Do Procurement Agreements Work?

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October 29, 2014

Abstract

Since 1990, the United States has signed agreements on government procurement with more than forty nations. Bids from non-agreement countries must overcome a preference margin in domestic firms' favor, whereas agreement partners' firms are to be accorded national treatment. The key research question is whether these agreements do indeed improve firms' success in procurement auctions, and if so, to what extent. I construct a theoretical framework to model the competitive behavior of bidders in this environment and derive a gravity-type equation to predict bilateral trade flows. Empirical results using U.S. data indicate that national treatment agreements increase partners' probability of success by 174 percent and total revenues by 251 percent; however, evidence suggests that these gains come primarily from trade diversion. Gains are concentrated in high-value contracts. Worldwide, agreements increase typical partners' annual income by $25 to $45 million.

Keywords: International Trade, International Agreements, Auctions, Government Procurement

JEL Codes: F14, F53, D44 , L1, H57

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I am indebted to my advisor, Rodney Ludema and my committee, Anna Maria Mayda and Lindsay Oldenski, for their invaluable comments and support.

1 Introduction

Following the large scale reduction in tariffs worldwide seen in recent decades, non-tariff barriers have emerged as the next hurdle to world economic integration. Not least among these barriers are the many policies maintained by states to preference domestic firms over foreign firms in bids for government procurement contracts. As awareness of the potential inefficiencies imposed by preference regimes has grown, countries have begun to sign agreements explicitly granting national treatment to partners' firms on a reciprocal basis. In 1990, only seven international trade agreements[1] included provisions regarding government procurement; by 2010, this number had grown to at least thirty-five, comprising over fifty signatory countries.

Public procurement is the process by which governments contract with firms for the delivery of goods and services. Worldwide, procurement spending accounts for between 14 and 19 percent of global GDP; in the United States, it represents between 30 and 40 percent of total discretionary government spending. Today, most countries reserve the majority of their procurement market for domestic suppliers; however, if all governments opened their markets to international competition, it has been estimated that the value of such contestable procurement would be nearly a third as large as the total value of world trade.[2]

Given the explosion in the number of international agreements and the sheer size of procurement markets, there is a surprising lack of research into the topic. There does exist a small body of theoretical literature, pioneered by McAfee and McMillan (1989), exploring the relationship between trade and procurement, but none have gone so far as to develop a multi-country general equilibrium model. Almost entirely nonexistent is the research empirically testing the real-world efficacy of procurement agreements.

The purpose of this paper is to evaluate the impact of U.S. national treatment agreements (NTAs) and answer the question: Do procurement agreements increase inter-partner trade? I first develop a theoretical model incorporating elements from the political economy, international trade, and auction theory literatures to predict trade flows as a function of comparative advantage and domestic preference levels. I then use this model to derive estimating equations with which to

[1] These seven agreements are: The (Tokyo Round) Government Procurement Agreement, the European Free Trade Association, the European Community, the Panama–Honduras Free Trade Agreement, the Australia–New Zealand Free Trade Agreement, the U.S.-Israel Free Trade Agreement, and the Canada-United States Free Trade Agreement

[2] Audet (2002)

empirically analyze the effects of NTAs on U.S. procurement awards. Because procurement contracts are granted in locations worldwide, I analyze the data both at the local level and aggregated over all locations. Procurement is measured along two dimensions: the number of contracts won by a partner and their total value. I use a control function to adjust for the potential selection bias represented by zeros in the data. I further employ an instrumental variable approach to control for potential endogeneity between NTA formation and volume of procurement flows.

Results indicate that national treatment agreements have a statistically significant effect on both the number of contracts a partner country may expect to win as well as total revenue from U.S. procurement contracts. The size and nature of the effect depends on the level of analysis. In a location where a partner has historically been awarded tenders, after signing an NTA the partner may expect to win 68 percent more contracts. Worldwide, signatory partners realize a more substantial 142 percent increase in number of contracts won, equivalent to an additional 135 contracts annually. Signatories' firms' revenues double after signing an agreement. Measured in terms of increased revenues, signing an NTA is worth approximately $42 million annually for the typical country. Agreement partners' gains in the United States are concentrated in large-value contracts, whereas local gains are dispersed among contracts of all sizes, which suggests a role for fixed costs in the preparation of bids abroad.

Finally, there is some evidence of trade diversion. Partners' market access does increase after signing an agreement; however, U.S. domestic firms' share of procurement is unaffected by the addition of new NTA partners, and the average non-NTA partner's market share falls. This suggests that partners' gains come at the expense of non-partner countries.

2 Background Information

As of yet, there is no international consensus on how to treat foreign bidders on domestic procurement contracts. Official policies cover the full spectrum, from Chile's policy of evaluating bids entirely blind to the bidder's nationality, to Mexico's complete ban on foreign firms' participation.[3] Most countries fall between these two extremes, maintaining preference policies that skew procurement towards domestic suppliers. These policies range from obfuscatory bureaucratic requirements

[3]Exceptions do exist to the Mexican ban. For instance, NAFTA partners are free to bid on Mexican procurement contracts and are awarded national treatment.

meant to deter foreign bidders to explicit preference margins in favor of domestic firms.

Procurement processes follow a typical pattern. The procuring agency extends an invitation to firms to submit bids. These invitations, which describe the required deliverable in detail, may be open to all capable bidders and posted in common trade bulletins or may be extended selectively to a limited list of pre-qualified firms. Ideally, countries seeking to minimize costs would invite international competition and award the contract to the lowest-price bidder. In practice, this is rarely the case.

In the United States, procurement from international sources is governed principally by the Buy American Act of 1933, which was intended to promote the use of American-made goods in federal projects.[4] In brief, the act requires procurers to favor firms supplying goods containing at least fifty percent domestic content.[5] Bids meeting this requirement are to be considered domestic, while all others are considered foreign. This domestic-favoring policy is implemented through price preference margins. All else being equal, in the event that a foreign firm submits the lowest-priced qualified bid, the procuring agency must inflate the bid price before evaluating the offer. The inflation rate varies depending on the status of the lowest domestic offer: 6 percent in cases where the lowest domestic offer is from a large business; 12 percent when from a business that is small, owned by a woman, owned by a member of a racial minority, or from an economically depressed region; and 50 percent for Department of Defense procurement contracts.[6] If this inflated price exceeds the lowest domestic offer, then the procurement agent must award the contract to the domestic firm. However, if the inflated bid is still less than the lowest domestic offer, then the agency is permitted to accept the foreign bid at its pre-inflation price.[7]

In a vein counter to the protectionism of the Buy American Act, by 2010 the United States had signed nearly a dozen trade agreements containing chapters bilaterally or plurilaterally liberalizing public procurement. The United States was, in fact, an early mover in this domain. The 1985

[4] 41 U.S.C. §§8301–8305

[5] The nationality of the firm is *de jure* irrelevant; the critical criterion is the domestic content of goods supplied. A domestic firm offering to supply imported goods is to be regarded as a foreign firm, while a foreign-owned firm supplying American-made goods would be considered domestic. However, in practice the nationality of the firm is the *de facto* determining factor.

[6] Department of Defense preference policies apply only to non-strategic goods and services. Armaments, munitions, and the like are governed by internal policies that restrict foreign contractors to a small set of military allies.

[7] These requirements are waived if the requisite goods are unavailable domestically at a reasonable price, if the end goods are intended for use outside the United States, or if the expected value of the contract does not exceed the micro-purchase threshold, which varies by agency but is generally $3,000.

Israel Free Trade Agreement was only the third trade agreement between any two modern states to explicitly address procurement.[8] In 1994, the United States began extending national treatment to Mexican and Canadian firms through NAFTA. It was a founding member of the Government Procurement Agreement (GPA), in 1981 joining with a small group of nations to symbolically recognize the importance of procurement liberalization. While the GPA's first incarnation was largely toothless, the agreement was given true force in 1996 by the addition of conflict resolution and appeals procedures, the reduction of disclosure thresholds, the massive expansion of covered product classes, the addition of services (including construction), and the extension to publicly owned entities and subnational units. By 2010, the United States was party to eleven agreements with a total of forty-three partners, the greatest number of partners and agreements of any nation.

These treaty obligations all share essential features, the most important of which is the national treatment requirement. Signatory states are required to treat each other's firms as if they were domestic. Foreign suppliers[9] that elect to submit bids are to be treated as U.S. firms, and thus are not subject to the Buy American Act's price inflation margins or domestic content requirements. Indeed, national treatment requires signatories' firms to be accorded the same preferences as domestic firms vis-à-vis non-signatory countries. Each agreement sets a minimum value threshold above which the terms of the agreement come into force. These thresholds range from $50,000 to $190,000 depending on the agreement and the class of good or service. For contracts with values above threshold, procuring agencies must publish a notice[10] in the treaty partner's appropriate trade bulletins inviting interested suppliers to submit tenders. All U.S. bilateral procurement agreements are comprehensive in their coverage, while the plurilateral WTO Government Procurement Agreement contains an annex for each member comprising a negative list of excluded goods and a positive list of included services.

The U.S. engagement with procurement policy is a reflection of the importance of procurement to the U.S. federal budget. In 1990, the federal government spent upwards of $151 billion on nearly 400,000 contracts awarded through the federal procurement system, which made up 12.5 percent of that year's entire $1.2 trillion federal budget. By 2010, this value had grown to $540 billion

[8] The 1973 Panama–Honduras FTA was the first; the second was the 1983 Australia–New Zealand Agreement

[9] with at least fifty percent ownership by nationals of the treaty partner, though this varies from agreement to agreement

[10] In general, the minimum requirement is 30 days' prior notice.

spread among nearly 6 million contracts, representing 15 percent of the $3.6 trillion budget.[11] A significant portion of the budget is reserved for entitlement programs, in which procurement plays a marginal role; a better indication of the importance of procurement is its share of total discretionary spending. In 1990, federal discretionary spending totaled $500 billion, of which 30 percent was procurement. In 2010, discretionary spending totaled $1.3 trillion, of which 40 percent was procurement spending.[12]

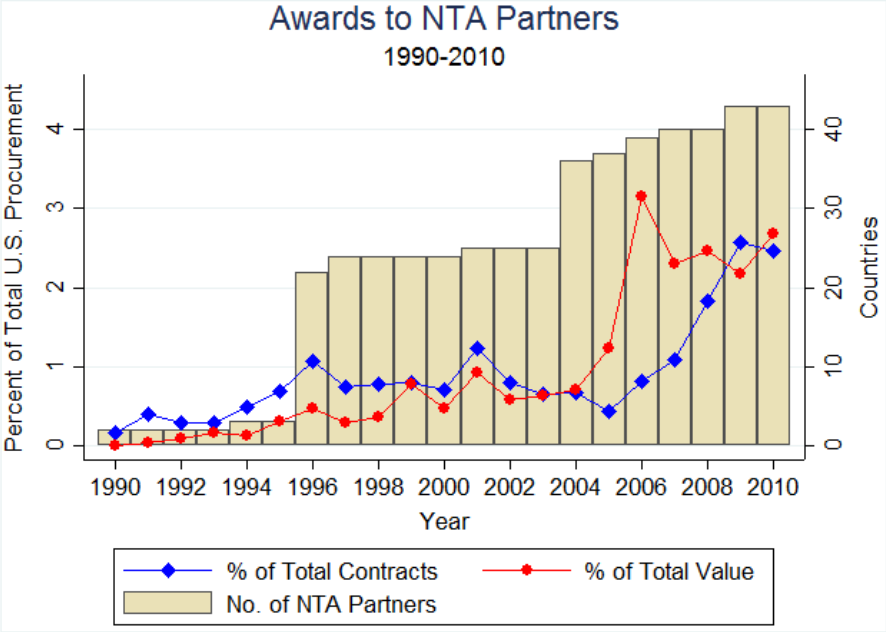

Figure 1: Contracts and value awarded to NTA partners, 1990–2010

In 2010, U.S. agencies signed over 5.7 million government procurement contracts.[13] These contracts engaged firms from 174 countries to supply goods and services in over 220 countries and territories. At that time, NTAs existed between the United States and 43 partner countries—agreements explicitly signed to increase competitiveness and openness.[14] However, despite its breadth, foreign participation in U.S. public procurement lacked depth: 93 percent of projects were located in the United States, and 97 percent of all contracts were awarded to U.S. firms.

Figure 1 illustrates how awards to foreign firms have evolved as the United States has added new NTA partners. Both in terms of number of contracts won and in total procurement value,

[11] See Federal Procurement Data System, `https://www.fpds.gov`
[12] See Office of Management and Budget, `http://www.whitehouse.gov/omb/budget/historicals`
[13] (U.S. Government Services Administration, 2014)
[14] A complete list of trade agreements and procurement agreements can be found in Appendix A-1

firms from partner countries have secured an increasing share of the U.S. procurement market. The purpose of this paper is to investigate the degree to which national treatment agreements have influenced this trend.

3 Literature Review

The effects of discriminatory procurement on trade flows are by no means insubstantial. Baldwin and Richardson (1972) estimate that the Buy American program's preference margins reduced imports in 1963 by roughly half a percentage point, or approximately $110 million. Lowinger (1976) found that the cost to the government of Buy American was $121 million in 1963 and predicted that imports by the U.S. government in the mid-1960s would increase seven-fold if preferences were eliminated.[15] Deardorff and Stern (1979) argued that, for industrialized countries, the welfare gains from eliminating discriminatory procurement policies would exceed the gains from all tariff liberalization in the Tokyo Round. Francois et al. (2000) evaluated the effects of the Tokyo Round GPA on procurement in the United States based on data from 1992–1993 disaggregated by sector and procuring agency. They found that in most markets the U.S. accounted for less than 5 percent of total demand, but that in some sectors—such as maintenance and repair, construction, and office equipment—government demand was significant enough that preference policies could be predicted to affect market access. Delta and Evenett (2000) investigated the distributional effects of preference policies in 1980s procurement and found that welfare gains were at best marginal, as benefits from diverting purchases to domestic suppliers were offset by increases in costs. No analysis has been conducted on data more recent than 1993, which leaves unexplored the past two decades of globalization and the concurrent proliferation of NTAs.[16]

Given the size of the government procurement market and the potential trade effects of the elimination of preference policies, there is a surprising dearth of research into the efficacy of public procurement agreements. In fact, to the best of my knowledge, there is currently only one paper that investigates this issue.

[15] For the counterfactual, Lowinger (1976) supposes that government and consumers have the same import propensity, and uses this as a guide for estimating the effects of preference policies.

[16] Audet (2002) attempts to quantify the size of procurement markets worldwide, but stops short of theoretical or empirical analysis. Hoekman and Mavroidis (2000) and Mattoo (1996) similarly serve primarily as surveys of the procurement literature.

Shingal (2011) studies whether the WTO's Government Procurement Agreement has fulfilled its intended purpose and led to greater market access for foreign suppliers. The study uses reports submitted by GPA members to compare the value of procurement awarded to foreign firms with counterfactual values which are calculated using a recursively defined time trend based on private consumption import profiles. The author concludes that the GPA has been ineffective in expanding market access. However, the study suffers from a number of limitations. Reports do not begin until the first full year after the agreement's entry into force, which makes establishing trends prior to the agreement problematic. Because signatory governments have been remiss in their treaty obligation to submit annual reports, only data for Switzerland and Japan are considered. The analysis further restricts the data to trade in services, which sees far less coverage under the GPA than does trade in goods. While Shingal (2011) does disaggregate trade flows into 25 service categories, the analysis lacks the requisite breadth and depth to conclusively test for the effects of GPA membership; its results, in the author's own acknowledgement, are "more suggestive than conclusive."

Fortunately, there exists a rich literature testing the effectiveness of free trade agreements (FTAs). Tinbergen (1962) was the first to publish an econometric study using a gravity-type equation, finding that FTAs boost flows by an average of 5 percent. The gravity equation has since emerged as the gold standard for empirical study of the average treatment effect of trade agreements on bilateral trade flows; many other studies have followed, though their results have often been contradictory.[17] Anderson (1979) and Anderson and van Wincoop (2003) provided theoretical underpinnings for the previously atheoretical gravity equation[18] and emphasized the omitted variable bias that results from failing to include price indices, known as multilateral resistance terms. Feenstra (1994) suggests that using country fixed-effects will account for these multilateral resistance terms and generate unbiased coefficient estimates. Trefler (1995) illustrates the importance of including instrumental variables to correct for endogeneity between trade flows on the left-hand side and trade agreement formation on the right. Baier and Bergstrand (2004) describe a rigorous process for determining the average treatment effect of free trade agreements on bilateral trade flows and econometrically illustrate the importance of incorporating each of the previous innovations. Reliably estimating the effects of procurement agreements on trade calls for detailed data

[17] See also Aitken (1973), Abrams (1980), Bergstrand (1985), Frankel et al. (1997)

[18] See also Baier and Bergstrand (2007) and Helpman and Krugman (1985)

and careful econometric analysis, which have thus far been absent from the relevant literature.

Baldwin (1970, 1984) and Baldwin and Richardson (1972) have argued for a neutrality result in preferential government procurement. In short, the neutrality result maintains that any preference which skew government purchases toward domestic suppliers will be perfectly offset by consumers shifting their purchases to foreign suppliers, effectively netting out. Miyagiwa (1991) theoretically explored the Baldwin-Richardson result in the context of perfect substitutes and found that neutrality continues to hold under a variety of market organizations. While its results do predict that preference regimes will affect procurement trade volumes, the theory suffers from ignoring the auction nature of government contracting and lacks the support of follow-up empirical analysis.

McAfee and McMillan (1989) were the first to introduce an auction framework into the analysis of government procurement and trade. In their model, each bidder draws a cost from a distribution unique to its home country. One country is said to hold a comparative advantage over another country if its cost distribution first-order stochastically dominates the other's. Cost is private knowledge, which the bidder uses to determine its bid. By offering a price preference in favor of the disadvantaged firm—whether it be foreign or domestic—the government can increase the competitive pressure on the advantaged firm, inducing it to offer a lower bid. Additionally, if domestic firms' profits enter the welfare function with the same weight as consumer surplus, it is always in the government's interest to offer a price preference in favor of domestic firms.

The optimality of small preference margins has so far proven to be a robust result. Brander and Spencer (1981) appeal to a profit-sharing argument for discrimination against foreign bidders, which they recommend implementing via linear tariffs. Branco (1994) shows that non-zero preferences still maximize welfare—even in the absence of comparative advantage—when considering the distortionary effects of taxes, which are used to endogenously determine specific weights for consumer surplus and domestic firms' profits. Naegelen and Mougeot (1998) expand the preference optimality result and suggest a complex modified first price auction by which to implement it. Rezende (2008) shows that, should the government impose a domestic preference policy, under standard conditions it is best policy to reveal the precise form of the discrimination. Doing otherwise fails to take full advantage of the potential pro-competitive effects of preference margins. Hubbard and Paarsch (2009) and Krasnokutskaya and Seim (2011) evaluate the optimality of discrimination with endogenous participation and find that while participation effects weaken

the preference effect, they do not completely eliminate it. Most recently, Cole and Davies (2014) have treated the issue, testing whether preference margins or tariffs are more distortionary, with the result that tariffs welfare-dominate preference margins. Intuitively, this follows because tariffs permit the government to capture some of the producer surplus.

Critically, all of these analyses lack any strategic interaction between governments and trade partners. Each takes a unilateral approach, and in no case do the authors consider whether preference policies are still welfare-maximizing in the presence of treaty obligations requiring both parties to eliminate preference margins. The theoretical model I introduce takes these interactions into account to establish a framework for testing the effectiveness of government procurement agreements. Furthermore, this paper addresses the lack of empirical analysis by using U.S. data to investigate the effect of NTAs on U.S. partners' market access, both in terms of number of contracts and in total value.

4 Theoretical Model

In this section I develop a theoretical model to predict trade flows in procurement markets in the presence of domestic preference margins. Governments are motivated by the competing goals of minimizing procurement expenditures and maximizing domestic firms' profits. Countries are characterized by the size of their procurement markets and the competitiveness of their procurement industries. Procurement is conducted by auction. In the absence of a national treatment agreement, foreign bids are disadvantaged vis-à-vis domestic bids by a fixed inflation margin. Firm's costs are private knowledge, but the distribution of costs is known to all. The theoretical model generates estimating equations which are used for the empirical analysis.

A government agency wishes to offer a contract to independent firms for an indivisible project which it values at v. The government alerts firms of the auction at time $t = 0$ and closes its tendering window at time $t = 1$, during which bidders arrive from each country i according to a Poisson process with constant instantaneous arrival rate μ_i. Once the tendering window closes, the government agency chooses its most-preferred bid.[19]

The set of all countries Ω consists of N individual countries, each of which may conduct its

[19] Let q represent the number of bidders from country i by the close of the auction. Then q is distributed according to $\Pr(q_i = k) = \frac{e^{-\mu_i}(\mu_i)^k}{k!}$ for $k = 0, 1, 2, ...$

own auctions, and whose firms may bid on auctions both domestically and abroad. Thus, from the perspective of auctioneer country n, the bidder countries are denoted by $i \in n, f_1 ... f_{N-1}$, consisting of one domestic country and $N-1$ foreign countries.

Bids are functions of firms' cost parameters, which are drawn from country-specific distributions $G_i(c)$ on $\kappa_i = [\underline{c}_i, \bar{c}_i]$. $G_i(c)$ is continuously differentiable with density $g_i(c)$. I restrict attention to the regular case, which corresponds to the assumption that the hazard rate $\frac{G_i(\cdot)}{g_i(\cdot)}$ is non-decreasing.[20]

The government's goal is to maximize total welfare, which it defines as a weighted function of consumer surplus and domestic producer surplus. The government assigns weight $\alpha_n \in [0,1]$ to the profits of domestic firms, where a value of 0 implies that the government ignores domestic profits, and a value of 1 implies that domestic profits' are valued equally to the government's cost savings. Procurement is funded through a non-distortionary lump-sum tax.[21]

The revelation principle (Myerson, 1981) insures that for any possible optimal auction mechanism there exists an equivalent direct revelation mechanism in which firms inform the government of their true costs and the government assigns payments accordingly. The solution to this mechanism design problem can be characterized by a set of equations $\{J_i(c), \Psi_i(c)\}$, where $J_i(\cdot)$ is the expected payment, $\Psi_i(\cdot)$ is the probability of awarding the contract to firm i, and c is the vector of all true firm costs. McAfee and McMillan (1989) solve a similar problem, though omitting the variable weight on domestic profits and allowing for a divisible good. I borrow liberally from their methodology in the following results.

The government's objective function is

$$W_n = \int_{\kappa} \left[v \sum\nolimits_i \Psi_i(c) - \sum\nolimits_i z_i(c) + \alpha_n \pi_n(c) \right] dG(c) \tag{4.1}$$

where $\kappa = \kappa_i \times ... \times \kappa_N$ and $G(c) = G_i(c)...G_N(c)$.

The firm's profits are given by

$$\pi_i(c) = E\left[z_i(c) - c_i \Psi_i(c) \right] \tag{4.2}$$

[20] This assumption is satisfied by most standard distributions and is sufficient for the existence of a unique equilibrium; see Bagnoli and Bergstrom (2005).

[21] This assumption avoids the complication of including a shadow cost to represent the distortionary effects of taxation; See Meade (1944).

Note that the envelope theorem implies

$$\frac{\partial \pi_i(c)}{\partial c_i} = -E_{-i}\left[\Psi_i(c_i; c_{-i})\right] \tag{4.3}$$

In designing the optimal mechanism, the government is subject to several constraints. The individual rationality (IR) constraints require expected profits for all firms to be non-negative:

$$\pi_i(c) \geq 0 \quad \forall i \in N \quad \forall c \in \kappa \tag{4.4}$$

Note that (4.4) implies the IR constraint is satisfied as long as $\pi_i(\bar{c}_i; c_{-i}) \geq 0$. The incentive compatibility (IC) constraints require truth-telling to be profit-maximizing, and are given by

$$\pi_i(c_i; c_{-i}) \geq \pi_i(\tilde{c}_i; c_{-i}) \quad \forall i \in N \ \ \forall c_i, \tilde{c}_i \in \kappa \text{ and } \tilde{c}_i \neq c_i \tag{4.5}$$

Finally, the probabilities of winning the auction for all bidding countries must sum to unity and be between zero and one. These feasibility constraints are given by

$$\sum\nolimits_i \Psi_i(c) = 1 \text{ and } 0 \leq \Psi_1(c) \leq 1 \quad \forall i \in N \quad \forall c \in \kappa \tag{4.6}$$

Consequently, total welfare for country n is given by

$$W_n = \int_{\kappa} \left\{ \sum\nolimits_i \left[(v - c_i)\,\Psi_i(c)\right] - \sum\nolimits_i \left[z_i(c) - c_i \Psi_i(c)\right] + \alpha_n \pi_n(c) \right\} dG(c) \tag{4.7a}$$

After substituting the conditions implied by the constraints, this can be rewritten as

$$W_n = \int_{\kappa} \sum_i \left[(v - c_i)\,\Psi_i(c)\right] dG(c) - \int_{\kappa} \sum_{i \neq n} \pi_i(c)\, dG(c) - \int_{\kappa} (1 - \alpha_n)\,\pi_n(c)\, dG(c) \tag{4.7b}$$

Next, I integrate by parts the second and third expressions and substitute using (4.3). We can set $\pi_i(\bar{c}_i) = 0$ without loss of generality, and $G_i(\underline{c}_i) = 0$. After recombining the limits of integration, this results in

$$W_n = \int_{\kappa} \left\{ \left(v - c_n - (1-\alpha_n)\frac{G_n(c_n)}{g_n(c_n)} \right) \Psi_n(c_n) + \sum_{i \neq n} \left[\left(v - c_i - \frac{G_i(c_i)}{g_i(c_i)} \right) \Psi_i(c_i) \right] \right\} dG(c) \quad (4.7c)$$

The solution to the mechanism design problem is the maximization of W_n with respect to $\Psi_i(c)$. In deciding which firm to award the contract, the government should evaluate the terms in large parentheses and choose the greater of the two. This implies the following decision rule,

Decision Rule

$\Psi_n(c) = 1$ and $\Psi_i(c) = 0 \ \forall i \neq n$ if $c_n - (1-\alpha_n)\frac{G_n(c_n)}{g_n(c_n)} \leq \min_{i \neq n} \left(c_i + \frac{G_i(c_i)}{g_i(c_i)} \right)$

Otherwise,

$\Psi_{i^*}(c) = 1$ and $\Psi_i(c) = 0 \ \forall i \neq i^*$ where $i^* = \arg\max_{i \neq n} \left(c_i + \frac{G_i(c_i)}{g_i(c_i)} \right)$

The payment function satisfying the decision rule is given by

$$J_i(c_i) = c_i + \frac{G_i(c_i)}{g_i(c_i)} \quad (4.8)$$

The decision rule and payment function above imply discrimination in favor of domestic firms. Suppose there exists a discrimination function $z_i(c_i)$ such that $c_n = z_i(c_i)$. This discrimination then takes the form

$$z_i(c_i) = \begin{cases} c_i & \text{if } i = n \\ c_i + \frac{G_i(c_i)}{g_i(c_i)} + (1-\alpha_n)\frac{G_n(c_n)}{g_n(c_n)} & \text{if } n \neq i \end{cases} \quad (4.9)$$

Following Eaton and Kortum (2002), a particularly convenient cost distribution is

$$G_i(c_i) = \left(\frac{c_i}{\beta_i} \right)^{\theta}$$

where $\beta_i > 0$ and $\theta > 0$. This cost distribution can be derived from a Pareto distribution of productivity.[22] The maximum cost a firm may draw in country i is given by β_i; countries

[22] Let s denote productivity and assume it is distributed Pareto, $f(s) = a s_{min}^{a} z^{-a-1}$. Unit cost is then $c = \frac{w}{s}$,

with relatively lower β_i are said to have a cost advantage in procurement industries. The shape parameter θ shifts the weight within the distribution such that as θ rises the mean of each distribution also rises. For mathematical simplicity, θ is common across countries. Given this distribution, the payment function becomes

$$J_i(c_i) = \frac{1+\theta}{\theta} c_i \tag{4.10}$$

This in turn leads to a discrimination function of the form

$$z_{i,n}(c_i) = \Delta_{i,n} c_i \quad \text{where } \Delta_{i,n} = \begin{cases} 1 & \text{if } i = n \\ \frac{1+\theta}{1+\theta-\alpha_n} & \text{if } n \neq i \end{cases} \tag{4.11}$$

The term $\Delta_{i,n}$ is determined by the parameters θ and α_n and represents the discrimination factor applied by country n against bids from i. That is, a foreign bid is inflated by $\Delta_{i,n}$ when evaluated against a domestic bid; however, in the event that a foreign firm's inflated bid still wins, the firm is paid $J_i(c_i)$, and not $J_i(\Delta_{i,n} c_i)$.

To select the winning bid, the government chooses the minimum value of $y_{i,n} = c_i \Delta_{i,n}$. Define $\tilde{y}_i$ as the minimum bid across all firms from country i. Let $H_i(\tilde{y})$ denote the distribution of $\tilde{y}$ from the perspective of country n, omitting the subscript.[23] That is, $H_i(\tilde{y})$ is one minus the probability that all evaluated bids from country i are greater than $\tilde{y}$, or

$$H_i(\tilde{y}) = 1 - e^{-\phi_i \tilde{y}^\theta} \qquad \tilde{y} \in [0, \infty]$$

where $\phi_i \equiv \mu_i (\beta_i \Delta_i)^{-\theta}$, and omitting the subscript n.[24]

Define $\hat{y} \equiv \min_i \tilde{y}_i$ as the minimum of $\tilde{y}_i$ over all bidding countries i. Furthermore, let

where w is the wage. If $c = h(s)$, then the distribution of c is $g(c) = f(h^{-1}(c)) \left| \frac{dh^{-1}(c)}{dc} \right|$. Thus, $g(c) = a c_{max}^{-a} c^{a-1}$, and $G(c) = c_{max}^{-1} c^a I(c)_{[0, c_{max}]}$.

[23] From here onward, I will generally suppress the subscript n wherever its inclusion overcomplicates notation; the text will note whether terms are general or specific to a single country n.

[24] Technically, given the granular nature of the Poisson distribution, the distribution of $\tilde{y}$ should be given by $H_i(\tilde{y}) = 1 - e^{-\phi_i \tilde{y}^\theta} + e^{-\mu}$ with a range of $y \in [0, \Delta\beta]$. This is because there is positive probability that no bid arrives. However, for the sake of simplicity, I will simply assume that $\tilde{y}$ is distributed according to a standard exponential distribution with limits between zero and infinity.

$\Phi_n \equiv \sum_i \mu_i(\beta_i\Delta_i)^{-\theta}$. The distribution of $\hat{y}$ is therefore

$$\hat{H}_n(\hat{y}) = 1 - e^{-\Phi_n \hat{y}^\theta} \qquad \hat{y} \in [0, \infty]$$

The probability that a firm from country i has the lowest evaluated bid $\hat{y}$ in country n is given by $\rho_{i,n} \equiv \Pr\left[\hat{y}_{i,n} \leq \min_i \left\{\hat{y}_{i,n}\right\}\right]$. For a given $\hat{y}_{i,n} = \hat{y}$, the probability that all other evaluated bids are higher is

$$\prod\nolimits_{s\neq i} \Pr\left[\hat{y}_{s,n} \geq \hat{y}_{i,n}\right] = \prod\nolimits_{s\neq i}\left(1 - \hat{H}_i(\hat{y})\right) = e^{-\Phi_{n,-i}\hat{y}^\theta}$$

where $\Phi_{n,-i} \equiv \sum_{s\neq i} \mu_s(\beta_s\Delta_{s,n})^{-\theta}$. Integrating over all possible values of $\hat{y}$ generates the following simple expression for $\rho_{i,n}$:

$$\rho_{i,n} = \frac{\phi_i}{\Phi_n} \tag{4.12}$$

With discrimination, countries may face varying likelihoods of tendering the winning bid in each country n. However, among countries that impose no discrimination against foreign bidders the likelihood of success for country i is constant, regardless of valuation v. Furthermore, in a world of complete nondiscrimination, the likelihood of country i winning an auction becomes a constant across all countries, denoted by $\bar{\rho}_i$. The probability $\rho_{i,n}$ also represents country i's share of country n's total procurement expenditure,[25] a result that will be important for the generation of an estimation equation.

The government pays a sum dependent on the uninflated cost. For computational simplicity, the average value of procurement contracts is common across countries. Because the government values the project at v, the maximum bid that it is willing to accept is $y_i \leq \frac{v\Delta_{i,n}\theta}{1+\theta}$.

This upper limit implies that there exists a positive probability that the government will receive no acceptable bid: either no firm bids on the project or all bids fall above the government's reservation value v. Let the government's valuation be less than the lowest of the maximum production costs across countries: $v \leq \min\{\beta_i\}_{i=1\ldots N}$.[26] The upper limit

[25] It can be shown that $\hat{H}_n(y) = \frac{1}{\rho_{i,n}} \int_0^\infty \prod_{s\neq i}[1 - H_s(y)]\, dH_i(\hat{y})$, which implies that conditioning on the origin of a bid does not affect the distribution of bids. This, together with the derivation of $\rho_{i,n}$, implies the result.

[26] This simplifies the bounds of integration.

also depends on $\Delta_{i,n}$, which is equal to 1 for domestic and NTA partner firms and equal to $\frac{1+\theta}{1+\theta-\alpha_n}$ for non-partners. Let Ω_n represent the set of all countries against whom country n does not discriminate: country n itself and its treaty partners, should any exist. Define $\rho_{\Omega_n} \equiv \sum_{i\in\Omega_n} \rho_i$ as the probability that country n or one of its treaty partners submits the lowest evaluated bid. Conditional on such a bid existing, the expected value of the lowest acceptable bid $\hat{y}$ is given by

$$E_n(\hat{y}) = \Phi_n^{-\frac{1}{\theta}} \left(\rho_{\Omega_n}\gamma_{\Omega_n} + \rho_{-\Omega_n}\gamma_{-\Omega_n}\right) \tag{4.13}$$

where γ_{Ω_n} and $\gamma_{-\Omega_n}$ are incomplete lower gamma distributions for agreement partners and non-partners, respectively.[27]

In the absence of discrimination $\hat{y} = \hat{c}$, where $\hat{c}$ is the minimum of all costs worldwide without any discrimination or inflation. Likewise, if all $\Delta_{i,n} = 1$, then $\Phi_n = \Phi$ for all n. Neither $\hat{c}$ nor Φ varies by country. The value of the minimum expected acceptable bid under complete non-discrimination is given by

$$E(\hat{c}) = \Phi^{-\frac{1}{\theta}}\gamma \tag{4.14}$$

In this case, the expected bid is equal to the expected payment and is constant across all countries.

In the case of discrimination, this expression becomes more complex. Recall that $E_n(\hat{y})$ is the expected value of the winning inflated bid under discrimination. If this bid comes from a domestic firm or a treaty partner, then $E_n(\hat{y})$ is the true value of the winning bid. However, if this bid comes from a country against which the auctioning nation discriminates, then the government instead pays a sum dependent on the uninflated value of the bid; that is, the government pays $\frac{1+\theta-\alpha_n}{1+\theta}E_n(\hat{y})$. Under discrimination, the expected payment P_n from

[27] $\gamma_{\Omega_n} = \gamma[\frac{1+\theta}{\theta}, \Phi_n(\frac{v\theta}{1+\theta})^\theta]$ and $\gamma_{-\Omega_n} = \gamma[\frac{1+\theta}{\theta}, \Phi_n(\frac{v\theta}{1+\theta-\alpha_n})^\theta]$. This is the incomplete lower gamma distribution, where $\gamma[s,x] = \int_0^x r^{s-1}e^{-r}dr$; See Nadarajah (2008)

country n to the winning firm is given by

$$P_n = \Phi_n^{-\frac{1}{\theta}} \left(\tfrac{1+\theta}{\theta} \rho_{\Omega_n} \gamma_{\Omega_n} + \tfrac{\theta+1-\alpha_n}{\theta} \rho_{-\Omega_n} \gamma_{-\Omega_n} \right) \tag{4.15}$$

where ρ_{Ω_n} is the probability that a domestic or NTA-partner firm wins, and $\rho_{-\Omega_n}$ is its complement.

Let $Q_{i,n}$ be defined as the total value of procurement awarded by country n to firms from country i, and let $Q_n \equiv \sum_i Q_{i,n}$ be country n's total procurement spending. Given these definitions, equation (4.12) can be expressed as $\rho_{i,n} = \frac{Q_{i,n}}{Q_n}$, which is to say that country i's share of country n's total procurement is simply equal to its probability of winning an auction in country n. Thus,

$$Q_{i,n} = \frac{\mu_i \beta_i^{-\theta} \Delta_{i,n}^{-\theta} Q_n}{\Phi_n} \tag{4.16}$$

Let $X_i \equiv \sum_n Q_{i,n}$ be country i's firms' total worldwide revenue from procurement contracts. This implies:

$$\mu_i \beta_i^{-\theta} = \frac{X_i}{\sum_s \frac{\Delta_{i,s}^{-\theta} Q_s}{\Phi_s}} \tag{4.17}$$

Rewriting (4.15) as Φ_n in terms of P_n and combining with (4.16) and (4.17) yields

$$Q_{i,n} = \frac{X_i Q_n \Delta_{i,n}^{-\theta} P_n^{\theta}}{\left(\tfrac{1+\theta}{\theta} \rho_{\Omega_n} \gamma_{\Omega_n} + \tfrac{1+\theta-\alpha_n}{\theta} \rho_{-\Omega_n} \gamma_{-\Omega_n} \right)^{\theta} \gamma_n^{\theta} \sum_s \frac{\Delta_{i,s}^{-\theta Q_s}}{\Phi_s}} \tag{4.18}$$

This equation bears a strong resemblance to standard gravity models. Rewriting in terms of natural logarithms results in

$$\begin{aligned} \ln Q_{i,n} = \ln X_i + \ln Q_n - \theta \ln \Delta_{i,n} + \theta \ln P_n \\ - \theta \ln \left(\tfrac{1+\theta}{\theta} \rho_{\Omega_n} \gamma_{\Omega_n} + \tfrac{1+\theta-\alpha_n}{\theta} \rho_{-\Omega_n} \gamma_{-\Omega_n} \right) - \ln \sum_s \frac{\Delta_{i,s}^{-\theta Q_s}}{\Phi_s} \end{aligned} \tag{4.19}$$

On the right-hand side, the first term is i's total procurement earnings, the second is n's total expenditure. The third is the negative effect of discrimination, while the fourth is the expected price or payment. The fifth term enters negatively and can be understood as a measure of the competitiveness of n's procurement market due to differences in discrimination

rates applied to bidding countries, and the sixth can be interpreted as a multilateral resistance term defined by the effective size of the world market for country i.

Of special interest is the ratio of the value of country i's procurement earnings in country n to the value awarded by country n to its own firms, given by $\frac{Q_{i,n}}{Q_{n,n}}$. Empirically, countries without exception exhibit a strong home bias with regards to awarding procurement contracts; however, this ratio is a good indicator of whether signing procurement agreements permits foreign firms to win more often against domestic opponents. It also provides insight into the source of any changes in NTA partners' procurement winnings, indicating whether they come from increased competitiveness across all firms or merely from cannibalizing market share from other foreign countries. Solving for this ratio significantly reduces the complexity of the preceding expression, resulting in

$$\frac{Q_{i,n}}{Q_{n,n}} = \frac{X_i}{X_n}\theta\Delta_{i,n}\frac{\sum_s \frac{\Delta_{i,s}^{-\theta}Q_s}{\Phi_s}}{\sum_s \frac{\Delta_{n,s}^{-\theta}Q_s}{\Phi_s}} \tag{4.20}$$

Writing in terms of natural logarithms, this becomes

$$\ln\frac{Q_{i,n}}{Q_{n,n}} = \ln\frac{X_i}{X_n} - \theta\ln\Delta_{i,n} + ln\sum_s \frac{\Delta_{i,s}^{-\theta}Q_s}{\Phi_s} - ln\sum_s \frac{\Delta_{n,s}^{-\theta}Q_s}{\Phi_s} \tag{4.21}$$

On the right-hand side, the first term is the ratio of i's worldwide procurement revenues to country n's worldwide revenue; in the absence of any discrimination we would expect the left-hand side and this ratio to be equivalent. The second term is the effect of discrimination, which has a minimum value of zero (corresponding to nondiscrimination when $\Delta_{i,n} = 1$) and becomes increasingly negative as discrimination rises.

The final two terms on the right-hand side merit greater explanation. The term $\frac{\Delta_{i,s}^{-\theta}Q_s}{\Phi_s}$ can be thought of as the expected size of the procurement market in some country s from the perspective of firms in country i after taking discrimination into account. Thus, the sum is the size of the world market for procurement from i's perspective. In a frictionless world of perfect nondiscrimination, the perceived size of the world market would be the same for both countries i and n. In such an environment, the last two terms of (4.21) would cancel

out. However, if country n were to sign sufficiently many nondiscrimination agreements such that the percent of world procurement covered by treaty were greater for n than for i, then increased competition would mitigate the increases i could expect to realize from signing an NTA with n. This implies that governments have a decreasing marginal benefit from signing agreements with countries who have already signed agreements with many other partners.

The empirical model I develop in section 7 considers only bilateral relationships, a restriction imposed by data limitations. However, within the model, trade flows are almost entirely determined by bilateral characteristics. The rest of the world has a marginal effect on the returns to signing an agreement. This affects the magnitude of any trade increase but not its sign. In the case of a single auctioneer country, these marginal effect are controlled for jointly by year fixed effects and multilateral resistance terms.

5 Estimation Strategy

The primary empirical estimation model takes the form

$$\begin{aligned}\ln Q_i = \beta_0 + \beta_1 \text{NTA}_{i,t} + \beta_2 \ln \text{Exports}_{i,t} + \beta_3 \ln Q_{\text{USA},j,t} \\ + \beta_4 \ln \text{Price}_{j,t} + \beta_5 \text{Gravity}_{i,t} + \upsilon_j + \omega_t + \delta_i + \epsilon_{i,j,t}\end{aligned} \tag{5.1}$$

where subscripts i, j, and t correspond to partner, location, and time, respectively. The three penultimate terms are fixed effects for place, year, and partner. The final term is the error.

The estimate of interest is β_1, the coefficient on NTA. A positive, statistically significant coefficient will offer evidence that these agreements do indeed work.

This estimating equation derives from the theoretical model for trade volumes seen in Equation (4.19). Slightly rearranged, this is

$$\ln Q_{i,n} = -\theta \ln \Delta_{i,n} + \ln X_i + \ln Q_n + \theta \ln P_n - \theta \ln \Theta_{i,n} - \ln \sum\nolimits_s \frac{\Delta_{i,s}^{-\theta Q_s}}{\Phi_s}$$

where $\Theta_{i,n} = \frac{1+\theta}{\theta}\rho_{\Omega_n}\gamma_{\Omega_n} + \frac{1+\theta-\alpha_n}{\theta}\rho_{-\Omega_n}\gamma_{-\Omega_n}$. The dependent variable $Q_{i,n}$ is total procurement awarded to country i by country n, measured in either number of contracts or total value.

The first term on the right-hand side represents the effect of discrimination, which I model as a dummy variable equal to 1 in the presence of a national treatment agreement and 0 otherwise.

The second term, X_i, is the total earnings of all firms in country i on all procurement projects worldwide. This information is unavailable, and so as a second best option I use the total revenue earned by country i from exports of procurement goods. In an average year, spending on goods accounts for only 45 percent of total procurement; however, as consistent internationally standardized data on trade in services for the set of countries considered in this analysis is not presently available, total exports of procurement goods remains the best option.

The third term, Q_n, represents total U.S. spending on procurement across all partners. The fourth term, P_n, is the expected contract price, which I model as the average contract value in each location and year. The fifth term $\Theta_{i,n}$, is a measure of barriers for country i to country n's procurement market. I model this as the standard set of gravity explanatory variables, including distance, GDP, common language, NAFTA membership, NATO membership, WTO membership, and FTA membership. The final term is the multilateral resistance term, which is accounted for using country fixed effects. To further ensure reliable results, I also include fixed effects for year and place of procurement, whenever applicable.

The error term accounts for the fact that nearly all the regressors are good-faith approximations of the parameters demanded by the theory. Under ideal circumstance, this error term would be normally distributed with an expected value of zero. However, two characteristics of the data and model may upset this.

First, as suggested by Baier and Bergstrand (2004) in their analysis of free trade agreements, NTAs will likely be endogenous as regressors. That is, while NTAs are signed explicitly to promote trade, it is not unreasonable to expect that the prior existence and size of procurement trade flows affect the formation of NTAs. To control for this potential endogeneity, I suggest an instrumental variable. Using a data set of all trade agreements among 186 countries, I count the number of non-U.S. partners with whom each country has an NTA. Countries range from zero NTA partners to a maximum of forty-three (the United States

and Singapore), with the average country having approximately 4 partners.[28]

I argue that countries with a higher general propensity to sign NTAs will also be more likely to sign an agreement with the United States, but that this propensity is uncorrelated with the partner's procurement trade volume with the United States. There are several potential objections to this claim. Countries with large and influential procurement industries may naturally seek to sign more NTAs in order to enlarge the international procurement market open to their firms. Conversely, Countries with negligible or high-cost procurement industries may sign more NTAs in order reduce government procurement expenditures. However, a survey of the countries with the most NTAs (containted in Appendix A-4) belies either of these explanations. European Union countries all have the same, high number of NTA partners. They are also all NTA partners of the United States. However, procurement trade flows between individual European countries and the United States vary drastically, from among the highest (the United Kingdom and Germany) to among the lowest (Cyprus and Slovakia). Furthermore, among non-EU countries, the nations of South America have a strong tendency to sign procurement agreements, and many have also done so with the United States. However, procurement trade flows with the United States likewise vary greatly from partner to partner, despite their similarity in total number of NTAs. A third objection relies on a trade diversion argument: the more non-U.S. partners a country has, the more its procurement industry firms will concentrate their efforts elsewhere, thus reducing trade volumes with the United States. Yet this supposes that firms are incapable of expanding production to meet the increased demand from greater U.S. market access. I conclude that number of partners is indeed correlated with signing an NTA with the United States, but that it is uncorrelated with the volume and value of U.S. procurement trade flows.

Second, correlation between the error term and the regressors may arise as a result of the log-linear specification. Using logged values means zeros are dropped. If these zeros were randomly distributed, this would not be a problem; however, there is ample room to suspect that some unmeasured country-level characteristics influence firms from a country to submit overly high tenders or to forgo bidding altogether. Thus, zeros contain pertinent information,

[28]The number of NTA partners for each country for the example year 2010 is given in Appendix A-4.

and dropping them will bias the resulting estimates. Following Helpman et al. (2008), I estimate the primary specifications in the form of Heckman selection models to correct for this potential selection bias.[29] Because there is a strong possibility that the source of the selection bias is unrelated to the endogeneity represented by NTA formation, I still use an instrument for NTA in the second-stage regressions. Following Amemiya (1985), I include the inverse Mills ratio from the first-stage probit selection models in subsequent two-stage least-squares regressions.

For the selection model's first-stage exclusion variable, I use a complementarity index which describes how well U.S. demand for procurement goods matches each partner's abilities to supply them. I adapt the trade complementarity index introduced by Michaely (1996), constructing a value-based index as follows:

$$\text{Complementarity Index } = 100\left(1 - \tfrac{1}{2}\sum\nolimits_{l}\left|\frac{x_{il}}{X_i} - \frac{Q_l}{Q}\right|\right)$$

where x_{il} is country i's exports of HS product code l, and X_i is country i's total exports in a given year of all relevant product codes. Likewise, Q_l is U.S. spending on procurement of product l, and Q is total U.S. procurement across all HS codes. Values range from 0 to 100, where higher values indicate a greater match between a country's production and U.S. procurement demands. Because this index is independent of trade volumes and instead focuses on the proven capacity of a partner to supply the goods requested by U.S. agents, this measure should be strongly correlated with the likelihood that a country is selected for at least some procurement but uncorrelated with trade volumes.

For data at the location level, over 99 percent of observations are zeros. I therefore aggregate across locations to produce a data set reporting the number of contracts and total value each partner supplies to the United States worldwide; that is, observations are partner-year. At this level of aggregation, zeros account for only 55 percent of the sample. Furthermore, this permits estimation of the worldwide effects of signing a national treatment agreement.

[29] See Heckman (1979)

The theoretical model also has predictions for how a country's market share will grow in relation to U.S. firms'. Recall that this expression is given in Equation (4.21). After minor reordering, this becomes

$$\ln \frac{Q_{i,n}}{Q_{n,n}} = -\theta \ln \Delta_{i,n} + \ln \frac{X_i}{X_n} + ln \sum_s \frac{\Delta_{i,s}^{-\theta} Q_s}{\Phi_s} - ln \sum_s \frac{\Delta_{n,s}^{-\theta} Q_s}{\Phi_s}$$

The ratio of country i's procurement winnings to U.S. procurement awards is a function of relative exports of procurement goods and services, U.S. discrimination against i, and the sizes of their markets as perceived by country i. In my empirical specification, the ratio of exports is restricted to procurement goods. The final terms are accounted for using fixed effects. I also include the set of gravity variables for control purposes.

The secondary empirical estimation model is given by

$$ln \left(\frac{Q_{i,j,t}}{Q_{US,j,t}} \right) = \beta_0 + \beta_1 \text{NTA}_{i,t} + \beta_2 \text{Exp Ratio}_{i,t} + \beta_3 \text{Gravity}_{i,t} + \upsilon_j + \omega_t + \delta_i + \epsilon_{i,j,t} \quad (5.2)$$

where Exp Ratio is partner i's exports of procurement goods in ratio to the United States' exports. The remaining terms assume the same meanings as in estimation equation (5.1).

Following an NTA, partners may expect to capture a greater share of the U.S. market. This may happen by winning contracts away from U.S. firms, from other foreign firms, or from both. By evaluating NTAs' impact on the partners' market share as a ratio to U.S. market share and non-NTA partners' market shares, I investigate the source of any gains. However, an insufficient increase in market share ratio to U.S. firms should not be construed as direct evidence that NTA partners are not receiving national treatment. Fixed costs may constrain firms to bid on only very large projects. Alternatively, U.S. firms may be so much more productive that they continue to win even without the aid of preference margins. In such cases, the majority of NTA gains will come from trade diversion.

To test the models' predictions I introduce a novel data set, which I discuss below.

6 Data

The U.S. Federal Procurement Data System (FPDS) offers a rich source of information on government contracting.[30] By law, every federal contract with an estimated value exceeding $3,000 must be recorded in the system, as well as every subsequent modification. In practice, many agencies record contracts well below this minimum. Information recorded for each contract includes its total value in U.S. dollars, the contractor's country of origin, the place of contract performance, date of signature, and the six-digit NAICS code associated with the good or service being supplied. The FPDS also includes all subsequent modifications or cancellations of contracts. However, because my purpose is to estimate the effects of government procurement agreements on the probability and expected value of winning procurement bids, I ignore later modifications and keep only the initial contract value.

The complete data set consists of annual observations beginning in 1990 and ending in 2010, for a total of 21 years. An observation qualifies for inclusion if it lists the contract value, place of performance, contract year, and nationality of the supplier. Unfortunately, many observations are missing one or more of these, with the data in the first seven years being far less complete than those in later years.[31] In 1990 there are only 653 qualifying contracts listed, while in 1997 there are 295,000, and by 2005 there are over 8 million. In the system's first years, data inputters appear to have been remiss in recording the nationality of winning contractors. Thus, I use the subset of years beginning in 1996 for the main analysis.[32]

In every procurement agreement, the participating parties commit to explicit value thresholds. For any contract with an estimated value above the threshold, agents must advertise in the treaty partner's relevant trade journals and allow firms sufficient notice to prepare bids. Among the United States' agreements, these thresholds vary widely: from roughly $50,000 for Israel, Mexico, and Canada to more than $180,000 for members of the GPA.[33] For consistency's sake, I label all contracts with values less than $50,000 as small contracts, which

[30] (U.S. Government Services Administration, 2014)

[31] Appendix A-3 shows the percent of qualifying observations by year, both in terms of value and number of contracts.

[32] As a robustness check, I also test my primary specifications on the full span of years as well as various subsets of years. Outcomes are not significantly affected by altering the sample period. Results are available upon request.

[33] Appendix A-2 contains all relevant thresholds

Table 1: NTA Coverage of U.S. Procurement

	Share of Total Contracts			*Share of Total Value*		
Year	Above Threshold	U.S. Location	Subject to NTAs	Above Threshold	U.S. Location	Subject to NTAs
1996	91.4	97.9	89.8	99.7	98.4	98.2
1997	96.3	98.8	95.4	99.9	97.7	97.5
1998	96.3	98.8	95.4	99.8	98.4	98.3
1999	93.3	98.5	92.2	99.5	97.6	97.2
2000	90.7	98.6	89.7	99.4	98.1	97.6
2001	83.2	98.0	81.9	99.2	97.9	97.2
2002	78.4	98.1	77.2	99.1	97.4	96.5
2003	73.1	98.0	71.7	99.0	94.8	93.8
2004	66.2	97.3	64.2	98.4	93.1	91.6
2005	84.2	97.1	82.1	97.9	91.4	89.5
2006	74.2	95.8	71.3	98.3	90.5	88.9
2007	83.2	96.3	80.8	98.2	90.2	88.6
2008	61.9	93.8	58.5	97.6	93.1	90.9
2009	74.7	92.2	69.7	98.6	74.8	73.6
2010	76.0	93.3	71.7	98.3	90.1	88.6

Because the data from 1990–1995 represent such a small portion of total procurement, they are here omitted.

are always exempt from any treaty provisions. All other contracts are considered large and are potentially subject to national treatment requirements for at least one treaty partner. Table 1 shows the respective shares of U.S. procurement that are above threshold, located in the territorial United States, and subject to national treatment agreement provisions.

Table 2: Procurement Location, Excluding U.S. Firms

	% of Value			% of Contracts		
Size	Local	USA	Abroad	Local	USA	Abroad
Large	86.06	7.13	6.81	90.42	7.15	2.43
Small	85.89	9.48	4.63	82.86	11.44	5.70
Overall	86.06	7.18	6.76	87.31	8.97	3.72

Local procurement is fulfilled in the winning firm's home country. USA reports fulfillment in the United States. Abroad reports fulfillment in a third country.

The data also include information on the location where the procurement contract was fulfilled. One would suspect there to be a strong local bias; that is, firms are more likely to win contracts for delivery in their home country. For instance, a British firm may provide cleaning services to the U.S. embassy in London, a Costa Rican firm may provide housing for American Peace Corps volunteers, and a Rwandan firm may provide well-digging services for local

USAID projects. Table 2 illustrates this local-favoring tendency. Of those contracts awarded to foreigners, roughly 90 percent were for contracts in their respective home countries. Only 7 percent of foreign-won bids were for projects in the territorial United States, leaving 3 percent of contracts to be fulfilled by foreign firms in third-party countries. For the empirical specifications, I construct 2 indicator variables: local and abroad. Local equals 1 if location and partner are the same, abroad equals 1 if location is a third-party country. This leaves the omitted base category as contracts won in the United States.

Table 3: Average Annual Procurement By Partner

Non-NTA States		Value				Contracts			
Size	Markets	World	In USA	Local	Abroad†	World	In USA	Local	Abroad†
Small	1.03	0.21	0.05	0.33	0.06	17.2	4.67	27.1	5.95
Large	0.87	14.4	1.95	23.3	7.68	36.9	13.1	66.9	3.82
Overall	1.33	13.9	0.95	19.4	4.26	52	9.87	78.5	6.04
NTA Partners									
Small	4.51	4.17	0.68	4.08	0.05	477	78.8	471	3.94
Large	3.54	170	23.1	175	5.4	849	39.3	973	7.88
Overall	5.75	174	17.4	163	2.88	1,327	99.6	1,332	7.02
All Foreign									
Small	1.65	0.93	0.33	1.34	0.05	101	38.1	759	4.63
Large	1.34	43.5	13.1	64.5	6.25	189	27.0	313	6.35
Overall	2.11	42.7	7.87	55.6	3.39	281	47.6	395	6.66
United States									
Small	127	4,430	4,214	-	1.71	720,567	686,834	-	268
Large	138	322,058	299,560	-	165	2.48 m	2.42 m	-	468
Overall	146	326,488	303,774	-	157	3.20 m	3.11 m	-	673

Note: For the United States, "In USA" and "Local" are equivalent. Values listed in millions USD, 2005 dollars.
† Per Location

The breakdown of procurement awards by country type are found in Table 3. This is divided into four sections, representing non-NTA countries, NTA partners, all foreign countries combined, and the United States. Each section reports the annual average number of markets, value in millions USD, and number of contracts for each group by size category. Value and contracts are further broken down by place of fulfillment, whether it be in the United States, locally, or abroad in a third-party country. World indicates the world average aggregated over all locations. Averages for small and large contracts include only those partners who succeeded in winning at least one contract in a location in a given year.[34] The final

[34]The empirical analysis is conducted in terms of log variables, in which zeros are omitted. I omit zeros from the

row of each section is the average after aggregating large and small contracts. The average non-NTA country can expect its firms to win approximately 52 tenders a year, for an annual revenue of roughly $14 million. NTA partners are more successful and on average win 1,327 contracts worldwide, for annual revenues of $174 million. In contrast, U.S. firms together win 3.2 million contracts each year for combined annual revenues of $327 billion. Clearly, procurement awards are skewed towards U.S. firms.

Table 4: Average Contract Value

Size	Non-NTA States	All Foreign	NTA Partners	United States
Small	$12,209	$9,208	$8,742	$6,147
Large	$390,244	$230,159	$200,236	$129,721
Overall	$267,308	$151,957	$131,123	$101,924

Values are in 2005 USD

The average contract value, found in Table 4, is highest for non-NTA countries, followed by NTA-partners. The United States has the lowest average contract value across all size categories. One possible explanation is the existence of fixed costs associated with international projects: firms only bid on large projects in the U.S. because expected profits from smaller projects do not exceed their fixed costs. This, in turn, suggests that future models of procurement bidding behavior may need to include a participation decision phase. While I do not explicitly include the effects of fixed costs, if NTAs cause firms to submit more tenders and win more often, this combined effect will be captured in the specifications analyzing number of contracts won.

Despite its many procurement agreements, the United States awards the vast majority of its procurement to domestic firms. As seen in Table 5, from the mid-1990s until the mid-2000s, less than one percent of procurement was awarded to foreign firms. Only in the final few years of the sample did foreign firms begin to make inroads. By 2010, foreign firms were capturing nearly 3 percent of all contracts and receiving 4 percent of all spending. The share of total spending awarded to NTA partners has always the lion's share of foreign-awarded procurement. The preference in favor of NTA partners is clear, yet it raises the question of whether each partner would have realized the same outcomes without an agreement.

reported averages for consistency and to allow direct application of regression results.

Table 5: U.S. Procurement by Award Recipient

			Share of Total Contracts		*Share of Total Value*	
Year	Total Countries	NTA Partners	Awarded to Foreign Firms	Awarded to NTA Partners	Awarded to Foreign Firms	Awarded to NTA Partners
1996	16	22	1.10	1.06	0.54	0.47
1997	67	24	0.80	0.73	0.32	0.29
1998	98	24	0.86	0.78	0.40	0.36
1999	116	24	0.94	0.79	0.86	0.78
2000	124	24	0.90	0.71	0.59	0.46
2001	128	25	1.58	1.24	1.11	0.92
2002	139	25	1.13	0.79	0.80	0.58
2003	148	25	0.94	0.65	0.84	0.62
2004	166	36	0.88	0.67	1.07	0.70
2005	150	37	0.49	0.42	1.90	1.23
2006	137	39	0.93	0.81	3.58	3.15
2007	136	40	1.21	1.09	3.34	2.31
2008	137	40	2.03	1.83	3.04	2.47
2009	140	43	3.20	2.58	3.17	2.17
2010	141	43	2.93	2.46	4.10	2.68

Because the data from 1990–1995 represent such a small portion of total procurement, they are here omitted.

To answer the question of whether or not a trend existed for partners before signing an agreement, I conduct the following exercise. For each NTA partner, I designate the year that its agreement with the United States entered into force as year zero. For example, Canada's year zero is 1988, while for European Union members, it is 1996, and for Peru year zero is 2009. I calculate the partner's market share in that year, in each of the 7 years prior to the NTA, and in the 7 years following, data permitting. I then average these market shares according to their distance in time from their respective years 0. Figure 2 graphically displays the results. The first panel depicts the simple average market share. In the years before an NTA, shares average less than 0.01 percent. They begin to rise in the first two years of the agreement, before spiking in the third. Because many of the NTAs were signed in the same years, it is possible that these results are driven by year-specific shocks. I therefore include the second panel of Figure 2. This graphs the ratio of partner's market share to the average foreign country's. Prior to their NTAs, partners average market shares approximately equal to the world average, with a slight downward trend. However, subsequent to signing an

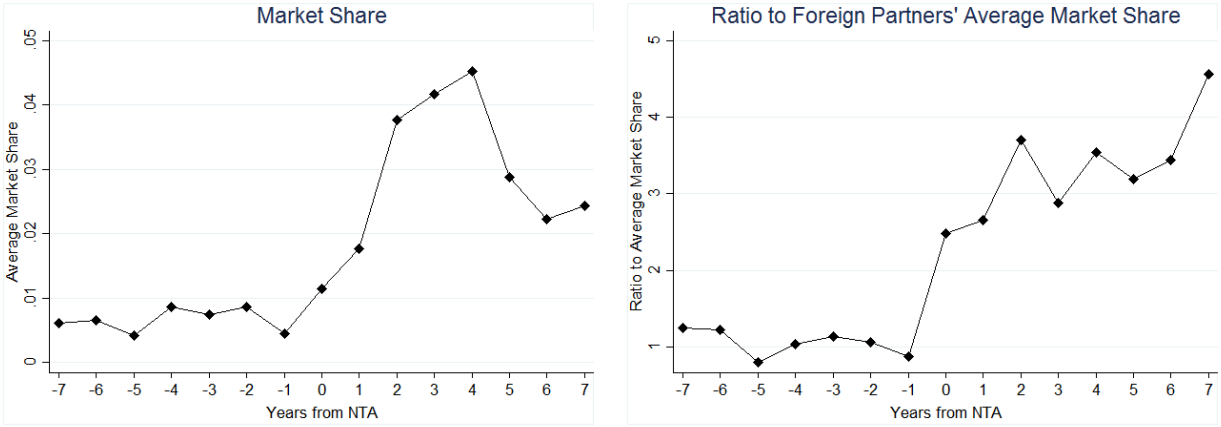

Figure 2: Average market shares of NTA partners before and after an NTA's entry into force

agreement, these shares leap to twice the world average and trend upwards.

For the empirical analysis, an observation consists of number of contracts or total procurement value aggregated by size (above threshold or below), place of performance, and the contractor's nationality. Using United Nations and World Trade Organization resources, I construct bilateral indicators for free trade agreements and national treatment agreements.[35] I similarly construct indicators for membership in NATO and in NAFTA. Population-weighted distance values come from the CEPII database and include intra-national distances. GDP data come from the United Nations. Bilateral variables for common language and GATT/WTO membership also come from CEPII.[36]

I construct a measure of exports of procurement goods by first generating a list of the 320 products[37] that together comprise 90 percent of all goods procured by the United States. Given the size and diversity of U.S. procurement, this is a reasonable estimate of the types of goods governments typically procure. I use this list to extract total exports of these commodities for each country from the UN Comtrade database.[38]

In Table 6, I exclude U.S. data and report summary statistics for partner countries alone.[39] While only 24 percent of country-year observations in the sample include agreements with

[35](World Bank, 2014)
[36](Head and Mayer, 2013)
[37]at the 1988 HS 4-digit level
[38](United Nations, 2014)
[39]Observations are country-year: value and contracts are aggregated across size categories and locations. Price is a value-weighted average across locations.

Table 6: Regressor Summary Statistics, Excluding U.S. Firms

Regression Variables	Obs.†	Mean	Standard Deviation	Min.	Max.	Weighted Average‡
NTA	1843	0.24	0.43	0	1.00	0.73
Value ($ mn)	1843	60.8	309.2	0	6,307	-
Contracts (k)	1843	0.40	2.58	0	44.42	-
Price ($ k)	1843	229.9	183.5	44.7	849.3	-
Exports ($ bn)	1820	33.5	90.5	0	1,164	188.7
GDP ($ bn)	1843	236	586	0.07	4,468	1298
Distance (km, pop-wt)	1843	9,410	3,406	2,079	16,466	8,636
FTA	1843	0.06	0.24	0	1	0.21
Common language	1843	0.29	0.45	0	1	0.29
WTO member	1843	0.81	0.39	0	1	0.97
NATO member	1843	0.15	0.36	0	1	0.43
NAFTA member	1843	0.02	0.12	0	1	0.15
Instrumental and Exclusion Variables						
NTA Partners	1843	8.16	13.80	0	43.00	-
Complementarity	1843	4.85	6.31	0	36.14	-

Note: All dollar values are in 2005 USD † Observations are country-year ‡ Weighted by value

the United States, fully 73 percent of all foreign-awarded procurement value goes to NTA partners. Similarly, between 1996 and 2010, only 6 percent of partners are involved in FTAs with the United States, but they received 26 percent of procurement spending. The average observation has a value of $61 million and represents 400 contracts.

It is important to note that the data do not include information on firm ownership. Rather, the nationality of a firm is assigned by the location of its headquarters. Thus, U.S. subsidiaries of foreign firms will be counted as U.S. firms. It is unclear whether procuring agents rely on the firm location or the firm ownership to determine domestic status.[40] If the primary consideration is location, then firms specialized in procurement industries may use foreign direct investment to circumvent preference margins in the same way consumer market firms use FDI to tariff jump. If the primary consideration is ownership, then any FDI would be due to cost-savings unrelated to procurement. Either way, reported foreign procurement winnings in the data will omit revenues and contracts won by domestic subsidiaries. Estimates in the analysis should therefore be thought of as lower bounds on the

[40]It is imminently unlikely that a domestic firm would submit a bid under the auspices of a foreign subsidiary and thus suffer discrimination margins when it could submit the bid as the domestic parent company and instead benefit from that same preferment.

true effect of NTAs. This is especially relevant if the latter condition holds: the procurement awarded to local subsidiaries that, because of the advent of an NTA, transitioned from foreign to national treatment will be reported as U.S. firm revenues. Given the scale of FDI in the United States, this would imply non-negligible underestimates of the effects of NTAs.

7 Empirical Results

The foremost question is: Do NTAs improve partners' outcomes, and if so, to what extent? This question applies primarily to auctions specifically covered by national treatment agreement provisions (above-threshold contracts located in the United States) and may be answered in terms of number of contracts won or total value awarded. NTAs may also have spillover effects such that partners realize general gains worldwide or specific gains in individual locations.

Secondly, I ask where procurement gains come from. Do they arise from trade diversion from non-member countries, from greater success against domestic firms, or some mixture of both? I investigate this question by analyzing the effects of NTAs on partners' market shares in ratio to U.S. market share.

7.1 Number of Contracts

National treatment agreements do indeed improve partner's procurement outcomes. Table 7 reports the results when the dependent variable is number of contracts (in natural logarithms). The primary specification is in model (6), in which I restrict the data to large contracts in the United States. The coefficient on NTA is positive and strongly significant.[41] All else being equal, NTA partners win 174 percent more large contracts in the United States than non-partners. Given federal budgeting practices, it is reasonable to assume that the total number of contracts offered within a given year is independent of price factors.[42]

[41] This result is robust across a multitude of specifications, including various procurement categories, time periods, and control regressors. Results for these specifications are not included in the paper, but are available from the author upon request.

[42] Agencies typically plan annual budgets at the beginning of the fiscal year. These do not have significant scope for alteration in response to normal market price fluctuations within the budget period. In support of this, in both the primary and the aggregate specifications average contract value (Price) is not a significant predictor of number

A percent increase in contracts won is thus equivalent to a percent increase in market share. An NTA nearly triples a partner's share of the U.S. procurement market.

To evaluate the impact of selection bias and endogeneity, I includes two OLS specifications in Table 7. The naïve regression in model (1) includes no fixed effects, selection bias correction, or instrumental variable. Model (2) adds fixed effects and controls for selection. Its results imply that there is indeed a selection bias. In the first stage regressions (found in Appendix A-6) predicting the existence of trade flows, the exclusion variable is strongly significant. To confirm that the complementarity index serves as an adequate exclusion restriction, I include the index with various subsets of the model's regressors to predict procurement values and volumes. In these results, the index is never significant at a 10 percent p-level or below. The complementarity index is significant for predicting the existence of trade, but it is insignificant in predicting the level of trade.

The nature of the endogeneity bias is made apparent by the addition of the instrument in Model (3).[43] The coefficient on NTA is now significantly positive, whereas without the instrument it is negative and insignificant. This implies an inverse relationship between NTA formation and procurement outcomes: countries that win fewer contracts are more likely to sign NTAs with the United States. Several economic explanations may account for this result. From an infant industry perspective, countries with burgeoning domestic procurement industries may grant their own firms a cost advantage equal to the size of the preference margin vis-à-vis non-partner firms by signing an NTA. From a cost-reduction perspective, a bilateral NTA may permit countries with small or unproductive procurement industries to eliminate their own inefficient preference policies when it would not be politically feasible to do so unilaterally. Finally, from the U.S. perspective, it may be easier to sign agreements with countries that are perceived as nonthreatening than with countries that are already successful in U.S. markets.

Models (3) and (5) estimate spillover effects. Model (3) reports that within the average

of contracts won. Of course, changes in prices will certainly affect the funds budgeted for procurement in following years and influence the number of projects planned.

[43]The Durbin test for endogeneity returns a χ^2-test statistic of 16.29, and the Wu-Hausman f-statistic is 15.47. There is less than a 1 in 10,000 chance that NTA is exogenous. The f-statistic on the test for weak instruments is 681, indicating that number of non-U.S. NTA partners is a strong candidate for instrumental variable.

location, signing an NTA with the United States increases the number of U.S. procurement contracts won by 68 percent. In model (4), NTA is correlated with a rise of 315 percent worldwide. This corresponds to an additional 135 contracts annually for the typical foreign country. Given than contracts average from $150,000 to $270,000, this is equivalent to an extra $23 million to $36.5 million each year.

Model (4) adds in U.S. firms' procurement revenues—with a corresponding indicator variable—and serves to confirm that the best predictor of success is American nationality. American nationals win 7,500 times as many contracts as non-Americans, all else being equal.

The large negative coefficient on NAFTA in model (5) stands out. Most likely, this result obtains because of the extreme disparity in Canadian and Mexican outcomes. Canadian firms win 13,800 contracts annually, while Mexican firms annually win 44. Whether this is due to Mexican firms' lack of involvement or lack of success is unclear.

7.2 Total Value

National treatment agreements also improve outcomes in terms of revenue. Table 8 reports results when the dependent variable is the natural logarithm of total revenue; primary regression results are found in model (4). NTA is correlated with a 251 percent increase in revenue from NTA-bound procurement. This is equivalent to an additional $33 million annually for the average foreign firm.

Models (1) and (3) estimate spillover effects. Model (1) reports that within an average location, signing an NTA with the United States increases the total value of procurement awards by 75 percent. Model (4) indicates that NTA is correlated with a 98 percent rise in worldwide procurement revenue. In dollar terms, this represents an additional $42 million a year for the typical country. For countries in the top quartile in terms of procurement flows, this is an increase upwards of $340 million annually.

Model (2) includes U.S. firm data and reinforces the extremity of home bias in procurement. In total, American firms' combined revenues are 4,340 times those of the average trading partner, all else being equal.

NTA has a differential effect on procurement volume and procurement value. While for

contracts the worldwide effect is greater than the within-U.S. effect, for revenue the opposite holds true.[44] This implies that foreign partner's additional winnings are concentrated in a small number of very large contracts in the United States, with spillover effects resulting in a larger number of small-value contracts abroad.

The probable source of this result is one familiar to the literature. Melitz (2003) explains the role fixed costs play in firms' export decisions. Here, it is likely that the fixed costs for a U.S.-based project greatly exceed the fixed costs of projects at home or in a nearby country. Firms only export when the prospective profits are large enough to exceed the additional fixed costs; therefore, firms bid abroad only on large contracts.

This implication becomes more concrete with a simple example. Suppose that the lowest American bid is just over $10 million. Given the 6 percent domestic preference, a firm without an NTA would have to submit a bid of at most $9.43 million for that bid to be evaluated as under $10 million. With an NTA, the firm could submit a bid of exactly $10 million and still win the contract. Assuming the lower bid was feasible, this implies an increase in the firm's profits of $567,000. Compare this to a below-threshold contract value of $49,000: for such a contract, the increase in profits is less than $2,800. Suppose fixed costs are $500 for small projects, $2,500 for large projects, and an additional $2,500 for projects outside the firm's home region. Given these fixed costs, it is profitable for the firm to bid on both large and small projects domestically, but on only large projects internationally.

Lastly, the sign on the exports coefficient is anamalous. In Table 7, exports enter negatively, while in Table 8, exports are not significant. Exports measures a partner's worldwide exports of procurement goods, and should be a strong indicator of its capacity to deliver procurement products. One explanation for the discrepancy is that because the majority of procurement is service-based, measuring goods exports is simply insufficient. Alternatively, it may be that non-market forces play a significant role in determining the winners of procurement auctions.

[44] Coefficients on NTA for world aggregates and within-U.S. procurement subject to treaty provisions are statistically different at the 5 percent level, for both contracts and value.

7.3 Market Shares

The results in Table 9 imply that NTA partner's gains may be the result of trade diversion from non-member countries. The dependent variable is the natural logarithm of the ratio of country market share to U.S. market share. Regressors are determined by the theoretical model, with the addition of gravity controls.

The theoretical model does not include a mechanism for trade creation: the number of auctions m each country conducts is exogenous. The insignificance of the price variable in Tables 7 and 8 lends credence to this assumption. Thus, one country's increase in market share necessitates another country's reduction. Given an increase in a partner's procurement awards, its market share ratio to the United States' is almost certain to rise. However, if the partner's gains are coming from winning more contracts when competing against American firms, its increase in market share ratio must be *greater* than its level increase. Practically, the NTA coefficients in Table 9 must be greater than their corresponding coefficients in Tables 7 and 8.

Inspecting the results tables, we see that there is no obvious difference between the coefficients on ratios and their corresponding level regressions. The exception is the location-based analysis, in which it does appear that in non-U.S. locations, NTA partners do take market share from U.S. firms.[45] However, this represents only a tiny fraction of total U.S. procurement spending. Both in the worldwide average and in the United States, while NTA partners' shares have risen, U.S. share has remained constant. Partners' gains must then have come at the expense of non-NTA countries. To confirm this, I test the effect of NTAs on market share ratio to the non-NTA partner average (results in Appendix A-5). As expected, NTAs increase partners' market share ratios to non-partners' market share more than NTAs increase partner's levels of procurement, supporting the conjecture that gains from NTAs are largely due to diversion away from non-NTA countries.

[45] Only the location-based regressions report statistically different coefficients on NTA between levels and ratios.

8 Conclusion

In this paper, I construct a theoretical framework to model the behavior of firms in government procurement auctions in which domestic bids receive a price preference margin over foreign bids. I use this framework to derive empirical estimation equations predicting procurement trade flows as a function of this preferment, bidders' comparative advantage, and gravity control variables. These empirical specifications test the effect of NTAs on partner's auction outcomes. To the best of my knowledge, this is the first model to predict procurement trade flows using an auction framework and the first broad empirical analysis of the effectiveness of national treatment agreements.

The principal result is that NTAs do increase members' procurement awards, both in terms of number of contracts and in total value. Worldwide, partners win 315 percent more contracts and earn 98 percent more revenue than other foreign countries. Within the subset of procurement contracts explicitly bound by treaty provisions, NTA partners win 174 percent more contracts and earn 251 percent higher revenues, suggesting that gains in the United States are concentrated in high-value contracts. A U.S. procurement agreement is worth between $23 and $45 million annually for the average country.

Foreign firms win only 2 percent of procurement contracts, with the remainder awarded to U.S. suppliers. Even after accounting for all theoretical considerations, the strongest predictor of auction success is American nationality. That is, while agreements require national treatment, partners do not realize "national" outcomes. Possible sources of this disparity include fixed costs of international tendering, productivity characteristics, and continued covert discrimination. As for the sources of partners' procurement gains, evidence suggests that trade is diverted away from foreign bidders who are not party to any U.S. agreement. Finding direct evidence of this suspected trade diversion is a possible future research question.

These findings are particularly relevant today. It is now more common for trade agreements to include procurement national treatment provisions than to omit them. It is important to understand whether these provisions are effective in lowering barriers to international

trade, and to what degree. The United States is currently in negotiations with more than a dozen countries to form new free trade agreements; hopefully, this paper can be of assistance in evaluating these potential NTAs. Albeit imperfect, national treatment agreements represent, at a conservative estimate, potentially tens of millions of dollars in new revenues and government savings. These agreements facilitate international trade and promote transparency, and as such, are a worthwhile goal.

Table 7: Dependent Variable: Natural Log of Number of Contracts

	(1) Naïve Regression	(2) Fixed Effects and Selection	(3) Location Data	(4) Including U.S. Firms, Aggregates	(5) Aggregated by Size and Location	(6) Subject to NTA Provisions
NTA	0.128***	-0.0197	0.520***	0.885***	1.425***	1.008***
	(0.0441)	(0.0871)	(0.157)	(0.161)	(0.194)	(0.154)
ln(Exports)	0.0551***	0.270***	0.245***	-0.0114	0.0864	-0.165***
	(0.0140)	(0.0376)	(0.0374)	(0.0258)	(0.0582)	(0.0501)
ln(US Proc)	0.253***	0.657***	0.660***	0.606	1.053***	1.728
	(0.00795)	(0.0233)	(0.0228)	(0.502)	(0.328)	(3.659)
ln(Price)	0.150***	0.236***	0.242***	0.246	0.143	2.351
	(0.00993)	(0.0139)	(0.0136)	(1.009)	(0.646)	(6.995)
Small	0.118***	0.429***	0.428***			
	(0.0288)	(0.0251)	(0.0246)			
Local	3.399***	10.57***	10.58***			
	(0.104)	(0.274)	(0.268)			
Abroad	1.081***	-1.005***	-1.002***			
	(0.0798)	(0.187)	(0.183)			
FTA	0.0874	0.367***	0.142	0.267	-0.417**	-0.241
	(0.0585)	(0.0810)	(0.101)	(0.203)	(0.189)	(0.158)
ln(Dist)	0.146***	-0.618	-0.561	0.0450	-26.24***	-0.295*
	(0.0362)	(5.155)	(5.187)	(0.0742)	(8.999)	(0.161)
ln(GDP)	0.124***	-0.759***	-0.732***	0.462***	-1.339***	0.612***
	(0.0159)	(0.161)	(0.157)	(0.0323)	(0.312)	(0.102)
Com. Lang.	0.0812***	4.190***	4.226***	0.218***	9.602***	1.069***
	(0.0313)	(1.156)	(1.161)	(0.0732)	(1.813)	(0.227)
WTO	0.135***	-0.134	-0.117	-0.0717	-0.302**	-0.538***
	(0.0434)	(0.111)	(0.108)	(0.0793)	(0.147)	(0.153)
NATO	-0.0673	0.300***	0.0142	-0.126	-1.588***	0.397***
	(0.0444)	(0.111)	(0.134)	(0.155)	(0.342)	(0.147)
NAFTA	0.324***	3.159	2.981	1.076**	-35.91**	1.703***
	(0.109)	(8.046)	(8.094)	(0.515)	(14.44)	(0.473)
Inv. Mills		3.527***	3.531***	-0.607***	-0.219**	0.956**
		(0.0856)	(0.0838)	(0.104)	(0.0874)	(0.381)
U.S. Firm				8.924***		
				(0.400)		
Constant	-7.543***	-18.05	-18.30	-11.03	233.2***	-50.12
	(0.479)	(48.47)	(48.77)	(19.45)	(86.03)	(137.2)
Observations	7,855	7,855	7,855	1,835	1,820	493
R-squared	0.399	0.638	0.636	0.819	0.772	0.665
Type	OLS	OLS	IV	IV	IV	IV
Fixed Effects	None	Year, Partner, Location	Year, Partner, Location	Year, Partner	Year, Partner	Year, Partner

Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Note: IV = NTA partners. Time period is 1996–2010. Results for 1st stage regressions are found in Appendix A-6. Regressions use data from foreign firms only, with the exception of model (4).

Table 8: Dependent Variable: Natural Log of Total Procurement Value

	(1) Full Location Data	(2) Including U.S. Firms, Aggregates	(3) Aggregated by Size and Location	(4) Subject to NTA Provisions
NTA	0.561**	0.687***	0.685***	1.257***
	(0.263)	(0.217)	(0.217)	(0.262)
ln(Exports)	0.286***	-0.0174	-0.0172	-0.0568
	(0.0559)	(0.0412)	(0.0412)	(0.0814)
ln(US Proc)	0.587***	0.520	0.510	-0.418
	(0.0215)	(0.662)	(0.671)	(5.680)
ln(Price)	-0.129***	-0.243	-0.241	-1.683
	(0.0191)	(0.689)	(0.695)	(5.193)
Small	-2.383***			
	(0.0350)			
Local	10.61***			
	(0.313)			
Abroad	-0.214			
	(0.252)			
FTA	0.123	0.666**	0.667**	-0.576*
	(0.164)	(0.287)	(0.287)	(0.307)
ln(Dist)	-14.04	0.103	0.103	-0.309
	(14.18)	(0.107)	(0.107)	(0.256)
ln(GDP)	-0.0290	0.582***	0.581***	0.565***
	(0.202)	(0.0522)	(0.0522)	(0.158)
Com. Lang.	4.415	0.404***	0.404***	1.360***
	(3.056)	(0.105)	(0.105)	(0.340)
WTO	0.306*	-0.249*	-0.249*	-1.122***
	(0.168)	(0.133)	(0.133)	(0.265)
NATO	-0.131	-0.0303	-0.0295	0.601***
	(0.219)	(0.202)	(0.202)	(0.231)
NAFTA	-21.93	0.952*	0.951*	1.845***
	(22.01)	(0.542)	(0.542)	(0.632)
Inv. Mills	3.139***	-1.202***	-1.205***	1.014*
	(0.0957)	(0.157)	(0.158)	(0.602)
U.S. Firm		8.376***		
		(0.473)		
Constant	119.6	0.869	1.113	44.57
	(132.8)	(25.28)	(25.49)	(212.7)
Observations	7,855	1,835	1,820	493
R-squared	0.657	0.516	0.629	0.635
Fixed Effects	Year, Partner, Location	Year, Partner	Year, Partner	Year, Partner

Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1
Note: IV = NTA partners. Time period is 1996–2010. Results for 1st stage regressions are found in Appendix A-6. Regressions use data from foreign firms only, with the exception of model (2).

Table 9: Dependent Variable: Natural Log of Ratio of Partner Market Share to U.S. Market Share

	Contracts			Value		
	(1)	(2)	(3)	(4)	(5)	(6)
	Full Location Data	Aggregated by Size and Location	Subject to NTA Provisions	Full Location Data	Aggregated by Size and Location	Subject to NTA Provisions
NTA	0.990***	1.443***	0.955***	1.060***	0.715**	0.946**
	(0.249)	(0.295)	(0.251)	(0.329)	(0.338)	(0.417)
ln(Export Ratio)	0.109*	0.0842	-0.156***	0.343***	0.200**	-0.0475
	(0.0587)	(0.0580)	(0.0492)	(0.0863)	(0.0847)	(0.0806)
Small	0.305***			-2.477***		
	(0.0342)			(0.0462)		
Local	9.828***			9.453***		
	(0.162)			(0.250)		
Abroad	2.663***			0.890**		
	(0.282)			(0.378)		
FTA	-0.274*	-0.424**	-0.199	-0.103	0.211	-0.535*
	(0.150)	(0.190)	(0.156)	(0.211)	(0.294)	(0.305)
ln(Dist)	-16.14	-26.41***	-0.286*	-34.97**	-38.86***	-0.301
	(10.48)	(8.941)	(0.161)	(17.63)	(13.08)	(0.256)
ln(GDP)	-1.545***	-1.338***	0.493***	-1.701***	-0.535*	0.422***
	(0.225)	(0.312)	(0.0835)	(0.315)	(0.300)	(0.133)
Com. Lang.	8.770***	9.644***	0.819***	12.48***	7.665***	1.056***
	(2.346)	(1.805)	(0.194)	(3.920)	(2.283)	(0.298)
WTO	-0.0150	-0.307**	-0.486***	0.655**	0.108	-1.058***
	(0.207)	(0.147)	(0.151)	(0.302)	(0.267)	(0.263)
NATO	-0.898***	-1.595***	0.427***	-0.308	-1.192**	0.633***
	(0.211)	(0.343)	(0.146)	(0.288)	(0.489)	(0.230)
NAFTA	-19.10	-36.17**	1.632***	-49.32*	-60.96***	1.768***
	(16.24)	(14.34)	(0.475)	(27.30)	(21.00)	(0.631)
Inv. Mills	1.810***	-0.256***	0.411	2.277***	-1.009***	0.345
	(0.132)	(0.0890)	(0.302)	(0.165)	(0.112)	(0.490)
Constant	140.5	239.6***	-12.53***	316.7*	356.0***	-13.38***
	(98.40)	(84.66)	(1.767)	(165.5)	(123.7)	(2.859)
Observations	7,638	1,820	493	7,638	1,820	493
R-squared	0.902	0.792	0.671	0.861	0.697	0.348
Fixed Effects	Year, Partner, Location	Year, Partner	Year, Partner	Year, Partner, Location	Year, Partner	Year, Partner

Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Note: IV = NTA partners. Time period is 1996–2010. 1st stage regressions results are found in Appendix A-6. Regressions use data from foreign firms only.

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APPENDIX

Table A-1: Trade and Procurement Agreements

Country Name	Procurement Agreement Year	RTA Year	GPA Membership
Australia	2005	2005	-
Austria	1996	-	1996
Bahrain	2006	2006	-
Belgium	1996	-	1996
Bulgaria	2007	-	2007
Canada	1988	1988	1996
Chile	2004	2004	-
Costa Rica	-	2004	-
Cyprus	2004	-	-
Czech Republic	2004	-	2004
Denmark	1996	-	1996
Dominican Republic	-	2004	-
El Salvador	-	2004	-
Estonia	2004	-	2004
Finland	1996	-	1996
France	1996	-	1996
Germany	1996	-	1996
Greece	1996	-	1996
Guatemala	-	2004	-
Honduras	-	2004	-
Hong Kong	1997	-	1997
Hungary	2004	-	2004
Iceland	2001	-	2001
Ireland	1996	-	1996
Israel	1985	1985	1996
Italy	1996	-	1996
Japan	1996	-	1996
Jordon	-	2001	-
Latvia	2004	-	2004
Lithuania	2004	-	2004
Luxembourg	1996	-	1996
Malta	2004	-	2004
Mexico	1994	1994	-
Morocco	2006	2006	-
Netherlands	1996	-	1996
Nicaragua	-	2004	-
Norway	1996	-	1996
Oman	2009	2009	-
Peru	2009	2009	-

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Table A-1 – Continued from previous page

Country Name	Procurement Agreement Year	RTA Year	GPA Membership
Poland	2004	-	2004
Portugal	1996	-	1996
Singapore	1997	2004	1997
Slovakia	2004	-	2004
Slovenia	2004	-	2004
South Korea	1996	-	1996
Spain	1996	-	1996
Sweden	1996	-	1996
Switzerland	1996	-	1996
Taiwan	2009	-	2009
United Kingdom	1996	-	1996

Table A-2: List of Thresholds by Partner

Agreement Partner	Goods and Services	Construction	Rules of Origin	Year
Australia	58,550	6,725,000	35 %	2006
Bahrain	175,000	7,611,532	35 %	2006
Chile	56,190	6,481,000	35 %	2006
Israel	50,000	50,000	35 %	1986
Morocco	175,000	6,725,000	35 %	2006
Oman	193,000	8,422,165	35 %	2008
Peru	193,000	7,407,000	100 %	2008
Singapore	56,190	6,481,000	100 %	2004
Mexico	50,000	6,500,000	50 %	1996
Canada	50,000	6,500,000	50 %	1996
GPA	189,800	4,380,000	35 %	1996

Note: All values are in USD of the given year

Table A-3: Total U.S. Procurement v. Qualified Observations

Year	Total Value†	Qualified Value†	Percent of Value	Total Contracts	Qualified Contracts	Percent of Contracts
1990	$105,979	$6,768	6.39	196,467	653	0.33
1991	$139,778	$7,008	5.01	338,941	1,002	0.30
1992	$132,911	$7,051	5.30	406,414	1,710	0.42
1993	$145,287	$20,996	14.45	367,838	1,702	0.46
1994	$144,400	$9,034	6.26	382,386	3,700	0.97
1995	$144,551	$9,877	6.83	447,943	6,002	1.34
1996	$187,467	$68,589	36.59	488,914	80,756	16.52
1997	$250,303	$210,203	83.98	462,134	295,424	63.93
1998	$245,144	$237,915	97.05	463,180	449,563	97.06
1999	$197,296	$191,260	96.94	529,002	509,882	96.39
2000	$214,885	$209,610	97.55	574,344	558,429	97.23
2001	$155,186	$152,609	98.34	419,600	410,619	97.86
2002	$290,558	$284,285	97.84	819,455	792,941	96.76
2003	$346,184	$336,218	97.12	1,434,596	1,371,093	95.57
2004	$363,333	$351,818	96.83	2,747,518	2,686,672	97.79
2005	$393,840	$383,579	97.39	8,651,137	8,570,270	99.07
2006	$475,406	$468,186	98.48	6,726,416	6,662,807	99.05
2007	$477,206	$475,097	99.56	5,417,781	5,404,778	99.76
2008	$432,661	$431,608	99.76	5,093,754	5,076,720	99.67
2009	$666,875	$665,988	99.87	5,273,727	5,266,235	99.86
2010	$556,335	$555,784	99.90	5,714,238	5,709,557	99.92

Source: US Federal Procurement Data System Annual Reports † millions USD, 2005 dollars

Table A-4: Number of Non-U.S. NTA Partners, 2010

Country	NTAs	Country	NTAs	Country	NTAs	Country	NTAs
Afghanistan	0	Denmark	40	Laos	0	Saudi Arabia	0
Albania	28	Djibouti	0	Latvia	40	Senegal	0
Algeria	0	Dominica	0	Lebanon	0	Seychelles	0
Angola	0	Dominican Republic	0	Lesotho	0	Sierra Leone	0
Antigua & Barbuda	0	Ecuador	0	Liberia	0	Singapore	43
Argentina	0	Egypt	0	Libya	0	Slovakia	40
Armenia	0	El Salvador	6	Lithuania	40	Slovenia	40
Australia	4	Equatorial Guinea	0	Luxembourg	40	Solomon Islands	0
Austria	40	Eritrea	0	Macedonia	0	South Africa	0
Azerbaijan	0	Estonia	40	Madagascar	0	South Korea	38
Bahamas	0	Ethiopia	0	Malawi	0	Spain	40
Bahrain	1	Fiji	0	Malaysia	0	Sri Lanka	0
Bangladesh	0	Finland	40	Mali	0	St Kitts and Nevis	0
Barbados	0	France	40	Malta and Gozo	40	St Lucia	0
Belarus	0	French Polynesia	0	Marshall Islands	0	St Vincent	0
Belgium	40	Gabon	0	Mauritania	0	Sudan	0
Belize	0	Gambia	0	Mauritius	0	Suriname	0
Benin	0	Georgia	0	Mexico	36	Swaziland	0
Bhutan	0	Germany	40	Micronesia	0	Sweden	40
Bolivia	0	Ghana	0	Moldova	0	Switzerland	39
Bosnia Herzegovina	0	Greece	40	Mongolia	0	Syria	0
Botswana	0	Grenada	0	Morocco	1	Taiwan	37
Brazil	0	Guatemala	6	Mozambique	0	Tajikistan	0
Brunei	3	Guinea	0	Namibia	0	Tanzania	0
Bulgaria	40	Guinea Bissau	0	Nepal	0	Thailand	0
Burkina Faso	0	Guyana	0	Netherlands	40	Togo	0
Burma (Myanmar)	0	Haiti	0	New Zealand	4	Tonga	0
Burundi	0	Honduras	6	Nicaragua	6	Trinidad & Tobago	0
Cambodia	0	Hong Kong	37	Niger	0	Tunisia	0
Cameroon	0	Hungary	40	Nigeria	0	Turkey	1
Canada	39	Iceland	39	Norway	39	Turkmenistan	0
Cape Verde Islands	0	India	0	Oman	1	Uganda	0
Central African Rep.	0	Indonesia	0	Pakistan	0	Ukraine	0
Chad	0	Iran	0	Palau	0	United Arab Emir.	0
Chile	42	Iraq	0	Panama	1	United Kingdom	40
China	0	Ireland	40	Papua New Guinea	0	United States	43
Colombia	3	Israel	38	Paraguay	0	Uruguay	0
Comoros Islands	0	Italy	40	Peru	3	Uzbekistan	0
Congo, Republic of	0	Jamaica	0	Philippines	0	Vanuatu	0
Costa Rica	6	Japan	39	Poland	40	Venezuela	0
Cote D'Ivoire	0	Jordon	0	Portugal	40	Vietnam	0
Croatia	0	Kazakhstan	0	Russia	0	Yemen	0
Cuba	0	Kenya	0	Rwanda	0		
Cyprus	40	Kuwait	0	Samoa	0		
Czech Republic	40	Kyrgyzstan	0	Sao Tome & Principe	0		

Table A-5: Dependent Variable: Log of Market Share Ratio to non-NTA State Average

	Contracts		Value	
	(1)	(2)	(3)	(4)
	Aggregated by Size and Location	Subject to NTA Provisions	Aggregated by Size and Location	Subject to NTA Provisions
NTA	1.444***	1.471***	0.664***	1.627***
	(0.295)	(0.108)	(0.216)	(0.120)
ln(Export Ratio)	0.0795	-0.183***	-0.0200	-0.107***
	(0.0581)	(0.0188)	(0.0415)	(0.0203)
FTA	-0.436**	-0.154**	0.644**	-0.339***
	(0.190)	(0.0729)	(0.288)	(0.0803)
ln(Dist)	-25.85***	-0.492***	0.101	-0.514***
	(8.886)	(0.0496)	(0.106)	(0.0596)
ln(GDP)	-1.319***	0.821***	0.590***	0.733***
	(0.312)	(0.0358)	(0.0518)	(0.0388)
Com. Lang.	9.485***	1.529***	0.408***	1.604***
	(1.802)	(0.0743)	(0.105)	(0.0797)
WTO	-0.305**	-0.586***	-0.233*	-1.069***
	(0.146)	(0.0520)	(0.133)	(0.0613)
NATO	-1.591***	0.250***	-0.0169	0.441***
	(0.342)	(0.0551)	(0.201)	(0.0629)
NAFTA	-35.34**	1.297***	0.971*	1.112***
	(14.25)	(0.148)	(0.541)	(0.160)
Inv. Mills	-0.303***	1.843***	-1.200***	1.504***
	(0.0912)	(0.137)	(0.166)	(0.142)
Constant	244.0***	-3.116***	-4.794***	-2.005***
	(84.07)	(0.555)	(1.221)	(0.675)
Observations	1,820	8,876	1,820	8,876
R-squared	0.791	0.298	0.465	0.299
Fixed Effects	Year, Partner	Year, Partner	Year, Partner	Year, Partner

Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1
Note: IV = NTA partners. Time period is 1996–2010. Regressions use data from foreign firms only.

Table A-6: Heckman First Stage Selection Probit Regression Results

	(1) Levels: Full Location Data	(2) Levels: Aggregated Data	(3) Levels: Subject to NTAs	(4) Ratios: Full Location Data	(5) Ratios: Aggregated Data	(6) Ratios: Subject to NTAs
NTA	0.035*	-0.010	0.761***	0.053***	-0.006	0.755***
	(0.019)	(0.225)	(0.113)	(0.018)	(0.219)	(0.112)
ln(Exports)	0.076***	0.123***	-0.013			
	(0.007)	(0.028)	(0.030)			
ln(Exp. Ratio)				0.089***	0.124***	-0.002
				(0.006)	(0.028)	(0.029)
ln(US Proc)	0.194***	0.656***	0.203			
	(0.004)	(0.111)	(0.129)			
ln(Price)	0.081***	0.983***	0.083			
	(0.004)	(0.173)	(0.181)			
Small	0.131***			0.119***		
	(0.012)			(0.012)		
Local	3.305***			0.960***		
	(0.052)			(0.028)		
Abroad	-0.398***			-2.238***		
	(0.042)			(0.023)		
FTA	0.167***	0.607	-0.120	0.119***	0.716	-0.043
	(0.026)	(0.609)	(0.174)	(0.025)	(0.632)	(0.174)
ln(Dist)	-0.044**	0.141	-0.062	-0.022	0.129	-0.046
	(0.018)	(0.093)	(0.088)	(0.017)	(0.092)	(0.087)
ln(GDP)	0.114***	0.094**	0.258***	0.049***	0.083**	0.227***
	(0.008)	(0.038)	(0.037)	(0.0072)	(0.037)	(0.036)
Com. Lang.	0.358***	0.174*	0.724***	0.197***	0.162*	0.679***
	(0.014)	(0.094)	(0.084)	(0.014)	(0.093)	(0.082)
WTO	0.002	0.232***	-0.232**	0.063***	0.220**	-0.208**
	(0.022)	(0.088)	(0.094)	(0.021)	(0.087)	(0.093)
NATO	0.271***	0.334	-0.077	0.193***	0.320	-0.058
	(0.018)	(0.249)	(0.124)	(0.018)	(0.242)	(0.123)
NAFTA	-0.100**	-1.173	0.283	-0.330***	-1.270	0.194
	(0.045)	(0.877)	(0.365)	(0.044)	(0.881)	(0.366)
Comp. Index	0.473***	10.67***	0.042***	0.030***	10.91***	0.054***
	-0.006	(0.935)	(0.006)	(0.001)	(0.923)	(0.006)
Constant	-7.349***	-25.81***	-5.201	-0.508***	-1.009	-1.688**
	(0.239)	(3.879)	(4.118)	(0.168)	(0.845)	(0.808)
Observations	805,936	2,603	2,588	947,208	2,588	2,588

Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1
Note: Exclusion variable is the procurement complementarity index