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ABSTRACT

This paper estimates trade barriers in government procurement, a market that accounts for 12 percent of world GDP. Using data from inter-country input–output tables in a gravity model, we find that home bias in government procurement is significantly higher than in trade between firms. However, this difference has decreased over time. Results also show that trade agreements with provisions on government procurement increase cross-border flows of services, whereas the effect on goods is small and not different from that in private markets. Provisions on transparency and procedural requirements are particularly instrumental in increasing cross-border government procurement.

1. Introduction

Government procurement is a major market, accounting for about 12% of world GDP in 2018 (Bosio et al., 2020). Given this important size, public authorities often prefer local over foreign providers in procurement contracts to achieve socioeconomic objectives (e.g., promoting "sustainable" local purchases, and the development of small and medium local enterprises).[1] Buy-national provisions are prime examples of measures that explicitly exclude foreign firms from government contracts. The Global Trade Alert (GTA) initiative has collected data since 2009 on the adoption of protectionist measures in government procurement and other policy areas. The data show that 56 new discriminatory measures in government procurement were enacted on average each year between 2009 and 2018.[2] This level of protectionism is higher than in most other policy areas (e.g., technical barriers to trade,

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[1] We use the terms "government", "public sector" and "public authorities" interchangeably to indicate public institutions that are buyers in the public procurement market.

[2] The average is across countries and over the 2009–2018 period. We include only policies that the GTA database classifies as "red" (i.e., which almost certainly discriminate against foreign firms) in the following policy areas (see also Disdier et al. (2021): "Government Procurement: Domestic Price Preference", "Government Procurement: Local Content Requirement", "Government Procurement: Market Access Restrictions" and "Government Procurement: Tendering

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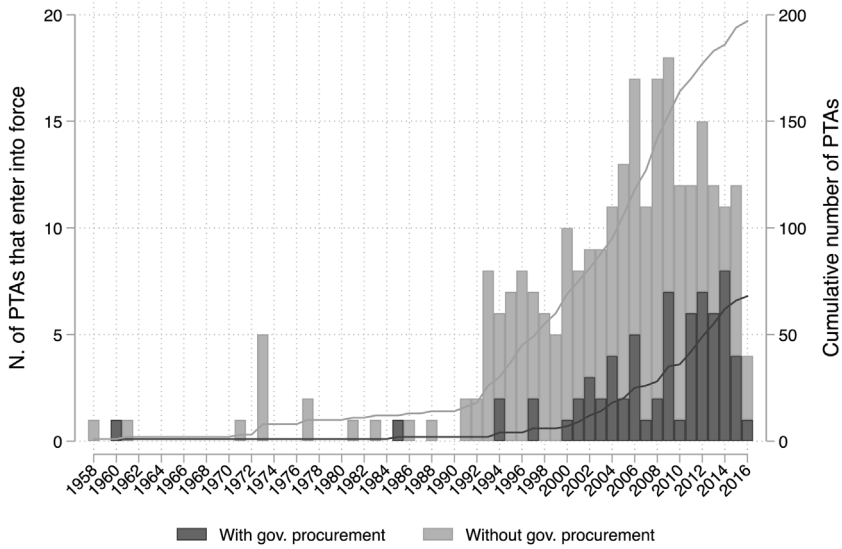

Fig. 1. Number of PTAs with and without enforceable provisions in government procurement. Note: Authors' calculations on the basis of the Deep Trade Agreements data from Mattoo et al. (2020). We exclude "Partial Scope Agreements".

sanitary and phitosanitary measures, export taxes and quotas), and inferior only to that in anti-dumping, tariff measures, export subsidies, and other subsidies.

In parallel with this protectionism, governments have committed to greater market access in public procurement through the WTO Government Procurement Agreement (GPA) as well as targeted provisions within preferential trade agreements (PTAs). Membership to the WTO GPA expanded from the initial 34 signatory countries (including EU member states) in 1996 to a group of 48 as of 2020. Meanwhile, the number of PTAs including enforceable provisions aimed at liberalizing procurement markets has been increasing over time. Fig. 1 shows that provisions on government procurement have become more common since 2000. In 2017, a quarter of PTAs in force had enforceable provisions on government procurement.

Against this seemingly contradicting policy landscape (unilateral discriminatory measures being adopted together with liberalizing ones), this paper aims to assess the importance of trade barriers in government procurement and identify the impact of trade agreements on cross-border flows. We employ data from the Trade in Value-Added (TiVA) database of the OECD on 62 countries between 1995 and 2015. Our preferred definition of purchases by the public sector sums the "General Government expenditures" and the "Public Administration", "Health" and "Education" output columns of the inter-country input–output (ICIO) tables. Bilateral trade values are distinguished by goods and services. Descriptive trends in the data show that the public sector spends considerably more on services than goods compared to the private sector. What is more, the import share of expenditure in government procurement relative to the one in the rest of the economy is particularly low in services, although important heterogeneity emerges across countries.

To move beyond descriptive evidence and estimate trade barriers in government procurement, we apply a canonical gravity framework relating bilateral cross-border procurement flows to different variables proxying for trade costs (or their inverse) and multilateral resistance terms. We also apply the same gravity framework to bilateral trade in the rest of the economy – what we refer to as the private market – which we use as a benchmark as well as a way to observe possible spillovers of procurement-specific policies. In gravity specifications without country-pair dummies, we identify the "border effect" introduced by McCallum (1995) – how much internal trade is larger than international trade – and subsequently estimated with different settings and techniques (Anderson and van Wincoop, 2003; Chen, 2004; de Sousa et al., 2012). This provides a first measure of trade barriers as it identifies the effect of crossing the border on domestic relative to international trade. Results show a large border effect in general, confirming the findings of the literature. Borders in government procurement are thicker than in private markets. The difference is significant and larger in services than in goods, consistent with the descriptive evidence. While discrimination of foreign firms contributes to the large border effect in government procurement, other characteristics of procurement contracts unrelated to the nationality of the supplier (e.g., the existence of 'set-aside' that favour small and medium size firms, differences in legal procedures across countries) might well inflate the value of domestic procurement contracts relative to that of contracts awarded to foreign firms.

Our preferred specifications control for directional country-pair fixed effects and hence permit better identification of the effects of trade policies (Baier and Bergstrand, 2007). We focus on provisions aimed at liberalizing government procurement that are

Process". These protectionist measures involve around 2500 country pairs (one country implementing the policy measure and the other being among the targets) per year.

included in PTAs, while controlling for the influence of other trade agreements — most notably in our sample, EU and WTO GPA memberships. We find that specific provisions included in PTAs distinctively increase cross-border government procurement in services relative to trade in services in the private sector. Our estimates suggest that cross-border procurement in services is 77 percent higher when two countries are part of a PTA with provisions on procurement. This effect is reduced when we isolate the influence of EU membership, which takes up almost half of the countries in our sample. The results point to an important effect of EU entry, suggesting that EU directives aimed at opening up government procurement markets have been instrumental in increasing public purchases of goods and services from abroad. According to our findings, trade in public markets between two countries is 40 (for goods) to 60 (for services) percent higher when both countries are EU members. As for the WTO GPA, we also find robust effects but only for cross-border government procurement in services. Since more than half of the GPA members are EU countries and many engage in 'deep' PTAs with procurement provisions, the effects of the GPA and those of the EU and PTAs might be confounded (Anderson et al., 2017).

In additional estimations, we find that the trade-creating effect of PTAs is driven by agreements that contain 'unilateral' provisions — i.e., provisions for which it is difficult to exclude firms from non-member countries. Three pieces of evidence support this finding. First, we estimate the effect of each provision in separate gravity models. While the co-occurrence of provisions makes the results purely suggestive, we find that measures aimed at fostering transparency and sharing of information (e.g., possibility of e-procurement, availability of statistics on government procurement) have the largest impact on cross-border procurement. This evidence is confirmed in a second exercise where we identify clusters of provisions in PTAs. PTAs with the most common provisions have weak effects, whereas 'deep' PTAs with rarer provisions – and, among those, mainly unilateral ones – have significant trade effects. Finally, results from an extended gravity model (see, e.g., Heid et al. (2021) and Beverelli et al. (2018)) show that the border effect in government procurement for services is significantly lower in countries that are members of PTAs with more unilateral provisions (i.e., those about transparency and procedural matters). This evidence indicates that participation in PTAs with non-discriminatory provisions increases cross-border procurement flows of services relative to domestic ones.

To examine further the tendency to buy national by public authorities, we estimate an index of "Constructed Home Bias" (CHB) in the public and private markets (Anderson and Yotov, 2010b; Anderson et al., 2014). This measure is complementary to the border effect as it compares the amount of actual internal trade (as estimated by the gravity equation) relative to internal trade in a counterfactual frictionless trade scenario. Holding total sales and expenditure fixed, trade barriers of different types around the world determine the size of the home bias index. Results confirm what anecdotal evidence suggests: home bias in government procurement is large and higher on average than in the private markets. The difference is less striking when we look at goods and services separately. This suggests that governments are more home-biased than the private sector because (i) they source more goods and services locally; and (ii) they spend more on services, which are more home biased. Over time, we find that the home bias in government procurement decreased for most countries in the sample and faster than in private markets, but important heterogeneity emerges. The developing countries in our sample including China, Vietnam and India – with high initial levels of home bias – experienced the strongest declines, whereas government procurement has become more national in most developed economies, such as Japan, Germany and France — which have low levels of home bias to start with.

The paper contributes to the relatively scant literature on government procurement in the context of international trade. Baldwin (1970) was the first to formally analyse the role of government expenditures in a traditional factor proportions model of international trade. His findings that discrimination in public expenditure is inconsequential for trade flows and specialization were confirmed only partly in oligopolistic settings (Miyagiwa, 1991) and with imperfect information (McAfee and McMillan, 1989).[3] Within general equilibrium models with increasing returns to scale, Brulhart and Trionfetti (2004) find that trade barriers in government expenditure can change the patterns of specialization, while Trionfetti (2001) identifies a significant impact of home-biased government procurement on agglomeration following trade liberalization. In all these papers, home bias in the public sector is treated as a parameter. Trionfetti (2000) provides a first attempt to quantify this home bias by comparing import penetration ratios across public and private sectors from domestic input–output tables for seven European countries. Rickard and Kono (2014) uses aggregate trade data in a gravity framework and find that countries with larger government procurement import less, thus suggesting public home bias. We extend this empirical strand of the literature by estimating trade barriers in government procurement directly, by using information from input–output tables, both in absolute terms and relative to the private sector. In doing so, we highlight the importance of the composition of government procurement – i.e., its bias towards services.

In this paper, we infer government procurement purchases from inter-country input–output tables to estimate the effect of trade agreements on cross-border purchases. Related work has exploited contract-level data mainly for the US (Federal Procurement database) and the EU (Tenders Electronic Daily (TED) database) to assess the local bias in public purchases. Using EU data, Herz and Varela-Irimia (2020) find large border effects both across and within European countries adopting a gravity-style estimation approach.[4] Fronk (2014) estimates the effect of PTAs in a gravity model using US federal procurement data — as such, he has one buyer (the US) from multiple suppliers. While measuring precisely procurement purchases (at least by certain public entities

[3] Cole et al. (2017) extends the model of McAfee and McMillan (1989) to establish an equivalence between price preferences in procurement auctions and import tariffs.

[4] Kutlina-Dimitrova and Lakatos (2014) provide evidence indicating that product market regulation and policies on Foreign Direct investments (FDIs) affect the probability of awarding a procurement contract to a foreign firm. Gourdon and Messent (2019) estimate the effect of PTAs on the value of procurement contracts awarded by the EU on non-EU firms using both contract-level and aggregate data. Their set of PTAs is thus limited to those signed by the EU.

and for values above certain thresholds),[5] the contract-level data cover only a single or a few countries (like in the case of the EU) and hence do not permit to investigate the effect of PTAs and their provisions. We overcome this limitation by using instead inter-country input–output tables to measure government procurement, and find a good match between our raw data on cross-border procurement and similarly defined variables computed using the TED database (European Commission, 2017). In our analysis, the use of the empirically successful gravity model aims also at filtering out noise in variables constructed from ICIO data and identifying central tendency in the data.[6]

Our empirical analysis draws extensively from the large literature on the gravity model of trade (Head and Mayer, 2015; Anderson, 2011). In doing so, we do not attempt to develop a fully-fledged theoretical model that explains, for instance, the allocation of public and private expenditures across sectors. Our focus is on the incidence of trade policy, taking aggregate sales and expenditure as given. Owing to the separability between allocation of resources within and across countries that is common to many models of trade, we infer trade costs in a "conditional general equilibrium" setting (Anderson and van Wincoop, 2004) — i.e., taking as given the allocations of resources across goods and services in the public and private markets. As Fronk (2014) shows, a gravity-style empirical model can be derived also from the auction framework of McAfee and McMillan (1989) combined with a standard comparative advantage model à la Eaton and Kortum (2002). We rely on this validity of the gravity framework for analysing cross-border government procurement and estimating measures of home bias. Further, our work expands the literature on the partial equilibrium effects of trade agreements (Baier and Bergstrand, 2007; Bergstrand et al., 2015) and its provisions (Dür et al., 2014; Kohl et al., 2016; Mattoo et al., 2017) by focusing on trade where the public sector is the buyer.[7] When we focus on specific PTA provisions on government procurement, we rely also on recent work showing how to identify the effect of non-discriminatory trade policy within a structural gravity model (Heid et al., 2021; Sellner, 2019; Beverelli et al., 2018).

The rest of the paper proceeds as follows. In Section 2, we briefly discuss the choice of the gravity equation as our empirical framework. In Section 3, we describe the empirical specification. Section 4 presents the data sources and discuss the construction of our main variables, whereas Section 5 provides a descriptive analysis of trade data. Section 6 presents the results of the gravity estimations and the home bias indexes. In Section 7 we conclude by discussing some possible policy implications of our results.

2. Theoretical framework

In this section, we present our theoretical framework, justify its choice, and describe how we bring it to the data.

We aim to define a simple framework that allows us to identify trade barriers in public procurement across countries. The gravity model can serve this purpose. It has been widely used to infer the determinants of bilateral trade and it is consistent with many general equilibrium models of trade (Head and Mayer, 2015). We argue that the gravity equation can be used also to explore the determinants of trade in government procurement. To show this, we work with the simplest theoretical framework that delivers a gravity equation: the one based on the national product differentiation assumption due to Armington (1969),[8] where each country is endowed with a differentiated variety of a type k (in our empirical applications, k corresponds to goods or services). As Anderson (1979) shows, this assumption coupled with CES preferences or technology delivers a gravity equation.

To better capture the procurement of goods and services, we consider shipments of goods and services that serve as inputs. The private and public market s in each country j sources inputs of type k originated from country i. Varieties are differentiated by the type $s \in \{p, r\}$ of buyer, where p stands for public and r denotes private market. One way to think about this assumption is that firms are specialized in either the public or private market.[9] Let $X_{ij}^{k,s}$ denote the value of shipments of good or service k from country i to market (public or private) s of country j. Trade is subject to a variable cost factor $t_{ij}^{k,s}$ of iceberg type. Given factory gate prices of $p_i^{k,s}$, destination prices are $p_{ij}^{k,s} \equiv p_i^{k,s} t_{ij}^{k,s}$. Let $E_j^{k,s}$ denote public or private expenditure on good type k in country j and $Y_i^{k,s}$ the income that suppliers in i derive from selling good k to market s.

Governments choose their optimal demand for input k from country i in order to minimize costs subject to a CES technology, which, for simplicity, is assumed to be equal across public and private markets. The different input varieties are thus assembled in a composite public good that is transferred to consumers.[10] Consumers derive utility from this public good and a private good

[5] The TED database includes contracts awarded by public authorities (at the national and sub-national levels) in countries of the European Economic Area and by EU institutions. Reporting is a requirement if the value of the contract is above a certain threshold (around 5 million euros for construction, and 130 000 euros for supplies and services). The US Federal Procurement Data System collects contract award data for procurement contracts at the federal level only.

[6] Fajgelbaum and Khandelwal (2016) use similar data from the World Input–Output Database (WIOD) to estimate the parameters of a non-homothetic gravity equation.

[7] A theoretically-consistent estimate of the comparative statics effect of trade agreements requires to specify the full general equilibrium model because changes in trade costs generally affect the allocation of resources across sectors. Different assumptions on the underlying structure of the economy can lead to a common formulation of the comparative statics effects of a change in trade costs as reviewed by Costinot and Rodriguez-Clare (2015). Egger et al. (2011), for instance, estimate the full trade effect of PTAs.

[8] The theoretical framework outlined here, being based on the gravity equation, can be derived from a number of assumptions on the demand and supply sides of the model (Head and Mayer, 2015). Ricardian comparative advantage models à la Eaton and Kortum (2002) and monopolistic competition models with Dixit–Stiglitz-type assumptions deliver a gravity equation. Larch and Lechthaler (2013), for instance, use a monopolistic competition framework to estimate the welfare maximizing share of domestic public procurement.

[9] Note that with an endogenous characterization of the supply side (e.g., in a monopolistic competition or Eaton–Kortum model), labour can freely move across sectors and hence across productions for governments and for private firms.

[10] For simplicity, we assume that the government simply aggregates the input varieties, without using any primary factor of production (e.g., labour and capital). This view is consistent with the government transferring goods and services to consumers. Note however that the gravity equation that we use in the empirical analysis is valid also if we let the government use primary factors.

aggregate transferred by the private firms.[11] Invoking the "trade separability" assumption (Anderson and van Wincoop, 2004), we require only that the allocation of resources across private and public goods can be separated from the allocation of income and expenditures within type (k, s) across countries.[12] Under this assumption, the government's problem can be partitioned in two steps. In a first step, the government chooses the level of aggregate expenditure and thus taxation that maximize household's utility (Larch and Lechthaler, 2013). In a second step, it chooses the optimal mix of spending across type k and sourcing country i, taking as given optimal expenditure for each good type k and hence public expenditure and optimal taxation. Separability implies that only this last step determines directly bilateral trade flows. Crucially, taxation does not affect bilateral trade flows under the "conditional general equilibrium" (Anderson and van Wincoop, 2004), as long as it does not come from border tariffs, which we assume throughout. While this limits the scope of the theory, it enables us to focus on trade costs.[13]

Under this structure, the CES demand function for an input variety of type k in market s is:

$$X_{ij}^{k,s} = \left(\frac{p_i^{k,s} t_{ij}^{k,s}}{P_j^{k,s}} \right)^{1-\sigma^k} E_j^{k,s} \tag{1}$$

where $P_j^{k,s} \equiv \left[\sum_i \left(p_i^{k,s} t_{ij}^{k,s} \right)^{1-\sigma^k} \right]^{1/1-\sigma^k}$ is the price index — i.e. the unit cost that market s faces to buy a bundle k of input varieties. The term $\sigma_k > 1$ is the elasticity of substitution between varieties of type k and is assumed to be equal across public and private market. Using market clearance on the supply side, $Y_i^{k,s} = \sum_j \left(p_i^{k,s} t_{ij}^{k,s} / P_j^{k,s} \right)^{1-\sigma^k} E_j^{k,s}$ to solve for the exogenous factory prices, we obtain the structural gravity model for each buyer $s \in \{p, r\}$:

$$X_{ij}^{k,s} = \frac{E_j^{k,s} Y_i^{k,s}}{Y^{k,s}} \left(\frac{t_{ij}^{k,s}}{P_j^{k,s} \Pi_i^{k,s}} \right)^{1-\sigma^k} \tag{2}$$

$$\left(P_j^{k,s} \right)^{1-\sigma^k} = \sum_i \left(\frac{t_{ij}^{k,s}}{\Pi_i^{k,s}} \right)^{1-\sigma^k} \frac{Y_i^{k,s}}{Y^{k,s}} \tag{3}$$

$$\left(\Pi_i^{k,s} \right)^{1-\sigma^k} = \sum_j \left(\frac{t_{ij}^{k,s}}{P_j^{k,s}} \right)^{1-\sigma^k} \frac{E_j^{k,s}}{Y^{k,s}} \tag{4}$$

where $Y^{k,s} \equiv \sum_i Y_i^{k,s}$ denotes world income generated from supplies of good k to buyer s. The Π_i's terms are referred to as "sellers' incidence" or "inward multilateral resistance", while the price indexes P_j's are suitably re-interpreted as "buyers' incidence" or "outward multilateral resistance" (Anderson and van Wincoop, 2003; Anderson and Yotov, 2010b). These terms summarize the average trade resistance between one country and the rest of the world. The system can be solved for the P_j's and Π_i's terms (up to a scalar) given data on income and expenditure and estimates of the trade cost vector $\{t_{ij}\}$.[14]

The structural gravity model can be used to derive a theoretically-consistent index of home bias, defined as the amount of *predicted* internal trade given trade costs relative to the same internal flow that would arise in a frictionless benchmark. In absence of trade barriers ($t_{ij} = 1 \forall i, j$), trade flows are proportional to income and expenditures shares: $X_{i,i}^{k,s}(t_{ij} = 1) = Y_i^{k,s} E_i^{k,s} / Y^{k,s}$. The "Constructed Home Bias" (CHB) index (Anderson and Yotov, 2010b) is thus:

$$CHB_i^{k,s} \equiv \left(\frac{t_{ii}^{k,s}}{\Pi_i^{k,s} P_i^{k,s}} \right)^{1-\sigma^k} \tag{5}$$

This index summarizes how trade costs around the world inflates domestic shipments over international trade, holding aggregate sales and expenditure constant. It thus provides a specific measure of preference for local suppliers that can be computed for both the private and public market.

As Anderson and Yotov (2010b) argue, the CHB index is comparable across types of goods and services, countries and over time, does not depend on normalization nor on estimates of σ^k. Importantly, it can be estimated given the structure of the gravity equation. As such, the estimated index is meant to capture the central tendency in the data and hence shares the good empirical properties of the gravity equation.[15] The CHB index is derived in Eq. (5) under a conditional general equilibrium analysis, which

[11] Private firms provide the private good aggregate under perfect competition.

[12] Cobb–Douglas preferences across public and private good aggregates satisfy this condition (e.g., see Larch and Lechthaler (2013)).

[13] Changes in trade costs affect the optimal allocation of resources across sources of good k, without altering the overall expenditure (and hence income for the exporting countries) on good k. This result clearly hinges upon the type of analysis that we are after. In a full general equilibrium model, changes in the patterns of trade alter factory gate prices and hence income and expenditure.

[14] A gravity-type equation for bilateral cross-border procurement flows can be obtained also in the framework of Fronk (2014), where prices are determined in a first-price sealed-bid auction similar to McAfee and McMillan (1989). In his model, bilateral flows are still a function of importer-specific terms, exporter-specific terms, and bilateral factors, but the theoretical counterparts of some terms are different from those of Eq. (2) — e.g., the set of importer-specific terms include the expected (average) price of procurement contracts and a measure of competitiveness of the procurement market.

[15] Another approach to measure trade cost is to solve the gravity equation in (2) for bilateral trade costs t_{ij}'s (Novy, 2013). This measure however does not directly relate to the concept of home bias as it ignores the role of the estimated multilateral resistance terms, which affect our definition of home bias in Eq. (5).

means that sales and expenditures (the Y's and the E's) do not change between the observed and the counterfactual (frictionless) scenario.[16] As in Anderson and Yotov (2010b), this approach is consistent with a strict interpretation of CHB as a measure of the incidence of trade costs.

3. Empirical strategy

Given data on the value of bilateral sector shipments $X_{ij}^{k,s}$ and proxies for the trade cost function $t_{ij}^{k,s}$, the parameters of the gravity equation in (2) can be consistently estimated. We follow common practice in the literature and use importer–year and exporter–year fixed effects specific to each buyer k and sector s in our regressions to control for the multilateral resistance and the sales and expenditure terms in Eq. (2). Adding a time subscript, the gravity model that we estimate is:

$$X_{ij,t}^{k,s} = \exp\left(m_{j,t}^{k,s} + e_{i,t}^{k,s} + \alpha^{k,s} T_{ij,t}^{k,s}\right) + \varepsilon_{ij,t}^{k,s} \tag{6}$$

The term $T_{ij,t}^{k,s}$ is the matrix of possibly time-varying bilateral trade cost variables and $\alpha_t^{k,s}$ is the associated vector of coefficients: $\left(t_{ij,t}^{ks}\right)^{\phi^{k,s}(1-\sigma_k)} \equiv \exp\left(\alpha_t^{k,s} T_{ij,t}^{k,s}\right)$; where the empirical parameter $\phi^{k,s}$ measures the elasticity of 'true' trade costs with respect to the 'observed' ones, and is allowed to vary by type of good and buyer. The m and e terms denote importer–year and exporter–year fixed effects, each specific to a buyer and type of good. To avoid collinearity and consistently with the structural gravity model in Eq. (2) (see Anderson and Yotov, 2010b), we normalize $exp(m_{USA,t}^{k,s}) = 1 \Rightarrow P_{USA,t}^{k,s} = 1$ in all our estimations.[17] In practice, we estimate the parameters of Eq. (6) through separate regressions for each buyer (government or private firms) and sector (goods or services). Following Egger and Tarlea (2015), standard errors are three-way clustered: by importer, by exporter and by symmetric country pair (i.e., the same indicator for the ij pair and the ji pair — this is the unit of variation for the covariates that enter the trade cost vector).

In specifying the trade cost function, we follow two approaches. First, we include time-invariant determinants of trade barriers that have been extensively used in the literature in addition to time-variant and policy-driven variables — including measures that capture changes in trade barriers specific to the public procurement market. In this case, the trade cost function is specified as follows:

$$\begin{aligned}\left(t_{ij,t}^{ks}\right)^{\phi^{k,s}(1-\sigma_k)} \equiv & \exp\left(\beta_1^{k,s} SMCTY_{ij} + \beta_2^{k,s} DIST_{ij} + \beta_3^{k,s} CONTIG_{ij} + \beta_4^{k,s} COLONY_{ij}\right) \\ & \exp\left(\beta_5^{k,s} LANG_{ij} + \beta_6^{k,s} LEGAL_{ij} + \beta_7^{k,s} PTANOPROC_{ij,t}\right) \\ & \exp\left(\beta_8^{k,s} PTAPROC_{ij,t} + \beta_9^{k,s} WTOGPA_{ij,t} + \beta_{10}^{k,s} EU_{ij,t}\right)\end{aligned} \tag{7}$$

where the $SMCTY$ indicator equals one if $i = j$, i.e. if the trade flow is internal. The coefficient β_1 thus identifies the (partial) border effect, i.e. how much trade within national borders is different from trade with other countries, controlling for other bilateral determinants of trade and for multilateral resistance terms. To net out the influence of other factors, all trade cost variables (except for distance) are switched on for same-country pairs, which is equivalent to assuming that internal trade faces the lowest observable trade costs (e.g., a common legal origin, an EU-type internal market).[18] We control for a standard set of other time-invariant determinants of bilateral trade. The variable $DIST$ is the log of the population-weighted bilateral distance (Mayer and Zignago, 2011). $CONTIG$ is a dummy equal to one if the two countries in the pair share a border, $COLONY$ equals one if the two countries share colonial history, $LANG$ equals one if the two countries share an official language, and $LEGAL$ is a dummy for common legal origin. These variables are sourced from CEPII (Mayer and Zignago, 2011).

Our second approach to modelling trade costs controls for unobserved time-invariant heterogeneity that can drive both the propensity to increase cooperation through various agreements and trade flows (Baier and Bergstrand, 2007). In particular, it consists in assuming the following specification:

$$\begin{aligned}\left(t_{ij,t}^{ks,FE}\right)^{\phi^{k,s}(1-\sigma^k)} \equiv & \exp\left(\beta_1^{k,s} PTANOPROC_{ij,t} + \beta_2^{k,s} PTAPROC_{ij,t} + \beta_3^{k,s} WTOGPA_{ij,t}\right) \\ & \exp\left(\beta_4^{k,s} EU_{ij,t} + \gamma_{ij}^{k,s}\right)\end{aligned} \tag{8}$$

where the γ's terms are directional country-pair fixed effects (specific to each buyer k and sector s) that capture unobserved and time-invariant determinants of trade costs.[19]

The time-varying trade policy covariates in Eq. (8) measure participation in trade agreements, with a focus on trade policies related to government procurement. The $PTANOPROC$ indicator equals one if the two countries in the pair are part of a PTA at time

[16] Holding taxation fixed, sales and expenditure would vary between the baseline, observed scenario and a counterfactual one because factory gate prices (and, in a supply-side model, factor prices) would change in response to changes in the levels of trade barriers.

[17] Given our structural interpretation of the model, the normalization implies that $\left(P_{j,t}^{k,s}\right)^{1-\sigma_k} = E_{j,t}^{k,s}/E_{USA,t}^{k,s} \exp\left(m_{j,t}^{k,s}\right)$. It follows that $P_{USA,t} = 1$.

[18] This choice affects the point estimate of the coefficient on the $SMCTY$ dummy (see footnote 31 presenting a robustness check), but it does not affect the other coefficients, nor the estimates of our baseline specification with directional country-pair fixed effects, and extensions thereof.

[19] Collinearity requires further restrictions on the set of fixed effects. As in Agnosteva et al. (2019), we suppress the time-invariant internal trade cost dummies so that the estimates of international time-invariant trade costs are relative to a geometric mean of the two countries' internal trade cost: $\exp(\gamma_{ij}^{k,s}) = \left[t_{ij}^{s,k}/\left(t_{ii}^{s,k} t_{jj}^{s,k}\right)^{1/2}\right]$.

t without any provision on government procurement. The $PTAPROC$ dummy captures instead country pairs that are involved in PTAs that explicitly include a chapter on government procurement. In extensions, we also estimate the impact of single provisions on government procurement as collected in the Deep Trade Agreements (DTA) database (Mattoo et al., 2020). The variable $WTOGPA$ equals one for country pairs where both countries are members of the WTO GPA. Started in 1996 and revised in 2014, the agreement aims to ensure national treatment to foreign firms in government procurement markets, although each member defines the areas of commitments (e.g. different public entities, goods vs. services) that can thus vary substantially across countries. Importantly and unlike most of the WTO agreements, the GPA is "plurilateral", meaning that it binds only its signatories having *de facto* the same structure of a PTA.[20] Among the 62 countries of our sample, 28 are EU members at some point in time. We isolate the distinctive role of the EU by adding a dummy for EU membership. The trade agreement variables are mutually exclusive – i.e., the $PTANOPROC$ and $PTAPROC$ dummies are turned to zero for EU countries when the EU indicator is equal to one.[21]

We first compare estimates of the trade cost function across public and private markets, for goods and services. When we adopt the specification without directional country-pair fixed effects (Eq. (7)), we focus on the estimates of the coefficient on the $SMCTY$ dummy as it captures the border effect and hence it can used as a first indicator of bias towards local purchases. We then use the specification in Eq. (8) with directional country-pair fixed effects to assess whether policy efforts to liberalize government procurement markets have increased cross-border flows. Specifically, we test if the coefficients on the PTA, GPA and EU dummies are positive and significant and if they are higher for government than for private flows.[22]

To take into account how trade barriers around the world create a preference for local purchases, we next estimate an index of home bias, the CHB. Differently from the border effect, the CHB measures how trade frictions shift up the observed internal trade relative to a frictionless benchmark, where international transactions are thus predicted to be much greater. To estimate the index, we manipulate the gravity equation in Eq. (2) as follows (see Anderson and Yotov, 2010b):

$$\widehat{CHB}_{i,t}^{k,s} = \frac{Y_t^{k,s}\,\hat{X}_{ii,t}^{k,s}}{E_{i,t}^{k,s}\,Y_{i,t}^{k,s}} = \frac{\left(\hat{t}_{ii,t}^{k,s}\right)^{\hat{\phi}^{k,s}\left(1-\sigma^k\right)}}{\left(\hat{P}_{i,t}^{k,s}\,\hat{\Pi}_{i,t}^{k,s}\right)^{1-\sigma^k}} \tag{9}$$

where the $\hat{\phi}$ term reflects the fact that we observe only an empirical estimates of trade costs (instead of the true ones). The estimated CHB is thus given by the predicted values of the gravity model rescaled by sector expenditures and incomes. The predictions are from the baseline gravity specification in Eq. (8). We first obtain CHB for goods and services separately (and for each market s) and then aggregate those to the country level using the product of sales and expenditure shares as weights, similar to Anderson et al. (2014).

This approach gives consistent estimates of the CHB index if the gravity equation is correctly specified, i.e., if the country-specific fixed effects are consistent estimates of their theoretical counterparts. Fally (2015) shows that this holds true – conditional on an assumed set of trade cost regressors, $t_{ij,t}$ (Egger and Nigai, 2015) – when the Poisson pseudo-maximum-likelihood (PPML) estimator proposed by Silva and Tenreyro (2006) is employed and income and expenditure are consistent with bilateral trade flows (i.e., $Y_{i,t}^{k,s} = \sum_j X_{ij,t}^{k,s}$, $E_{j,t}^{k,s} = \sum_i X_{ij,t}^{k,s}$). The peculiar properties of the estimator imply that the actual income and expenditure values equal the predicted ones, which should normally be used as both are endogenous in the general equilibrium gravity model. We thus employ the PPML estimator, which has the added advantages of controlling for heteroskedasticity in the data and statistically dealing with zero trade flows.

4. Data

To bring this empirical artillery to the data, we need information on bilateral trade that involves the public sector as a buyer, on a large enough sample of countries. Other studies that investigate trade barriers in government procurement employ data from inter-country input–output tables (Riker, 2013; Messerlin and Mirodout, 2012) as these can split public expenditures from national accounts across type of goods and services purchased and country of origin. We thus follow this route and employ data from the TiVA initiative of the OECD. Similarly to other ICIO database (e.g., Timmer, 2012), the TiVA database harmonizes national IO tables and combines them with information from national accounts and bilateral trade statistics in goods and services to obtain an international input–output table (see OECD, 2013b for details). The estimation procedure allocates output from each country and sector to intermediate usage (by all sectors) or final demand across countries. Following national accounts, the final demand part includes a column for government expenditures on final goods and services. While far from perfect and inevitably rife with measurement errors

[20] While the agreement entered officially into force in 1996, it was firstly signed in 1994. We thus assume that the countries that entered the agreement in 1996 were already *de facto* members in 1995, the first year of our panel.

[21] We isolate the effect of EU membership also because its 'depth' in government procurement – which is articulated in EU directives – is not accounted for the in the DTA database — which instead is based on an analysis of the text of trade agreements.

[22] To statistically compare the coefficients across government and private regressions, we stack the observations for the two types of buyer and estimate a gravity specification where all covariates and fixed effects are interacted with an indicator for government flows (we still split the sample between goods and services). The p-value of the interaction terms between a covariate and the government indicator determines whether the associated coefficient is significantly different across government and private markets. Note that because the sample is balanced along its dimensions (importer, exporter, sector, buyer and year), this approach is equivalent to estimating the gravity equation separately for each buyer and sector (e.g., the coefficient on the PTAPROC variable in the government market – for services or goods – equals the sum of the coefficients on the PTAPROC variable alone and the coefficient on the PTAPROC variable interacted with the government indicator).

(which, if classical, do not bias our empirical estimates), this type of data is the only one that enables international comparison of public expenditures across countries and sectors.[23] Data on procurement contracts that has been used in related work (Herz and Varela-Irimia (2020) and Fronk (2014); see also footnote 5) are limited to one country or to a group of countries (US or the EU) and hence would make identification of the effect of different PTAs problematic.

We combine the 2018 and 2016 editions of the TiVA database to obtain data on 62 countries, for goods and services, between 1995 and 2015. The 2016 edition covers the 1995–2011 period, while the 2018 edition covers the 2005–2015 period. We employ data from the 2016 edition from 1995 to 2004, and data until 2015 from the latest edition. The industry classifications in the two editions are not fully compatible. The 2018 edition uses the ISIC Rev. 4 classification, whereas the 2016 edition is based on the ISIC Rev. 3 one. While harmonization of the two classifications at the industry-level can be problematic,[24] the definitions of the goods and services aggregate sectors, and of the 'buying' sectors composing government entities did not change. We therefore conduct our analysis with the aggregates of goods and services, and provide robustness checks using the more detailed industry-level data. Table A.2 in the Appendix lists the goods and services industries that are included in the data. As for the country composition, Kazakhstan is included in the 2018 edition only, whereas Thailand never reports imports in public procurement (no imports are reported also in the Government Expenditures column). Therefore, we exclude both countries from the analysis. For simplicity, we also exclude the Rest-of-the-World aggregate that is part of the dataset.

To measure government procurement flows, we have to define the perimeter of the public sector. The OECD defines public procurement as "intermediate consumption (goods and services purchased by governments for their own use, such as accounting or IT services), gross fixed capital formation (acquisition of capital excluding sales of fixed assets, such as building new roads and investments in military defence systems)[25] and social transfers in kind via market producers (goods and services produced by market producers, purchased by government and supplied to households)" (OECD, 2013a, p.130). We cannot measure gross fixed capital formation by the public sector because the TiVA database, like other ICIO data, does not provide a split between public and private gross fixed capital formation. Our measure of government procurement includes social transfers in kind and intermediate consumption of goods and services. The "General Government Expenditure" column of final demand in the ICIO tables provides the values of social transfers in kind of goods and services via market producers. To measure intermediate consumption, we take the column vectors from the input–output matrix (i.e., goods and services for intermediate use) that correspond to government entities. European Commission (2017) proposes three ways to define these entities in an input–output matrix: (i) a "narrow" classification that includes only the "Public Administration" column; (ii) a "typical" definition that adds the "Health" and "Education" columns to the "Public Administration" one; and (iii) a "broad" classification that adds to the "typical" one the columns that pertain to utilities, half of the columns with postal and telecommunication services, and one third of the land transport column. The empirical evidence that we present in this and in the next sections relies on the "typical" definition, and we check the robustness of our main results to the use of the "narrow" definition (the results are shown in the Appendix). Because the TiVA data are not detailed enough (i.e., land transportation is included in a broader "transport and storage" sector), we cannot appropriately implement the "broad" definition.

Social transfers in kind, as measured by the "General Government Expenditure" column of the ICIO tables, absorb the majority of government procurement flows in our data. As shown in Fig. A.3 in the Appendix, their average share across countries is stable around 72 percent throughout the sample period. There is however significant variation across countries, as revealed by the country-specific numbers reported in Table A.3. Not surprisingly, the social transfers share of government procurement tends to be higher in countries with traditionally larger welfare state (e.g., 80 percent in France against 57 percent in the US). Our conceptual framework (see Section 2), where the government aggregates goods and services and delivers them to private agents, is consistent with this large share of social transfers in government procurement.

We use data from ICIO tables to construct variables of cross-border procurement flows, which are notably difficult to measure.[26] As a check on the reliability of our data, we compare the government procurement variable as constructed from the TiVA ICIO tables with similar variables aggregated from the contract-level TED database. The report of the European Commission (2017) computes the import share in the total value of government procurement (import penetration ratio) using the TED data by country (EEA members) and year between 2009 and 2015. Figs. A.4 and A.5 in the Appendix plot import penetration in our data against import penetration in the contract-level data taken from the European Commission (2017). There is a strong positive correlation: in the country–year panel (Fig. A.4), the correlation coefficient equals 0.64, and in the cross-country data (Fig. A.5) the rank correlation coefficient is 0.58, both suggesting that countries that have high import penetration in our data display also high import penetration with the contract-level data. Both graphs also show that the average import penetration in the TiVA data is slightly higher (8.8 percent) than that in the contract-level data (5.5 percent) — but it is higher in the contract-level data for 13 percent of the country–year

[23] An alternative approach that relies only on official trade statistics is used by Rickard and Kono (2014) (and adopted also by Gourdon and Messent (2019)). It indirectly identifies the effect of trade barriers on cross-border government procurement by allowing the effect of bilateral factors on trade as recorded by official statistics to vary with the size of the government procurement sector by country. An important limitation of this approach in our setting is that it is not consistent with the CHB indexes that we use to quantify home bias. In particular, size and trade costs effects interact in this approach: total government purchases, which enter overall expenditure in the gravity model, are allowed to influence the direct effect of trade costs.

[24] See this note: http://www.oecd.org/industry/ind/tiva-2018-differences-tiva-2016.pdf from the OECD on the subject.

[25] Procurement of military services and products that do not represent assets should be included in our measure of government procurement flows.

[26] Service trade flows are also notoriously difficult to measure, especially by country pair. This difficulty (and the possible measurement error that goes with it) should however apply to both 'public' and 'private' transactions — concerns in the interpretation of our empirical results comparing public and private market should thus be attenuated.

observations. Besides statistical discrepancies, the major difference between the two sources of data is that purchases by private firms in the Health and Education sectors are included in government procurement under our "typical" definition, whereas they are not in the contract-level data. A larger propensity of these firms to import relative to other public authorities can explain at least partially the higher import penetration found in the TiVA data. In support of this conjecture, adopting the "narrow" definition of government procurement that excludes purchases by the Health and Education sectors reduces the average difference in import penetration ratios between the two data sources to 2 percentage points.[27] The similarity in the level and cross-country variation between our measure of import penetration and the same measure with direct yet limited contract-level data supports the relevance of our data to an analysis of home bias in government procurement across countries.

Once public procurement is defined using the ICIO data, we identify a private market that is suitable for comparisons. The sum of the other columns in the ICIO table and the "Household expenditure" column in the final demand section is the most immediate and comparable definition of 'private procurement'. This choice can nevertheless lead to an overlapping with government procurement to the extent to which public authorities operate outside the "typical" definition of government (i.e., outside the Public Administration, Health, and Education columns). Such an overlap between the public and private markets should work against finding significant differences in trade barriers between the two.

The other major source of our data is the Deep Trade Agreements (DTA) database (Mattoo et al., 2020). We use it to measure participation in PTAs with specific provisions on government procurement. The DTA section on government procurement includes around 100 questions on the content of chapters on government procurement in PTAs. We treat each question as a distinct provision and, after excluding questions that are difficult to classify as moves towards greater openness,[28] we end up with a list of 35 provisions. These are listed in Table A.4 in the Appendix and grouped under seven categories as provided by the DTA database: overview, non-discrimination (national treatment), coverage, procedural disciplines, (ex-post and ex-ante) transparency, dispute Settlement and new issues. We use these data in our baseline specification (Eqs. (6) and (8)) to define the variable $PTAPROC$ as a dummy for the years when a country pair is part of a PTA with (any) provisions in government procurement (the dummy $PTANOPROC$ measures membership in other PTAs). We exploit information on the different provisions in extensions of our baseline model.

5. Descriptive trends

Before turning to the empirical estimates of the gravity models, we investigate descriptive trends in the data. The objective here is twofold: (i) to identify patterns of expenditures across goods and services in public and private markets as these affect estimated home bias at the country-level; and (ii) to have a first look at trade barriers by looking at import penetration ratios. First, we compute the service expenditure share for each country in the 'typical' public and private markets as defined above. Fig. 2 shows the variation over time of the mean of this share by year (together with the 10th and 90th percentile), for procurement and private markets — the country-specific numbers for selected years are in Table A.5 in Appendix. One pattern stands out: government procurement is vastly about services. The average government in our sample devotes to services around 90 percent of total procurement purchases, a share that is much higher than that for private purchases.[29]

We then turn to import penetration ratios defined as the value of imports divided by total expenditures. While purely descriptive, the measure has been used extensively to assess openness to trade, including in government procurement markets (Messerlin and Mirodout, 2012). We compute the import penetration ratios by country and type of purchasing entities (public or private). Fig. 3 reports the yearly means of the ratio of public to private import penetration ratios for goods and services. A value greater than one suggests that public markets are more open than private ones. Public markets are less open than private ones in services for all countries, while for goods the picture is more nuanced: import penetration is on average 18 percent higher for governments than for private firms, but there are large differences across countries (see Table A.6 in the Appendix). Between 1995 and 2015, relative openness of government procurement in services slightly increases, whereas it decreases on average for goods.[30]

While purely illustrative, this descriptive analysis delivers some messages that are relevant to the subsequent econometric estimations. Government procurement is mainly about services, which are generally less traded than goods. These two observations alone mechanically increase home bias in the public sector at the country level as services are weighted more in government procurement than in private markets. The sector-specific gravity model in Eq. (6) controls for this influence as it allows comparisons of estimates across public and private markets *within* the goods or services aggregate. The analysis of import penetration ratios indeed suggests that already within services, public markets are markedly less open than private ones, with important heterogeneity across countries and over time. The ensuing empirical analysis aims to investigate this variation further.

[27] The remaining difference could partly be explained by the fact that contracts with value over 200 million euros are excluded from the European Commission (2017) report. Since foreign firms are more likely to win larger government procurement contracts, this choice might bias the import penetration numbers in the report downwards.

[28] We consider the 'horizontal' depth of the government procurement chapter (if any). We thus drop questions that measure 'vertical' depth — i.e., those about the content of phasing in provisions for developing countries, that compare the content of the provision with the corresponding article of the (revised) WTO GPA, and combine some questions that are mutually exclusive (e.g., whether the chapter covers only goods or goods and services). We also combine the provisions under the category "new issues" (i.e., e-procurement, sustainable procurement, SME participation, safety standards and cooperation) into a single one, because each of these provisions are found in two PTAs at most.

[29] This pattern is confirmed when we adopt the "narrow" definition of government procurement, as shown in Fig. A.6 in Appendix.

[30] When using the "narrow" definition of government procurement in Fig. A.7 in the Appendix, we find similar results: if anything, the relative government import penetration is lower especially in services.

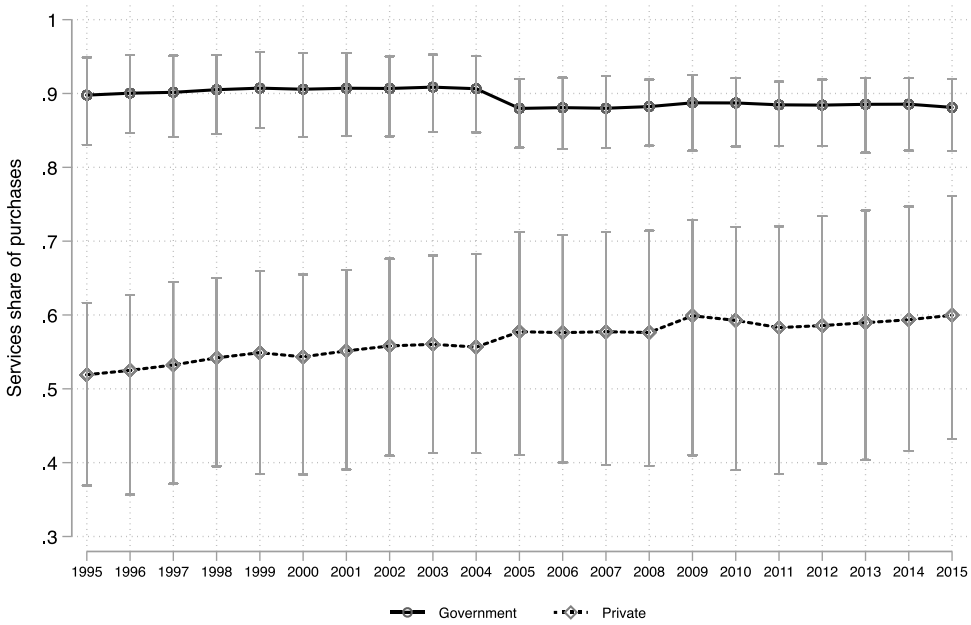

Fig. 2. Avg. services share of purchases in public and private markets over time. Note: Raw data are sourced from the TiVA database. Purchases from and sales to ROW are included in the computations. Government procurement flows are computed using the "typical" definition (see the main text for details). The upper caps of the vertical bars are at the 90th percentile of the distribution across countries, whereas the lower caps are at the 10th percentile.

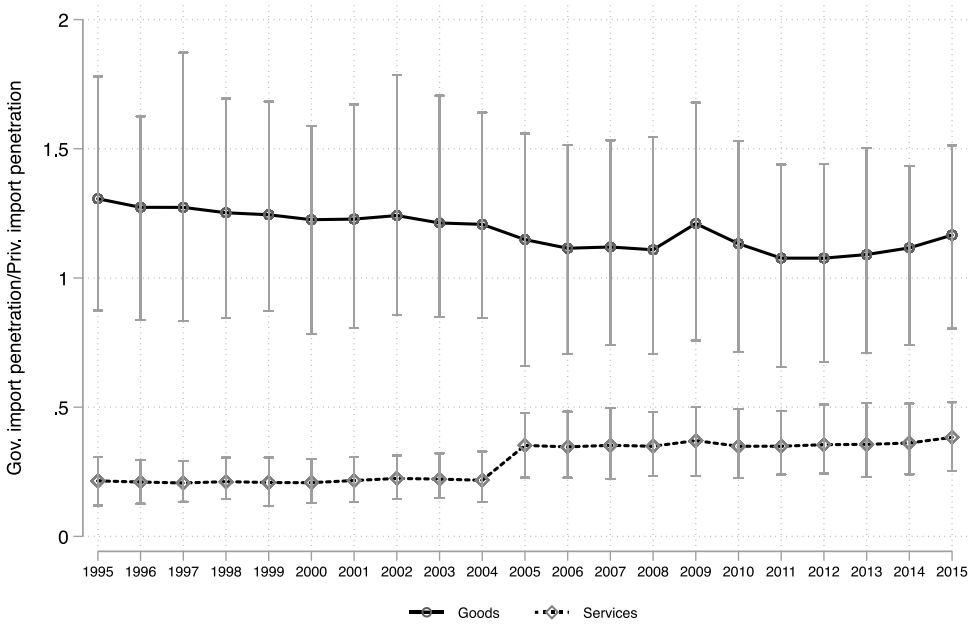

Fig. 3. Avg. government import penetration to private import penetration ratio over time. Note: Raw data are sourced from the TiVA database. Purchases from and sales to ROW are included in the computations. Government procurement flows are computed using the "typical" definition (see the main text for details). The upper caps of the vertical bars are at the 90th percentile of the distribution across countries, whereas the lower caps are at the 10th percentile.

6. Empirical results

In this section, we discuss the results from the gravity Eq. (6) and the estimated CHB. The objective is to estimate the border effect and the effect of trade agreements in government procurement (relative to private markets) by applying the empirical framework described in Section 3.

To make the analysis clear and in line with the descriptive evidence, we sum up bilateral trade values over supplying industries in goods (including also primary sectors) and services aggregates. To allow for adjustments over time in trade flows (Piermartini and Yotov, 2016), we use data from six years in four-year intervals (1995, 1999, 2003, 2007, 2011, 2015). We report robustness checks by (i) leaving the dependent variable at the industry level (see Table A.2 in the Appendix) and allowing for industry-specific multilateral resistances; and (ii) using the full 1995–2015 yearly panel of country pairs. For each specification and supplying sector, we report the estimates for the private market next to the ones for the government one to ease comparison. Coefficients in bold are significantly different (at the 10 percent level) across the two markets (see also footnote 22).

6.1. Gravity results

Baseline results

Tables 1 and 2 report the PPML gravity estimates for goods and services, respectively. In columns (1) and (2), we use the 'pooled' specification for trade costs — i.e., without directional country-pair fixed effects (see Eq. (7)). The large and significant coefficients on the 'same country' dummy ($SMCTY$ variable) give a strong indication of home bias, especially in government procurement. For trade in goods (Table 1), the estimates in column (1) imply that, after controlling for observable determinants of trade, government procurement from local suppliers is exp(1.985) = 7.28 times higher than that from foreign suppliers. In private markets, local sales are exp(1.638) = 5.14 times higher than international sales. As expected, the border effect is much larger in services, and significantly higher in government procurement than in private markets (Table 2). The estimates in column (1) suggest that government purchases of local services are exp(4.024) = 55.9 times the purchases of services from abroad.[31] The disproportionately large border effect in government procurement is only an indication of protectionist (e.g., "buy-national") policies. Other characteristics that are specific to government contracts and that are not protectionist might still favour local over foreign firms. In the US for instance, set-aside policies that provide preferences for certain categories of firms (e.g., small and medium sized firms, veteran- or Native-owned firms) can indirectly exclude foreign bidders from competition.

The common language and legal origin dummy variables in the gravity equation can control, at least partially, for a local bias in government procurement due to cross-country differences in the legal language and procedure. The estimates indeed suggest that speaking the same official language increases significantly cross-border procurement, but the effect is not significantly different from the one on trade in private markets. Sharing the same type of legal system does not seem to affect trade flows. Coefficients on the other time-invariant determinants of trade costs have the expected sign and most of them are statistically significant. Distance has the usual depressing role on bilateral trade, regardless of whether the purchaser is a private or public entity. The negative effect is rather on the lower end of the range of distance effects found in the literature (Disdier and Head, 2008) and, interestingly, it is stronger in goods than in services. Time-varying and policy-driven determinants of trade are included in columns (1) and (2) of Tables 1 and 2 merely as controls. In these specifications, omitted variable bias from unobserved bilateral determinants of trade is likely to plague the estimated effects of the covariates.

Columns (3) to (10) report the estimates of gravity models with directional country-pair fixed effects, which absorb the influence of all time-invariant determinants of trade flows (e.g., see the specification in Eq. (8)). As Baier and Bergstrand (2007) argue, this specification attenuates the endogeneity concerns related to the coefficients on time-varying variables measuring changes in trade policy. The implied effects of trade agreements are 'partial' as the multilateral resistance terms, sales, and expenditure are taken as given.

Since many countries are part of multiple types of agreements relevant to government procurement (e.g., countries sign deep PTAs with procurement provisions, while being part of the WTO GPA and – relevant to our sample of countries – of the EU), we assess the contribution of each type of agreement by adding them progressively to our specification. The PPML estimates in Table 1 suggest that initiatives specific to government procurement (i.e., PTAs with provisions on government procurement and WTO GPA) have significant effects on trade in goods. The estimates in column (5) suggest that cross-border government procurement in goods goes up by 20 percent when two countries join a PTA with procurement provisions. The effect is however lower than that of joining a PTA without those provisions.[32] The influence of the WTO GPA is instead null or even negative when we control for all the relevant types of trade agreements. Importantly, we find that the effect of these policies that are meant to liberalize government procurement is slightly lower than in private markets. When it comes to goods trade, policies specific to procurement markets included in PTAs might partly be proxying for the effect of provisions in other areas (e.g., non-tariff measures, investments).[33]

Trade agreements have instead significant and specific effects on cross-border government procurement of services. As Table 2 shows, most of the average trade effect of PTAs is driven by those that have provisions on government procurement. The estimates in column (5) imply that entering a PTA with provisions on government procurement boosts trade in public markets by 77 percent –

[31] The coefficients on the $SMCTY$ dummy are higher if we change the values of the other trade cost dummies for same-country pairs. Table A.7 reports the $SMCTY$ coefficients if we switch off all other dummies — this treatment is equivalent to charging the $SMCTY$ dummy with all differences between internal and external trade (including those that might be explained by other observables). For instance, the estimates in column (3) imply that government purchases of local services are exp(6.99) = 1086 times the purchases of foreign ones. Crucially, the relative differences in the border effect are confirmed: the border is thicker in services than in goods, and for government procurement than for private markets (and especially so for services).

[32] With an estimated coefficient $\hat{\beta}$, we compute the associated percent effect as: $\left[\exp\left(\hat{\beta}\right) - 1\right] \times 100\%$.

[33] This attenuated effect of PTAs on cross-border procurement in goods is confirmed when we control for bilateral applied tariffs, which reduces the estimation sample by 16 percent because of missing tariff data.

the relative effect on private markets being only a 15 percent increase – compared to the 37 percent increase brought about by PTAs without procurement provisions. Columns (7) and (9) show that part of this distinctive effect of procurement provisions is driven by membership in the WTO GPA and the EU. In particular, membership to the WTO GPA increases significantly cross-border public procurement of services — an effect that is larger than that of PTAs with procurement provisions. Entering the EU single market has promoted the most cross-border purchases of services by public authorities, as shown in column (9). Looking at the estimates for private markets, the positive effects of PTAs with procurement provisions and of the WTO GPA disappear when we control for the EU dummy (column (10)): as expected, it is EU membership that boosts trade in services between firms, and not trade policies specific to government procurement.

Going from column (3) to column (9), the effect of deep PTAs with procurement provisions is almost halved, suggesting that the trade creating effects of these PTAs partly overlap with those of the WTO GPA and of the EU single market. The confounding effects of deep PTAs and the WTO GPA are not surprising. Anderson et al. (2017) find that the legal text of chapters on government procurement in PTAs is often similar to the one of the WTO GPA (especially of the revised GPA that entered into force in 2014). In our sample of 62 countries, the likelihood that a country is part of a preferential trade agreement with provisions on government procurement with at least another country in a given year equals 95 percent for GPA members, and only 34 percent for non-GPA members. In other words, almost all GPA signatories participate also in a PTA with procurement provisions in our sample. The disproportionate presence of EU countries in our sample and the depth of trade agreements signed by the EU with other countries makes identification of separate effects of EU and PTA membership also problematic. Our gravity estimates for services thus indicate that each of these trade policies (PTAs, WTO GPA, and the EU) have a distinctive trade-creating effect when it comes to government procurement.

The evidence on the border effect and on the trade effects of trade agreements is confirmed in three sets of robustness checks, whose results are reported in Appendix. Tables A.8 and A.9 show that the estimates of the gravity models are similar when we use an alternative "narrow" definition of government procurement, which excludes purchases recorded in the "Health" and "Education" columns in the TiVA input–output tables. Results are confirmed also if we estimate the gravity models using the full yearly panel (Tables A.10 and A.11).[34,35] Finally, we confirm our baseline findings when the dependent variable is further disaggregated by the industries (listed in Table A.2) within the goods and services sectors. In Tables A.12 and A.13, the regressions control for country–industry–year fixed effects, consistent with an industry-level gravity model, while we maintain directional country-pair fixed effects, which is consistent with the assumption that trade costs vary across services and goods but not within each of the two aggregates. The estimates are close to the baseline ones in Tables 1 and 2.[36]

Effects of PTAs provisions specific to government procurement

The baseline results rely on the use of dummy variables to identify the presence of provisions on government procurement in PTAs. The DTA database of Mattoo et al. (2020) however provides also detailed information on the inclusion of specific provisions in each PTA, listed in Table A.4 in the Appendix (see Section 4 for details). We thus exploit this information to gain a better understanding of the type of measures that can drive the average trade effect of covering government procurement in a PTA.

We perform two distinct exercises to assess the role of different types of provisions. Using the gravity model with directional country-pair fixed effects (see columns (3) to (10) in Tables 1 and 2), we first assess the trade effect of each provision on trade flows. In a second step, we estimate the effect of different groups of provisions.

To gauge the role of each provision, we run separate regressions of bilateral flows on an indicator variable for the presence of a provision, controlling for PTAs with other measures in government procurement, PTAs without government procurement, WTO GPA and EU membership (the effect of the single provision is thus relative to a country pair that is not part of a PTA at a given time). Fig. A.8 of the Appendix displays the statistically significant coefficients when we consider government procurement in goods. The provisions with the largest trade-creating effect concern the disclosure of statistics and quantitative information on the country's procurement market. Only the six provisions with largest coefficients have a qualitatively larger effect than in the baseline estimates, where all government provisions are bunched together (see Table 1).

Fig. A.9 shows the results of the same exercise for services. Almost all provisions taken individually contribute significantly to cross-border government procurement of services. As for goods, provisions on the disclosure of information and the availability of electronic auctions are those with the largest impact. Interestingly, these provisions are also among the rarest in PTAs (see their shares in the number of PTAs in Table A.4 in the Appendix), indicating that 'going deeper' (i.e., adding relatively new provisions) in the liberalization of procurement markets fosters more cross-border procurement. The other provisions have however similar effects, thus suggesting that it is difficult to disentangle the contribution of each provision.

At this point, the evidence remains purely suggestive because of the strong co-occurrence of different provisions in the same PTA: the average Jaccard index – i.e., the number of agreements where two provisions occur over the total number of agreements where

[34] Egger et al. (2020) argue for the use of annual data for the estimation of the dynamic trade effects of PTAs. Their results nonetheless confirm that using annual or time-interval data does not affect substantially the contemporaneous effects, which are the focus of our paper. Future work might investigate the anticipated and lagged effects of trade agreements on cross-border government procurement.

[35] In results available upon request, we confirm our baseline findings in annual regressions that use only years before 2008 — i.e., before the 2008–9 crisis that was followed by an expansion in government spending.

[36] In another robustness (results available upon request), we replicate the baseline estimation for services after excluding tax haven countries (Singapore, Ireland, Luxembourg, Malta and Cyprus — list from Gravelle (2015)) from the sample. We perform this test because tax havens might erroneously show up as supplier countries of services because of profit shifting motives. The baseline effects of Table 2 are confirmed, indicating that the trade policy effects are not driven by anomalies with tax haven countries in the service data.

Table 1
PPML gravity estimates, Goods.

Dep. var: X_{ij}	(1) Gov.	(2) Priv.	(3) Gov.	(4) Priv.	(5) Gov.	(6) Priv.	(7) Gov.	(8) Priv.	(9) Gov.	(10) Priv.
SMCTY	1.985***	1.638***								
	(0.255)	(0.326)								
DIST	**−0.651*** **	**−0.812*** **								
	(0.076)	(0.082)								
CONTIG	0.239*	0.280								
	(0.137)	(0.176)								
COLONY	0.290	0.385								
	(0.192)	(0.271)								
LANG	0.352**	0.277**								
	(0.150)	(0.128)								
LEGAL	−0.002	0.041								
	(0.090)	(0.089)								
PTA(NOPROC)	−0.086	0.038	0.214***	0.294***	0.384*	0.318**	0.385*	0.318**	0.381*	0.314**
	(0.207)	(0.181)	(0.065)	(0.053)	(0.209)	(0.126)	(0.209)	(0.126)	(0.209)	(0.126)
PTAPROC	0.168	0.269**			0.191***	0.288***	0.212***	0.274***	0.163**	0.218***
	(0.147)	(0.110)			(0.063)	(0.060)	(0.062)	(0.057)	(0.068)	(0.050)
WTOGPA	0.596***	0.362***					−0.071	0.044	−0.171**	−0.088
	(0.187)	(0.137)					(0.098)	(0.087)	(0.074)	(0.085)
EU	0.064	0.126							0.499***	0.575***
	(0.201)	(0.129)							(0.118)	(0.092)
Obs	23,064	23,064	23,064	23,064	23,064	23,064	23,064	23,064	23,064	23,064

Note: Each column corresponds to a separate regression. All regressions include importer–year and exporter–year fixed effects. Columns (3) to (10) include also directional country-pair fixed effects. In columns (3) and (4), the $PTA(NOPROC)$ dummy equals one if the two countries in the pair belong to the same PTA (with or without provisions on government procurement). In the other columns, the $PTA(NOPROC)$ dummy equals one if the two countries in the pair belong to the same PTA without provisions on government procurement. Data are for the years 1995, 1999, 2003, 2007, 2011 and 2015. Coefficients in bold are statistically different (at the 10 percent level) between the 'Gov.' and 'Priv.' regressions. To perform the statistical comparison, we estimate regressions where the 'Gov.' and 'Priv.' observations are stacked and all covariates and fixed effects are interacted with a dummy for government flows. Standard errors are three-way clustered by importer, exporter and symmetric country-pair. Significant at: *10%, **5%, ***1% level.

Table 2
PPML gravity estimates, Services.

Dep. var: X_{ij}	(1) Gov.	(2) Priv.	(3) Gov.	(4) Priv.	(5) Gov.	(6) Priv.	(7) Gov.	(8) Priv.	(9) Gov.	(10) Priv.
SMCTY	**4.024*** **	**2.597*** **								
	(0.296)	(0.206)								
DIST	−0.446***	−0.380***								
	(0.087)	(0.118)								
CONTIG	0.186	0.394**								
	(0.132)	(0.154)								
COLONY	0.674***	0.890***								
	(0.179)	(0.146)								
LANG	0.647***	0.608***								
	(0.132)	(0.114)								
LEGAL	0.075	0.067								
	(0.070)	(0.074)								
PTA(NOPROC)	0.353*	0.401**	**0.543*** **	**0.087**	**0.318*** **	**−0.207**	**0.317*** **	**−0.206**	**0.314*** **	**−0.208**
	(0.201)	(0.190)	(0.116)	(0.072)	(0.118)	(0.128)	(0.117)	(0.128)	(0.117)	(0.127)
PTAPROC	−0.104	−0.071			**0.572*** **	**0.148** **	**0.390*** **	**0.094* **	**0.326*** **	**0.034**
	(0.127)	(0.125)			(0.127)	(0.071)	(0.092)	(0.056)	(0.089)	(0.052)
WTOGPA	**1.001*** **	**0.736*** **					**0.427*** **	**0.132* **	**0.302*** **	**0.041**
	(0.107)	(0.097)					(0.100)	(0.078)	(0.081)	(0.076)
EU	0.032	0.110							**0.669*** **	**0.337*** **
	(0.178)	(0.164)							(0.138)	(0.104)
Obs	23,064	23,064	23,064	23,064	23,064	23,064	23,064	23,064	23,064	23,064

Note: Each column corresponds to a separate regression. All regressions include importer–year and exporter–year fixed effects. Columns (3) to (10) include also directional country-pair fixed effects. In columns (3) and (4), the $PTA(NOPROC)$ dummy equals one if the two countries in the pair belong to the same PTA (with or without provisions on government procurement). In the other columns, the $PTA(NOPROC)$ dummy equals one if the two countries in the pair belong to the same PTA without provisions on government procurement. Data are for the years 1995, 1999, 2003, 2007, 2011 and 2015. Coefficients in bold are statistically different (at the 10 percent level) between the 'Gov.' and 'Priv.' regressions. To perform the statistical comparison, we estimate regressions where the 'Gov.' and 'Priv.' observations are stacked and all covariates and fixed effects are interacted with a dummy for government flows. Standard errors are three-way clustered by importer, exporter and symmetric country-pair. Significant at: *10%, **5%, ***1% level.

at least one of the two provisions occur – across pairs of provisions equals 0.54 (Fig. A.10 in the Appendix visualizes the values of bilateral indexes). We try to control for this co-occurrence by exploring the existence of clusters of provisions. Appendix A.1 in

the Appendix provides details on the Hierarchical Agglomerative Clustering (HAC) method that we apply to our data in order to identify statistical groupings of provisions.[37] We detect two large clusters (groups 1 and 2 in the third column of Table A.4), which tend to group popular provisions (on average, these provisions are found in 60 and 58 percent, respectively, of PTAs), and a number of single- and two-provision clusters (group 3 in Table A.4). These isolated clusters include the provisions with the largest trade effects in Figs. A.8 and A.9. Therefore, when we test for the effects of these three groups of provisions (the two large clusters and a residual group) in our gravity model, we find that only provisions outside the two large clusters have a robust and positive effect on cross-border procurement (see Table A.1 in the Appendix). These findings accord with the indicative evidence of a trade-creating effect of deep PTAs in government procurement. Two limitations however persists: (i) there is still strong correlations between clusters, especially between clusters 1 and 2 (see Appendix A.1 in the Appendix), which can explain the inconclusive evidence on the effects of these two clusters; (ii) each cluster comprises provisions of different types (see the categories in the second column of Table A.4).

In a different approach, we group provisions sharing similar characteristics. The results of the provision-specific analysis so far suggest that initiatives aimed at enhancing transparency and making procedures more accessible have the highest trade impact (these are provisions under the "Transparency" and "Procedural disciplines" categories in Table A.4). A common trait of these provisions is that, while included in PTAs, they do not discriminate against non-members — they have a public good component and hence non-member countries cannot be excluded from its use. For instance, firms from non-member countries can access new and more detailed information and statistics about procurement contracts that governments make available as a result of provisions in PTAs. This greater transparency and availability of information can create opportunities for suppliers from non-member countries (as well as for those from member countries) inasmuch as they have access to the domestic procurement market.[38] To identify the distinctive impact of these provisions, we construct a variable that captures the extent of importers' "unilateral" liberalization — i.e., liberalization in areas likely to benefit both trade agreement member countries as well as non-members. This variable is equal to the importer's share of provisions in government procurement areas related to transparency and procedural disciplines ever included in any of its trade agreements. In the sample of countries that are members of PTAs with unilateral provisions, 80 percent of all available provisions are covered on average. This figure grows over the sample period, from 65 percent in 1995 to 90 percent in 2015 (see Fig. A.11 in the Appendix), thus indicating the increasing depth of PTAs in government procurement.

The variable is unilateral as it only varies across importers and over time. To estimate its impact in a gravity framework, we follow recent work by Heid et al. (2021), Piermartini and Yotov (2016), and Beverelli et al. (2018) and add to our baseline specification (Eq. (8)) an interaction between the unilateral provision variable and the same-country dummy.[39] As noted by these papers, the sign and the statistical significance of the coefficient on this interaction terms depend on whether the trade policy measure (i) does not discriminate across trading partners; and (ii) it affects international flows differently from domestic ones. We interpret this coefficient as indicating the extent to which deep commitments in government procurement affect domestic relative to international trade (see also Anderson et al. (2018) for a similar interpretation in a comparable exercise).

Tables 3 and 4 present the results for goods and services, respectively. For goods, the estimates suggest that adopting non-discriminatory measures has a null or even positive effect on domestic vs. cross-border government procurement. In particular, the coefficient on the unilateral depth variable interacted with the same-country dummy turns positive in column (3) of Table 3, where we control for the influence of GDP and GDP per capita of the importer (as proxies for country size and economic development) on the border effect. This seemingly surprising result is confirmed in column (5), where we include interactions with a measure of the quality of institutions (the average across the six categories of the World Bank's World Governance Indicators (WGI) database, which is found to decrease the border effect, consistent with the evidence from Beverelli et al. (2018)), and with other trade agreement variables that can have non-discriminatory effect — the EU and WTO GPA dummies equal one if the importer is a member of these agreements. The positive and significant interaction effect found also for trade in private markets – where unilateral depth in procurement provisions should not matter – suggests that the interaction of interest might be capturing the influence of other factors omitted from our specification. Alternatively, the results indicate that domestic firms might take advantage of more transparent procedures and open data on government procurement in goods, at the expenses of foreign firms.

Different than for goods, results in services – where the border effect is found to be significantly larger in public than private markets (see columns (1) and (2) of Table 2) – suggest that countries with deep provisions on government procurement are more open to international trade. The interaction effect in Table 4 is consistently negative and significant across specifications for public markets, and the effect becomes weaker as we control for size and economic development. As an indication that the unilateral depth measure captures policies relevant to government procurement in services, the interaction effect is not significant for private markets. These results suggest that deep non-discriminatory provisions on government procurement in PTAs have been instrumental in promoting cross-border procurement flows in services — where governments have been buying significantly more locally than firms.

[37] The method is used extensively in machine learning (Hastie et al., 2009) and has been recently applied in economics (e.g., Besley et al. (2021)).

[38] In most cases foreign firms are not banned from procurement auctions (Evenett and Hoekman, 2005). If they exist, buy national clauses come often in the form of preference margins — e.g., as of March 2022, contracting authorities in the US government are required to inflate by 20 to 30 percent the low offers of foreign firms from countries that are covered by the GPA or by a PTA with procurement provisions (US Federal Acquisition Regulations, 2022). As long as these restrictions are not prohibitive, firms from non-member countries could participate in the procurement auctions if they know about them.

[39] Sellner (2019) finds that this approach to identify the effects of non-discriminatory trade policies outperforms other methods such as a two-step estimator where estimates of the importer–year fixed effects in the baseline gravity equation are regressed on the unilateral variable.

Table 3
PPML gravity estimates: unilateral depth in trade agreements. Goods.

Dep. var: X_{ij}	(1) Gov.	(2) Priv.	(3) Gov.	(4) Priv.	(5) Gov.	(6) Priv.
PTANOPROC	0.357*	0.242**	0.089	−0.015	0.078	0.009
	(0.189)	(0.117)	(0.130)	(0.086)	(0.123)	(0.074)
PTAPROC	0.132**	0.118**	0.082	0.037	0.067	0.020
	(0.060)	(0.051)	(0.062)	(0.069)	(0.058)	(0.064)
WTOGPA	−0.224**	−0.250***	−0.120*	−0.117	0.024	0.011
	(0.095)	(0.077)	(0.064)	(0.082)	(0.093)	(0.099)
EU	0.471***	0.502***	0.315**	0.359***	−0.161	0.082
	(0.121)	(0.094)	(0.137)	(0.119)	(0.150)	(0.141)
SMCTY × Unilateral Proc. Depth	**−0.157**	**−0.441*** **	**0.516*** **	**0.188** **	**0.597*** **	**0.202** **
	(0.207)	(0.159)	(0.099)	(0.084)	(0.114)	(0.091)
SMCTY × Ln(GDP)			0.755	0.560	0.080	0.695
			(0.720)	(0.440)	(0.761)	(0.512)
SMCTY × Ln(GDPpc)			−1.448	−1.121**	−0.695	−1.190**
			(0.882)	(0.453)	(0.912)	(0.528)
SMCTY × Institutions					**−0.360** **	**0.007**
					(0.171)	(0.147)
SMCTY × EU (imp.)					**−1.110*** **	**−0.592*** **
					(0.235)	(0.214)
SMCTY × WTOGPA (imp.)					0.472***	0.414***
					(0.167)	(0.114)
Obs	23,064	23,064	23,064	23,064	19,220	19,220

Note: Each column corresponds to a separate regression. All regressions include importer–year, exporter–year and directional country-pair fixed effects. Data are for the years 1995, 1999, 2003, 2007, 2011 and 2015. Coefficients in bold are statistically different (at the 10 percent level) between the 'Gov.' and 'Priv.' regressions. To perform the statistical comparison, we estimate regressions where the 'Gov.' and 'Priv.' observations are stacked and all covariates and fixed effects are interacted with a dummy for government flows. Standard errors are three-way clustered by importer, exporter and symmetric country-pair. Significant at: *10%, **5%, ***1% level.

Table 4
PPML gravity estimates: unilateral depth in trade agreements. Services.

Dep. var: X_{ij}	(1) Gov.	(2) Priv.	(3) Gov.	(4) Priv.	(5) Gov.	(6) Priv.
PTANOPROC	**0.026**	**−0.215***	−0.363***	−0.301***	−0.317**	−0.261***
	(0.113)	(0.121)	(0.140)	(0.110)	(0.134)	(0.099)
PTAPROC	−0.005	0.025	−0.085	−0.008	−0.108	−0.023
	(0.085)	(0.058)	(0.074)	(0.058)	(0.066)	(0.052)
WTOGPA	**−0.258** **	**0.029**	**−0.087**	**0.046**	0.361***	0.266***
	(0.106)	(0.067)	(0.081)	(0.061)	(0.123)	(0.084)
EU	0.428***	0.331***	0.485***	0.434***	0.127	0.078
	(0.157)	(0.114)	(0.137)	(0.103)	(0.129)	(0.120)
SMCTY × Unilateral Proc. Depth	**−1.424*** **	**−0.032**	**−0.284** **	**0.222** **	**−0.298*** **	**0.141**
	(0.303)	(0.145)	(0.119)	(0.110)	(0.105)	(0.113)
SMCTY × Ln(GDP)			−1.365**	−1.105**	−1.636**	−1.198**
			(0.619)	(0.477)	(0.675)	(0.493)
SMCTY × Ln(GDPpc)			0.764	1.087**	1.076	1.230**
			(0.637)	(0.507)	(0.693)	(0.532)
SMCTY × Institutions					0.061	−0.165
					(0.216)	(0.175)
SMCTY × EU (imp.)					−0.985***	−0.932***
					(0.228)	(0.218)
SMCTY × WTOGPA (imp.)					**1.142*** **	**0.780*** **
					(0.187)	(0.136)
Obs	23,064	23,064	23,064	23,064	19,220	19,220

Note: Each column corresponds to a separate regression. All regressions include importer–year, exporter–year and directional country-pair fixed effects. Data are for the years 1995, 1999, 2003, 2007, 2011 and 2015. Coefficients in bold are statistically different (at the 10 percent level) between the 'Gov.' and 'Priv.' regressions. To perform the statistical comparison, we estimate regressions where the 'Gov.' and 'Priv.' observations are stacked and all covariates and fixed effects are interacted with a dummy for government flows. Standard errors are three-way clustered by importer, exporter and symmetric country-pair. Significant at: *10%, **5%, ***1% level.

An important result from Tables 3 and 4 is that the bilateral trade policy effects become much lower and lose significance as we control for the unilateral components of trade agreements. One explanation for this intriguing result is that part of the bilateral component of the trade agreement variables is actually unilateral, and hence not identified. Another way to read the finding is that most of the trade effect documented in the baseline specifications is actually non-discriminatory. Importantly, this is the case also for the EU dummy, which was the trade policy variable with the strongest effect in Tables 1 and 2. The negative coefficient on the

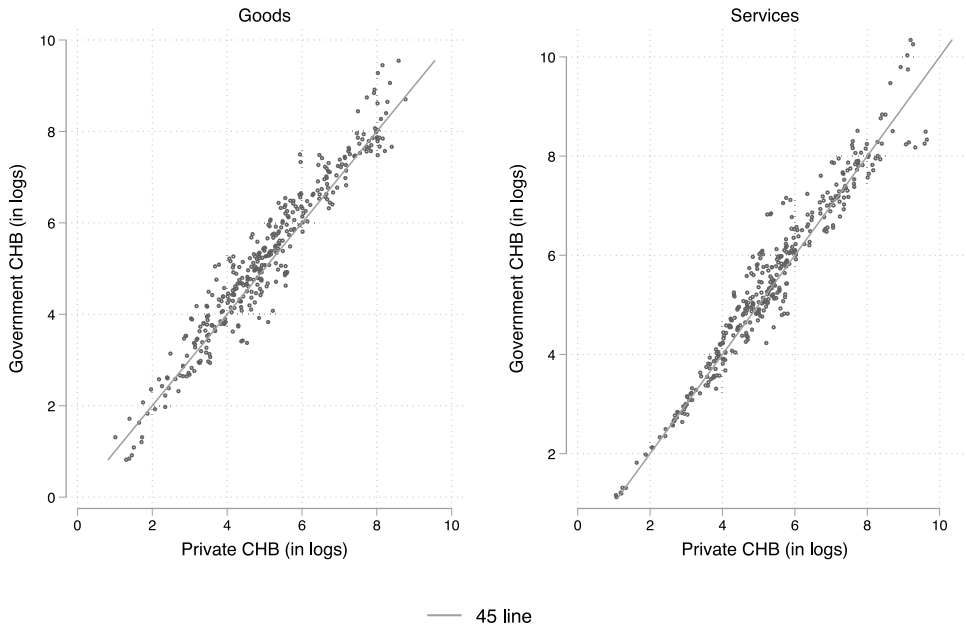

Fig. 4. CHB indexes by sector. Note: Estimated CHB indexes (see Eq. (9)) for Goods and Services are constructed using estimates from columns (9) and (10) of Tables 1 and 2. Each dot in the plots represents a country–year observation in the sample (e.g., ARG in 1995).

interaction between the same-country dummy and the EU indicator suggests that a substantial part of this effect comes from trade with both EU and non-EU countries.

In sum, the results from these extensions of our baseline gravity model indicate that less common provisions have the largest positive effects on cross-border procurement, at least in services. Most of these provisions are unilateral, and hence benefit also suppliers from non-member countries (besides those from member countries), at the expenses of local ones.

6.2. Constructed home bias

As the estimates of the border effect in Tables 1 and 2 suggest, government procurement is mostly local in spite of the liberalizing effects of trade agreements, especially in services. The border effect however provides only a partial measure of home bias since it does not take into account the effects of (changes in) trade barriers in other countries — in a gravity model, these influences play out through the multilateral resistance terms (see Eq. (2)). To overcome this drawback, we estimate the Constructed Home Bias (CHB) index proposed by Anderson and Yotov (2010b) for government procurement and for private markets. The CHB measures how much trade frictions around the world interact in shifting up domestic trade relative to what would be observed in a counterfactual world without trade barriers, holding constant overall sales and expenditure. As such, it aims to capture the general equilibrium interactions of trade barriers (conditional on aggregate sales and expenditure) and hence goes beyond the 'partial equilibrium' view of local bias from the perspective of a single country. The index encompasses all types of trade frictions (both 'man-made' trade policies and structural barriers) and hence it cannot be interpreted as a measure of protectionism.

Estimated CHB indexes in public and private markets are constructed as in Eq. (9) separately for goods and services. The fixed-effects specification of the trade cost function in Eq. (8) (whose estimates are reported in columns (9) and (10) of Tables 1 and 2) is used in the estimation as it controls for all time-invariant factors that can affect bilateral trade.[40]

We first address the question of whether home bias in government procurement is higher than in private markets. Perhaps not surprisingly, the answer is a strong (but not resounding) "Yes". Fig. 4 shows scatter plots of the estimated CHB index in government procurement against the same index for private markets, for goods and services. We take logs of both variables in order to smooth out the visual effect of some extreme outlier. Governments are generally more home biased than firms in their purchasing strategies as most of the observations lie above the 45 degree lines. Government home bias is higher than the private one for 67 percent of the country–year observations in goods, and a similar 62 percent in services.

To better appreciate differences across public and private markets as well as heterogeneity across countries, Table A.14 in the Appendix reports the values of the estimated CHB indexes for goods. Home bias in government procurement is on average 35 percent higher than home bias in private markets throughout the period. Looking at differences across countries, we confirm what Anderson

[40] Note that under that specification $t^{k,s}_{ii,t} = t^{k,s}_{jj,t} \forall i, j$, i.e. the border effect is equal across countries. Estimated trade costs worldwide affect the CHB via the multilateral resistance terms.

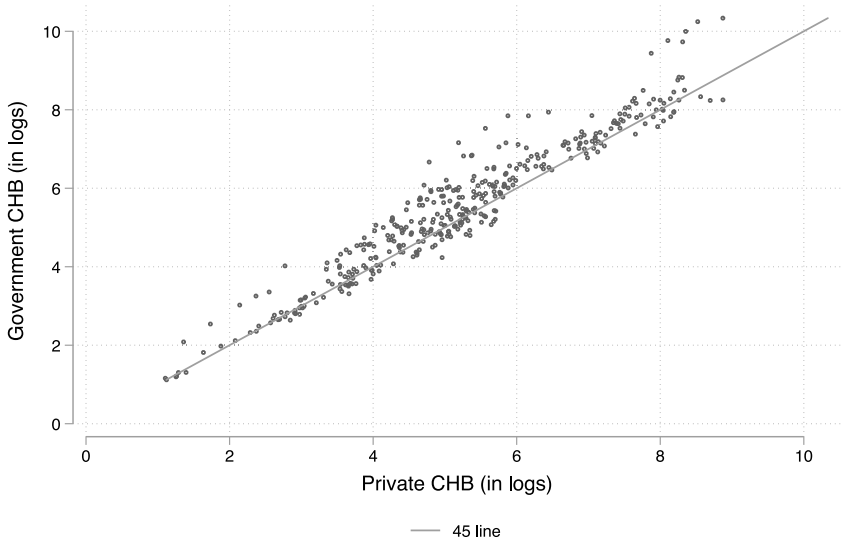

Fig. 5. CHB indexes at the country level. Note: Country-level CHB indexes equal the weighted sum of goods and services CHBs; where the weights equal the expenditures-sales product shares. Estimated CHB indexes (see Eq. (9)) for Goods and Services are constructed using estimates from columns (9) and (10) of Tables 1 and 2. Each dot in the plots represents a country–year observation in the sample (e.g., ARG in 1995).

and Yotov (2010a) find for total trade: CHB is massive for small countries like Cambodia, Cyprus, and Brunei. This is because these countries naturally trade a lot with other countries and thus a high share of their income goes through bilateral trade barriers around the world, driving up the multilateral resistance terms. At the other end of the spectrum, CHBs are the lowest for large countries such as the US, Japan and China. While governments are more home biased than firms in their purchases of goods, their CHBs have declined more strongly. Only 22 out of 62 countries in our sample experienced an increase in government home bias, whereas CHBs in private markets went up for 32 countries. On average, home bias in government procurement of goods is 10 percent lower in 2015 relative to 1995. In private markets, the average home bias went up on average by 17 percent.

Table A.15 in the Appendix reports estimated CHBs for services. As for goods, government procurement in services is more home biased than services purchases by private firms – on average, government CHBs are 18 percent higher than private CHBs. Between 1995 and 2015, home bias in government procurement of services went up in only 19 countries out of 62 in our sample – a share similar to that for private markets. The average CHB in government procurement is 11 percent lower in 2015 relative to 1995, a decrease that follows the one observed in goods. Unlike for goods, home bias in services went down on average also for private markets.[41]

The estimated CHB indexes are then aggregated at the country level as weighted sum of the sector CHBs, where the weights are equal to sector's expenditure-sales product shares (see Anderson et al. (2014)).[42] Fig. 5 plots the country-level government CHBs against the private ones. At the country level, government procurement markets are more home biased than at the sector level. Government home bias is 70 percent higher than private home bias on average (government CHB is higher than private CHB in 71 percent of the country–year observations). The larger difference between government procurement and private markets at the country than at the sector level is due to a composition effect. Government procurement is disproportionately more about services than goods (see also Fig. 2), and services are more home biased than goods (48 percent more for governments and 70 percent more for firms).

Table A.16 in the Appendix reports the country-level CHB indexes for government procurement and private firms. The last two columns give the percent change in the CHB for each country in the sample. At the aggregate level like at the sector level, we confirm

[41] In results available upon request, we find similar difference between CHB in public and private for services when we exclude tax havens (see footnote 36).

[42] This aggregation follows from the gravity model in Eq. (2). To see this, note that the aggregate CHB for market s in country i is defined as (time subscript omitted for brevity):

$$CHB_i^s \equiv \frac{\sum_k X_{ii}^{k,s}}{\sum_k \frac{E_i^{k,s} Y_i^{k,s}}{Y^{s}}} = \frac{\sum_k \frac{E_i^{k,s} Y_i^{k,s}}{Y^{k,s}} \left(\frac{t_{ii}^{k,s}}{\Pi_i^{k,s} P_i^{k,s}} \right)^{1-\sigma^k}}{\sum_k \frac{E_i^{k,s} Y_i^{k,s}}{Y^{k,s}}}$$

After using the definition of the sector CHB from Eq. (5) and simplifying, we obtain the expression for aggregate CHB as weighted sum of sector-specific CHBs:

$$CHB_i^s = \sum_k CHB_i^{k,s} \frac{Y_i^{k,s} E_i^{k,s}}{\sum_k Y_i^{k,s} E_i^{k,s}}$$

where the weights are: $\frac{Y_i^{k,s} E_i^{k,s}}{\sum_k Y_i^{k,s} E_i^{k,s}}$.

the strong negative relationship between home bias and country size. We also find that home bias in government procurement has gone down over time — the average change equals a 11 percent decrease (remarkably similar to the changes observed in the goods and in the services sectors), and more so than in private markets. Large variation however emerges across countries. The largest percent increases in government home bias are observed among developed economies — e.g., Japan, Germany and France. These countries have however also low levels of CHBs. Developing countries such as China, Vietnam and India report the largest drops in government home bias.[43] Interestingly given the large trade effect of the EU single market (see Tables 1 and 2), most old EU member states experience an increase in home bias in government procurement during the sample period, whereas home bias went down in countries that entered the EU during the period (Croatia being the exception).[44]

These findings are confirmed when we construct the CHBs indexes with estimates from the more detailed industry-specific gravity regressions — i.e., by re-interpreting the superscript k in Eq. (9) as indicating one of the goods and services industries listed in Table A.2. We estimate our baseline specification (with directional country-pair fixed effects) by industry — the trade cost vector is therefore industry-specific (see, e.g., Anderson and Yotov (2010b); and Anderson et al. (2014)). The industry CHBs are then aggregated at the sector (goods and services) level and at the country level by using their expenditures-sales product share as weights. The aggregated CHBs correlate strongly with the baseline ones: the pairwise correlation coefficient is always greater than 0.88. Crucially, the main findings are confirmed, thus indicating that the results are robust to heterogeneous trade costs within goods and services. As Fig. A.12 in Appendix visually suggests, governments are more home-biased than firms in both goods and services, with the difference being magnified at the country level, where the average CHBs for governments is 132 percent higher than the average one for firms.[45] Over time, the average change in the government CHBs equals a 10 percent decrease.[46]

Overall, the analysis using the CHB indexes reveals that, while government procurement is significantly more home biased than private purchases, it has gone down faster. Important heterogeneity however emerges across countries. While the gravity results suggest that PTAs have partly raised cross-border government procurement, the CHB values remind us that government procurement remains vastly home biased, even if the trends show a slow opening up to trade.

7. Concluding remarks

This paper estimates trade barriers in government procurement. In doing so, it analyses the role of trade agreements to see if and how much they have contributed to reduce those barriers.

Using Inter-Country Input–Output (ICIO) tables from the TiVA database for 62 countries between 1995 and 2015, we obtain estimates of government purchases across sectors and countries of origin and use those in a standard gravity model. The estimates suggest that governments are significantly more local in their purchasing decisions than private firms. The border effect is large and significantly higher for public markets, especially in services. Yet, we find that preferential trade agreements and the EU single market in particular have contributed to the opening up of government procurement, with the effect being larger and more robust in services than in goods. Non-discriminatory provisions specific to government procurement are driving the trade-creating effect of PTAs in services, whereas the effects are overall weak in goods.

The estimates from the gravity model are then used to estimate indexes of home bias in government procurement and private markets. These measures capture the overall tendency to trade locally rather than internationally, and hence include also factors other than protectionist trade policies. Home bias is larger in government procurement than in private markets. Two mechanisms can account for this difference: (i) governments being on average more home biased than firms in purchases of both services and goods; and (ii) governments spending relatively more on services, which are more home biased than goods. We find that this difference is however shrinking over time: home bias in government procurement is declining faster than home bias in private markets.

Our results have implications for trade negotiations. A strong result of our analysis is that national borders are relatively thicker in services, which absorb the lion share of public spending. Furthermore, we find that policy initiatives targeted at government procurement have been able to increase cross-border procurement of services. These findings highlight a potential complementarity between trade negotiations on services and government procurement. Since government procurement is mainly about services, liberalization of trade in services is a necessary condition to open up procurement markets. At the same time, liberalization of procurement markets can be an important driving force for greater trade in services.

[43] These patterns are consistent with convergence in CHBs — e.g., home bias decreases faster in countries with higher initial levels. We find strong evidence for both unconditional and conditional (on the country-level covariates used in Table A.17) convergence in regressions of changes in country-level CHBs on their initial values. The estimated elasticity is negative and significant — it equals −0.12 (standard error = 0.03) in the unconditional case and −0.4 (standard error = 0.15) in the conditional one. As in Levchenko and Zhang (2016), we can compute the implied speed of convergence. The conditional (unconditional) elasticities imply that 12.6 (3.2) percent of the initial difference between CHBs across countries is expected to disappear every five years.

[44] We explore the determinants of country-level CHBs by regressing them on country characteristics. For consistency with the analysis in Tables 3 and 4, we use the same set of variables that interact with the border effect, with a focus on the PTA unilateral depth variable in government procurement. The results, reported in Table A.17 in the Appendix, suggest that the home bias is lower in countries that participate in PTAs with more unilateral provisions on procurement. The negative correlation is stronger for government procurement than for private markets, but becomes weaker when we control for country fixed effects, which absorbs also the time-invariant influence of country size.

[45] The difference between public and private CHBs at the country level is larger than in the baseline because the difference in CHBs between services and goods is also bigger — services are on average 71 percent more home biased than goods in government procurement, and 101 percent more so in private markets.

[46] In results available upon request, we find even stronger evidence of convergence using industry-level CHBs – which allows us to control also for industry and country fixed effects – than the baseline country-level CHBs.

Appendix

A.1. Identifying clusters of provisions on government procurement in PTAs

To detect the presence of clusters of provisions on government procurement in our sample of PTAs, we perform a Hierarchical Agglomerative Clustering (HAC) analysis. The objective is to find clusters of provisions such that those within each cluster are more similar than those assigned to different clusters. In our setting, HAC is particularly suitable to this purpose since it amounts to progressively joining (group of) provisions that are most similar between each other (see Hastie et al. (2009) for details).[47] As we move up in the hierarchy, the clusters are larger and its elements are less similar between themselves.

We want to cluster provisions based on their co-occurrence in PTAs. We thus construct a matrix with the 35 provisions (see Table A.4) in the rows and 86 dummy variables, one for each PTA, in the columns. The first step of the HAC consists in choosing an appropriate measure of similarity. The Jaccard index is particularly relevant to clustering using dichotomous variables. For each pair of provisions, it equals the number of agreements where the two provisions occur over the total number of agreements with at least one of them. Fig. A.10 displays the bilateral values in an heatmap, with darker colours denoting higher values. Another ingredient of HAC is the linkage method, which measures similarity between groups of provisions. We opt for the "complete linkage" method as it maximizes dissimilarity between different groups.[48]

With a similarity measure and a linkage method, the HAC algorithm results in a dendrogram, which can be used to visually identify clustering patterns. Fig. A.1 shows the dendrogram that we obtain on the PTA provisions. Higher bars indicate lower similarity and hence clusters that include less similar provisions. Two large clusters seem to emerge at relatively high similarity (we number them 1 and 2), which is marked by the horizontal line in Fig. A.1.[49] At this "cut" of the dendrogram, there are a number of single- or two-provisions clusters, which we treat as a residual category (referred to as group 3) and are hence included in the same circle to the right of the graph. To assess the validity of this cluster configuration – which counts 16 clusters in total –, we use three standard methods in the literature (Hastie et al., 2009; Makles, 2012). They are all based on finding the cluster configuration that reduces the most intra-cluster variation (and hence maximizes the part of the variance explained by the clusters).[50] In the "Elbow method", intra-cluster variation (measured as sum of squared deviations, WSS) is plotted against the possible cluster configurations. In panel (a) of Fig. A.2, we detect a kink with 16 clusters, suggesting that adding further clusters does not explain much of the variance. Another useful statistic is the proportional reduction of error (PRE) coefficient, which equals the decrease in WSS with k clusters relative to the $k-1$ clusters: $PRE_k = \frac{WSS(k-1)-WSS(k)}{WSS(k-1)}$. Panel (b) of Fig. A.2 shows that the largest decrease is indeed found with 16 clusters. A third method is based on the η^2 coefficient, which compares intra-cluster variation with k clusters with that of single cluster (or no cluster at all — i.e., $\eta^2 = 1 - \frac{WSS(k)}{WSS1}$). As for the Elbow method, we look for the number of clusters beyond which the marginal increase in η^2 is minimal. The kink in panel (c) of Fig. A.2 seems to occur with 15 clusters. By looking at the dendrogram, it is indeed visible that the two large clusters, 1 and 2, join just above the chosen threshold level of similarity. In other words, the two clusters are quite similar.

We list the three groups of provisions (cluster 1, 2 and the residual group 3) in the third column of Table A.4. One pattern clearly stands out: the rarest provisions belong to the residual group 3. The average provision in clusters 1 or 2 is present in around 60 percent of PTAs, whereas the average provision in the residual group appears in 40 percent of the agreements.

Another characteristic of group 3 is that it includes most of the provisions that have the largest trade creating effect in Figs. A.8 and A.9. To attenuate the influence that the co-occurrence of provisions can have on those results, we re-estimate our baseline gravity equation for government procurement, but now replace the $PTAPROC$ indicator (see Eq. (8)) with variables measuring membership in PTAs that contain provisions in the three clusters that we have identified. Table A.1 displays the estimates for goods (columns 1 to 3) and services (columns 4 to 6). We employ three measurements: (i) dummies equal to one for membership in a PTA that includes at least a provision in the group (columns 1 and 4); (ii) the count of provisions of a group included in a PTA (columns 2 and 5); and (iii) the fraction of provisions in a group that are included in a PTA (columns 3 and 6). In all the specifications, being in a PTA with provisions in the residual group 3 has a positive and significant effect on cross-border procurement, with the impact being more important for services. Having provisions in the two clusters 1 and 2 has a weak and sometimes even negative effect on cross-border procurement. The high collinearity (see the evidence from Figs. A.1 and A.2, panel (c)) between the indicators for groups 1 and 2 might prevent us from identifying a distinctive effect of each group of provisions.

[47] In particular, HAC is preferred to a K-means method because the latter requires pre-specifying a target number of clusters.

[48] As James et al. (2013) note, complete linkage is preferred over single linkage as it produces more balanced dendrograms.

[49] Choosing the cluster configuration amounts to "cutting" the dendrogram at a certain height: provisions that "fuse" below the line belong to the same cluster.

[50] Note that since the intra-cluster variation decreases with the number of clusters, these methods do not seek to minimize intra-cluster variation.

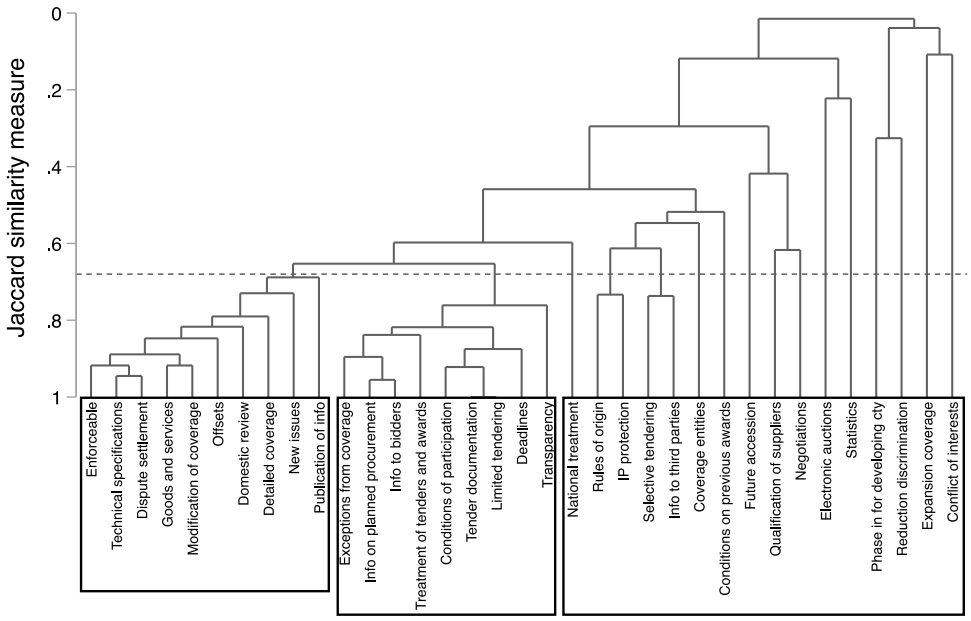

Fig. A.1. HAC dendrogram — Complete linkage, Jaccard similarity. Note: Dendrogram obtained from a HAC analysis of the 35 provisions included in the 86 PTAs of the dataset. The horizontal line is at a Jaccard index of 0.68.

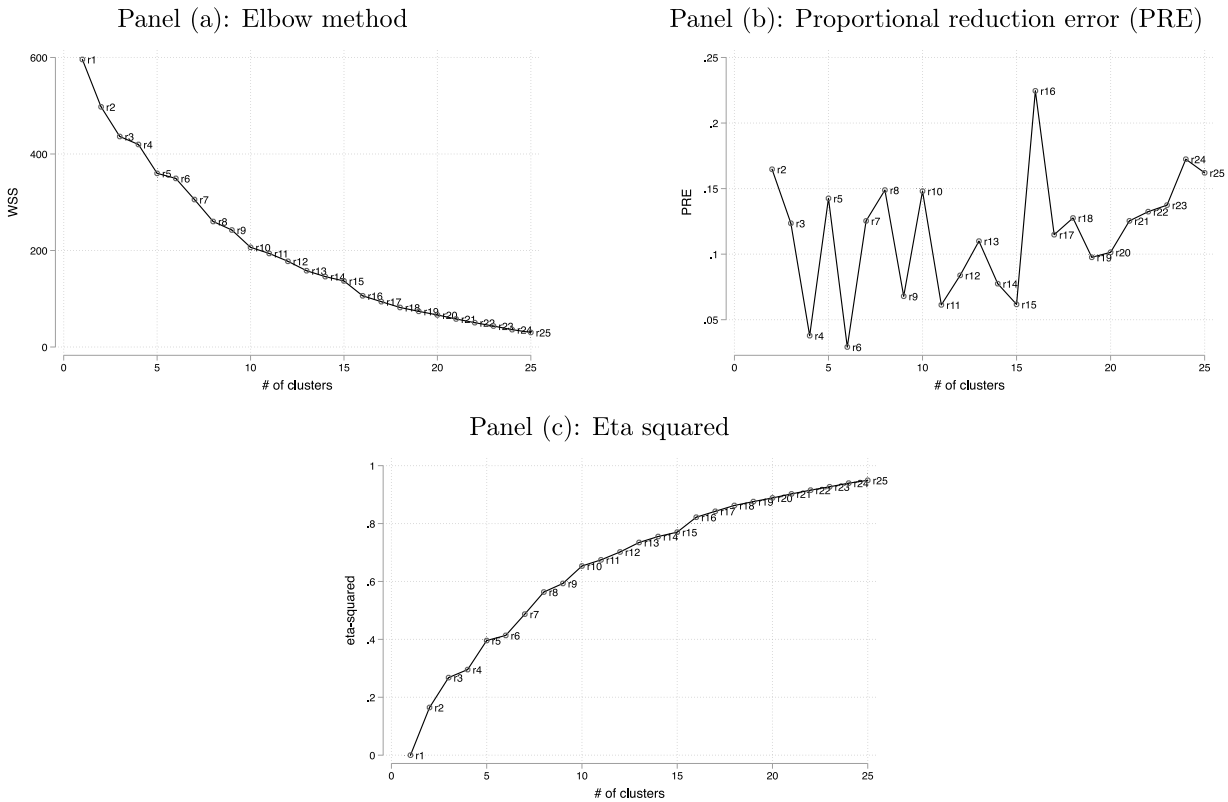

Fig. A.2. Validating the number of clusters. Note: WSS in Panel (a) is the sum of squared deviations within clusters. HAC analysis based on the Jaccard similarity index and complete linkage.

Table A.1
PPML gravity estimates; Government procurement: Clusters of provisions.

Dep. var: X_{ij}	(1)	(2)	(3)	(4)	(5)	(6)
	Goods			Services		
	Dummy	Count	Share	Dummy	Count	Share
PTANOPROC	0.380*	0.378	0.378	0.314***	0.310***	0.310***
	(0.212)	(0.255)	(0.255)	(0.116)	(0.115)	(0.115)
PTAPROC: group 1	0.159	0.004	0.045	−0.481***	−0.075**	−0.746**
	(0.106)	(0.033)	(0.326)	(0.156)	(0.032)	(0.318)
PTAPROC: group 2	−0.172***	−0.080***	−0.719***	0.186**	0.006	0.050
	(0.056)	(0.019)	(0.173)	(0.093)	(0.031)	(0.282)
PTAPROC: group 3	0.149	0.077***	1.233***	0.572***	0.095***	1.515***
	(0.126)	(0.021)	(0.335)	(0.136)	(0.036)	(0.570)
WTOGPA	−0.166**	−0.156*	−0.156*	0.309***	0.321***	0.321***
	(0.073)	(0.082)	(0.082)	(0.082)	(0.088)	(0.088)
EU	0.493***	0.482***	0.482***	0.663***	0.650***	0.650***
	(0.117)	(0.120)	(0.120)	(0.138)	(0.141)	(0.141)
Obs	23,064	23,064	23,064	23,064	23,064	23,064

Note: Data for government procurement flows. Each column corresponds to a separate regression. All regressions include importer–year, directional country-pair, and exporter–year fixed effects. In columns (1) and (4), *PTAPROC: group n* is a dummy variable equal to 1 if the two countries in the pair are members of a PTA with provisions classified in group $n = (1, 2, 3)$ (see the third column of Table A.4). In columns (2) and (5), *PTAPROC: group n* counts the number of procurement provisions in group $n = (1, 2, 3)$ that are covered in a PTA in force between the two countries in the pair. In columns (3) and (6), *PTAPROC: group n* is the share of procurement provisions in group $n = (1, 2, 3)$ that are covered in a PTA in force between the two countries in the pair. Data are for the years 1995, 1999, 2003, 2007, 2011 and 2015. Standard errors are three-way clustered by importer, exporter and symmetric country-pair. Significant at: *10%, **5%, ***1% level.

A.2. Additional tables and figures

See Tables A.2–A.17 and Figs. A.3–A.12.

Table A.2
List of industries.

Aggregate sector	Industry	ISIC Rev 3 (1995–2004)	ISIC Rev 4 (2005–2015)
Goods	Agriculture, Forestry and Fishing	01, 02, 03, 04, 05	01, 02, 03
	Mining	10, 11, 12 , 13, 14	05, 06, 07, 08, 09
	Food and Beverages	15, 16	10, 11, 12
	Textile and Apparel	17, 18, 19	13, 14, 15
	Wood, paper products and printing	20, 21, 22	16, 17, 18
	Chemical products	23, 24, 25, 26	19, 20, 21, 22, 23
	Metals and metal products	27, 28	24, 25
	Machinery and equipment	29, 30, 31, 32, 33	26, 27, 28
	Transport equipment	34, 35	29, 30
	Other manufacturing	36, 37	31, 32, 33
Services	Retail and hotel services	50, 51, 52, 55	45, 46, 47, 55, 56
	Transport and telecommunication services	60, 61, 62, 63, 64	49, 50, 51, 52, 53, 58, 59, 60, 61
	Finance and insurance	65, 66, 67	64, 65, 66
	Real estate	70, 71	68
	Public administration, health and education	75, 80, 85, 86, 87, 88	84, 85, 86, 87, 88, 90, 91, 92, 93, 94, 95, 96
	Other services	72, 73, 74	62, 63, 69, 70, 71, 72, 73, 74, 75, 77, 78, 79, 80, 81, 82

Note: The "Industry" column reports the industry aggregation that is used in the regressions with industry-level trade flows (see Tables A.12 and A.13). The third and fourth columns reported the corresponding two-digit chapters of the ISIC Rev. 3 and ISIC Rev. 4 industrial classifications.

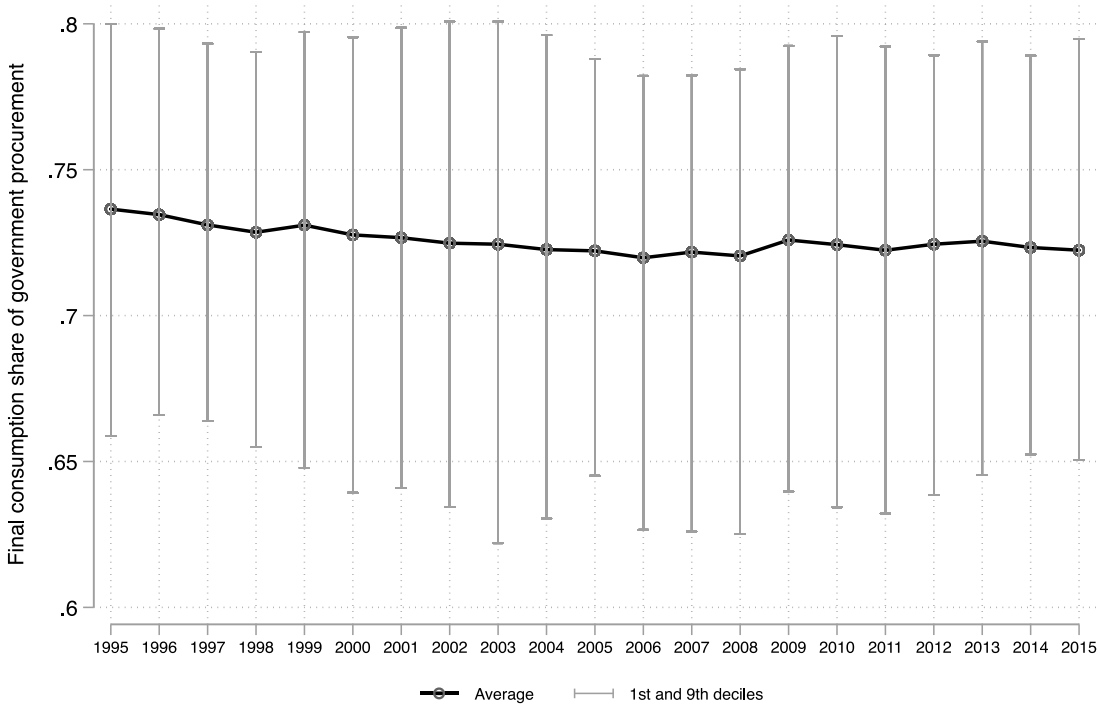

Fig. A.3. Final expenditure share of government procurement. Note: Part of government procurement absorbed by social transfers in kind as measured by the "General Government Expenditure" column of the ICIO TiVA tables. The remaining part represents intermediate consumption as in the "typical" definition (see the main text for details). Purchases from and sales to ROW are included in the computations.

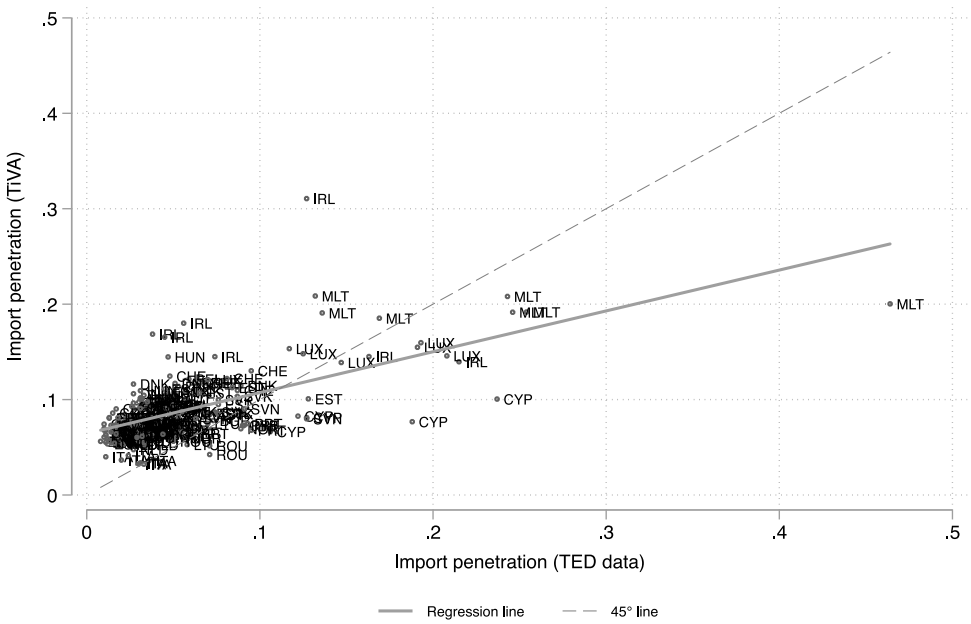

Fig. A.4. Import penetration in government procurement with TiVA and with the TED data (country–year panel). Note: Import penetration equals the import share in the total value of government procurement. In the vertical axis, raw data are source from the TiVA database. Public procurement flows are computed using the "typical" definition (see the main text for details). The values on the horizontal axis are taken from the European Commission (2017, Table 16). The sample includes EEA members (30 countries) between 2009 and 2015.

Table A.3
Final expenditure share of government procurement, by country (in %).

Cty	1995	1999	2003	2007	2011	2015	Avg.
ARG	77.5	77.6	71.3	77.0	81.0	83.2	77.8
AUS	74.0	74.5	73.6	72.8	70.9	65.1	72.1
AUT	78.9	76.5	76.5	77.3	76.6	76.0	76.8
BEL	79.8	79.2	78.3	75.9	74.5	74.6	76.8
BGR	73.4	71.9	72.0	71.4	74.9	75.4	72.1
BRA	67.8	68.9	68.7	73.1	73.8	73.4	71.2
BRN	73.2	74.6	76.0	80.9	79.6	83.6	77.5
CAN	68.0	65.3	65.4	67.8	67.6	70.0	67.0
CHE	64.0	62.9	63.3	60.8	59.7	57.9	61.4
CHL	76.3	75.9	72.0	69.6	69.7	69.8	72.3
CHN	68.5	64.8	65.4	70.6	70.4	70.2	69.4
COL	76.2	72.9	64.8	68.9	69.2	68.6	69.4
CRI	76.0	76.0	76.1	77.2	78.5	77.6	76.9
CYP	80.2	74.8	74.2	76.0	78.6	81.1	77.8
CZE	75.9	77.9	77.5	75.3	75.1	77.2	76.6
DEU	78.6	77.5	77.2	75.0	73.1	73.6	75.8
DNK	80.4	80.3	79.8	76.8	77.1	76.0	78.3
ESP	78.5	78.9	78.3	77.0	77.3	76.6	77.8
EST	73.1	72.6	72.0	73.6	74.7	76.5	73.6
FIN	76.3	76.0	75.0	71.1	69.1	69.9	72.7
FRA	79.6	80.2	80.1	81.0	80.2	79.8	80.1
GBR	68.4	66.5	65.8	69.6	68.7	67.4	67.8
GRC	75.7	78.6	73.8	77.4	82.9	81.1	77.7
HKG	77.5	72.5	75.6	60.6	62.8	66.1	69.3
HRV	77.5	79.0	77.7	75.4	74.0	72.5	75.4
HUN	79.1	78.9	81.0	79.2	78.1	77.8	78.8
IDN	69.5	57.7	62.2	75.2	79.6	79.5	70.2
IND	82.1	81.6	85.0	74.3	76.7	72.4	78.3
IRL	65.9	68.3	67.9	72.3	71.9	73.7	70.5
ISL	67.1	66.4	64.0	65.6	66.8	66.1	65.8
ISR	69.2	67.9	67.0	71.5	69.0	71.4	69.9
ITA	79.7	79.7	79.1	77.7	76.4	76.4	78.2
JPN	72.5	73.3	70.4	73.7	72.7	72.1	72.5
KHM	76.9	73.6	61.2	80.8	81.4	78.1	74.8
KOR	72.3	72.1	69.6	65.3	64.6	65.3	68.0
LTU	73.5	78.4	77.1	77.9	78.3	76.6	76.8
LUX	80.0	80.7	78.7	80.6	79.2	79.3	79.5
LVA	71.7	74.2	70.3	78.1	74.3	74.6	74.3
MAR	65.7	79.4	82.8	73.8	74.1	75.3	75.2
MEX	78.2	78.8	80.6	78.2	78.2	77.6	78.6
MLT	80.9	78.9	78.3	76.1	75.6	73.0	77.2
MYS	70.4	69.4	62.1	67.3	70.3	69.7	68.1
NLD	77.1	76.3	75.4	73.3	73.6	73.4	74.5
NOR	77.5	78.3	77.3	77.0	77.4	77.1	77.5
NZL	72.6	69.2	69.2	71.7	70.9	70.9	71.0
PER	65.6	63.2	61.9	67.1	64.1	68.0	64.4
PHL	64.4	64.0	61.2	70.2	72.3	72.8	67.7
POL	80.4	81.8	81.9	78.0	77.1	76.3	79.0
PRT	74.9	75.1	75.7	75.5	72.3	73.8	74.6
ROU	76.0	75.0	76.9	75.7	75.7	74.7	75.7
RUS	70.8	67.0	67.9	72.5	73.9	69.3	70.9
SAU	72.7	73.6	75.1	83.5	74.9	83.0	77.6
SGP	53.4	53.5	55.8	50.4	54.7	54.5	53.4
SVK	75.3	75.0	77.9	77.9	76.4	76.5	76.4
SVN	73.4	74.3	75.8	75.0	75.5	74.7	74.8
SWE	74.2	75.0	75.8	75.2	74.1	74.9	74.9
TUN	84.7	81.1	85.5	54.9	58.1	60.4	68.9
TUR	71.0	69.4	70.0	45.6	48.1	48.0	58.9
TWN	68.7	68.1	69.1	68.6	68.5	68.5	68.5
USA	59.5	57.7	57.2	56.3	55.7	54.5	56.8
VNM	70.5	68.7	67.9	62.6	63.2	58.9	65.8
ZAF	73.5	71.0	66.6	64.5	65.2	66.6	68.1
Mean	73.7	73.1	72.4	72.2	72.2	72.2	72.6
Median	74.1	74.5	74.0	74.1	74.0	73.7	74.4

Note: Part of government procurement absorbed by social transfers in kind as measured by the "General Government Expenditure" column of the ICIO TiVA tables. The remaining part represents intermediate consumption as in the "typical" definition (see the main text for details). Purchases from and sales to ROW are included in the computations.

Table A.4
Provisions on government procurement included in PTAs.

Provision	Category	HAC group	# PTAs	Share of PTAs
Phase in for developing cty	Non-discrimination	3	71	0.83
Detailed coverage	Overview	1	57	0.66
Technical specifications	Procedural disciplines	1	54	0.63
National treatment	Non-discrimination	3	54	0.63
Info on planned procurement	Transparency	2	54	0.63
Goods and services	Coverage	1	53	0.62
Dispute settlement	Dispute resolution	1	53	0.62
Info to bidders	Transparency	2	52	0.60
Exceptions from coverage	Coverage	2	52	0.60
Enforceable	Overview	1	52	0.60
Modification of coverage	Coverage	1	51	0.59
Conditions of participation	Procedural disciplines	2	51	0.59
Publication of info	Transparency	1	49	0.57
Limited tendering	Procedural disciplines	2	49	0.57
Tender documentation	Procedural disciplines	2	49	0.57
Offsets	Non-discrimination	1	49	0.57
Treatment of tenders and awards	Procedural disciplines	2	49	0.57
Domestic review	Dispute resolution	1	47	0.55
New issues	New issues	1	47	0.55
Deadlines	Procedural disciplines	2	46	0.53
Rules of origin	Non-discrimination	3	45	0.52
Transparency	Procedural disciplines	2	44	0.51
IP protection	Procedural disciplines	3	42	0.49
Info to third parties	Transparency	3	40	0.47
Selective tendering	Procedural disciplines	3	40	0.47
Coverage entities	Coverage	3	39	0.45
Qualification of suppliers	Procedural disciplines	3	38	0.44
Future accession	Non-discrimination	3	33	0.38
Conditions on previous awards	Procedural disciplines	3	31	0.36
Negotiations	Procedural disciplines	3	26	0.30
Reduction discrimination	Non-discrimination	3	25	0.29
Conflict of interests	Procedural disciplines	3	23	0.27
Statistics	Transparency	3	15	0.17
Electronic auctions	Procedural disciplines	3	14	0.16
Expansion coverage	Non-discrimination	3	11	0.13

Note: List of provisions on government procurement included in at least one of the PTAs. This list is obtained after cleaning the original list in the DTA database (see footnote 28). The total number of PTAs considered in the table (86) excludes those signed by countries in the "rest-of-world" (ROW) aggregate of TiVA ICIO tables (because this aggregate is not the estimation sample) as well as EU internal agreements (see footnote 21). The categories in the second column are taken from the DTA database. The three "HAC groups" in the third column are based on the results of the cluster analysis described in Appendix A.1 of the Appendix.

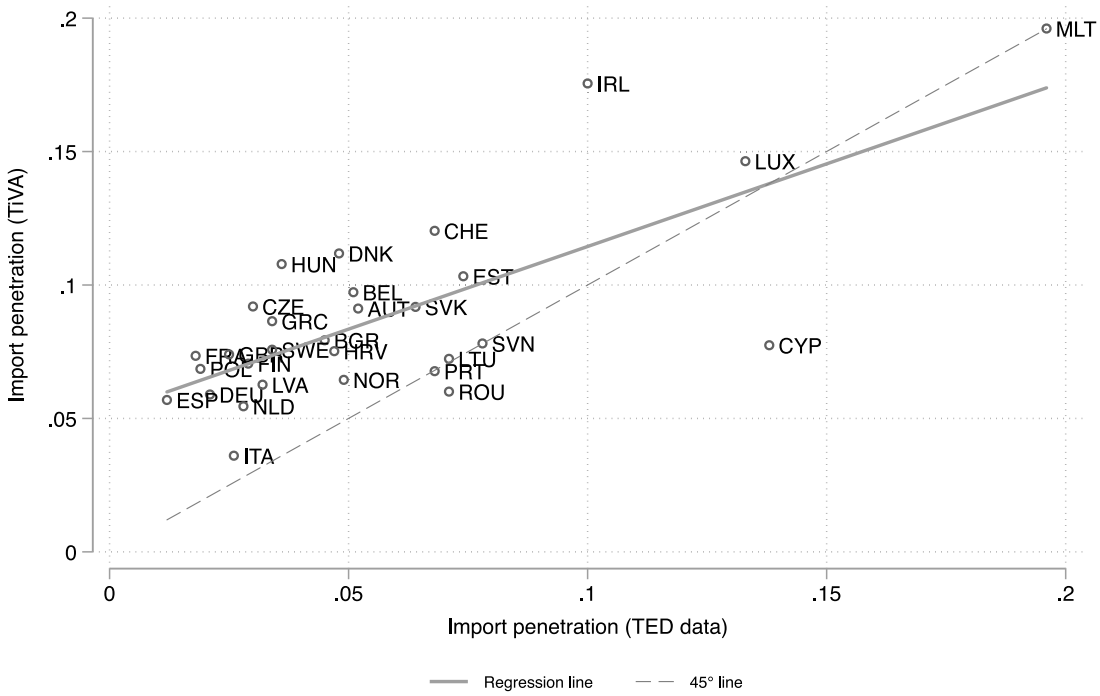

Fig. A.5. Import penetration in government procurement with TiVA and with the TED data (2009–2015 totals). Note: Import penetration equals the import share in the total value of government procurement. Values are summed by country in the 2009–2015 period. In the vertical axis, raw data are source from the TiVA database. Public procurement flows are computed using the "typical" definition (see the main text for details). The values on the horizontal axis are taken from the European Commission (2017, Table 14). The sample includes EEA members (30 countries) between 2009 and 2015.

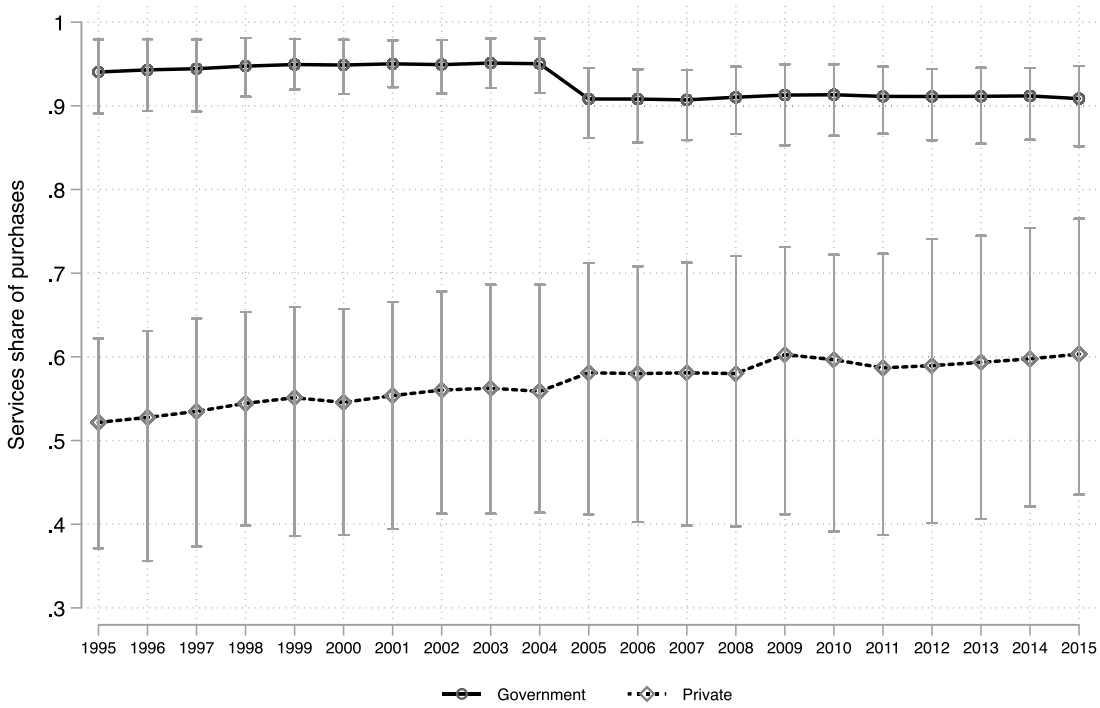

Fig. A.6. Avg. Services share of purchases in public and private markets over time. "Narrow" definition. Note: Raw data are sourced from the TiVA database. Purchases from and sales to ROW are included in the computations. Public procurement flows are computed using the "narrow" definition (see the main text for details). The upper caps of the vertical bars are at the 90th percentile of the distribution across countries, whereas the lower caps are at the 10th percentile.

Table A.5
Services share of purchases in public and private markets.

Cty	1995		1999		2003		2007		2011		2015		Avg.		2015–1995 diff. (in %)	
	Gov.	Priv.	Gov.	Priv.	Gov.	Priv.	Gov.	Priv.	Gov.	Priv.	Gov.	Priv.	Gov.	Priv.	Gov.	Priv.
ARG	0.96	0.59	0.96	0.61	0.92	0.49	0.86	0.48	0.85	0.47	0.83	0.47	0.90	0.52	−13.1	−21.5
AUS	0.92	0.67	0.93	0.70	0.93	0.72	0.91	0.70	0.92	0.72	0.93	0.76	0.92	0.71	0.7	13.1
AUT	0.93	0.61	0.93	0.62	0.93	0.63	0.90	0.65	0.91	0.65	0.89	0.67	0.92	0.64	−4.1	9.8
BEL	0.94	0.60	0.94	0.63	0.94	0.64	0.90	0.65	0.90	0.66	0.91	0.68	0.92	0.64	−3.9	13.0
BGR	0.84	0.43	0.85	0.47	0.88	0.49	0.87	0.55	0.90	0.58	0.90	0.59	0.87	0.52	7.2	35.6
BRA	0.94	0.50	0.95	0.55	0.94	0.50	0.93	0.56	0.91	0.56	0.91	0.60	0.93	0.55	−3.0	18.2
BRN	0.93	0.50	0.96	0.49	0.97	0.44	0.85	0.34	0.85	0.37	0.76	0.28	0.89	0.40	−18.9	−44.9
CAN	0.92	0.57	0.93	0.58	0.91	0.59	0.87	0.63	0.90	0.64	0.88	0.63	0.90	0.61	−4.7	9.8
CHE	0.88	0.65	0.88	0.66	0.89	0.68	0.87	0.68	0.86	0.71	0.86	0.73	0.87	0.68	−3.1	13.5
CHL	0.92	0.52	0.93	0.59	0.93	0.58	0.90	0.56	0.91	0.59	0.91	0.62	0.92	0.58	−1.2	20.3
CHN	0.83	0.23	0.84	0.30	0.83	0.32	0.78	0.32	0.79	0.31	0.80	0.35	0.81	0.31	−4.2	50.7
COL	0.92	0.55	0.91	0.57	0.90	0.55	0.89	0.54	0.89	0.55	0.90	0.58	0.90	0.56	−1.5	5.6
CRI	0.90	0.48	0.90	0.49	0.91	0.53	0.81	0.54	0.86	0.58	0.88	0.64	0.88	0.54	−2.2	32.6
CYP	0.94	0.53	0.93	0.56	0.91	0.59	0.94	0.71	0.96	0.76	0.96	0.81	0.94	0.66	2.2	52.8
CZE	0.88	0.51	0.91	0.52	0.92	0.53	0.90	0.56	0.89	0.57	0.88	0.56	0.90	0.54	0.1	9.6
DEU	0.93	0.60	0.93	0.62	0.93	0.62	0.88	0.62	0.89	0.62	0.90	0.64	0.91	0.62	−3.4	6.6
DNK	0.96	0.63	0.96	0.66	0.96	0.68	0.91	0.72	0.91	0.74	0.89	0.76	0.93	0.70	−7.4	20.1
ESP	0.93	0.55	0.93	0.56	0.93	0.60	0.88	0.63	0.90	0.63	0.89	0.64	0.91	0.60	−3.6	15.8
EST	0.90	0.45	0.90	0.56	0.91	0.56	0.92	0.62	0.92	0.59	0.91	0.60	0.91	0.56	1.0	33.1
FIN	0.92	0.53	0.91	0.54	0.93	0.58	0.85	0.57	0.91	0.61	0.89	0.65	0.90	0.58	−3.4	22.1
FRA	0.93	0.59	0.94	0.60	0.94	0.64	0.92	0.70	0.91	0.71	0.91	0.73	0.92	0.66	−1.3	24.1
GBR	0.90	0.62	0.91	0.68	0.92	0.72	0.92	0.75	0.91	0.74	0.91	0.77	0.91	0.71	0.9	24.3
GRC	0.91	0.58	0.92	0.60	0.90	0.63	0.89	0.67	0.91	0.67	0.91	0.66	0.91	0.63	0.3	14.9
HKG	0.96	0.81	0.97	0.89	0.98	0.91	0.92	0.75	0.91	0.69	0.92	0.65	0.94	0.78	−4.4	−19.5
HRV	0.86	0.45	0.88	0.48	0.89	0.52	0.87	0.57	0.88	0.59	0.87	0.60	0.88	0.53	1.8	33.1
HUN	0.90	0.47	0.91	0.46	0.92	0.50	0.88	0.52	0.90	0.51	0.86	0.50	0.90	0.49	−4.2	7.0
IDN	0.85	0.37	0.79	0.35	0.83	0.41	0.89	0.39	0.92	0.38	0.92	0.40	0.87	0.38	8.5	7.6
IND	0.90	0.35	0.90	0.39	0.90	0.41	0.89	0.40	0.89	0.39	0.90	0.44	0.89	0.40	0.0	24.4
IRL	0.93	0.53	0.91	0.58	0.91	0.64	0.87	0.75	0.91	0.77	0.88	0.78	0.90	0.68	−6.2	46.6
ISL	0.92	0.55	0.93	0.58	0.93	0.64	0.93	0.70	0.91	0.64	0.91	0.67	0.92	0.63	−1.1	22.6
ISR	0.91	0.58	0.90	0.61	0.90	0.63	0.86	0.61	0.87	0.63	0.89	0.66	0.89	0.62	−2.6	14.2
ITA	0.95	0.56	0.95	0.59	0.95	0.61	0.91	0.62	0.93	0.63	0.90	0.65	0.93	0.61	−4.8	17.2
JPN	0.89	0.59	0.90	0.62	0.89	0.63	0.86	0.61	0.84	0.62	0.85	0.62	0.87	0.61	−4.8	4.4
KHM	0.81	0.41	0.86	0.34	0.81	0.32	0.78	0.36	0.81	0.34	0.82	0.35	0.81	0.35	1.5	−15.0
KOR	0.86	0.43	0.86	0.44	0.85	0.46	0.83	0.46	0.81	0.42	0.82	0.46	0.84	0.45	−4.6	7.6
LTU	0.88	0.46	0.91	0.49	0.91	0.52	0.91	0.55	0.91	0.50	0.91	0.55	0.91	0.51	2.8	19.6
LUX	0.96	0.68	0.96	0.77	0.95	0.78	0.94	0.89	0.96	0.91	0.97	0.95	0.96	0.83	1.8	39.9
LVA	0.88	0.52	0.92	0.63	0.89	0.62	0.93	0.68	0.93	0.68	0.93	0.69	0.91	0.64	6.0	33.6
MAR	0.92	0.36	0.97	0.35	0.98	0.36	0.86	0.43	0.84	0.40	0.84	0.43	0.90	0.39	−9.1	20.5
MEX	0.94	0.50	0.94	0.48	0.95	0.53	0.83	0.51	0.84	0.51	0.82	0.52	0.89	0.51	−12.6	3.4
MLT	0.88	0.46	0.90	0.52	0.92	0.53	0.86	0.74	0.83	0.81	0.85	0.85	0.87	0.65	−2.9	83.0
MYS	0.88	0.45	0.88	0.38	0.84	0.36	0.82	0.37	0.79	0.38	0.79	0.38	0.83	0.39	−9.8	−15.7
NLD	0.92	0.62	0.93	0.66	0.93	0.69	0.92	0.68	0.93	0.68	0.93	0.70	0.93	0.67	0.3	13.7
NOR	0.93	0.60	0.94	0.63	0.95	0.65	0.86	0.67	0.85	0.67	0.87	0.68	0.90	0.65	−7.3	12.9
NZL	0.95	0.60	0.94	0.63	0.94	0.64	0.90	0.64	0.90	0.64	0.91	0.68	0.92	0.64	−4.3	14.0
PER	0.86	0.52	0.87	0.54	0.89	0.54	0.88	0.51	0.90	0.52	0.91	0.53	0.89	0.53	5.3	1.2
PHL	0.80	0.35	0.84	0.45	0.86	0.45	0.81	0.43	0.83	0.43	0.80	0.43	0.83	0.42	0.0	25.1
POL	0.90	0.49	0.94	0.56	0.94	0.58	0.89	0.57	0.90	0.56	0.89	0.58	0.91	0.56	−1.5	19.1
PRT	0.93	0.54	0.93	0.57	0.93	0.60	0.91	0.63	0.92	0.64	0.91	0.65	0.92	0.60	−1.3	20.8
ROU	0.79	0.38	0.82	0.47	0.85	0.49	0.89	0.51	0.88	0.55	0.89	0.59	0.85	0.50	12.5	55.3
RUS	0.89	0.48	0.89	0.52	0.91	0.56	0.88	0.59	0.89	0.61	0.87	0.60	0.89	0.56	−1.8	25.3
SAU	0.96	0.61	0.96	0.60	0.95	0.59	0.92	0.52	0.92	0.56	0.92	0.58	0.94	0.57	−4.1	−5.2
SGP	0.79	0.58	0.79	0.63	0.80	0.67	0.87	0.69	0.87	0.71	0.89	0.74	0.84	0.67	12.2	28.6
SVK	0.88	0.49	0.90	0.54	0.92	0.53	0.86	0.51	0.89	0.55	0.88	0.55	0.89	0.53	−0.3	12.4
SVN	0.89	0.51	0.90	0.54	0.91	0.54	0.90	0.58	0.91	0.60	0.88	0.61	0.90	0.56	−1.8	18.9
SWE	0.93	0.61	0.94	0.62	0.94	0.63	0.90	0.65	0.90	0.68	0.92	0.71	0.92	0.65	−1.6	17.7
TUN	0.92	0.32	0.92	0.39	0.94	0.42	0.85	0.51	0.80	0.49	0.79	0.48	0.87	0.44	−13.7	46.5
TUR	0.80	0.48	0.87	0.55	0.90	0.47	0.91	0.57	0.91	0.57	0.89	0.57	0.88	0.54	11.1	19.1

(*continued on next page*)

Table A.5 (*continued*).

Cty	1995		1999		2003		2007		2011		2015		Avg.		2015–1995 diff. (in %)	
	Gov.	Priv.	Gov.	Priv.	Gov.	Priv.	Gov.	Priv.	Gov.	Priv.	Gov.	Priv.	Gov.	Priv.	Gov.	Priv.
TWN	0.83	0.45	0.87	0.50	0.89	0.48	0.89	0.45	0.87	0.42	0.87	0.46	0.87	0.46	5.5	2.0
USA	0.87	0.65	0.88	0.68	0.88	0.70	0.88	0.69	0.88	0.69	0.90	0.73	0.88	0.69	3.7	12.5
VNM	0.86	0.35	0.85	0.34	0.82	0.29	0.79	0.29	0.80	0.28	0.78	0.28	0.82	0.31	−9.9	−19.7
ZAF	0.88	0.52	0.90	0.54	0.89	0.55	0.89	0.55	0.90	0.57	0.91	0.60	0.89	0.56	2.8	14.6
Mean	0.90	0.52	0.91	0.55	0.91	0.56	0.88	0.58	0.89	0.59	0.88	0.60	0.89	0.57	−1.7	16.9
Median	0.91	0.52	0.91	0.56	0.91	0.57	0.89	0.58	0.90	0.60	0.89	0.61	0.90	0.57	−1.7	16.9

Note: The last two columns show differences between 2015 and 1995 in percent. Data on purchases from and sales to ROW are included in the calculations. Government and Private markets are defined according to the "typical" definition (see the main text for details).

Table A.6
Government import penetration to Private import penetration ratio.

Cty	1995		1999		2003		2007		2011		2015		Avg.		2015–1995 diff. (in %)	
	Goods	Serv.	Goods	Serv.	Goods	Serv.	Goods	Serv.	Goods	Serv.	Goods	Serv.	Goods	Serv.	Goods	Serv.
ARG	1.34	0.21	1.25	0.19	1.48	0.22	1.44	0.47	1.31	0.54	1.29	0.61	1.35	0.37	−3.6	195.1
AUS	1.54	0.41	1.40	0.42	1.40	0.43	1.30	0.50	1.28	0.46	1.19	0.39	1.35	0.44	−22.4	−4.0
AUT	1.12	0.22	1.12	0.22	1.08	0.23	0.88	0.43	0.82	0.51	0.94	0.51	0.99	0.35	−15.4	133.2
BEL	1.09	0.12	1.08	0.12	0.96	0.26	0.77	0.50	0.69	0.36	0.74	0.52	0.89	0.31	−31.9	332.3
BGR	1.60	0.23	1.67	0.16	1.18	0.19	0.98	0.24	1.11	0.27	1.25	0.28	1.30	0.23	−22.0	21.4
BRA	1.22	0.22	1.44	0.25	1.44	0.27	1.29	0.29	1.13	0.32	1.49	0.36	1.34	0.28	22.0	59.4
BRN	1.78	0.22	2.79	0.25	4.40	0.28	3.23	0.46	2.33	0.36	2.84	0.50	2.89	0.35	59.8	125.8
CAN	1.49	0.22	1.01	0.19	0.70	0.20	1.54	0.33	1.44	0.27	1.43	0.39	1.27	0.27	−4.3	74.6
CHE	1.00	0.33	1.05	0.35	1.01	0.35	1.02	0.39	1.08	0.50	1.12	0.55	1.05	0.41	12.1	66.2
CHL	1.47	0.12	1.24	0.12	1.19	0.14	1.06	0.22	1.27	0.27	1.23	0.27	1.24	0.19	−16.1	131.2
CHN	0.25	0.07	0.18	0.07	0.15	0.09	0.66	0.28	0.61	0.28	0.85	0.35	0.45	0.19	235.7	406.1
COL	1.57	0.18	1.63	0.20	2.21	0.36	1.30	0.31	1.45	0.36	1.56	0.28	1.62	0.28	−0.9	59.4
CRI	1.37	0.12	1.35	0.12	1.23	0.12	1.62	0.47	1.43	0.38	1.24	0.33	1.37	0.25	−9.6	178.9
CYP	1.42	0.11	1.30	0.18	1.49	0.21	1.20	0.32	1.14	0.26	1.01	0.27	1.26	0.22	−28.6	154.0
CZE	1.04	0.28	1.15	0.23	1.01	0.22	1.24	0.32	1.04	0.34	0.93	0.33	1.07	0.29	−10.4	17.3
DEU	1.20	0.22	1.30	0.24	1.32	0.22	0.81	0.37	0.97	0.32	0.91	0.46	1.09	0.30	−23.8	107.2
DNK	1.04	0.17	0.94	0.16	0.96	0.20	0.92	0.43	0.87	0.46	0.76	0.49	0.91	0.32	−27.7	188.2
ESP	1.36	0.25	1.39	0.26	1.31	0.30	1.17	0.44	1.03	0.46	1.12	0.41	1.23	0.35	−17.8	59.1
EST	1.20	0.20	1.28	0.16	1.08	0.17	1.20	0.26	1.17	0.27	1.23	0.33	1.19	0.23	2.9	68.6
FIN	0.90	0.27	0.74	0.23	0.77	0.25	0.68	0.57	0.74	0.34	0.82	0.46	0.77	0.35	−9.1	70.1
FRA	1.11	0.21	1.14	0.20	1.13	0.21	1.17	0.45	1.19	0.47	1.26	0.52	1.17	0.34	13.0	151.9
GBR	1.41	0.27	1.41	0.27	1.42	0.30	1.23	0.44	1.07	0.43	1.28	0.49	1.30	0.37	−9.4	84.3
GRC	2.16	0.33	2.00	0.34	1.79	0.28	1.43	0.49	1.43	0.54	1.51	0.44	1.72	0.40	−30.1	35.0
HKG	0.99	0.14	1.02	0.18	1.03	0.17	0.91	0.28	0.91	0.29	0.82	0.32	0.95	0.23	−17.5	123.9
HRV	1.63	0.40	1.68	0.29	1.38	0.32	0.97	0.41	0.88	0.45	0.87	0.44	1.24	0.38	−46.5	10.7
HUN	1.23	0.18	0.93	0.15	0.88	0.18	0.73	0.31	0.90	0.28	1.03	0.35	0.95	0.24	−16.4	89.7
IDN	1.80	0.20	1.50	0.32	1.09	0.25	1.01	0.38	1.12	0.35	1.19	0.41	1.28	0.32	−34.1	104.3
IND	1.72	0.25	1.08	0.18	0.80	0.15	0.68	0.27	0.39	0.30	0.75	0.22	0.90	0.23	−56.3	−11.1
IRL	1.18	0.23	0.88	0.16	0.85	0.15	0.85	0.52	0.98	0.34	0.87	0.63	0.94	0.34	−26.3	172.7
ISL	1.36	0.24	1.32	0.22	1.29	0.23	1.58	0.44	1.72	0.48	1.62	0.53	1.48	0.36	18.8	120.7
ISR	1.43	0.18	1.12	0.20	0.98	0.21	0.95	0.59	0.99	0.52	1.18	0.46	1.11	0.36	−17.7	148.2
ITA	1.25	0.16	1.27	0.15	1.20	0.17	0.94	0.31	0.87	0.30	0.81	0.32	1.06	0.24	−35.4	100.8
JPN	0.85	0.20	0.95	0.20	0.86	0.22	0.79	0.40	0.78	0.44	1.16	0.48	0.90	0.32	36.5	133.9
KHM	2.52	0.23	2.24	0.14	1.83	0.18	1.48	0.33	1.39	0.30	1.35	0.36	1.80	0.26	−46.6	59.8
KOR	1.13	0.16	0.86	0.18	0.86	0.21	0.64	0.30	0.65	0.31	0.73	0.35	0.81	0.25	−35.5	122.8
LTU	1.15	0.14	1.10	0.12	0.96	0.12	1.01	0.34	0.61	0.31	0.90	0.35	0.96	0.23	−21.7	151.9
LUX	0.98	0.24	1.06	0.24	1.03	0.29	1.42	0.20	1.19	0.23	1.26	0.25	1.16	0.24	28.5	7.4
LVA	1.34	0.26	1.15	0.19	1.27	0.29	1.36	0.25	1.19	0.28	1.29	0.26	1.27	0.26	−4.0	2.1
MAR	1.57	0.06	1.87	0.03	1.72	0.02	1.01	0.18	1.06	0.18	1.10	0.24	1.39	0.12	−29.8	290.6
MEX	0.88	0.25	0.72	0.19	0.92	0.20	0.88	0.28	1.01	0.30	0.97	0.27	0.90	0.25	10.4	6.6
MLT	0.81	0.16	0.95	0.20	0.89	0.27	0.74	0.22	1.24	0.12	1.20	0.20	0.97	0.19	47.4	27.2
MYS	1.26	0.19	1.09	0.16	0.91	0.16	1.17	0.26	1.29	0.31	1.32	0.34	1.17	0.24	5.1	74.5
NLD	0.78	0.31	0.82	0.30	0.87	0.32	0.76	0.27	0.65	0.26	0.84	0.26	0.79	0.29	8.2	−16.0
NOR	1.22	0.24	1.16	0.23	1.27	0.27	0.51	0.51	0.45	0.48	0.64	0.53	0.88	0.38	−48.0	116.4
NZL	2.30	0.20	1.34	0.26	1.30	0.23	1.51	0.48	1.41	0.45	1.45	0.43	1.55	0.34	−37.3	112.8
PER	1.79	0.14	1.56	0.19	1.71	0.16	1.06	0.23	1.09	0.31	1.26	0.33	1.41	0.23	−29.8	137.6
PHL	1.70	0.18	1.31	0.18	1.05	0.18	1.89	0.29	1.44	0.31	1.82	0.41	1.53	0.26	7.3	125.2
POL	1.10	0.15	1.22	0.16	1.18	0.18	1.14	0.32	1.24	0.32	1.29	0.36	1.19	0.25	17.6	132.7
PRT	1.09	0.17	0.99	0.18	0.99	0.18	1.06	0.32	1.03	0.35	1.12	0.39	1.05	0.26	2.6	127.6

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Table A.6 (*continued*).

Cty	1995		1999		2003		2007		2011		2015		Avg.		2015–1995 diff. (in %)	
	Goods	Serv.	Goods	Serv.	Goods	Serv.	Goods	Serv.	Goods	Serv.	Goods	Serv.	Goods	Serv.	Goods	Serv.
ROU	1.25	0.30	1.58	0.36	1.39	0.35	1.11	0.22	1.09	0.27	1.39	0.37	1.30	0.31	11.3	24.9
RUS	1.28	0.17	1.02	0.16	1.16	0.21	1.55	0.46	1.66	0.49	1.74	0.41	1.40	0.32	36.5	149.1
SAU	1.47	0.19	1.34	0.19	1.19	0.21	1.18	0.69	1.07	0.52	1.31	0.74	1.26	0.42	−10.3	285.6
SGP	0.94	0.25	1.03	0.28	0.91	0.34	0.76	0.39	0.44	0.41	0.55	0.46	0.77	0.35	−41.2	88.1
SVK	0.87	0.31	0.87	0.28	0.79	0.21	1.06	0.27	1.07	0.32	1.14	0.31	0.97	0.28	30.8	−0.7
SVN	1.18	0.24	1.11	0.24	1.10	0.25	0.85	0.35	0.79	0.31	0.80	0.32	0.97	0.28	−31.6	31.4
SWE	1.19	0.23	1.04	0.22	1.05	0.23	0.86	0.39	0.73	0.42	0.82	0.45	0.95	0.32	−31.1	95.2
TUN	1.35	0.06	1.31	0.08	1.36	0.07	1.10	0.23	0.98	0.32	1.02	0.32	1.19	0.18	−24.5	417.5
TUR	0.86	0.43	0.96	0.31	1.02	0.16	1.31	0.24	1.29	0.24	1.46	0.30	1.15	0.28	70.3	−30.1
TWN	1.07	0.19	1.20	0.19	1.00	0.17	0.78	0.20	0.78	0.20	0.85	0.23	0.95	0.20	−20.8	18.5
USA	0.81	0.29	0.80	0.31	0.83	0.33	0.86	0.35	0.85	0.41	1.05	0.42	0.87	0.35	30.4	44.4
VNM	2.26	0.26	2.14	0.21	2.10	0.19	1.17	0.21	1.20	0.21	1.35	0.20	1.70	0.21	−40.4	−24.9
ZAF	1.59	0.14	1.80	0.18	1.59	0.22	1.26	0.23	1.22	0.21	1.32	0.21	1.46	0.20	−16.7	44.2
Mean	1.30	0.21	1.25	0.21	1.21	0.22	1.11	0.35	1.07	0.35	1.16	0.38	1.18	0.29	−4.8	102.1
Median	1.24	0.21	1.16	0.20	1.10	0.21	1.06	0.33	1.07	0.32	1.17	0.36	1.17	0.28	−15.7	92.5

Note: The last two columns show differences between 2015 and 1995 in percent. Data on purchases from and sales to ROW are included in the calculations. Government and Private markets are defined according to the "typical" definition (see the main text for details).

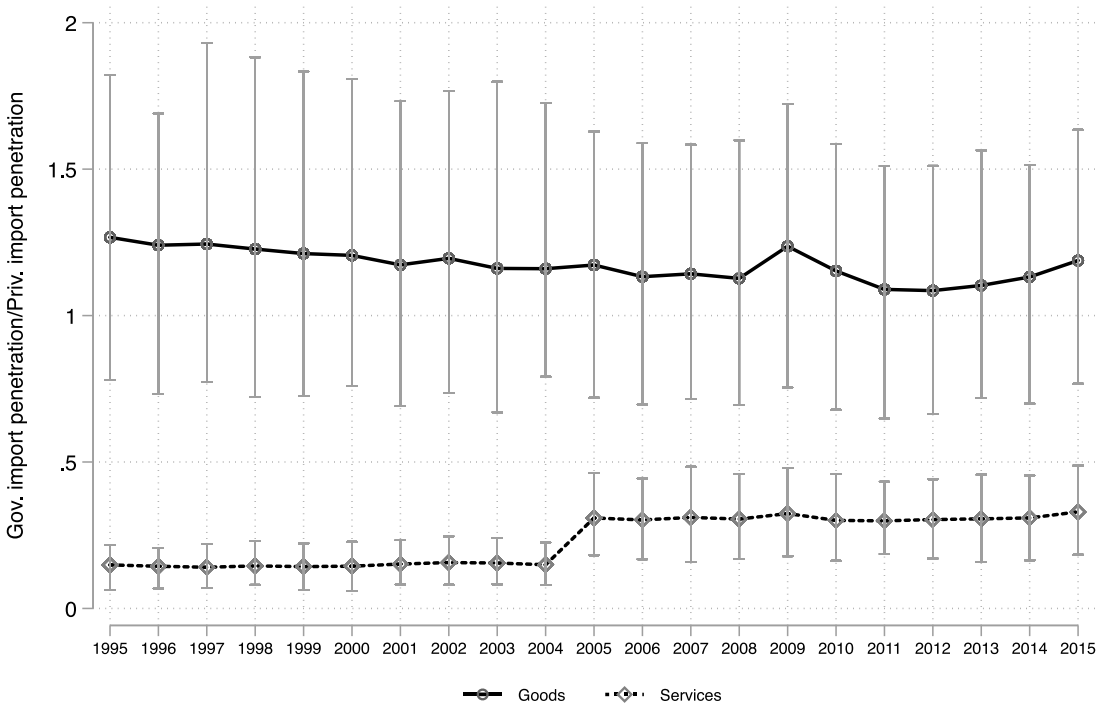

Fig. A.7. Avg. Government import penetration to Private import ratio over time. "Narrow" definition. Note: Raw data are sourced from the TiVA database. Purchases from and sales to ROW are included in the computations. Public procurement flows are computed using the "narrow" definition (see the main text for details). The upper caps of the vertical bars are at the 90th percentile of the distribution across countries, whereas the lower caps are at the 10th percentile.

Table A.7
PPML gravity estimates; assigning the highest trade costs to same-country observations.

Dep. var: X_{ij}	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Typical				Narrow			
	Goods		Serv.		Goods		Serv.	
	Gov.	Priv.	Gov.	Priv.	Gov.	Priv.	Gov.	Priv.
SMCTY	3.439***	3.147***	**6.992*** **	**5.802*** **	3.422***	3.153***	**7.341*** **	**5.805*** **
	(0.272)	(0.277)	(0.279)	(0.358)	(0.312)	(0.277)	(0.289)	(0.355)
Obs	23,064	23,064	23,064	23,064	23,064	23,064	23,064	23,064

Note: Each column corresponds to a separate regression. All regressions include importer–year and exporter–year fixed effects, and the set of covariates in Eq. (7). The estimates of the other covariates are identical to those in Columns (1) and (2) of Tables 1, 2, A.8 and A.9, and are omitted for brevity. In all regressions, the other dummy covariates are switched on for same-country observations. In the Columns (1) to (4) trade flows in public and private markets are based on the "typical" definition, whereas in Columns (5) to (8) they follow the "narrow" definition (see the main text for details). Data are for the years 1995, 1999, 2003, 2007, 2011 and 2015. Coefficients in bold are statistically different (at the 10 percent level) between the 'Gov.' and 'Priv.' regressions. To perform the statistical comparison, we estimate regressions where the 'Gov.' and 'Priv.' observations are stacked and all covariates and fixed effects are interacted with a dummy for government flows. Standard errors are three-way clustered by importer, exporter and symmetric country-pair. Significant at: *10%, **5%, ***1% level.

Table A.8
PPML gravity estimates, Goods, "narrow" definition.

Dep. var: X_{ij}	(1) Gov.	(2) Priv.	(3) Gov.	(4) Priv.	(5) Gov.	(6) Priv.	(7) Gov.	(8) Priv.	(9) Gov.	(10) Priv.
SMCTY	2.065***	1.646***								
	(0.288)	(0.325)								
DIST	**−0.634*** **	**−0.810*** **								
	(0.093)	(0.082)								
CONTIG	0.284*	0.278								
	(0.154)	(0.175)								
COLONY	0.342*	0.379								
	(0.194)	(0.271)								
LANG	0.329*	0.278**								
	(0.174)	(0.127)								
LEGAL	−0.044	0.042								
	(0.103)	(0.088)								
PTA(NOPROC)	−0.183	0.039	**0.208*** **	**0.293*** **	0.287	0.321**	0.287	0.320**	0.283	0.317**
	(0.227)	(0.180)	(0.056)	(0.053)	(0.207)	(0.126)	(0.207)	(0.127)	−0.207	−0.126
PTAPROC	0.194	0.264**			0.200***	0.287***	0.217***	0.273***	0.173**	0.217***
	(0.190)	(0.108)			(0.061)	(0.060)	(0.061)	(0.057)	−0.068	−0.051
WTOGPA	0.570***	0.369***					−0.065	0.042	−0.156**	−0.09
	(0.212)	(0.137)					(0.104)	(0.087)	−0.075	−0.085
EU	0.058	0.123							0.503***	0.575***
	(0.225)	(0.129)							−0.132	−0.091
Obs	23,064	23,064	23,064	23,064	23,064	23,064	23,064	23,064	23,064	23,064

Note: Each column corresponds to a separate regression. All regressions include importer–year and exporter–year fixed effects. Columns (3) to (10) include also directional country-pair fixed effects. In columns (3) and (4), the $PTA(NOPROC)$ dummy equals one if the two countries in the pair belong to the same PTA (with or without provisions on government procurement). In the other columns, $PTA(NOPROC)$ indicates membership in PTAs without provisions on government procurement. Data are for the years 1995, 1999, 2003, 2007, 2011 and 2015. Coefficients in bold are statistically different (at the 10 percent level) between the 'Gov.' and 'Priv.' regressions. To perform the statistical comparison, we estimate regressions where the 'Gov.' and 'Priv.' observations are stacked and all covariates and fixed effects are interacted with a dummy for government flows. Standard errors are three-way clustered by importer, exporter and symmetric country-pair. Significant at: *10%, **5%, ***1% level.

Table A.9
PPML gravity estimates, Services, "narrow" definition.

Dep. var: X_{ij}	(1) Gov.	(2) Priv.	(3) Gov.	(4) Priv.	(5) Gov.	(6) Priv.	(7) Gov.	(8) Priv.	(9) Gov.	(10) Priv.
SMCTY	**4.147*****	**2.608*****								
	(0.289)	(0.209)								
DIST	−0.420***	−0.382***								
	(0.089)	(0.118)								
CONTIG	0.233*	0.390**								
	(0.123)	(0.153)								
COLONY	0.706***	0.890***								
	(0.170)	(0.148)								
LANG	0.612***	0.609***								
	(0.119)	(0.114)								
LEGAL	0.065	0.068								
	(0.065)	(0.073)								
PTA(NOPROC)	0.435**	0.399**	**0.684*****	**0.082**	**0.482*****	**−0.208**	**0.481*****	**−0.208**	**0.478*****	**−0.210***
	(0.210)	(0.190)	(0.141)	(0.071)	(0.123)	(0.128)	(0.121)	(0.127)	(0.121)	(0.127)
PTAPROC	0.001	−0.078			**0.710*****	**0.142****	**0.465*****	**0.091**	**0.402*****	**0.030**
	(0.117)	(0.124)			(0.153)	(0.070)	(0.110)	(0.056)	(0.113)	(0.051)
WTOGPA	**0.972*****	**0.738*****					**0.560*****	**0.127**	**0.427*****	**0.035**
	(0.117)	(0.096)					(0.108)	(0.078)	(0.086)	(0.076)
EU	0.170	0.103							**0.751*****	**0.335*****
	(0.175)	(0.163)							(0.156)	(0.104)
Obs	23,064	23,064	23,064	23,064	23,064	23,064	23,064	23,064	23,064	23,064

Note: Each column corresponds to a separate regression. All regressions include importer–year and exporter–year fixed effects. Columns (3) to (10) include also directional country-pair fixed effects. In columns (3) and (4), the $PTA(NOPROC)$ dummy equals one if the two countries in the pair belong to the same PTA (with or without provisions on government procurement). In the other columns, $PTA(NOPROC)$ indicates membership in PTAs without provisions on government procurement. Data are for the years 1995, 1999, 2003, 2007, 2011 and 2015. Coefficients in bold are statistically different (at the 10 percent level) between the 'Gov.' and 'Priv.' regressions. To perform the statistical comparison, we estimate regressions where the 'Gov.' and 'Priv.' observations are stacked and all covariates and fixed effects are interacted with a dummy for government flows. Standard errors are three-way clustered by importer, exporter and symmetric country-pair. Significant at: *10%, **5%, ***1% level.

Table A.10
PPML gravity estimates, Goods, full sample.

Dep. var: X_{ij}	(1) Gov.	(2) Priv.	(3) Gov.	(4) Priv.	(5) Gov.	(6) Priv.	(7) Gov.	(8) Priv.	(9) Gov.	(10) Priv.
SMCTY	1.957***	1.619***								
	(0.259)	(0.331)								
DIST	**−0.646*****	**−0.819*****								
	(0.076)	(0.086)								
CONTIG	0.238*	0.290								
	(0.134)	(0.177)								
COLONY	0.323*	0.396								
	(0.188)	(0.272)								
LANG	0.360**	0.287**								
	(0.153)	(0.128)								
LEGAL	−0.003	0.038								
	(0.087)	(0.088)								
PTA(NOPROC)	−0.095	0.037	**0.167*****	**0.268*****	0.329*	0.275**	0.330*	0.275**	0.326*	0.272**
	(0.212)	(0.187)	(0.064)	(0.052)	(0.187)	(0.110)	(0.187)	(0.110)	(0.187)	(0.110)
PTAPROC	0.163	0.227*			**0.142****	**0.266*****	**0.156****	**0.258*****	0.102	0.190***
	(0.155)	(0.120)			(0.063)	(0.060)	(0.062)	(0.059)	(0.067)	(0.054)
WTOGPA	0.602***	0.378***					−0.051	0.024	−0.169**	−0.118
	(0.176)	(0.131)					(0.108)	(0.095)	(0.084)	(0.089)
EU	0.079	0.083							0.467***	0.565***
	(0.196)	(0.124)							(0.122)	(0.092)
Obs	80,724	80,724	80,724	80,724	80,724	80,724	80,724	80,724	80,724	80,724

Note: Each column corresponds to a separate regression. All regressions include importer–year and exporter–year fixed effects. Columns (3) to (10) include also directional country-pair fixed effects. In columns (3) and (4), the $PTA(NOPROC)$ dummy equals one if the two countries in the pair belong to the same PTA (with or without provisions on government procurement). In the other columns, $PTA(NOPROC)$ indicates membership in PTAs without provisions on government procurement. Data are for all years between 1995 and 2015. Trade flows are constructed according to the "typical" definition. Coefficients in bold are statistically different (at the 10 percent level) between the 'Gov.' and 'Priv.' regressions. To perform the statistical comparison, we estimate regressions where the 'Gov.' and 'Priv.' observations are stacked and all covariates and fixed effects are interacted with a dummy for government flows. Standard errors are three-way clustered by importer, exporter and symmetric country-pair. Significant at: *10%, **5%, ***1% level.

Table A.11
PPML gravity estimates, Services, full sample.

Dep. var: X_{ij}	(1) Gov.	(2) Priv.	(3) Gov.	(4) Priv.	(5) Gov.	(6) Priv.	(7) Gov.	(8) Priv.	(9) Gov.	(10) Priv.
SMCTY	**4.027*****	**2.574*****								
	(0.290)	(0.205)								
DIST	−0.455***	−0.391***								
	(0.088)	(0.118)								
CONTIG	0.190	0.390**								
	(0.134)	(0.154)								
COLONY	0.676***	0.888***								
	(0.171)	(0.141)								
LANG	0.636***	0.612***								
	(0.130)	(0.113)								
LEGAL	0.077	0.066								
	(0.072)	(0.075)								
PTA(NOPROC)	0.368*	0.426**	**0.479*****	**0.069**	**0.277*****	**−0.199***	**0.275*****	**−0.199***	**0.273*****	**−0.201***
	(0.203)	(0.192)	(0.096)	(0.063)	(0.104)	(0.113)	(0.104)	(0.113)	(0.104)	(0.113)
PTAPROC	−0.116	−0.092			**0.509*****	**0.134****	**0.368*****	**0.095***	**0.317*****	**0.039**
	(0.124)	(0.130)			(0.107)	(0.062)	(0.081)	(0.052)	(0.079)	(0.049)
WTOGPA	**0.996*****	**0.753*****					**0.342*****	**0.098**	**0.233****	**0.006**
	(0.104)	(0.096)					(0.102)	(0.080)	(0.094)	(0.079)
EU	0.007	0.071							**0.598*****	**0.314*****
	(0.171)	(0.162)							(0.135)	(0.099)
Obs	80,724	80,724	80,724	80,724	80,724	80,724	80,724	80,724	80,724	80,724

Note: Each column corresponds to a separate regression. All regressions include importer–year and exporter–year fixed effects. Columns (3) to (10) include also directional country-pair fixed effects. In columns (3) and (4), the $PTA(NOPROC)$ dummy equals one if the two countries in the pair belong to the same PTA (with or without provisions on government procurement). In the other columns, $PTA(NOPROC)$ indicates membership in PTAs without provisions on government procurement. Data are for all years between 1995 and 2015. Trade flows are constructed according to the "typical" definition. Coefficients in bold are statistically different (at the 10 percent level) between the 'Gov.' and 'Priv.' regressions. To perform the statistical comparison, we estimate regressions where the 'Gov.' and 'Priv.' observations are stacked and all covariates and fixed effects are interacted with a dummy for government flows. Standard errors are three-way clustered by importer, exporter and symmetric country-pair. Significant at: *10%, **5%, ***1% level.

Table A.12
PPML gravity estimates, Goods, industry-level trade data.

Dep. var: X_{ij}	(1) Gov.	(2) Priv.	(3) Gov.	(4) Priv.	(5) Gov.	(6) Priv.	(7) Gov.	(8) Priv.	(9) Gov.	(10) Priv.
SMCTY	**1.822*****	**1.472*****								
	(0.238)	(0.322)								
DIST	**−0.751*****	**−0.895*****								
	(0.077)	(0.088)								
CONTIG	0.138	0.228								
	(0.148)	(0.168)								
COLONY	0.370**	0.427*								
	(0.163)	(0.250)								
LANG	0.412***	0.306**								
	(0.153)	(0.134)								
LEGAL	0.016	0.105								
	(0.078)	(0.102)								
PTA(NOPROC)	−0.091	0.052	**0.147****	**0.265*****	0.263	0.270**	0.265	0.270**	0.255	0.262**
	(0.191)	(0.182)	(0.058)	(0.054)	(0.240)	(0.122)	(0.240)	(0.122)	(0.239)	(0.121)
PTAPROC	0.128	0.281**			**0.132****	**0.264*****	0.178***	0.251***	0.105*	0.176***
	(0.132)	(0.117)			(0.061)	(0.066)	(0.064)	(0.062)	(0.060)	(0.045)
WTOGPA	**0.698*****	**0.417****					**−0.157**	**0.035**	**−0.308*****	**−0.129**
	(0.185)	(0.188)					(0.129)	(0.104)	(0.113)	(0.114)
EU	0.090	0.211							0.582***	0.617***
	(0.197)	(0.181)							(0.136)	(0.113)
Obs	230,330	230,454	230,330	230,454	230,330	230,454	230,330	230,454	230,330	230,454

Note: Each column corresponds to a separate regression. All regressions include importer–industry–year and exporter–industry–year fixed effects. Columns (3) to (10) include also directional country-pair fixed effects. In columns (3) and (4), the $PTA(NOPROC)$ dummy equals one if the two countries in the pair belong to the same PTA (with or without provisions on government procurement). In the other columns, $PTA(NOPROC)$ indicates membership in PTAs without provisions on government procurement. Data are for the years 1995, 1999, 2003, 2007, 2011 and 2015. The dependent variable is at the industry level (Table A.2 reports the list of industries). Coefficients in bold are statistically different (at the 10 percent level) between the 'Gov.' and 'Priv.' regressions. To perform the statistical comparison, we estimate regressions where the 'Gov.' and 'Priv.' observations are stacked and all covariates and fixed effects are interacted with a dummy for government flows. Standard errors are three-way clustered by importer, exporter and symmetric country-pair. Significant at: *10%, **5%, ***1% level.

Table A.13
PPML gravity estimates, Services, industry-level trade data.

Dep. var: X_{ij}	(1) Gov.	(2) Priv.	(3) Gov.	(4) Priv.	(5) Gov.	(6) Priv.	(7) Gov.	(8) Priv.	(9) Gov.	(10) Priv.
SMCTY	**4.365*****	**2.797*****								
	(0.356)	(0.229)								
DIST	−0.506***	−0.403***								
	(0.094)	(0.117)								
CONTIG	0.147	0.386**								
	(0.156)	(0.156)								
COLONY	0.487*	0.741***								
	(0.281)	(0.160)								
LANG	0.639***	0.584***								
	(0.158)	(0.117)								
LEGAL	0.094	0.077								
	(0.072)	(0.073)								
PTA(NOPROC)	0.244	0.357*	**0.508*****	**0.095**	**0.276**	**−0.199***	**0.274**	**−0.199***	**0.270**	**−0.202***
	(0.267)	(0.184)	(0.123)	(0.073)	(0.175)	(0.117)	(0.173)	(0.117)	(0.175)	(0.117)
PTAPROC	−0.126	−0.062			**0.539*****	**0.157****	**0.372*****	**0.099**	**0.320*****	**0.042**
	(0.143)	(0.125)			(0.132)	(0.074)	(0.106)	(0.061)	(0.118)	(0.060)
WTOGPA	**1.060*****	**0.742*****					**0.424*****	**0.145****	**0.322*****	**0.057**
	(0.144)	(0.100)					(0.106)	(0.073)	(0.102)	(0.069)
EU	0.020	0.119							**0.611*****	**0.334*****
	(0.186)	(0.170)							(0.173)	(0.103)
Obs	184,512	184,512	184,512	184,512	184,512	184,512	184,512	184,512	184,512	184,512

Note: Each column corresponds to a separate regression. All regressions include importer–industry–year and exporter–industry–year fixed effects. Columns (3) to (10) include also directional country-pair fixed effects. In columns (3) and (4), the $PTA(NOPROC)$ dummy equals one if the two countries in the pair belong to the same PTA (with or without provisions on government procurement). In the other columns, $PTA(NOPROC)$ indicates membership in PTAs without provisions on government procurement. Data are for the years 1995, 1999, 2003, 2007, 2011 and 2015. The dependent variable is at the industry level (Table A.2 reports the list of industries). Coefficients in bold are statistically different (at the 10 percent level) between the 'Gov.' and 'Priv.' regressions. To perform the statistical comparison, we estimate regressions where the 'Gov.' and 'Priv.' observations are stacked and all covariates and fixed effects are interacted with a dummy for government flows. Standard errors are three-way clustered by importer, exporter and symmetric country-pair. Significant at: *10%, **5%, ***1% level.

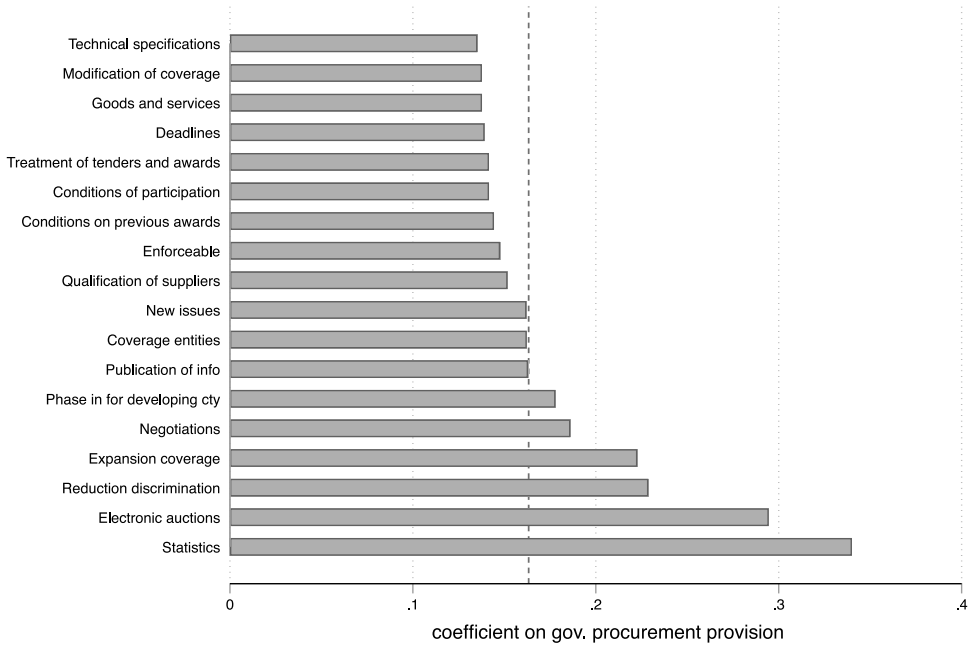

Fig. A.8. Trade effect of single provisions on government procurement — Goods. Note: The bars represent estimated coefficient on a dummy for the presence of the indicated provision. We show only coefficients that are significant at the 10% level. The dependent variable of the gravity model is bilateral flows in government procurement. Controls include a dummy for PTAs without government procurement, a dummy for PTAs with provisions other than the one being 'tested', a dummy for membership in the WTO GPA, and an EU dummy. All regressions include exporter–year, importer–year and directional country-pair fixed effects.

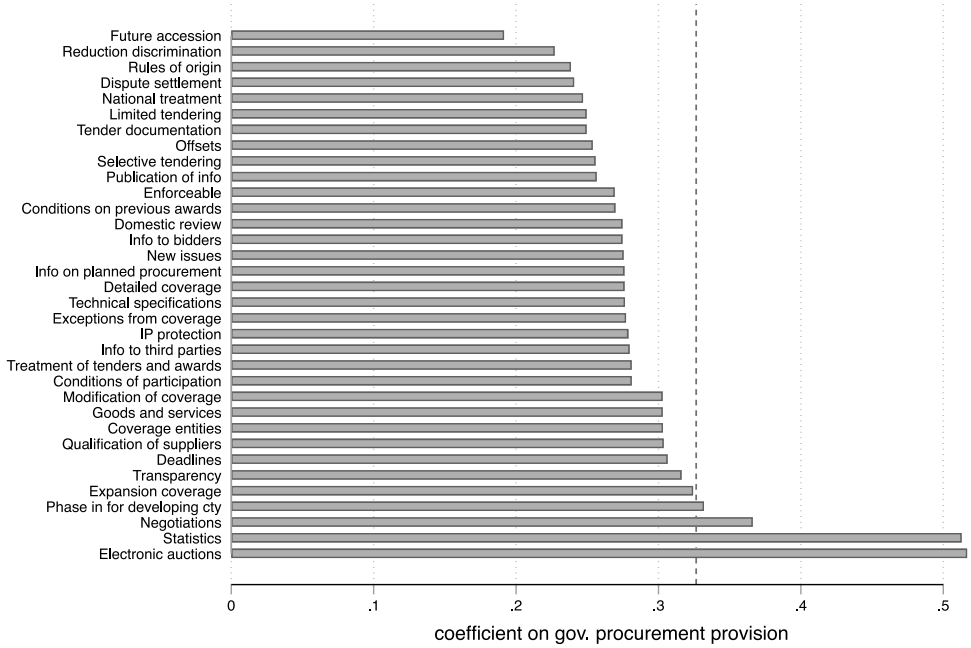

Fig. A.9. Trade effect of single provisions on government procurement — Services. Note: The bars represent estimated coefficient on a dummy for the presence of the indicated provision. We show only coefficients that are significant at the 10% level. The dependent variable of the gravity model is bilateral flows in government procurement. Controls include a dummy for TAs without government procurement, a dummy for TAs with provisions other than the one being 'tested', a dummy for membership in the WTO GPA, and an EU dummy. All regressions include exporter–year, importer–year and directional country-pair fixed effects.

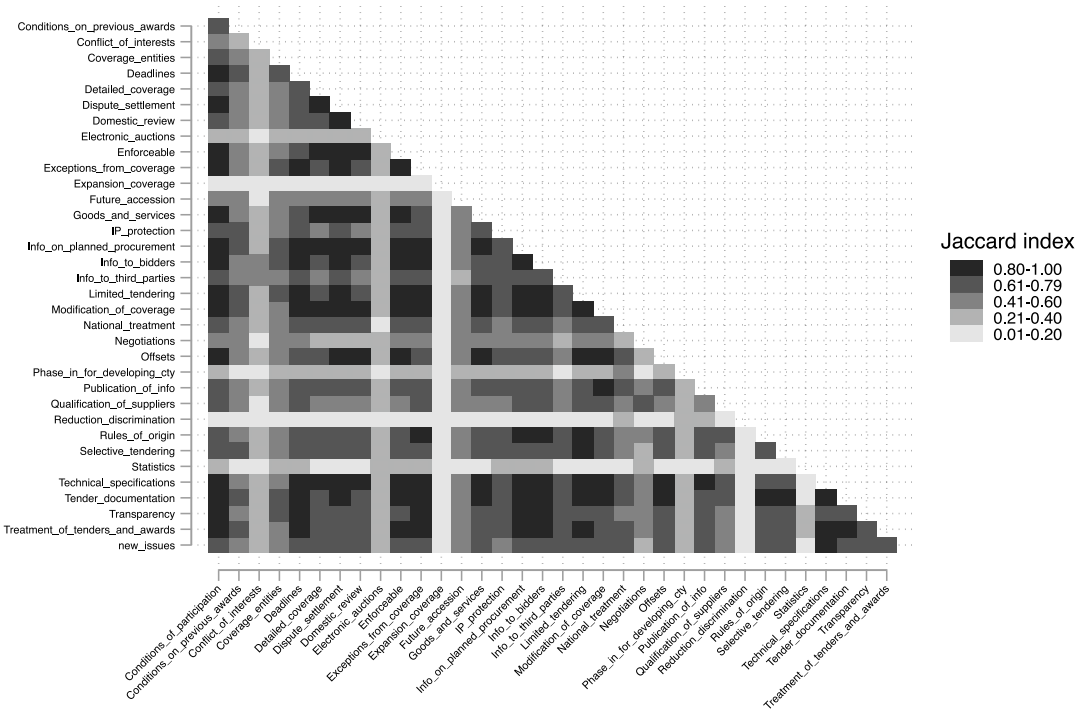

Fig. A.10. Bilateral co-occurrence of provisions on government procurement in PTAs. Note: The Jaccard index in our application is equal to the number of agreements where two provisions occur over the total number of agreements where at least one of the two provisions in the pair occurs.

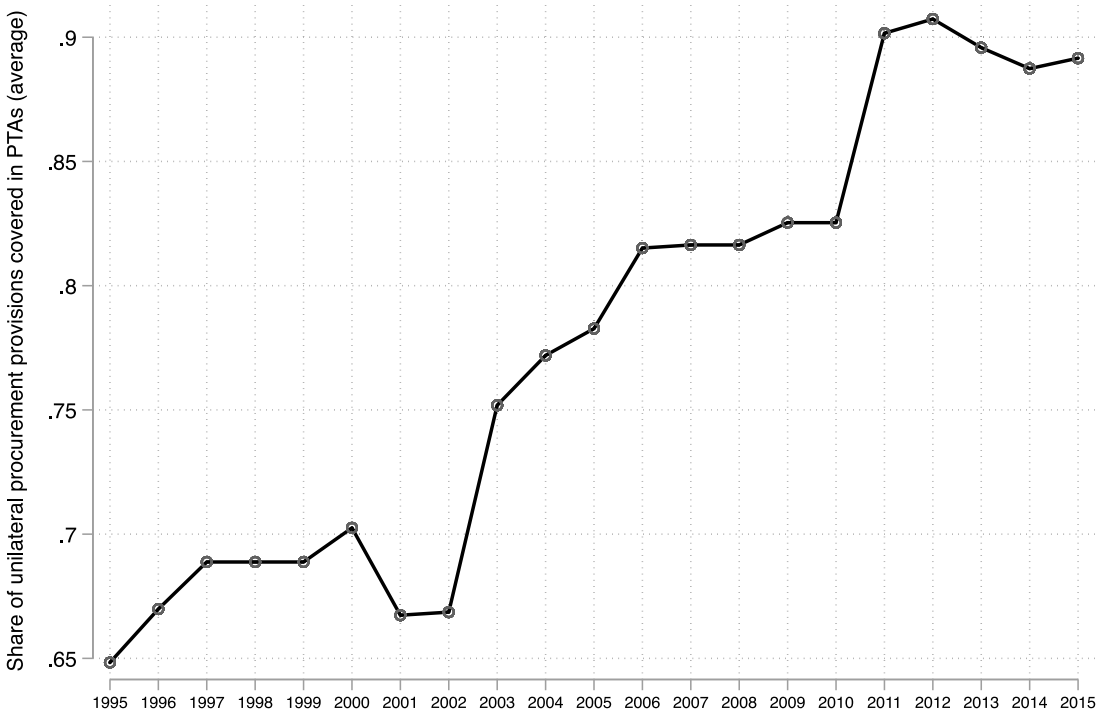

Fig. A.11. Evolution of the unilateral depth in government procurement of PTAs. Note: The unilateral depth variable equals the maximum of the shares of unilateral provisions (those under "Procedural disciplines" and "Transparency" categories, 19 in total) covered by PTAs where a country is member. The sample used to compute the average across countries reported on the vertical axis includes only agreements that contain at least one unilateral provision.

Table A.14
CHB indexes — Goods.

Cty	1995		1999		2003		2007		2011		2015		Avg.		2015–1995 diff. (in %)	
	Gov	Priv	Gov	Priv	Gov	Priv	Gov	Priv	Gov	Priv	Gov	Priv	Gov	Priv	Gov	Priv
ARG	315	108	293	104	387	165	204	127	124	94	81	84	234	114	−74.4	−22.0
AUS	84	65	83	66	85	65	70	55	59	49	73	64	76	61	−12.4	−1.6
AUT	105	91	118	101	120	95	101	96	116	111	114	137	112	105	8.9	51.2
BEL	86	56	92	64	84	62	63	66	72	79	79	104	79	72	−8.6	86.0
BGR	1079	782	1141	1013	945	789	741	536	1000	618	1048	735	992	745	−2.9	−5.9
BRA	44	32	66	44	75	44	52	32	31	24	43	37	52	35	−1.7	15.1
BRN	5694	3962	8606	4236	10706	3065	2509	2026	2862	1751	1940	2539	5386	2930	−65.9	−35.9
CAN	26	31	24	27	19	26	20	27	24	31	23	34	23	29	−13.0	8.6
CHE	37	64	43	74	42	74	30	80	31	83	29	93	35	78	−21.9	46.2
CHL	624	216	596	259	695	258	433	174	421	172	371	201	524	213	−40.5	−7.1
CHN	23	12	13	9	11	7	8	6	6	4	4	3	11	7	−84.0	−77.0
COL	322	214	218	242	336	269	245	199	204	169	230	212	259	218	−28.7	−0.9
CRI	1941	1391	1368	1140	1667	1272	1430	1304	1267	1310	1075	1286	1458	1284	−44.6	−7.6
CYP	5508	3033	3912	3327	3086	3046	3194	2839	4444	3818	6023	6411	4361	3746	9.3	111.3
CZE	240	197	291	188	232	146	168	110	173	123	194	153	216	153	−19.1	−22.7
DEU	11	10	13	11	14	11	11	11	13	14	14	17	13	12	24.3	76.0
DNK	150	135	160	151	159	147	101	157	111	202	102	261	131	175	−31.8	93.3
ESP	48	32	53	33	45	29	30	28	38	40	44	51	43	35	−8.5	56.6
EST	2583	2666	2418	2403	2276	1865	1713	1264	1813	1449	1758	1672	2093	1887	−31.9	−37.3
FIN	138	133	137	137	141	134	95	132	161	168	158	230	138	156	14.2	72.9
FRA	14	16	18	17	17	17	17	21	19	26	21	35	18	22	49.6	123.8
GBR	15	19	14	19	15	20	16	23	19	33	19	35	16	25	24.6	77.7
GRC	219	191	260	215	167	201	145	212	241	294	333	410	228	254	51.9	115.3
HKG	771	394	762	547	1115	773	469	275	522	271	418	241	676	417	−45.8	−38.9
HRV	555	826	785	926	870	807	712	753	873	1032	919	1313	786	943	65.4	58.9
HUN	274	240	273	222	217	175	160	138	207	168	210	204	223	191	−23.3	−15.1
IDN	152	64	153	76	133	70	185	58	156	39	162	44	157	58	6.1	−31.0
IND	116	41	83	37	89	33	65	24	50	21	49	21	75	30	−58.1	−47.9
IRL	89	138	71	114	61	104	50	128	59	185	46	164	63	139	−48.4	18.6
ISL	2209	2571	2132	2293	2085	2408	1923	2270	2603	3175	2550	3493	2250	2702	15.4	35.9
ISR	157	260	128	256	134	266	133	256	136	260	137	272	138	262	−12.2	4.5
ITA	34	18	34	18	32	17	22	19	32	25	31	33	31	22	−9.6	82.1
JPN	5	5	6	6	7	8	9	10	7	10	10	15	7	9	99.1	186.5
KHM	13998	5336	12694	3470	6900	2762	7435	2805	6268	2283	4638	1799	8655	3076	−66.9	−66.3
KOR	42	27	45	29	38	26	28	23	29	22	26	23	35	25	−36.5	−12.9
LTU	1862	1899	1736	1631	1451	1176	1253	811	1228	846	1402	1054	1489	1236	−24.7	−44.5
LUX	1378	746	1492	822	1327	779	1226	828	1607	1109	2015	1419	1507	950	46.2	90.1
LVA	2535	3017	2934	2916	2046	2154	2080	1405	2599	1796	2806	2099	2500	2231	10.7	−30.4
MAR	747	378	1528	389	1802	382	497	420	464	407	417	465	909	407	−44.3	23.1
MEX	97	50	66	32	65	32	38	30	43	36	38	39	58	37	−60.6	−22.2
MLT	2141	3215	2407	3042	2623	2994	1774	3046	1943	3695	2131	4437	2170	3405	−0.5	38.0
MYS	145	114	143	96	108	77	116	76	100	68	94	67	118	83	−35.3	−41.6
NLD	44	46	49	52	45	50	46	52	57	62	64	79	51	57	44.9	71.1
NOR	194	129	204	126	194	115	89	105	87	118	107	161	146	126	−44.7	25.2
NZL	615	319	546	358	508	315	346	301	353	328	383	378	459	333	−37.8	18.7
PER	577	395	556	408	707	386	653	321	569	254	496	259	593	337	−14.1	−34.5
PHL	196	159	203	176	307	201	311	183	287	160	186	129	248	168	−4.8	−18.9
POL	142	113	203	112	186	100	96	70	108	76	106	92	140	94	−25.4	−18.1
PRT	228	144	234	150	220	148	198	167	252	219	310	286	240	186	35.9	99.4
ROU	429	328	407	411	346	326	319	191	365	232	456	282	387	295	6.1	−14.3
RUS	63	60	116	94	75	58	35	33	34	32	41	39	61	53	−34.8	−34.9
SAU	210	130	183	121	154	104	121	82	106	72	90	92	144	100	−56.9	−28.8
SGP	104	123	119	136	117	135	136	131	122	123	120	125	120	129	15.4	1.7
SVK	523	445	649	463	577	342	334	217	404	240	388	268	479	329	−25.8	−39.7
SVN	751	648	847	684	819	613	597	504	684	640	677	790	729	647	−9.9	21.9
SWE	73	76	73	77	75	76	59	81	66	99	83	133	72	90	14.5	74.8
TUN	1664	689	1432	626	1781	642	758	773	628	849	606	909	1145	748	−63.6	32.0
TUR	108	81	103	85	137	64	174	60	194	64	160	65	146	70	48.8	−20.0
TWN	47	46	57	47	73	47	81	49	80	49	81	55	70	49	72.5	20.7
USA	2	4	2	4	2	4	3	5	3	6	4	6	3	5	48.2	31.4
VNM	755	395	655	295	560	229	375	170	267	123	172	83	464	216	−77.3	−79.0
ZAF	147	129	188	140	145	119	156	115	150	119	212	171	166	132	44.3	32.4
Mean	863	601	875	570	798	499	556	428	597	483	591	587	713	528	−9.6	16.8
Median	175	134	195	138	163	140	150	130	153	123	159	157	151	146	−12.3	6.6

Note: Constructed Home Bias indexes estimated from the specifications in columns (9) and (10), Table 1.

Table A.15
CHB indexes — Services.

Cty	1995		1999		2003		2007		2011		2015		Avg.		2015–1995 diff. (in %)	
	Gov	Priv	Gov	Priv	Gov	Priv	Gov	Priv	Gov	Priv	Gov	Priv	Gov	Priv	Gov	Priv
ARG	143	108	134	108	431	320	272	244	171	167	125	148	213	182	−12.0	36.5
AUS	69	55	68	55	67	51	56	47	42	35	45	39	58	47	−35.2	−29.0
AUT	104	117	125	139	136	130	130	122	142	126	157	149	132	131	50.4	27.1
BEL	80	74	94	84	92	83	89	82	95	84	104	102	92	85	29.8	38.9
BGR	2617	1759	2272	2246	1635	1625	1216	893	1323	872	1429	996	1749	1398	−45.4	−43.4
BRA	27	46	40	59	57	78	34	42	25	29	33	40	36	49	21.4	−13.5
BRN	3781	8680	3834	14 556	4158	15 486	3549	11 234	3932	9420	4880	14 952	4022	12 388	29.1	72.3
CAN	36	50	36	47	35	43	31	37	29	37	35	43	34	43	−0.5	−14.0
CHE	109	69	143	86	139	83	135	82	112	68	109	71	125	77	−0.8	2.3
CHL	689	367	574	390	713	422	486	323	371	246	350	255	531	334	−49.3	−30.5
CHN	57	59	29	34	27	26	22	22	13	14	8	8	26	27	−85.4	−86.9
COL	310	268	228	324	407	415	282	305	219	233	209	262	276	301	−32.3	−2.2
CRI	3194	2513	2710	2323	2676	2213	3174	2150	1853	1577	1327	1249	2489	2004	−58.4	−50.3
CYP	3805	2952	2934	3042	2486	2621	2103	1520	2086	1542	3505	1997	2820	2279	−7.9	−32.4
CZE	443	367	427	377	320	278	253	212	263	205	341	278	341	286	−23.0	−24.2
DEU	11	11	13	14	15	15	16	15	17	16	18	19	15	15	71.1	67.9
DNK	109	145	117	164	119	155	124	139	135	151	159	177	127	155	46.2	21.9
ESP	48	43	51	47	45	37	38	30	41	38	53	49	46	41	11.5	14.0
EST	4933	6029	3960	3966	3470	2857	2325	1871	2537	2134	2455	2326	3280	3197	−50.2	−61.4
FIN	168	228	190	249	183	222	179	214	177	221	201	264	183	233	19.2	16.1
FRA	14	18	16	21	16	19	17	18	19	20	22	24	17	20	55.7	31.5
GBR	20	20	17	16	15	15	14	14	20	20	19	19	18	17	−4.1	−9.1
GRC	235	205	236	222	192	195	153	163	216	213	322	318	226	219	37.3	55.2
HKG	391	126	281	121	330	141	380	156	411	167	319	170	352	147	−18.5	34.6
HRV	882	1403	1021	1558	1102	1174	871	906	980	1076	1190	1389	1008	1251	35.0	−1.0
HUN	494	602	529	607	372	415	339	346	426	415	506	526	444	485	2.3	−12.6
IDN	283	165	457	243	325	186	234	161	158	105	148	108	267	161	−47.5	−34.6
IND	137	103	98	89	114	77	75	56	60	46	51	38	89	68	−62.5	−62.6
IRL	323	240	297	194	212	148	190	108	237	151	306	143	261	164	−5.3	−40.5
ISL	2794	4277	2241	3519	1938	3018	1602	2081	2843	3754	2498	3439	2319	3348	−10.6	−19.6
ISR	174	308	160	292	183	309	228	318	197	262	170	241	185	288	−1.9	−21.5
ITA	25	23	25	23	23	21	23	20	28	24	35	30	27	23	39.9	30.6
JPN	6	5	7	7	8	8	12	11	10	10	14	14	10	9	131.6	182.5
KHM	30 986	9881	28 422	10 579	17 121	9184	22 782	9028	17 958	7517	12 991	5652	21 710	8640	−58.1	−42.8
KOR	85	56	95	66	79	57	57	49	66	52	55	49	73	55	−35.5	−12.8
LTU	2990	3984	2091	3114	1866	2080	1339	1348	1481	1512	1564	1585	1888	2271	−47.7	−60.2
LUX	1231	357	1284	318	1156	291	923	204	938	209	918	188	1075	261	−25.4	−47.3
LVA	3831	4460	3027	3104	2614	2314	1677	1271	2145	1513	2236	1728	2588	2398	−41.6	−61.3
MAR	706	994	705	1162	739	1159	689	941	665	912	649	968	692	1022	−8.0	−2.6
MEX	160	97	97	68	84	60	98	61	98	66	95	69	105	70	−40.9	−29.5
MLT	6883	4932	6900	4504	6391	4326	4966	2279	4028	2001	3731	1961	5483	3334	−45.8	−60.2
MYS	397	271	509	315	396	279	385	266	318	213	317	214	387	260	−20.1	−20.9
NLD	50	56	57	59	50	55	45	55	49	59	59	71	52	59	17.8	26.7
NOR	155	191	154	189	133	171	135	149	127	147	143	182	141	171	−7.8	−4.5
NZL	429	351	438	392	421	344	365	324	355	321	346	311	392	340	−19.2	−11.4
PER	916	575	873	648	955	652	820	639	591	445	448	406	767	561	−51.1	−29.5
PHL	506	411	478	375	670	432	682	399	557	316	393	253	548	364	−22.3	−38.6
POL	207	199	190	160	183	139	125	104	130	103	141	120	163	137	−32.2	−39.8
PRT	240	223	226	226	206	207	199	196	243	227	330	302	241	230	37.3	35.2
ROU	1172	804	938	817	656	616	354	319	447	302	472	315	673	529	−59.7	−60.8
RUS	79	108	164	180	80	94	41	45	35	36	48	46	74	85	−39.0	−57.9
SAU	138	271	121	282	124	300	124	331	94	225	69	183	112	265	−50.2	−32.3
SGP	413	151	430	159	442	164	336	144	311	115	266	107	366	140	−35.6	−29.5
SVK	1218	1140	1284	1088	1026	816	753	581	670	491	720	567	945	781	−40.8	−50.3
SVN	1283	1274	1308	1320	1244	1204	1098	983	1119	1083	1461	1371	1252	1206	13.9	7.6
SWE	70	104	73	110	77	110	80	105	84	105	90	124	79	110	27.9	18.7
TUN	1706	2066	1486	1727	1564	1651	1124	1571	1292	1564	1309	1771	1413	1725	−23.2	−14.3
TUR	271	129	169	118	174	126	176	76	191	75	182	75	194	100	−32.7	−41.6
TWN	125	98	121	96	155	110	149	126	155	125	151	128	143	114	21.4	30.9
USA	4	3	3	3	3	3	3	3	4	4	3	3	3	3	−9.3	−4.7
VNM	2841	1353	2600	1187	2632	1123	2007	827	1391	569	871	371	2057	905	−69.3	−72.6
ZAF	184	190	207	212	194	187	157	170	130	147	166	195	173	184	−9.4	2.6
Mean	1384	1067	1255	1094	1024	986	973	751	885	709	829	793	1058	900	−10.9	−10.7
Median	256	214	227	224	209	201	214	183	206	186	205	186	233	202	−15.2	−14.2

Note: Constructed Home Bias indexes estimated from the specifications in columns (9) and (10), Table 2.

Table A.16
Aggregated CHB indexes.

Cty	1995		1999		2003		2007		2011		2015		Avg.		2015–1995 diff. (in %)	
	Gov	Priv	Gov	Priv	Gov	Priv	Gov	Priv	Gov	Priv	Gov	Priv	Gov	Priv	Gov	Priv
ARG	143	108	134	107	431	235	270	179	169	125	124	111	212	144	−13.3	3.1
AUS	70	57	69	57	67	53	56	48	42	37	45	41	58	49	−35.1	−27.7
AUT	104	110	125	130	136	122	129	117	142	123	156	147	132	125	49.8	33.7
BEL	80	68	94	79	92	78	89	79	95	83	104	103	92	82	29.4	50.3
BGR	2573	1150	2253	1575	1626	1218	1208	769	1320	791	1425	918	1734	1070	−44.6	−20.2
BRA	27	39	40	53	57	61	34	38	25	27	33	39	36	43	21.4	−0.7
BRN	3782	5980	3836	7142	4161	5231	3524	3136	3909	2717	4682	3602	3982	4635	23.8	−39.8
CAN	36	43	36	40	34	37	31	34	29	35	35	41	33	38	−0.8	−5.3
CHE	108	68	141	84	138	82	130	82	109	70	105	73	122	76	−3.1	7.6
CHL	689	294	575	344	712	365	485	260	372	222	350	240	530	288	−49.2	−18.3
CHN	56	16	29	13	26	11	21	9	13	6	8	4	25	10	−85.6	−75.6
COL	310	248	228	295	407	359	282	262	219	207	210	245	276	269	−32.3	−0.9
CRI	3179	1930	2689	1698	2666	1820	3126	1831	1844	1502	1324	1256	2471	1673	−58.3	−34.9
CYP	3809	2977	2936	3108	2487	2705	2106	1620	2090	1661	3510	2131	2823	2367	−7.8	−28.4
CZE	440	289	425	290	319	221	252	173	262	176	339	229	340	230	−23.1	−20.7
DEU	11	11	13	13	15	14	16	14	17	15	18	18	15	14	70.5	71.5
DNK	109	143	117	161	119	154	124	141	135	157	158	185	127	157	45.0	29.6
ESP	48	39	51	42	45	35	38	29	41	39	53	49	46	39	11.3	26.9
EST	4909	4180	3948	3432	3462	2555	2322	1720	2532	1932	2449	2144	3270	2660	−50.1	−48.7
FIN	168	183	189	199	183	190	176	183	176	205	200	257	182	203	19.0	39.9
FRA	14	17	16	20	16	19	17	18	19	20	22	25	17	20	55.7	43.8
GBR	20	20	17	16	15	16	14	15	20	21	19	20	18	18	−3.9	−2.7
GRC	235	201	236	221	192	196	153	169	216	225	322	333	226	224	37.4	66.0
HKG	392	136	281	127	331	145	381	167	412	180	319	181	353	156	−18.4	33.1
HRV	876	1082	1018	1248	1100	1036	869	860	979	1063	1185	1369	1004	1110	35.3	26.5
HUN	492	398	526	383	370	295	335	254	422	298	498	366	441	332	1.3	−8.1
IDN	279	88	437	111	316	105	233	87	158	57	148	63	262	85	−46.8	−28.9
IND	136	56	98	52	114	48	75	35	60	29	51	28	89	41	−62.5	−49.0
IRL	321	190	291	159	209	134	183	111	230	156	279	146	252	149	−12.8	−23.1
ISL	2791	3595	2241	3120	1939	2874	1603	2109	2842	3609	2498	3449	2319	3126	−10.5	−4.1
ISR	173	292	159	283	183	299	226	302	195	262	170	247	184	281	−2.1	−15.5
ITA	25	21	25	21	23	20	23	20	28	24	35	31	27	23	39.5	45.1
JPN	6	5	7	7	8	8	12	11	10	10	14	15	10	9	130.4	183.3
KHM	30 812	7136	28 153	5025	16 829	4074	21 967	4252	17 403	3315	12 585	2629	21 291	4405	−59.2	−63.2
KOR	84	38	93	44	78	39	56	34	64	33	54	34	72	37	−36.2	−9.1
LTU	2974	2820	2089	2417	1862	1701	1338	1155	1478	1205	1562	1393	1884	1782	−47.5	−50.6
LUX	1231	411	1284	347	1156	315	923	214	939	217	919	192	1075	283	−25.4	−53.2
LVA	3815	3866	3026	3062	2610	2280	1679	1290	2147	1553	2238	1779	2586	2305	−41.3	−54.0
MAR	706	527	706	571	740	588	685	632	660	585	643	659	690	594	−9.0	25.0
MEX	160	74	97	48	84	48	95	46	96	51	92	55	104	54	−42.5	−25.1
MLT	6779	4058	6838	3869	6359	3806	4890	2350	3992	2082	3714	2026	5429	3032	−45.2	−50.1
MYS	390	173	496	151	381	122	370	122	304	106	302	104	374	130	−22.7	−39.7
NLD	50	53	57	57	50	54	45	55	49	59	59	72	52	59	18.0	35.9
NOR	155	171	154	171	133	156	133	137	126	140	142	178	141	159	−8.4	4.0
NZL	429	341	439	383	421	337	364	318	355	323	347	322	393	337	−19.2	−5.4
PER	909	494	867	544	952	535	817	471	591	348	449	339	764	455	−50.7	−31.3
PHL	491	219	468	250	660	293	668	267	548	223	384	178	536	238	−21.8	−18.7
POL	207	153	190	142	183	126	124	93	130	93	140	111	162	120	−32.2	−27.9
PRT	240	190	226	200	206	190	199	190	243	225	330	298	241	216	37.3	57.0
ROU	1131	462	918	590	648	468	354	262	446	276	472	305	661	394	−58.2	−33.9
RUS	79	83	163	141	80	80	41	41	35	35	48	44	74	70	−39.0	−47.4
SAU	138	210	121	211	125	199	124	157	94	130	69	143	112	175	−50.1	−32.0
SGP	390	142	409	153	420	157	329	142	304	116	262	109	352	136	−33.0	−23.2
SVK	1205	775	1277	826	1022	609	744	422	667	402	716	451	938	581	−40.6	−41.8
SVN	1277	977	1303	1060	1240	969	1091	833	1114	960	1443	1205	1245	1001	13.1	23.3
SWE	70	95	73	100	77	101	79	99	84	104	90	125	79	104	27.8	31.1
TUN	1705	997	1486	984	1565	1034	1116	1179	1263	1209	1274	1303	1401	1118	−25.3	30.6
TUR	262	104	168	106	174	93	176	71	191	71	182	72	192	86	−30.6	−31.1
TWN	121	67	120	72	153	76	147	81	153	76	150	87	141	76	23.3	29.4

(*continued on next page*)

Table A.16 (*continued*).

Cty	1995		1999		2003		2007		2011		2015		Avg.		2015–1995 diff. (in %)	
	Gov	Priv	Gov	Priv	Gov	Priv	Gov	Priv	Gov	Priv	Gov	Priv	Gov	Priv	Gov	Priv
USA	4	4	3	3	3	3	3	4	4	4	3	4	3	3	−8.5	−2.6
VNM	2808	628	2556	475	2557	357	1858	261	1288	179	787	119	1975	337	−72.0	−81.0
ZAF	183	162	207	182	193	160	157	149	131	138	167	188	173	163	−9.0	16.2
Mean	1374	798	1246	755	1016	640	953	487	871	489	815	526	1046	616	−11.3	−4.2
Median	251	178	227	177	207	175	212	162	206	156	205	178	233	161	−15.9	−8.6

Note: Constructed Home Bias indexes estimated from the specifications in columns (7) and (8), Tables 1 and 2. Aggregated CHBs equal a weighted average of sector-level CHBs from Tables A.14 and A.15, where the weights equal the product of expenditure and sales (as shares).

Table A.17
OLS regressions of CHBs on PTAs unilateral depth in government procurement and country characteristics.

Dep. var: Ln(CHB)	(1) Gov.	(2) Priv.	(3) Gov.	(4) Priv.	(5) Gov.	(6) Priv.	(7) Gov.	(8) Priv.	(9) Gov.	(10) Priv.
Unilateral procurement depth	−1.008***	−0.649*	−1.153**	−0.703	−0.102	−0.095	−0.065	−0.065	−0.061	0.039
	(0.371)	(0.338)	(0.490)	(0.451)	(0.089)	(0.098)	(0.041)	(0.056)	(0.053)	(0.049)
Ln(GDP)							−0.927***	−0.935***	−0.878***	−1.115***
							(0.157)	(0.176)	(0.190)	(0.209)
Ln(GDPpc)							0.037	0.084	−0.031	0.287
							(0.162)	(0.181)	(0.204)	(0.227)
EU									0.031	−0.160**
									(0.066)	(0.075)
WTOGPA									−0.015	−0.037
									(0.029)	(0.025)
Institutions									0.045	−0.025
									(0.065)	(0.051)
Year FEs	N	N	Y	Y	Y	Y	Y	Y	Y	Y
Country FEs	N	N	N	N	Y	Y	Y	Y	Y	Y
Obs	372	372	372	372	372	372	372	372	310	310
R^2	0.059	0.028	0.064	0.029	0.985	0.985	0.997	0.997	0.997	0.998

Note: The unit of observation in all regressions is a country–year in the sample (years included are 1995, 1999, 2003, 2007, 2011 and 2015). The variables are described in Section 6. Standard errors are clustered by country. Significant at: *10%, **5%, ***1% level.

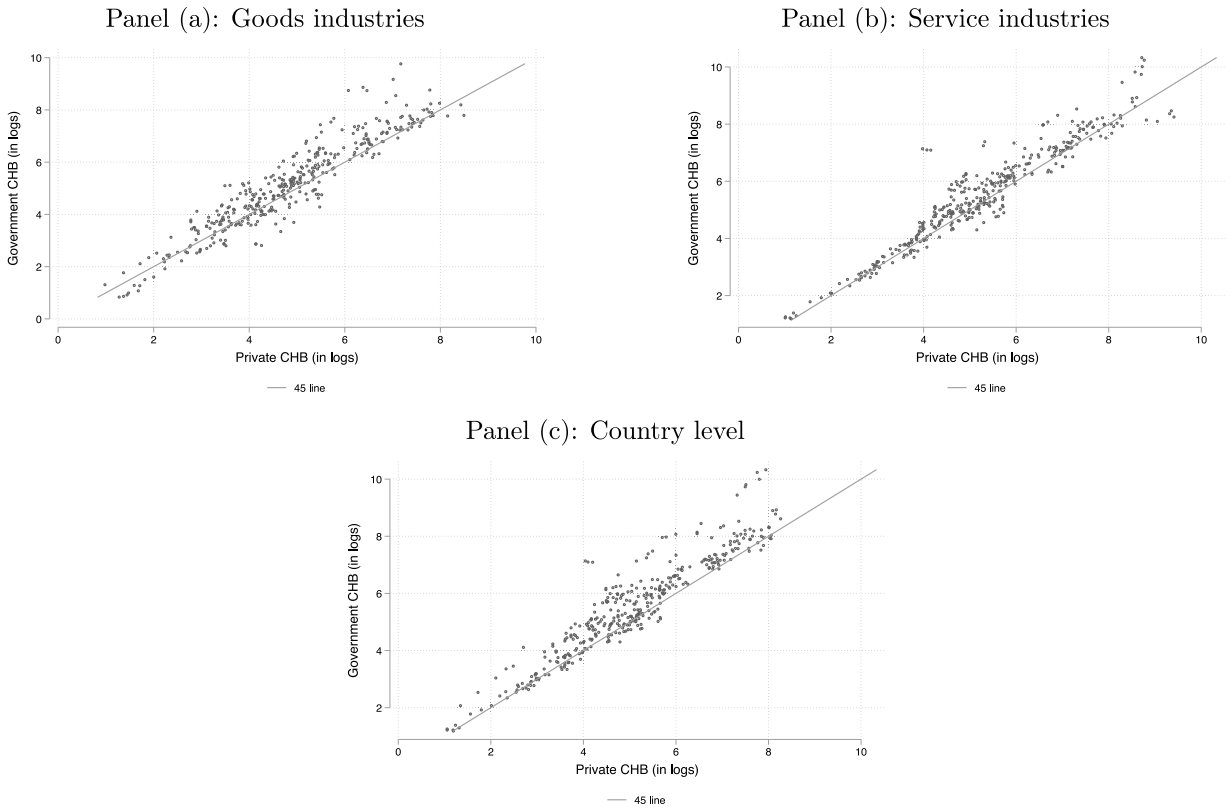

Fig. A.12. CHBs based on industry-level gravity estimates. Note: CHBs indexes are weighted sum of industry-specific CHBs. The industry-specific CHBs are constructed (see Eq. (9)) from estimates of gravity regressions by industry (see the list in Table A.2). The weights used in the aggregation are industry-specific expenditures-sales product shares. Each dot represents a country–year observation (e.g., ARG in 1995).

Appendix B. Supplementary data

Supplementary material related to this article can be found online at https://doi.org/10.1016/j.euroecorev.2022.104204.

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