. In the first step, we estimate the relative home bias across governments in the intensive margin. We do so by exploiting variation in sales within a firm-origin-destination across government types. This variation resembles the one exploited by running a diff-in-diff at the firm level. The first difference would be how much a given firm sells locally vs. non-locally, whereas the second difference would come from comparing that across the two types of buyers: national vs. subnational governments.

We find that conditional on firms participating, sub-national governments award 33% more value to local firms (relative to non-local) than national governments do. In the second step, we estimate the relative home bias in the extensive margin. To do so, we compare firms' local vs. non-local participation rates across government types. We find that participation rates of non-local domestic firms, relative to local ones, are around 60% lower for subnational governments. This result, together with our estimate for the intensive margin, implies that sub-national governments impose a fixed cost to domestic non-local firms which is around 5% higher than its counterpart for national governments. We calibrate the rest of parameters so that the model replicates well the relative size of each region-government type and a gravity equation relating procurement flows at the firm level with distance. Our model replicates well the observed procurement flows both at the region and country level.

We use the model to quantify the role of government's home bias in explaining the observed shares of procurement value awarded to local firms. In particular, we ask the following question. *How different would procurement flows be if subnational governments had the same bias as national governments do?* To answer this question, we perform counterfactuals in which we make the subnational governments to have the same bias against non-local domestic firms as national governments do. Our main finding is that reducing the intensive margin home bias of subnational governments would reduce the average share of procurement value awarded to local firms by around 27% (50.07 in the baseline vs. 37.93 in the counterfactual). This of course comes entirely from a reduction in the local share for subnational governments (51.90 in the baseline vs. 38.26 in counterfactual). We also find that a big part of this effect comes from an increase in non-local firms' participation: the fraction of firms that sell to subnational governments in non-local domestic regions would increase from 2.55 to 6.07.

Contribution and related literature. The segmentation of international goods markets, usually referred to as border effects, was postulated as one of the "Six Major Puzzles" in international macroeconomics by Obstfeld and Rogoff (2000). In his pioneering paper, McCallum (1995) found that trade among Canadian provinces was twenty times greater than trade between Canadian provinces and U.S states. Although extensive subsequent work convincingly showed that the border effects are not as extreme as initially argued (Anderson and Van Wincoop (2003)), a fair interpretation of the current literature is that border effects exist and are quantitatively relevant. In fact, and perhaps more surprisingly, border effects also seem to be present across (supposedly) perfectly integrated countries (Santamaría, Ventura, and Yeşilbayraktar (2021)) and even across regions within the same country (Wolf (2000)). In this paper, we aim to contribute to the understanding of this puzzle by quantifying the role of governments in explaining the international and inter-regional "missing trade" in procurement.

The presence of protectionism in government procurement is a recurrent topic in the policy debate. For example, in the case of the US, the federal government openly and actively discriminates against foreign firms when making its sourcing decisions.[4] In fact, the "Buy American" scheme represented one of the main blocks in Joe Bidden's trade policy agenda during the recent presidential campaign.[5] The case of Europe is more intriguing. Even though the EU regulation based on "the single market spirit" should make the market for public procurement be perfectly integrated, "Improving access to procurement markets" is one of the six strategic priorities to improve the public procurement system by the European Commission.[6] Our results point towards the existence of high levels of hidden protectionism within Europe, both across and within countries, which governments implement by concentrating high shares of their purchases on local firms. In that respect, our paper contributes to the literature that aims to understand the causes of market fragmentation in the EU (Chen (2004), Head and Mayer (2000)).

Our findings are silent about the causes of this protectionism. One possibility is that governments internalize consumers' preferences, which may be biased towards domestically produced goods (Morey (2016)). A second possibility is that regional and national governments maximize their respective citizens' welfare and use public procurement to manipulate the terms of trade. In that respect, our paper is related to the vast literature that analyzes optimal trade policy (Limao (2008)). A third possibility is that governments' home bias is simply driven by "politics". Applying the Grossman and Helpman (1994)'s theory to the context of public procurement, it could be the case that the presence of locally based lobbies biases governments' choices towards local firms, even if that is not in the interest of local consumers.

[4] The Buy American Act (1933) requires the US government to "prefer" US-made products and services in its purchases.

[5] "Joe Biden will mobilize the talent, grit, and innovation of the American people and the full power of the federal government to bolster American industrial and technological strength and ensure the future is made in all of America by all of America's workers. Biden believes that American workers can out-compete anyone, but their government needs to fight for them". https://joebiden.com/made-in-america/

[6] See for instance "Making Public Procurement work in and for Europe". 3.10.2017 COM(2017) 572.

The existence of governments' home bias is a potential source of spatial misallocation of resources in the EU. Although the European Commission is making big efforts to harmonize the public procurement system within the Union, our results suggest that all kinds of governments still have high levels of discretion that allow them to systematically distort their purchases from non-local firms. To the extent that these distortions are not uniform across governments and space, they will generate dispersion in marginal products across firms producing within the EU. Dispersion in marginal products will generate the type of TFP losses emphasized by the misallocation literature (e.g., Hsieh and Klenow (2009), Restuccia and Rogerson (2008) or Guner, Ventura, and Xu (2008)). More related to our framework, Fajgelbaum, Morales, Serrato, and Zidar (2019)) show that dispersion in tax rates across US states generates significant aggregate output and welfare losses.

Finally, our paper is related to the literature that analyzes the micro aspects of public procurement. First, it relates to the literature that analyzes the factors that determine the outcomes in the allocation of procurement projects (e.g., Engel, Fisher, and Galetovic (2001), Decarolis (2018)). It also relates to the recent empirical literature that investigates the capability of governments to generate desired economic outcomes (e.g. Bandiera, Prat, and Valletti (2009)).

The rest of the paper is organized as follows. In section 2, we show that import penetration rates are significantly lower in procurement than in the private sector, both when looking at across countries and within-country procurement flows. In section 3, we explain how we built our dataset and present some summary statistics. In section 4, we present some novel stylized facts that motivate using a canonical model of trade with heterogenous agents for our analysis. In section 5, we carry out a simple decomposition to show that national and subnational governments exhibit very different import penetration rates in their purchases, and that these difference can be important to explain the observed low penetration rates in procurement. In section 6, we present our model. In section 7, we explain our strategy to estimate governments' home bias. In section 8, we explain how we calibrate the rest of the parameters of the model. In section 9, we perform counterfactuals to quantify the importance of governments' home bias in explaining import penetration rates in procurement. In section 10, we conclude.

2 Comparing government vs. private sector purchases

Before we start our analysis, we document that procurement activity displays a stronger local bias than other economic interactions such as imports by households and firms. In this section, we provide evidence regarding the differences in import penetration rates between governments' purchases and the private sector for France and Spain. First, we use Input-output tables together with our procurement data to show that government procurement exhibits much lower cross-country import penetration rates than their counterparts for private intermediate goods expenditure and final expenditure. Second, we use inter-regional data together with our procurement data to show that government procurement also exhibits much lower within-country import penetration rates

than its counterpart for total trade.

Table I

SHARE OF EXPENDITURE (%) ON FOREIGN GOODS

	France			Spain		
	Firms	HHs	Proc.	Firms	HHs	Proc.
	(1)	(2)	(3)	(4)	(5)	(6)
Agriculture, Hunting, Forestry and Fishing	7.58	20.65	1.96	.	.	.
Mining and Quarrying	84.39	40.04	5.70	89.18	29.98	0.18
Food, Beverages and Tobacco	11.81	28.82	0.07	7.26	25.51	0.26
Textiles and Textile Products	35.31	89.98	8.97	56.99	86.77	0.04
Leather and Footwear	100.00	100.00	7.03	48.22	68.63	2.66
Pulp, Paper, Printing and Publishing	23.14	17.46	3.97	17.23	10.92	21.13
Coke, Refined Petroleum and Nuclear Fuel	34.64	28.56	0.45	.	.	.
Chemicals and Chemical Products	71.82	50.54	1.05	55.08	54.64	0.89
Machinery, Nec	35.03	58.30	5.40	35.82	64.71	1.70
Electrical and Optical Equipment	65.91	73.12	2.44	59.16	83.28	0.86
Transport Equipment	50.88	42.31	3.90	67.69	51.90	4.33
Manufacturing, Nec; Recycling	30.25	49.19	1.18	11.83	42.61	1.20

Notes: This table shows import penetration rates, measured as the share of expenditure on goods produced outside the country for the year 2010. Columns (1) and (4) show the share of intermediate inputs expenditure on foreign goods in France and Spain respectively. Columns (2) and (5) show the share of final expenditure on foreign goods by households. Columns (3) and (6) show the share of procurement expenditure on foreign goods. Numbers in columns (1), (2), (4), and (5) have been computed using the WIOT input output-tables. Numbers in Columns (3) and (6) have been computed using our micro dataset (see section 3).

2.1 Evidence across country borders

Table I shows import penetration rates for agents in the private sector and government procurement across industries with a sufficiently high degree of tradability.[7] The numbers in columns (1), (2), (4), and (5) have been computed using the World Input-Output Tables (WIOT). In columns (1) and (4), i.e., "Firms", we report the share of intermediate goods expenditure that is imported. In columns (2) and (5), i.e., "HHs", we report the share of final consumption and investment expenditure by households that is imported. In columns (3) and (6), i.e., "Proc", we report the share of government procurement expenditure that is imported.

Our main finding is that the penetration rates in government procurement are significantly lower than their counterparts for private sector agents. In the case of France, for example, the average penetration rate for firms and households is around 24%, which compares to a much lower penetration rate of 2.29% in government procurement. In the case of Spain, penetration rates

[7] We arbitrarily classify sectors as highly tradable if the penetration rate for "Firms" in Spain is above 10%.

Table II

SHARE OF EXPENDITURE ON GOODS FROM THE SAME REGION

	(1) Procurement	(2) All trade
Agriculture, Hunting, Fishing, and Forestry	70.94	33.10
Mining and Quarrying	39.56	53.07
Food	78.10	27.70
Textile and Leather	40.80	27.07
Wood, cork, paper, publishing, and graphic arts	58.75	21.38
Chemical, rubber, and plastics	35.93	24.27
Coke and refined petroleum products	75.39	44.64
Machinery and mechanical and electronic equipment	49.66	37.29
Transport equipment	41.11	19.71
Metallurgy and metal products	32.58	23.70
Other non metallic mineral products	65.50	50.70
Furniture and other manufactured goods	51.17	18.30

Notes: This table shows regional border effects in procurement and total trade, where border effects are defined as the share of expenditure that stays within the same region. In the case of procurement (column 1), this is simply the share of procurement value awarded to firms located within the same region. In the case of total trade (column 2), this is computed as the share of goods' shipments originated in a region that stays within the region. Column 3 reports the share of that sector in total procurement expenditure. To compute the numbers in column 2, we use the dataset built by Santamaría, Ventura, and Yeşilbayraktar (2021). To compute the numbers in columns 1 and 3, we use our dataset, whose details on how it is constructed are explained in the next section.

for firms and households are around 25% on average, which compare to the 1.85% in government procurement. Importantly, these stark differences in import penetration rates between the private and the government sector are also present when looking within highly tradable industries. For example, the import penetration rate in *Transport equipment* for firms is around 50% in France and 67% in Spain, whereas their counterparts for public procurement are only 3.90% and 4.33%.

2.2 Evidence within country borders

In table II, we show the share of expenditure on local goods, defined as goods produced within the same region, averaged across French and Spanish regions. In particular, in column 1, we show the share of procurement value awarded to firms located within the same region. In column 2, we show the share of total trade flows that stays within the local region, as measured in the dataset built by Santamaría, Ventura, and Yeşilbayraktar (2021).[8] In contrast to what we show in section 2.1 at the country level, this dataset only allows us to compare government procurement flows to total trade across regions, which already contains all the flows related to government purchases.

[8]The share of total trade flows that stays within the local region is approximated by the share of shipments of goods originated in a region that stay within the region, using a detailed freight road transport survey. For more details see Santamaría, Ventura, and Yeşilbayraktar (2021).

Our main finding is that (across regions) import penetration rates are systematically and significantly lower in government procurement than in total trade. In the case of *Machinery and mechanical and electronic equipment*, which accounts for around 9% of the total procurement expenditure, the share of expenditure on local firms is around 50% in procurement and 37% in total trade. We find similar differences in other industries: 41% vs. 20% in *Transport equipment*, 78% vs. 27% in *Food*, or 75% vs. 44% in *Coke and refined petroleum products*.

3 Micro Data on Procurement Flows

We use publicly available data from Opentender, a procurement platform funded by a European Union Horizon 2020 project devoted to increasing the transparency of the procurement sector in Europe. The Opentender dataset consists of merging data from different national sources and Tenders Electronic Daily (TED), which is the online version of the supplement to the Official Journal of the EU dedicated to European public procurement. All procurement contracts above a certain threshold awarded by European public institutions must be published in TED.[9] Therefore, although many contracts below the threshold are published in TED, relatively big projects will be over-represented in our data.

Because we want to focus on procurement contracts that are comparable across countries, we focus our analysis on those contracts published by TED only, with the intention to avoid sample selection issues that might arise when combining data from national platforms for different countries. National regulations concerning public procurement not subject to the EU Directives do not need to converge in many essential aspects. Among others: the choice of procedure, its publication, the set of thresholds, the choice of participants, and the awarding criteria. On the contrary, EU Directives assure that the procurement legal framework is the same for all Member States.

We currently restrict our sample to contracts awarded in France and Spain. Overall, our final dataset contains 1,194,482 lot-level contracts between 2009 and 2019. Each lot observation contains information of a contract between a firm (supplier or bidder) and a contracting authority (buyer). For each awarded lot we have data on: the type or procedure used to allocate the contract, the product code of the tender (CPV), the year, the estimated price, the final price, the name and location of the government agency buying, and the name and location of the firm selling.

3.1 Classifying agencies into government types: national vs. sub-national

At the core of our data work is to classify buying agencies into different government types. Our main goal is to divide all contracting authorities into four geographical levels: national, regional,

[9] Currently, these thresholds are determined by the EU Directives (Directive 2014/24/EU on public procurement, and Directive 2014/25/EU on procurement by entities operating in the water, energy, transport and postal services sectors). The thresholds for publication depend on the type of government and type of contract. For example, the threshold for supplies and services contracts by central government authorities is €139,000.

provincial, and local. Additionally, we want to isolate some government agencies that do not have a clear geographical scope: hospitals, universities, social security agencies, and independent institutions. To achieve our goal, we apply the following three-steps procedure.

1. First, we use official sources that contain lists with public entities' names and the type of government to which they belong in each country. For the case of Spain, we use two different lists: one provided by the *Plataforma de Contratación del Sector Público* (PCSP) and one provided by the Ministry of Finance. These two lists together contain 10,788 different entities. For the case of France, we use three different lists. One provided by official website of the French administration (service-public.fr), one provided by the open platform for French public data (data.gouv.fr), and one provided by the National Statistics Bureau of France (INSEE). The combination of these three lists contain 5,726 different entities in France. Using these list of entities, we are able to classify into the above-mentioned categories the buyers of 58% of our observations for Spain and 14% of our observations for France.

2. Second, we construct a list of 270 keywords for Spain and 235 for France. For example, if the buyer's name contains the word *alcalde*, i.e., Mayor, we classify it as a local government type. Importantly, the construction of these keywords is based on the official lists used in the previous step. As a robustness check, we apply these keywords procedure to the institutions that were already classified in the first step and find a successful rate of 99%. After applying the first and second step, we are able to classify 97% of the buyers in Spain and 76% in France.

3. And third, we use official lists of territorial organizations that contain all Spanish and French regions, provinces, and municipalities. If the name of the buyer contains the name of one of these territories, we classify the buyer as belonging to that particular geographical level. For example, *Galicia* is a Spanish region. Therefore, the buyer *Xunta de Galicia* is classified as a regional government.[10] In this last step, we manually check every assignment to make sure that we do not do obvious mistakes.

After applying our procedure, we end up having the buying agencies of 84% of our observations classified into the following government types: national, regional, provincial, local, hospitals, universities, social security agencies, and independent institutions.[11] Throughout the paper, we will exclude hospitals, universities, social security agencies, and independent institutions. Additionally, for simplicity, we will re-classify regional, provincial, and local entities into *sub-national governments* and national entities into *national governments*.

[10]Some territorial organizations of different levels share the same name. For instance, *Barcelona* might refer to a municipality or a province. We leave those cases unclassified.

[11]Most of the unclassified buyers can not be classified either because they are too generic (for instance, "president" or "director") and do not appear in the official lists, or because they are private companies, which sometimes are subject to EU publicity regulation.

3.2 Summary statistics

In this section, we present some descriptive statistics from the final dataset that we will use in our empirical analysis. First, we present summary statistics from the perspective of the sellers, i.e., the establishments from which both national and subnational governments purchase. Second, we present statistics from the perspective of the buyers, i.e., the governments.

Sellers. We next introduce some notation that we will use throughout the paper. Let's N_o be the total number of establishments located in region o. In column 1 of table III, we report N_o for the three biggest Spanish and French regions in terms of total expenditure. Take for instance the case of the two regions where the capital cities are located, Madrid and Ile-de-France. We find that $N_o = 7,324$ for the case of the former and $N_o = 37,799$ for the case of the latter. As mentioned above, our data under-represents procurement contracts awarded in Spain, which translates into differences in terms of the number of establishments that we observe in Spanish vs. French regions.

TABLE III

DESCRIPTIVE STATISTICS - SELLERS

	N_o	number of d, g pairs				
		mean	50th	75th	90th	99th
	(1)	(2)	(3)	(4)	(5)	(6)
Spain						
o= Andalusia	3,248	1.55	1.00	1.00	4.00	10.00
o= Catalonia	5,548	2.09	1.00	2.00	6.00	20.00
o= Madrid	7,324	2.73	1.00	2.00	10.00	25.00
France						
o= Ile-de-France	37,799	2.30	1.00	2.00	7.00	23.00
o= Provence-Alpes-Cote d'Azur	13,797	1.66	1.00	1.00	4.00	11.00
o= Rhone-Alpes	19,980	1.90	1.00	2.00	5.00	15.00

Notes: Table III shows descriptive statistics about establishments operating in the top 5 Spanish and French regions in terms of total expenditure. Column 1 shows the number of establishments operating in that particular region. Columns 2, 3, 4, 5, and 6 show the average number of destination markets (region-gov.type), and the associated 50th, 75th, 90th and 99th percentiles. We compute all the numbers after pooling all the establishments and years 2009-2019 together.

Columns 2-6 show information about the number of markets to which these establishments sell. To be concrete, let's define a market as a destination region-government type pair $\{d, g\}$. For example, one possible market would be $\{d = \text{Catalonia}, g = \text{Subnational}\}$. In column 2, we report the average number of destination markets across all the establishments located in each of the six o regions. For example, the establishments located in Andalusia sell in 1.55 different markets on average. This number is significantly higher for the establishments located in Madrid or Ile-de-France, which sell to 2.73 and 2.30 destination markets, respectively.

In columns 3-6, we report the median, 75th, 90th, and 99th percentile of the distribution of destination markets in each of the 6 regions. We find that the majority of establishments only sell in one destination market. In particular, the median is equal to one in all regions. At the same time, we find that a significant fraction of establishments sell to three or more destination markets. In the case of the region of Catalonia, for example, ten percent of the establishments sell to at least six destination markets, and one percent of the establishments sell to at least twenty destination markets.

Table IV

DESCRIPTIVE STATISTICS - BUYERS

	$g =$ National gov.						$g =$ Sub-National gov.					
	$\sum_o N^g_{or}$	$X^g_{or}(j)$					$\sum_o N^g_{or}$	$X^g_{or}(j)$				
		mean	25th	50th	75th	99th		mean	25th	50th	75th	99th
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Spain												
r = Andalusia	243	1.40	0.22	0.45	1.03	5.79	3,395	2.46	0.13	0.36	1.18	8.39
r = Catalonia	247	1.45	0.24	0.40	0.92	6.53	4,741	3.16	0.13	0.37	1.20	10.86
r = Madrid	5,341	7.93	0.25	0.68	2.82	22.98	2,975	5.44	0.21	0.60	2.09	21.21
France												
r = Ile-de-France	9,530	8.47	0.23	0.61	2.42	27.16	11,240	4.11	0.17	0.48	1.73	15.00
r = Provence-Alpes-Cote d'azur	1,503	2.22	0.14	0.32	1.04	10.00	7,492	2.40	0.11	0.30	0.98	7.42
r = Rhone-Alpes	1,330	2.43	0.15	0.33	1.05	8.00	10,425	2.37	0.12	0.33	1.00	6.97

Notes: Table IV shows descriptive statistics about the governments buying in the top 5 Spanish and French regions in terms of total expenditure. In columns 1 and 7, respectively, we report the number of firms from which national and sub-national governments a particular region buy. In columns 2 and 8, we show the average value of purchases from a given supplier. In columns 3, 4, 5, 6, and 9, 10, 11, 12, we report 25th, 50th, 75th, and 99th percentile of the distribution of value of purchases from a given supplier. We compute all the numbers after pooling all the establishments and years 2009-2019 together.

Buyers. Let's define N^g_{or} as the number of establishments located in region o from which a government type g located in region r buys. In column 1 of table IV, we report the sum of N^g_{or} across all origins o ($\sum_o N^g_{or}$) for the case of national governments, where the six reported regions refer to the destination r. Column 7 shows the counterpart of that variable for the case of subnational governments. For example, we find that there are 5,341 establishments (located across all Spanish and French regions) that sell to national governments located in Madrid. We also find that sub-national governments buy from a larger number of establishments than national governments (except for the region of Madrid). For example, in the region of Ile-de-France, sub-national governments buy from 11,240 establishments, which compares to the 9,530 from which

the national government buys.

Let's now define $X_{or}^{g}(j)$ as the expenditure by government type g located in region r on goods produced by establishment j from region o. In columns 2 and 8 of table IV, we report the average of that variable across all j's and o's for a given r, both for national and subnational governments. For example, we find that the national government located in Catalonia buys €1.40 millions on average. This number ranges from €0.91 millions for the case of national governments in Pays de la Loire to €7.93 millions for the case of national governments in Madrid.

We notice that these high average values are explained by the right tail of the distribution. The establishments in the very right tail of the distribution are awarded very big amounts. For example, 1% of the establishments that sell to the subnational government in Catalonia, are awarded €10 million or more. However, there are many establishments in our dataset that are awarded relatively low amounts. Take for instance the case of the establishments that sell to the national government in Catalonia: 25% percent of the establishments are awarded €240,000 or less, 50% of the establishments are awarded €400,000 or less, and 75% of the establishments are awarded €920,000 or less.

4 Firm-level stylized facts on procurement flows

In this section, we present some empirical regularities about firms' participation in procurement. Our goal is to show that participation into procurement markets (defined by the region or by the government level and region) seems to follow the same pattern of participation into exporting markets. Our dataset contains 192,155 plants (defined as a firm at a specific origin region). Out of them, 66% of plants (126,935) only sell to governments at home, i.e., the same region where they are located. This means that 34% of the firms in our sample "exports" to governments out of their home region, either within the same country or abroad.

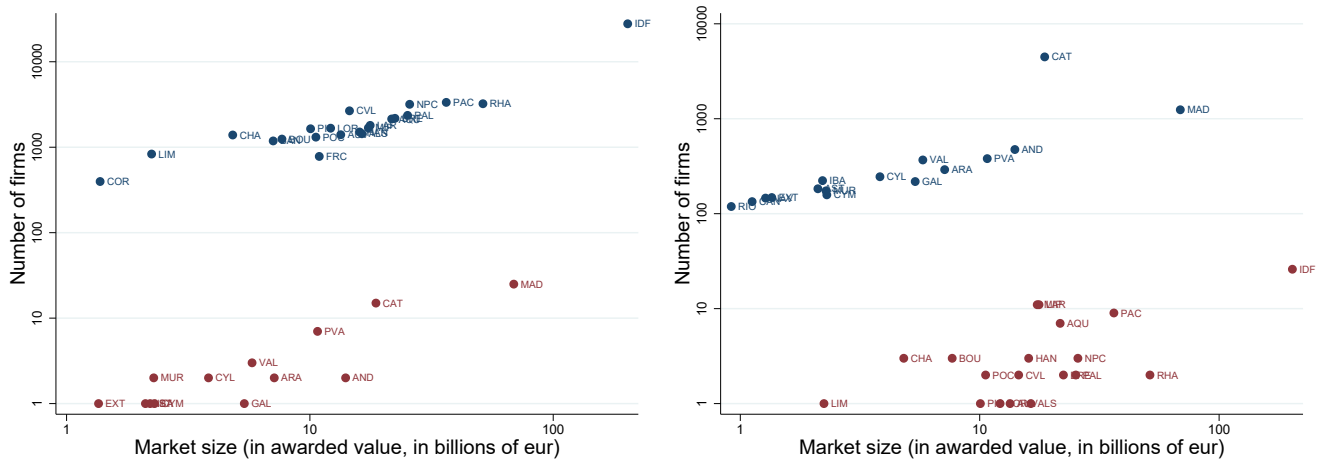
We show that some of these regularities are remarkably similar to the ones presented by Eaton, Kortum, and Kramarz (2011) about firms' participation into exporting markets. We choose the Spanish region of Catalonia and the French region Ile de France to illustrate the empirical regularities we find in the overall sample. Catalonia and Ile de France are quite different in their geographical location and in their levels of industrialization and regardless of these differences we observe the same pattern of firm participation in public procurement. Similar patterns emerge for other regions in Spain and France.

Fact 1. *Firms' participation in procurement increases in procurement market size as measured by governments' total expenditure but i) Firms participate disproportionately more in their own country and ii) within their country, firms participate disproportionately more in their own region.*

Figure I shows the number of firms from Ile de France (panel A) and from Catalonia (panel B) that sell to different regions as a function of the (procurement) market size of the destination region. The first clear pattern is that firm participation (number of firms in each market) is higher

Figure I

Procurement flows destination (entry)



(A) Firms located in Ile de France (B) Firms located in Catalonia

within the home country. The second pattern that emerges is that, within the home country, the home region (Ile de France and Catalonia respectively) are outliers with an exceptionally high entry of firms, well above the linear trend.

Fact 2. *The difference in participation of firms in their home region is particularly strong for sub-national governments*

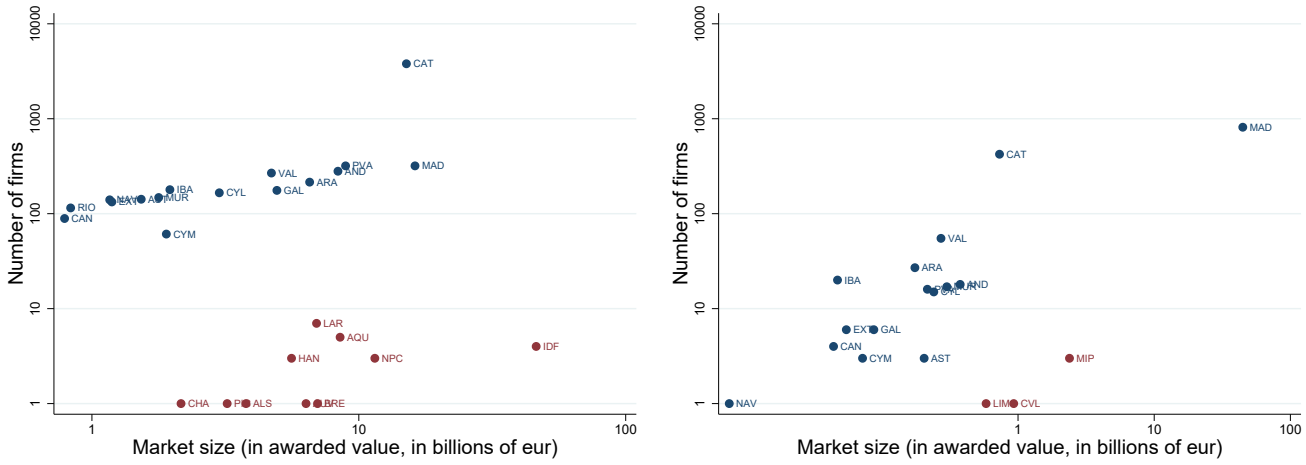
Figures II and III show firm participation in Catalonia and Ille de France respectively disaggregated by subnational and national governments. After breaking down the number of firms partcipating by government level we see the second stylised fact: while participation in the home region is on trend for sales to national governments, participation of firms in their home region is a clear outlier when selling to the sub-national government.

Fact 3. *The firms' sales distribution within an origin o has a remarkably similar shape across destinations r. The shape of this distribution is well approximated by a Pareto except for the very lower end of the distribution.*

Figure IV plots the distribution of sales Andalusian and Catalan firms, respectively, in their four largest domestic markets. As we can see in both figures, the sales distribution has a very similar shape across all destinations that seems to follow very closely a Pareto distribution. The similarity of these facts with those about firms' participation into exporting markets is what motivates us to use the canonical model of international trade with firm heterogeneity for our quantitative analysis.

Figure II

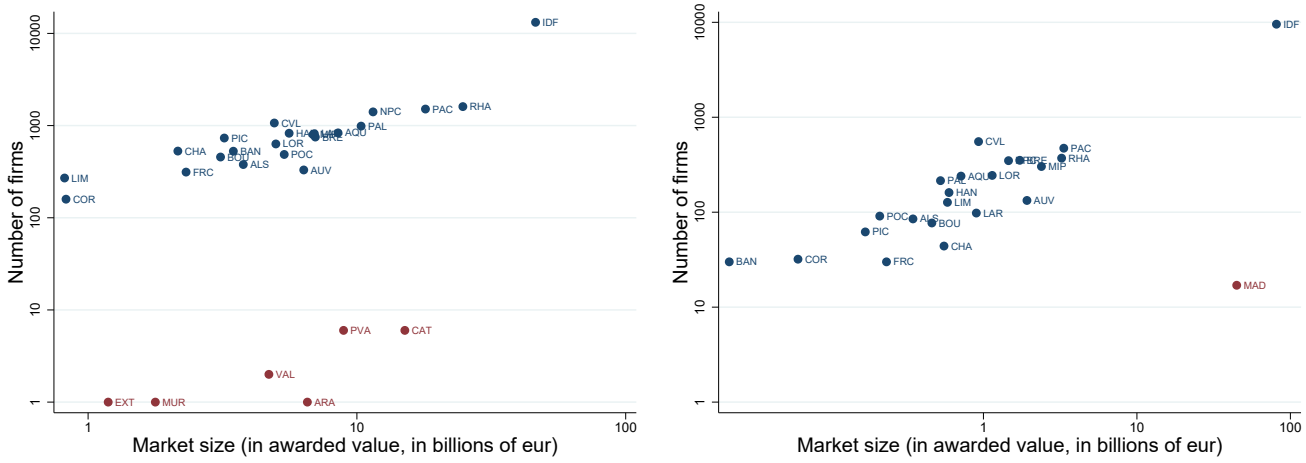
Procurement flows destination (entry) - Catalonia



(A) Sub-national goverments (B) National goverments

Figure III

Procurement flows destination (entry) - Ille de France



(A) Sub-national goverments (B) National goverments

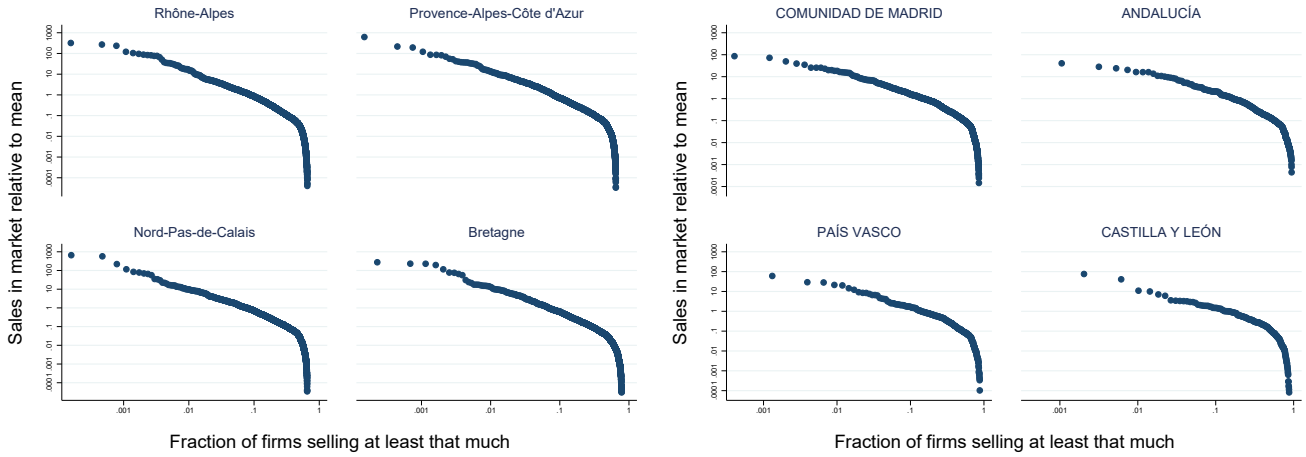
5 A simple decomposition of the home bias: national vs. sub-national governments

Before introducing our model, we show that the share of procurement value awarded to local firms is different across different government types, i.e., national vs. sub-national. In particular, we show that sub-national governments tend to buy significantly higher fractions of their purchases from firms located within the same region.

We denote total sales by firms located in region o in region r by X_{or}. We denote region r's total expenditure, i.e., expenditure by the national government plus the sub-national government, by X_r. We define the expenditure share of region r on goods produced by firms in region o as:

Figure IV

Sales distribution in procurement



(A) Firms located in Ile de France (B) Firms located in Catalonia

$$\pi_{or} \equiv \frac{X_{or}}{X_r} \tag{1}$$

Given this notation, we define the local share of procurement as the share of procurement value in region r awarded to firms from that same region r:

$$\pi_{rr} = \frac{X_{rr}}{X_r} = \frac{X^n_{rr} + X^s_{rr}}{X^n_r + X^s_r}$$

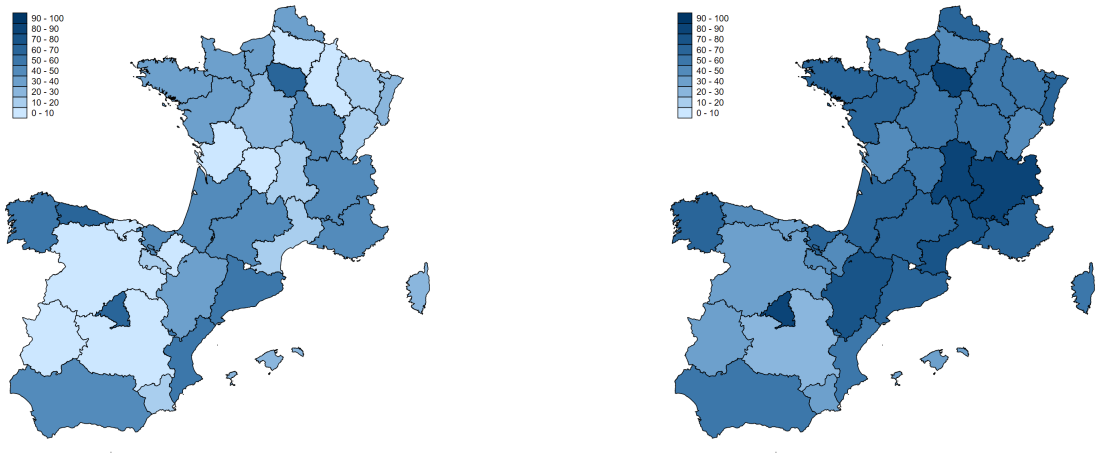
which is simply the sum of the expenditure by both national and sub-national governments on firms located within the same region ($X^n_{rr} + X^s_{rr}$) divided by these two governments total expenditure ($X^n_r + X^s_r$). After some simple manipulations:

$$\overbrace{\pi_{rr}}^{0.56} = \overbrace{\left(\frac{X^n_r}{X^n_r + X^s_r}\right)}^{0.11} \underbrace{\overbrace{\left(\frac{X^n_{rr}}{X^n_r}\right)}^{0.33}}_{\pi^n_{rr}} + \overbrace{\left(\frac{X^s_r}{X^s_r + X^s_r}\right)}^{0.89} \underbrace{\overbrace{\left(\frac{X^s_{rr}}{X^s_r}\right)}^{0.58}}_{\pi^s_{rr}} \tag{2}$$

Equation (2) shows that the share of procurement value awarded to local firms in a given region (π_{rr}) can be decomposed into a weighted average of the respective shares for the two types of governments (π^s_{rr} and π^n_{rr}), using the share of expenditure accounted for by each government in the region as weights. The numbers on top of the variables represent their sample averages. A couple of things are worth noticing. First, they represent a higher share of total governments' expenditure (0.89 vs. 0.11). Second, sub-national governments tend to allocate significantly more expenditure to local firms than national governments. As we show in Panel A of Figure V), national governments purchase, on average, 33% of procurement value from local firms while sub-national governments (panel B) buy 58% of value from local firms.

Figure V

Border effects in public procurement



(A) Share of value purchased from local firms by national government

(B) Share of value purchased from local firms by subnational governments

Notes: (A) shows the share of procurement value awarded by national governments to firms located within the same region. (B) shows the share of procurement value awarded by subnational governments to firms located within the same region. Darker blue means higher shares.

We next perform a naive counterfactual to assess how much of the observed aggregate local share of procurement can be potentially explained by the different purchasing behavior of sub-national vs. national governments. To that end, we set π^s_{rr} equal to π^n_{rr} for all regions and recompute the implied π_{rr}. Table V shows the results from this counterfactual. Overall, we find that forcing the sub-national governments to behave like national governments would decrease the aggregate local share of procurement by 42% on average. There is high variation across regions, though. In regions like Aragon (ESP) or Normandie (FR) the difference between sub-national and national governments explains more than 50% of the aggregate local procurement share. This is a combination of the large gap in the local procurement share across governments (around 70% sub-national vs. around 30% national) and the fact that sub-national governments account for a high fraction of total government expenditure (around 95%). In other regions, like Madrid or Ile de France, the role played by this difference across governments is significantly smaller (around 5%). This is a combination of a small gap in the local share of procurement across governments (around 72% sub-national vs. around 69% national) and a relatively low fraction of total government expenditure being accounted for by sub-national governments (27% for the case of Madrid and 57% for the case of Ile de France).

6 Model

In this section, we present a multi-region static trade model which is heavily built on Chaney (2008) and Eaton, Kortum, and Kramarz (2011). There are R regions indexed by o, r. Each

Table V

A naive counterfactual exercise

	Data					Counterfactual
	(1)	(2)	(3)	(4)	(5)	(6)
	$\frac{X_r^n}{X_r^n+X_r^s}$	π_{rr}^n	$\frac{X_r^s}{X_r^s+X_r^s}$	π_{rr}^s	π_{rr}	π_{rr}
Andalusia (ESP)	0.06	0.40	0.94	0.51	0.50	0.40 $\downarrow$ 19%
Catalonia (ESP)	0.06	0.58	0.94	0.64	0.63	0.58 $\downarrow$ 9%
Madrid (ESP)	0.27	0.69	0.73	0.82	0.72	0.69 $\downarrow$ 5%
Aragon (ESP)	0.04	0.32	0.96	0.77	0.75	0.69 $\downarrow$ 57%
Ile de France (FR)	0.57	0.68	0.43	0.84	0.75	0.68 $\downarrow$ 9%
Normandie (FR)	0.05	0.30	0.95	0.72	0.70	0.30 $\downarrow$ 56%
Bretagne (FR)	0.19	0.31	0.81	0.67	0.60	0.31 $\downarrow$ 48%
Hauts de France (FR)	0.04	0.39	0.85	0.95	0.83	0.39 $\downarrow$ 52%
mean	0.11	0.33	0.89	0.58	0.56	0.33 $\downarrow$ 42%

Notes: This table shows the results from applying a naive counterfactual to the decomposition shown in equation 2. This counterfactual consists of setting π_{rr}^s equal to π_{rr}^n for all regions and recompute the implied π_{rr}. Columns 1-5 show the different components of equation 2 as measured in the data for each region. Column 6 shows π_{rr} computed in the naive counterfactual.

region is populated by L_r consumers who inelastically supply one unit of labor. The utility of a representative consumer from region r is given by:

$$U(C_r^q, C_r^n, C_r^s) = (C_r^q)^{1-\mu} \left[(C_r^n)^{\gamma_r} (C_r^s)^{1-\gamma_r} \right]^{\mu} \tag{3}$$

where C_r^q is the consumption of a perfectly tradable homogeneous good; C_r^n is the consumption of the public good produced by the national government located in region r; and C_r^s is the consumption of the public good produced by the sub-national government located in region r. Since we consider two government levels, we use γ_r and $1-\gamma_r$ to denote the shares of the national and sub-national governments respectively.

6.1 The private good sector

The private good q is an homogeneous freely tradable good produced by a perfectly competitive representative firm that has access to the following CRS production function:

$$Q_r = A_r L_r^q \tag{4}$$

The perfectly competitive firm's problem yields to the following first order condition:

$$P_r^q A_r = w_r \tag{5}$$

Since the good is freely tradable, there will be a unique price in the two regions P^q. By setting this private good sector as the numeraire we have that:

$$w_r = A_r \tag{6}$$

which means that wages are perfectly pinned down by the different regions' productivity levels.

6.2 Governments

Governments produce non-tradable final public goods by combining intermediate inputs produced by private sector firms:

$$Y_r^g = \left(\sum_{o=1}^{R} \int_{\Omega_{or}^g} (\alpha_{or}^g)^{\frac{1}{\sigma}} y_{or}^g(j)^{\frac{\sigma-1}{\sigma}} dj \right)^{\frac{\sigma}{\sigma-1}} \tag{7}$$

where $y_{or}^g(j)$ is the intermediate good used by government g in region r provided by firm j producing in region o, and $\sigma > 1$ is the elasticity of substitution across varieties. Hence we can write the demand for the good produced by firm j located in region o by government-type g from region r as:

$$y_{or}^g(j) = Y_r^g \left(\frac{P_r^g}{p_{or}(j)} \right)^{\sigma} \alpha_{or}^g \tag{8}$$

where P_r^g is the aggregate price index paid by government-type g in region r; Y_r^g is total demand by that government; and $p_{or}(j)$ is the price charged by firm j from region o. The parameter α_{or}^g represents an exogenous demand shock that is origin-destination-government type specific. This parameter will allow us to capture the extent of governments' home-bias in the intensive margin, i.e., the fact that governments award less procurement value to non-local firms. For convenience, we write the demand function in terms of sales:

$$X_{or}^g(j) \equiv p_{or}^g(j) y_{or}^g(j) = X_r^g \left(\frac{P_r^g}{p_{or}^g(j)} \right)^{\sigma-1} \alpha_{or}^g \tag{9}$$

where $X_r^g = Y_r^g P_r^g$ is total expenditure by government g in region r and the price index is given by:

$$P_r^g \equiv \left(\sum_{o=1}^{R} w_o L_o \int_{\bar{z}_{or}^g}^{\infty} \alpha_{or}^g \left(\frac{\sigma}{\sigma-1} \frac{w_o \tau_{or}}{z} \right)^{1-\sigma} f(z) dz \right)^{\frac{1}{1-\sigma}} \tag{10}$$

6.3 Firms: production of the intermediate goods

There is a continuum of firms in each region that compete under monopolistic competition with each other and with firms from other regions. Firms have access to a constant marginal cost technology in which labor is the only factor of production. A firm j in region o has efficiency $z(j)$ and its cost of labor is w_o. Therefore, the unit cost of producing is:

$$c_o(j) = \frac{w_o}{z(j)} \tag{11}$$

We assume that firms' productivity is distributed over $[1, +\infty]$ and according to a Pareto distribution with a shape parameter θ (with $\sigma - 1 < \theta$). Therefore, the measure of firms in region o that can produce their variety with efficiency at least z is $z^{-\theta}$.

6.3.1 Firms' problem.

Since there are constant returns to scale and the demand functions in each market are independent of each other, we can split a firm's problem into independent problems in each market. Let's focus on a firm from region o producing good j selling to destination r and government type g. The firm's profits in this market are given by:

$$\Pi^g_{or}(j) \quad = \quad p^g_{or}(j) y^g_{or}(j) - w_o \tau_{or} l^g_{or}(j) - E^g_{or} \tag{12}$$

where τ_{or} measures origin-destination bilateral natural frictions such as transportation costs and E^g_{or} captures the cost of entry into different markets. This parameter, which we assume to be origin-destination-government type specific, will allow us to capture governments' home bias in the extensive margin, i.e., the fact that there will be barriers to entry for non-local firms that can be government type specific. The firm maximizes the following problem:

$$\max_{l^g_{or}} \quad \Pi^g_{or}(j) \tag{13}$$

$$\text{s.t} \quad y_{or}(j) = z_o(j) l_{or}(j) \tag{14}$$

$$p^g_{or} = y^g_{or}(j)^{-\frac{1}{\sigma}} P^g_r (Y^g_r)^{\frac{1}{\sigma}} (\alpha^g_{or})^{\frac{1}{\sigma}} \tag{15}$$

which yields to the optimal price charged by the firm:

$$p^g_{or} = \frac{\sigma}{\sigma - 1} \frac{w_o}{z(j)} \tau_{or} \tag{16}$$

Entry. A firm j producing in region o will sell to government-type g in region r if and only if $\Pi^g_{or}(j) > 0$. This implies that there will be a productivity cutoff, $\bar{z}^g_{or}$, that measures how productive a firm from region o must be in order for this firm to sell to government g in region r:

$$\bar{z}^g_{or} = \frac{w_o \tau_{or}}{P^g_r} \left(\frac{\sigma}{\sigma - 1} \right) \left(\sigma \frac{E^g_{or}}{\alpha^g_{or}} \frac{1}{X^g_r} \right)^{\frac{1}{\sigma - 1}}, \tag{17}$$

Notice that this productivity cutoff is not only origin-destination but also government type specific. Intuitively, within a given origin-destination, a higher number of firms will sell to governments with lower barriers to entry E^g_{or} or higher demand shocks α^g_{or}. Also, as it is standard in this type of models, the productivity cutoff is increasing in firms' origin wages w_o and transportation costs τ_{or}, and decreasing in market size X^g_r and the price index P^g_r.

Sales. Sales to government-type g in region r by firm j producing in region o are given by:

$$X_{or}^{g}(j) = X_{r}^{g}\left(\frac{\sigma-1}{\sigma}\right)^{\sigma-1}\left(\frac{P_{r}^{g}}{\tau_{or}}\frac{z(j)}{w_{o}}\right)^{\sigma-1}\alpha_{or}^{g} \tag{18}$$

This equation will be crucial to implement our identification strategy. As it is commonly the case in these model, firms' sales are increasing in market size X_r^g and how competitive firm j is relative to other firms selling into that market $(P_r^g z(j)/\tau_{or} w_o)$. The novel feature of this equation is that firms' sales within a particular destination to a given government type depends on governments' demand shock α_{or}^g. That is, conditional on origin-destination factors, variation in how much a firm j sells across government types identifies their relative α_{or}^g. We provide a more formal explanation in the next Section.

7 Estimating governments' home bias

In this section, we present our strategy to estimate governments' home-bias parameters, both in terms of the intensive and the extensive margin. The intensive margin of home bias is captured by the origin-destination-government type parameter $\alpha_{o(c)r(c')}^{g}$. Notice that, because we will allow the α's and E's to depend on whether the firm is from a different region within the same country or from a foreign region, we have introduced some extra notation that reflects the country where the region is.

7.1 Intensive Margin

To estimate the intensive margin of governments' home-bias, we impose the following structure:

$$\begin{aligned}
\alpha_{o(c)r(c')}^{g} &= \tilde{\alpha}^{g} \quad \text{if} \quad o \neq r \quad \text{and} \quad c \neq c' \quad , \\
\alpha_{o(c)r(c')}^{g} &= \alpha^{g} \quad \text{if} \quad o \neq r \quad \text{but} \quad c = c' \quad , \\
\alpha_{o(c)r(c')}^{g} &= 1 \quad \text{if} \quad o = r,
\end{aligned} \tag{19}$$

Notice that we normalize to one the preference for local firms ($o = r$) for the two governments. We assume that the parameters $\tilde{\alpha}^g$ and α^g vary across governments but are constant across regions. That is, sub-national/national governments have the same preferences in every region. Our hypothesis is that the extent of home bias depends on the geographical scope of the government. In the case of the sub-national government, we expect it to have a preference for local firms ($o = r$), no matter whether they are domestic or not, i.e., $\tilde{\alpha}^s < 1$ and $\alpha^s < 1$. In the case of national governments, our hypothesis is that they are indifferent between buying local or non-local as long as the firm is domestic, i.e., $\alpha^n = 1$, but discriminate against non-local firms (and have a preference for buying domestic), i.e., $\tilde{\alpha}^n < 1$.

By taking logs on both sides and using this structure for $\alpha_{o(c)r(c')}^{g}$, we can write the empirical counterpart of equation (18):

$$\begin{aligned}\log X(j)^g_{o(c)r(c')} &= \beta_1 \times \mathbb{1}\underbrace{(o \neq r \;.\; c = c')}_{\text{domestic non-local}}\mathbb{1}\underbrace{(g = s)}_{\text{sub. gov.}} + \beta_2 \times \mathbb{1}\underbrace{(c \neq c')}_{\text{foreign}}\mathbb{1}\underbrace{(g = s)}_{\text{sub. gov.}} \\ &+ \text{FE}_j + \text{FE}_{r(c')g} + \text{FE}_{o(c)r(c')} + \epsilon_{jr(c')g} \end{aligned} \tag{20}$$

where FE_j are firm fixed effects, $\text{FE}_{r(c')g}$ are destination-government type fixed effects, $\text{FE}_{o(c)r(c')}$ are origin-destination fixed effects, and $\epsilon_{jr(c')g}$ is an error term. Firm fixed effects control for firm's productivity and wages paid at origin. Destination-government type fixed effects control for the size of the government in a given region and the price index it faces. Finally, origin-destination fixed effects control for any kind of natural friction like distance, geography, information frictions, etc.

This regression allows to identify the relative home biases across governments (see appendix A for details). In particular, we show that $\exp(\beta_1) = \alpha^s/\alpha^n$ and $\exp(\beta_2) = \tilde{\alpha}^s/\tilde{\alpha}^n$. The intuition for how the relative α's are identified comes from the diff-in-diff nature of the regression. The relative bias against domestic non-local firms (α^s/α^n) is identified by comparing the difference between a local firm's sales in its own region and a non-local but domestic firm's sales in that same region across government types. The relative bias against non-domestic firms is identified by comparing the difference between a local firm's sales in its own region and a foreign firm's sales in that same region across government types.

Results. Column 1 of Table VI shows the results from estimating equation 20. Our findings are as follows. First, we find a negative and significant estimate associated to the regional home bias, i.e., $\beta_1 = -0.387$. This estimate implies that sub-national governments buy more from local firms, relative to domestic non-local firms, than national governments do. In terms of magnitude, our estimate implies that sub-national governments buy around 32% more from local firms, relative to domestic non-local firms, than national governments do. Through the lens of our model, that implies that $\exp(\beta_1) = \exp(-0.387) = \alpha^s/\alpha^n = 0.679$. Second, we find a positive but far from significant estimate of β_2. Through the lens of our model, that implies that $\exp(\beta_2) = \exp(0.00) = \tilde{\alpha}^s/\tilde{\alpha}^n = 1.00$. This means that national and sub-national governments have the same home bias when buying from local vs. foreign firms.

7.2 Extensive margin

Since the productivity distribution is Pareto, we can make use of equation 17 and express the share of firms in region o selling to destination r and government type g as:

$$\text{S}^g_{or} = \Pr(z \geq \bar{z}^g_{or}) = \left[w_o \tau_{or} \frac{1}{P^g_r} \left(\frac{\sigma}{\sigma - 1} \right) \left(\sigma \frac{E^g_{or}}{\alpha^g_{or}} \frac{1}{X^g_r} \right)^{\frac{1}{\sigma-1}} \right]^{-\theta} \tag{21}$$

To estimate the extensive margin of governments' home-bias, i.e., E^g_{or}, we impose the following structure:

Table VI

Estimating Governments' Home bias

Dependent variable:	(1) $\log X(j)^g_{o(c)r(c')}$	(2) $\log S^g_{or}$
domestic non-local x sub.gov	-0.387***	-0.884***
	(0.069)	(0.057)
foreign x sub.gov	0.672	-2.278***
	(0.955)	(0.331)
plant FE	yes	n/a
dest.-gov. type FE	yes	yes
origin-dest. FE	yes	yes
Observations	76,767	3,284
R^2	0.421	0.377

Notes: Column 1 of Table VI shows the results of estimating equation 20. Column 2 shows the results of estimating equation 23. The variable "domestic non-local x sub.gov" refers to the interaction variable $\mathbb{1}(o \neq r \ . \ c = c')\mathbb{1}(g = s)$. The variable "foreign x sub.gov" refers to the interaction variable $\mathbb{1}(c \neq c')\mathbb{1}(g = s)$

$$
\begin{aligned}
E^g_{o(c)r(c')} &= \tilde{E}^g \quad \text{if} \quad o \neq r \quad \text{and} \quad c \neq c' \ , \\
E^g_{o(c)r(c')} &= E^g \quad \text{if} \quad o \neq r \quad \text{but} \quad c = c' \ , \\
E^g_{o(c)r(c')} &= 1 \quad \text{if} \quad o = r,
\end{aligned} \tag{22}
$$

Notice that, as in the case of α^g_{or}, we normalize to one the entry costs for local firms ($o = r$) for the two government types. We also assume that the parameters $\tilde{E}^g$ and E^g vary across governments but are constant across regions. Similarly to the intensive margin home bias, our hypothesis is that the size of entry costs depends on the geographical scope of the government. In the case of the sub-national government, we expect it to impose higher entry costs to non-local firms than to local firms, i.e., $\tilde{E}^s > 1$ and $E^s > 1$. In the case of national governments, our hypothesis is that they are indifferent between buying local or non-local as long as the firm is domestic, i.e., $E^n = 1$, but impose higher entry barriers to non-domestic firms, i.e., $\tilde{E}^n > 1$.

By using this structure and taking logs on both sides, we can write the empirical counterpart of equation (21):

$$\begin{aligned}\log \mathrm{S}_{or}^{g} &= \gamma_1 \times \mathbb{1}\underbrace{(o \neq r \ . \ c = c')}_{\text{domestic non-local}} \mathbb{1}\underbrace{(g = s)}_{\text{sub. gov.}} + \gamma_2 \times \mathbb{1}\underbrace{(c \neq c')}_{\text{foreign}} \mathbb{1}\underbrace{(g = s)}_{\text{sub. gov.}} \\ &+ \mathrm{FE}_{r(c')g} + \mathrm{FE}_{o(c)r(c')} + u_{jr(c')g} \end{aligned} \tag{23}$$

where $\mathrm{FE}_{r(c')g}$ are destination-government type fixed effects, $\mathrm{FE}_{o(c)r(c')}$ are origin-destination fixed effects, and $u_{jr(c')g}$ is an error term. Firm fixed effects control for firm's productivity and wages paid at origin. Destination-government type fixed effects control for the size of the government in a given region and the price index it faces. Finally, origin-destination fixed effects control for any kind of natural friction like distance, geography, information frictions, etc.

This regression, together with values of σ and θ and the estimates from regression 20, will allow us to identify the relative entry costs charged by the two government types (see Appendix B for details). In particular, we can show that $\exp\left(\frac{\gamma_1}{\frac{\theta}{1-\sigma}}\right) = \frac{E^s/\alpha^s}{E^n/\alpha^n}$ and $\exp\left(\frac{\gamma_2}{\frac{\theta}{1-\sigma}}\right) = \frac{\tilde{E}^s/\tilde{\alpha}^s}{\tilde{E}^n/\tilde{\alpha}^n}$. The relative entry costs to domestic non-local firms is identified by comparing the difference between the local firms' participation rate in its own region and the non-local (but domestic) firms' participation rate in that same region across government types. The relative entry cost to non-domestic firms is identified by comparing the difference between local firms' participation rate in its own region and foreign firms' participation rate in that same region across government types.

Results. Column 2 of Table VI shows the results from estimating equation 23. First, we find a negative and significant coefficient associated to the relative regional home bias, i.e., $\gamma_1 = -0.885$, which implies that participation rates of non-local domestic firms, relative to local ones, are around 60% lower for subnational governments. To recover the relative entry cost as implied by the model, we need values for the CES elasticity σ, the Pareto shape parameter θ, and the relative home bias in the intensive margin (see equation 17). In particular,

$$\frac{E_s}{E_n} = \frac{\alpha_s}{\alpha_n} \exp\left(\frac{\gamma_1}{\theta/(1-\sigma)}\right) = \exp(\beta_1) \exp\left(\frac{\gamma_1}{\theta/(1-\sigma)}\right) = 1.057$$

where the last step comes from using standard values of $\sigma = 5$, $\theta = 8$, and our results from estimating the intensive margin home bias, $\beta_1 = -0.387$. This number implies that sub-national governments impose a fixed cost to domestic non-local firms which is around a 5% higher than its counterpart for national governments. The intuition for why we find such a small gap despite the large difference in participation is the following. Through the lens of the model, firm entry and hence participation rates are also driven by the intensive margin home bias α. Given the large differences in α across the two governments estimated in the previous section, a 5% gap in entry costs is enough to rationalize the observed differences in entry rates from the model's perspective. Second, we find a negative and significant effect associated to the relative international home bias, i.e., $\gamma_2 = -2.278$. This implies that participation rates of local firms relative to foreign firms are around 90% lower for subnational governments. We again use the model's structure to recover the implied relative entry cost for foreign firms:

$$\frac{\tilde{E}_s}{\tilde{E}_n} = \frac{\tilde{\alpha}_s}{\tilde{\alpha}_n} \exp\left(\frac{\gamma_2}{\theta/(1-\sigma)}\right) = \exp(\beta_2) \exp\left(\frac{\gamma_2}{\theta/(1-\sigma)}\right) = 3.123$$

This calculation implies that sub-national governments impose a fixed cost to foreign firms which is around three times bigger than its counterpart for national governments. The reason for this high gap is two-fold. First, as mentioned above, there is high difference in foreign participation rates across governments. Second, we estimate no difference in the intensive margin home bias for foreign firms, i.e., $\tilde{\alpha}_s/\tilde{\alpha}_n$. The combination of these two factors is interpreted by the model as a large difference in entry costs.

8 Parametrization

In this section, we explain how we choose the parameter values of the model. We calibrate our model to 38 Spanish and French regions.[12] We define a market as a region-government type (national or subnational). We next explain our calibration strategy, and table VII summarizes it.

Levels of α and E. The identification strategy presented in section 7.1, which exploits within firm-origin-destination variation, allows us to estimate the relative α's and E's across governments but not their levels. In order to pin down the levels, we make several assumptions.

1. National and subnational governments behave equally towards local firms and we normalise their preference parameter for local firms to 1 and the entry cost they impose to local firms to 1. This assumption is implicit in the way we parametrize α and E in sections 7.1 and 7.2.

2. National governments do not discriminate against non-local domestic firms, they treat non-local domestic firms as they treat local firms. This means that we set α^n=1 and $E^n = 1$. Therefore, the national government has the same bias towards domestic firms as towards local firms.

3. National governments discriminate foreign firms as much as subnational governments discriminate non-local domestic firms: $\tilde{\alpha}^n = \alpha^s$ and $\tilde{E}^n = E^s$.

We combine these assumptions with our estimated relative parameters from the previous section. For the intensive margin, our estimate of β_1 and assumption 2 implies that $\alpha^s = 0.679$, meaning that subnational governments prefer non-local domestic firms only 67.9% of how much they prefer local firms. And assumption 3 together with our estimate of β_2 gives us that this same discrimination is applied to non-domestic firms: $\tilde{\alpha}^n = \tilde{\alpha}^s$=0.679.

For the extensive margin, assumption 2 and our estimate of γ_1 allow us to recover the level of the fixed cost imposed by the subnational government to non-local domestic firms as $E^s = 1.057$. This is 5.7% higher than the fixed cost imposed to local firms. According to assumption number 3,

[12] We exclude the Canary Islands, the two Spanish autonomous cities (Ceuta and Melilla), and the five overseas departments and regions of France (French Guiana, Guadeloupe, Martinique, Mayotte, and Reunion).

this is also the fixed cost that the national government imposes to foreign firms, thus $\tilde{E}^n = 1.057$. Finally, assumption 3 together with our estimate of γ_2 mean that the fixed cost of the subnational governments to foreign firms is $\tilde{E}_s = 3.276$, three times larger than the fixed cost imposed by the national government.

These assumptions are conservative but quite arbitrary, so we will run some robustness exercises and show that the main results of the paper would be unaltered if we were to change these assumptions.

Transportation costs τ_{or}. In order to parametrize transportation costs, we assume that they are a function of distance given by some elasticity ϕ, i.e., $\tau_{od} = \text{distance}_{od}^{\phi}$. To identify ϕ, we make the model to match the observed average share of procurement value awarded to local firms (0.53). Conceptually, our strategy consists on imputing all the variation coming from bilateral natural frictions that are constant at the origin-destination level (and therefore constant for all governments) to the presence of transportation costs.

Productivity distribution and the Armington elasticity. As mentioned above, and following the previous literature (for instance Broda and Weinstein (2006) and Eaton and Kortum (2002)), we choose $\sigma = 5$ for the elasticity of substitution across varieties and $\theta = 8$ for the shape parameter of the Pareto distribution of firm productivities.

Size of governments. There are two moments related to the size of governments in the model. The first moment is the size of subnational governments relative to national governments (X_r^s vs. X_r^n). Given the Cobb Douglas structure in the utility function (equation 6), we choose the parameter γ_r so that the model generates the observed share of total procurement that is awarded by subnational governments in each region (0.89 on average). The second moment is the size of the government sector relative to the private sector. We impose this moment to be the same across all regions (0.30) and choose μ accordingly. Notice that the value of this parameter will be inconsequential for our main results. The reason is that all our counterfactuals will consist on changing governments' home bias parameters and we will only look at changes in trade flows within the government sector.

Remaining parameters. In order to measure differences in economic size across regions, we compute total procurement expenditure in each state $X_r = X_r^s + X_r^n$ and calibrate L_r so that the model replicates the observed distribution. We find large differences in economic size across regions. For example, Ile-de-France (the largest region) accounts for 29.1% of the total observed procurement expenditure in France and Spain, while La Rioja (the smallest region) only accounts for 0.1%. Finally, in our baseline calibration, we do not allow for heterogeneity in productivity of the private sector across regions and set $A_r = 1$ for all regions.

Table VII

Model parameters

Parameter	Description	Source/Target	Value
Home bias			
α^n	Pref. for non-local domestic firms (nat. gov.)	Assumption	1.000
α^s/α^n	Pref. for non-local domestic firms (relative)	Estimated	0.679
$\tilde{\alpha}^n$	Pref. for foreign firms (nat. gov.)	Assumption	0.679
$\tilde{\alpha}^s/\tilde{\alpha}^n$	Pref. for foreign firms (relative)	Estimated	1.000
E^n	Entry cost for non-local domestic firms (nat. gov.)	Assumption	1.000
E^s/E^n	Entry cost for non-local domestic firms (relative)	Estimated	1.057
$\tilde{E}^n$	Entry cost for foreign firms (nat. gov.)	Assumption	1.057
$\tilde{E}^s/\tilde{E}^n$	Entry cost for foreign firms (relative)	Estimated	3.123
Other parameters			
ϕ	Elasticity of trade cost w.r.t distance	Calibrated	0.16
σ	Elasticity of substitution	Broda and Weinstein (2006)	5.00
θ	Pareto shape parameter	Eaton and Kortum (2002)	8.00
L_r	Labor endowment	Calibrated	region-specific
γ_r	Relative size of sub-national gov.	Calibrated	region-specific
μ	Size of the government sector	Calibrated	0.30

Notes: This table shows the parameter values in our baseline parametrization. The top panel shows the parameters related to governments' home bias. The bottom panel shows the rest of parameters.

8.1 Outcome of the model

Table VIII shows the value of some relevant moments related to the intensive and extensive margin of procurement flows. Column 1 shows these moments as measured in the data. Column 2 shows the same moments as measured in our baseline parametrization. We next discuss the performance of the model along several dimensions of the data.

First, the model generates local and non-local domestic shares that are very aligned with the data. Local shares refer the share of procurement value in a particular region awarded to firms located in that same region. This is not surprising for the aggregate (53% data vs. 50% model) because that is the calibration target that we use to identify extent of transportation costs. However, the model does a very good job in terms of the relative local share. In the data, the local share of procurement is around 29% for national governments and 56% for subnational governments. In the model, these numbers are 35% and 51% respectively, which means that the model accounts for around 76% of the difference between governments. Remember that this difference between governments is generated by the relative α parameter estimated through structural equation 20. Non-local domestic shares refer to the share of procurement value in a particular region awarded to firms located in different regions within but from the same country. In the data, these shares are 70% for national governments and 43% for subnational governments. The model accounts for

around 79% of the gap (56% for national governments vs. 43% for subnational governments).

Table VIII

Model outcome / counterfactuals

			(1) Data (%)	(2) Model (%)	(3) E1	(4) E2	(5) E3
Local Share	X^g_{rr}/X^g_r	Nat. $(g=n)$	29.29	35.26	35.26	35.26	35.26
		Sub. $(g=s)$	56.46	51.90	38.26	47.05	35.26
		Aggregate	53.47	50.07	37.93	45.75	35.26
Non-local domestic Share	$\sum_{o\neq r(o,r\in c)} X^g_{or}/X^g_r$	Nat. $(g=n)$	70.33	56.74	56.74	56.74	56.74
		Sub. $(g=s)$	43.38	43.85	58.85	41.59	56.74
		Aggregate	46.35	45.27	58.62	43.26	56.74
Foreign Share	$\sum_{o\neq r(o\in c',r\in c)} X^g_{or}/X^g_r$	Nat. $(g=n)$	0.37	7.98	7.98	7.98	7.98
		Sub. $(g=s)$	0.14	4.23	2.89	11.36	7.98
		Aggregate	0.17	4.64	3.45	10.99	7.98
Participation rate in local region	S^g_{rr}	Nat. $(g=n)$	7.06	11.96	15.62	12.59	16.45
		Sub. $(g=s)$	71.01	97.28	95.97	97.12	95.59
Participation rate in non-local domestic regions	$S^g_{or(o,r\in c)}$	Nat. $(g=n)$	0.85	0.82	1.31	0.88	1.38
		Sub. $(g=s)$	2.17	2.55	6.07	2.85	6.73
Participation rate in foreign regions	$S^g_{or(o\in c',r\in c)}$	Nat. $(g=n)$	0.01	0.06	0.08	0.07	0.09
		Sub. $(g=s)$	0.01	0.08	0.08	0.77	0.82

Notes: Column 1 of this table shows some relevant moments as measured in the data. The number reported for the "Local Share", "Non-local domestic share", and "Foreign Share" have been computed taking the average across all regions. The "Participation rate in the local region" is the average across all origin regions. The "Participation rate in non-local domestic regions" refers to the average across all origin-non local domestic destination pairs. The "Participation rate in foreign regions" refers to the average across all origin-foreign destination pairs.

Second, the model over-predicts the foreign shares, which are defined as the share of procurement value in a particular region awarded to foreign firms. That is, firms tend to sell significantly more in foreign countries in our model than in the data. In particular, only 0.15% of total procurement is awarded to foreign firms in the data whereas its counterpart in the model is 4.64%. This tension between the model and the data is coming from the fact that we do not match perfectly the local share. That is, our model slightly under-predicts the share of procurement awarded to local firms and over-predicts the share of procurement awarded to foreign firms. That being said, the model is able to generate around 70% of the difference between the two governments.

Third, the model's performance in terms of participation rates are mixed. The model generates a fraction of firms that sell in their own region (participation rate in the local region) that is too high as compared to the data. In the model, around 97% (11%) of firms sell in to the subnational (national) government of their own region, whereas only around 71% (7%) do that in the data.

The model, however, can explain around 80% of the difference between the two governments. The model also does a good job in terms of the participation rate in non-local domestic regions, which is defined as the fraction of firms from a particular region that sell in another particular domestic region (excluding its own): 0.85% vs. 0.82% for national governments and 2.17% vs. 2.55% for subnational governments. Finally, the model over-predicts the participation rates in foreign regions, which is the fraction of firms from a particular region that sell in another particular foreign region. These rates are extremely low in the data for both type of governments (around 0.01%) and significantly higher in the model (0.06% and 0.08% for national and subnational governments respetively).

9 Counterfactuals

In this section, we quantify the role of government's home bias in explaining the observed shares of procurement value awarded to local firms. In particular, we ask the following question. How different would procurement flows be if subnational governments had the same bias as national governments do? To answer this question, we perform three different counterfactuals to simulate three different economies. In the first counterfactual (E1), we make the subnational governments to have the same (intensive margin) bias against non-local domestic firms as national governments, i.e., $\alpha^s = \alpha^n = 1.00$. In the second counterfactual (E2), we set the entry cost that subnational governments impose to non-local domestic firms to be the same as the one imposed by national governments, i.e., $E^s = E^n = 1.00$. In the third counterfactual (E3), we set $\alpha^s = \alpha^n = 1.00$ and $E^s = E^n = 1.00$ at the same time.

Column 3 of table VIII shows the results from the first counterfactual. The main finding from this counterfactual is that reducing the intensive margin home bias of the subnational government to that of the national government would reduce the average share of procurement value awarded to local firms by around 27% (50.07 in the baseline vs. 37.93 in E1). This of course comes entirely from a reduction in the local share for subnational governments (51.90 in the baseline vs. 38.26 in E1). A big part of this effect comes from the fact that the fraction of firms that sell to subnational governments in non-local domestic regions increases significantly, from 2.55 to 6.07.

Column 4 of table VIII shows the results from the second counterfactual. We find that the reduction in local shares is lower than in the previous counterfactual. In particular, the average share of procurement value awarded to local firms would fall by around 9% (50.07 in the baseline vs. 45.75 in E2), which is driven by an increase of around 11% in the fraction of firms that sell to subnational governments in other domestic regions (2.55 in the baseline vs. 2.85 in E2). This smaller effect is driven by the fact that the change in the entry cost in this counterfactual is relatively small ($E^s = 1.05$ in the baseline vs. $E^s = 1.00$ in E2).

Finally, column 5 of table VIII shows the results from the third counterfactual. The main finding is that making the subnational government equal to the national government in the two margins would reduce the average share of procurement value awarded to local firms by around

29.5% (50.07 in the baseline vs. 35.26 in E3).

10 Conclusions

Governments of all kinds are sizeable active buyers in modern economies. Public procurement, defined as the value of governments' purchases of goods and services from private firms, accounts for around 12% of global GDP. In fact, governments are the main buyers in some major industries like construction, medical equipment, transport, waste management or energy. In the particular case of the EU, for example, over 250,000 public authorities spend 2 trillion euro of public money on the purchase of goods and services every year. Despite improving their current public procurement systems is at the core of many countries' agendas for industrial policy, we still know very little about its effectiveness as a policy tool for increasing overall efficiency.

Using a dataset with information on several millions of public procurement contracts awarded across European regions, we document the presence of substantial border-effects: contracts are much more likely to be awarded to firms located within the region where the contract is awarded. We isolate governments' role in explaining these observed border effects by applying a novel strategy that relies on observing the same firm selling to several destinations and different government types within a destination.

We find that governments' home-bias explains a big chunk of the observed border effects. We also find that sub-national governments are the main responsible: setting the sub-national government parameters to national governments' levels would decrease the border effects by 29.5%. Both the intensive margin of home-bias, i.e., awarding less value to participating non-local firms, and the extensive margin, i.e., higher entry barriers for non-local firms, are quantitatively important in accounting for the observed border effects. Our results point towards the existence of big inefficiencies in the allocation of government procurement expenditure across firms, regions, and countries within the European Union.

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Appendix

A Identification (intensive margin)

In this Appendix, we describe our identification strategy for the intensive margin of home bias more in detail. Let's put together different versions of equation (18):

$$\frac{X^g_{oo}(j)/X^g_{ro}(j')}{X^{g'}_{oo}(j)/X^{g'}_{ro}(j')} = \left(\frac{\alpha^g_{oo}/\alpha^g_{ro}}{\alpha^{g'}_{oo}/\alpha^{g'}_{ro}}\right)\left(\frac{\tau_{ro}/\tau_{oo}}{\tau_{ro}/\tau_{oo}}\right)^{\sigma-1} = \left(\frac{\alpha^g_{oo}/\alpha^g_{ro}}{\alpha^{g'}_{oo}/\alpha^{g'}_{ro}}\right) \tag{24}$$

This last equation is at the core of our identification strategy. Observing the same firm selling to the same destination across different government types allows us to get rid of the term that contains the bilateral natural frictions τ_{or} and hence estimate the home bias parameters. By imposing the structure on α^g_{or} described in Section 7, we can use the above expression to compute the relative home biases. In particular, if o and r belong to the same country, the above expression becomes α_s/α_n. If if o and r belong to different countries, the above expression becomes $\tilde{\alpha}_s/\tilde{\alpha}_n$.

In practice, we run the following regression:

$$\begin{aligned} \log X^g_{o(c)r(c')}(j) &= \beta_1 \times \mathbb{1}\underbrace{(o \neq r \;.\; c = c')}_{\text{domestic non-local}}\mathbb{1}\underbrace{(g = s)}_{\text{sub. gov.}} + \beta_2 \times \mathbb{1}\underbrace{(c \neq c')}_{\text{foreign}}\mathbb{1}\underbrace{(g = s)}_{\text{sub. gov.}} \\ &+ \text{FE}_j + \text{FE}_{r(c')g} + \text{FE}_{o(c)r(c')} + \epsilon_{jr(c')g} \end{aligned} \tag{25}$$

We work with three different dummy variables. The first dummy takes value one when the firm is non-local ($o \neq r \;.\; c = c'$) but domestic and zero otherwise. The second dummy takes value one when the firm is foreign ($c \neq c'$) and zero otherwise. The third dummy variable takes value one when the government is sub-national ($g = s$) and zero when the government is national. The coefficient β_1 is identified by double-differentiating:

$$\begin{aligned} \beta_1 &= E\left[\left(\log X^s_{o(c)o(c)}(j) - \log X^s_{o(c)r(c)}(j)\right) - \left(\log X^n_{o(c)o(c)}(j) - \log X^n_{o(c)r(c)}(j)\right)\right] \\ &= \left(\log\alpha^s_{o(c)o(c)} - \log\alpha^s_{o(c)r(c)}\right) - \left(\log\alpha^n_{o(c)o(c)} - \log\alpha^n_{o(c)r(c)}\right) \\ &= -\left(\log\alpha^s - \log\alpha^n\right) \end{aligned} \tag{26}$$

where the last step comes from applying the structure defined by equations 19. Similarly, the coefficient β_2 is identified by double-differentiating:

$$\begin{aligned} \beta_2 &= E\left[\left(\log X^s_{o(c)o(c)}(j) - \log X^s_{o(c)r(c')}(j)\right) - \left(\log X^n_{o(c)o(c)}(j) - \log X^n_{o(c)r(c')}(j)\right)\right] \\ &= \left(\log\alpha^s_{o(c)o(c)} - \log\alpha^s_{o(c)r(c')}\right) - \left(\log\alpha^n_{o(c)o(c)} - \log\alpha^n_{o(c)r(c')}\right) \\ &= -\left(\log\tilde{\alpha}^s - \log\tilde{\alpha}^n\right) \end{aligned} \tag{27}$$

B Identification (extensive margin)

In this Appendix, we describe our identification strategy for the extensive margin of home bias more in detail. Let's put together different versions of equation (21):

$$\frac{S^g_{oo}/S^g_{ro}}{S^{g'}_{oo}/S^{g'}_{ro}} = \left[\frac{\frac{E^g_{oo}/\alpha^g_{oo}}{E^g_{ro}/\alpha^g_{ro}}}{\frac{E^{g'}_{oo}/\alpha^{g'}_{oo}}{E^{g'}_{ro}/\alpha^{g'}_{ro}}}\right]^{\frac{\theta}{1-\sigma}} \left(\frac{\tau_{ro}/\tau_{oo}}{\tau_{ro}/\tau_{oo}}\right)^{\theta} = \left[\frac{\frac{E^g_{oo}/\alpha^g_{oo}}{E^g_{ro}/\alpha^g_{ro}}}{\frac{E^{g'}_{oo}/\alpha^{g'}_{oo}}{E^{g'}_{ro}/\alpha^{g'}_{ro}}}\right]^{\frac{\theta}{1-\sigma}} \tag{28}$$

Notice that observing participation rates in the same destination across different government types allows us to get rid of the term that contains the bilateral natural frictions τ_{or} and hence estimate the entry costs conditional on values for the α's. By imposing the structure on E^g_{or} described in Section 7, and estimating the relative α's as explained above, we can use the above expression to compute the relative entry costs. In particular, if o and r belong to the same country, the above expression becomes $\left[\frac{E^{g'}_{ro}/\alpha^{g'}_{ro}}{E^g_{ro}/\alpha^g_{ro}}\right]^{\frac{\theta}{1-\sigma}}$. If o and r belong to different countries, the above expression becomes $\left[\frac{\tilde{E}^{g'}_{ro}/\tilde{\alpha}^{g'}_{ro}}{\tilde{E}^g_{ro}/\tilde{\alpha}^g_{ro}}\right]^{\frac{\theta}{1-\sigma}}$. In practice, we run the following regression:

$$\begin{aligned}\log \mathrm{S}^g_{or} &= \gamma_1 \times \mathbb{1}\underbrace{(o \neq r \;.\; c = c')}_{\text{domestic non-local}}\mathbb{1}\underbrace{(g = s)}_{\text{sub. gov.}} + \gamma_2 \times \mathbb{1}\underbrace{(c \neq c')}_{\text{foreign}}\mathbb{1}\underbrace{(g = s)}_{\text{sub. gov.}} \\ &+ \mathrm{FE}_{r(c')g} + \mathrm{FE}_{o(c)r(c')} + u_{jr(c')g}\end{aligned} \tag{29}$$

We work with three different dummy variables. The first dummy takes value one when the firm is non-local ($o \neq r \;.\; c = c'$) but domestic and zero otherwise. The second dummy takes value one when the firm is foreign ($c \neq c'$) and zero otherwise. The third dummy variable takes value one when the government is sub-national ($g = s$) and zero when the government is national. The coefficient γ_1 is identified by double-differentiating:

$$\begin{aligned}\gamma_1 &= E\left[\left(\log S^s_{o(c)o(c)} - \log S^s_{r(c)o(c)}\right) - \left(\log S^n_{o(c)o(c)} - \log S^n_{r(c)o(c)}\right)\right] \\ &= \frac{\theta}{1-\sigma}E\left[\left(\log\frac{E^s_{o(c)o(c)}}{\alpha^s_{o(c)o(c)}} - \log\frac{E^s_{r(c)o(c)}}{\alpha^s_{r(c)o(c)}}\right) - \left(\log\frac{E^n_{o(c)o(c)}}{\alpha^n_{o(c)o(c)}} - \log\frac{E^n_{r(c)o(c)}}{\alpha^n_{r(c)o(c)}}\right)\right] \\ &= \frac{\theta}{1-\sigma}E\left[\log\frac{E^n}{\alpha^n} - \log\frac{E^s}{\alpha^s}\right]\end{aligned} \tag{30}$$

where the last step comes from applying the structure defined by equations 22. Similarly, the coefficient γ_2 is identified by double-differentiating:

$$\begin{aligned}\gamma_2 &= E\left[\left(\log S^s_{o(c)o(c)} - \log S^s_{r(c')o(c)}\right) - \left(\log S^n_{o(c)o(c)} - \log S^n_{r(c')o(c)}\right)\right] \\ &= \frac{\theta}{1-\sigma}E\left[\left(\log\frac{E^s_{o(c)o(c)}}{\alpha^s_{o(c)o(c)}} - \log\frac{E^s_{r(c')o(c)}}{\alpha^s_{r(c')o(c)}}\right) - \left(\log\frac{E^n_{o(c)o(c)}}{\alpha^n_{o(c)o(c)}} - \log\frac{E^n_{r(c')o(c)}}{\alpha^n_{r(c')o(c)}}\right)\right] \\ &= \frac{\theta}{1-\sigma}E\left[\log\frac{\tilde{E}^n}{\tilde{\alpha}^n} - \log\frac{\tilde{E}^s}{\tilde{\alpha}^s}\right]\end{aligned} \tag{31}$$