International Agreements on Trade in Government Procurement: Formation and Effect

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Abstract

Government procurement accounts for 14 to 19 percent of world GDP, and if entirely liberalized, could increase the value of world trade by up to 30 percent. However, governments commonly reserve the majority of their procurement markets for domestic suppliers, often erecting bureaucratic barriers to foreign firms' participation or offering domestic firms explicit price preference margins. This diversion to local firms creates scope for inefficiency. In recognition of this, recent years have seen the birth of public procurement agreements in which parties agree to accord each other's firms national treatment. These national treatment agreements (NTAs) include the plurilateral WTO Government Procurement Agreement with 43 signatory countries and an ever-expanding multitude of bilateral agreements.

This dissertation examines the pattern of NTA formation among countries and their resulting trade and welfare effects. I develop a multi-country Ricardian model of procurement auctions in which firms decide to submit bids based on private-knowledge cost parameters drawn from country-specific distributions. Governments are free to systematically disadvantage endogenously-determined classes of bidders in order to maximize social welfare. In the first chapter of the dissertation, I use numerical simulations to quantify the effects of NTAs on government expenditure, industry profits, and national welfare and to predict the pattern of NTA formation. I empirically test

these predictions on data from 68 countries from 1990 to 2010. Simple sign tests correctly predict over 75 percent of all NTA relationships and extended regression results account for over 84 percent of all observed variation.

In the second chapter, I extend the model to predict the volume of procurement trade between countries as a function of country-level productivity parameters and endogenous domestic preference margins. The model generates gravity-like estimating equations which I test empirically using U.S. data from 1996 to 2010. Results indicate that NTAs increase partners' procurement revenues by approximately 250 percent. However, these gains likely come from trade diversion.

The results of this dissertation are particularly timely. TPP and TTIP negotiations are ongoing, and policy makers must consider the extent to which government procurement will be included in these agreements.

INDEX WORDS: International Trade, International Agreements, Auctions, Government Procurement

Dedication

I would like to dedicate this dissertation to my parents, Dean and Lori Fronk, whose continual love and pride in my accomplishments make me in turn proud to be their son.

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I would like to thank Rodney Ludema, who accepted the unenviable task of guiding an ofttimes hapless and bewildered grad student through the shoals and storms of academic research—a task he accomplished with patience and bonhomie—and without whose sage counsel this dissertation would doubtless have been impossible. I further wish to thank Anna Maria Mayda and Lindsay Oldenski for the countless hours they dedicated to improving my research and encouraging me on my path. I would also like to acknowledge the contributions made by James Albecht, Susan Vroman, and Behzad Diba, whose advice and support buoyed me up along this long journey.

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Chapter 1

Formation of National Treatment Agreements

1.1 Introduction

Most national governments grant their domestic firms preference over foreign firms when deciding whom to award procurement contracts. Preferences take myriad forms, from bureaucratic hurdles thrown up against foreign participants to explicit price margins in favor of domestic firms. To circumvent these discriminatory policies, countries sign national treatment agreements (NTAs), in which they agree to treat each other's bidders in procurement auctions as if they were domestic firms. Prior to 1990, there existed seven international agreements regarding government procurement: six bilateral agreements plus the plurilateral WTO Tokyo Round Government Procurement Agreement (GPA). In 2000, this number had only risen to nine total agreements. However, by 2010, there were more than thirty NTAs. As new agreements have formed and existing agreements have added members, the number of trading relationships governed by NTAs has exploded. Figure 1.1 reports the number of bilateral NTA relationships among the the 68 countries considered in this chapter.

Despite the proliferation of international procurement agreements, the literature has been silent on the determinants of NTA formation. There does exist a small body of theoretical and empirical literature examining the effects of domestic preference policies on cross-border procurement participation. However, to the best of my knowledge no paper has explored the conditions under which NTAs are mutually

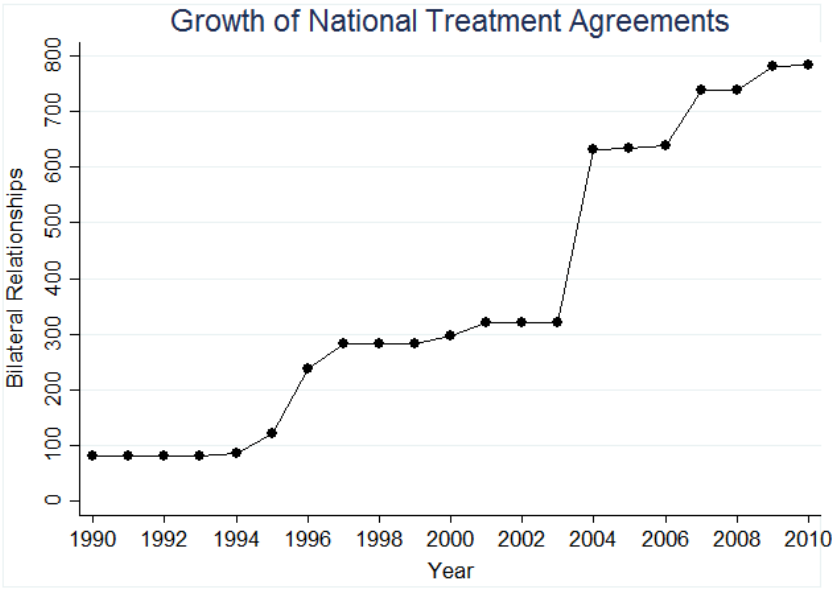

Figure 1.1: Bilateral NTA Relationships

welfare-improving or their resultant impacts on welfare, spending, and firm profits. The purpose of this chapter is to provide a theoretical framework for explaining why some countries sign national treatment agreements, either through accession to an existing NTA or by forging a new bilateral agreement, while others do not.

I construct a theoretical framework that uses country-level characteristics to quantify the welfare impacts of eliminating domestic preferences. Each government conducts a number of auctions annually. Bids arrive from domestic and foreign firms according to country-specific arrival rates and cost distributions; firms' realized costs are private knowledge, but arrival rates and cost distributions are common knowledge. To make the analysis tractable, I assume costs are exponentially distributed. Foreign bids are inflated by a well-known rate before they are compared to domestic

bids. Governments choose the welfare-maximizing bid, where welfare is the weighted sum of government cost savings and domestic firms' profits.

The theoretical model produces a number of general results. Unilateral nondiscrimination is welfare-improving only in the case in which governments accord zero weight to domestic firms' profits; that is, if domestic firms have any political influence at all, countries will only reduce barriers to foreign participation on a reciprocal basis. Countries that are similar in size and productivity always benefit from signing agreements, as do large, productive countries (such as the OECD group of countries). In such cases, the increases in government savings and the opening of new foreign markets to local firms more than offsets the losses to domestic firms from increased competition. Large, relatively unproductive countries (such as the BRICs) generally prefer discrimination. These countries' firms are less able to compete in a more competitive partner's market and so their increase in earnings abroad are small. Domestically, foreign bidders succeed more often against local firms, and the losses to the domestic industry outweigh the government's cost savings. Unlike their larger counterparts, small developing countries may benefit from NTAs when cost savings outweigh domestic industry revenues, which occurs when the new partner is neither too large nor too relatively productive.

Unfortunately, the theoretical model is not amenable to analytic solution. I therefore employ numerical simulations to quantify the country characteristics for which NTAs are mutually welfare-improving and to quantify their market impacts. For these simulations, I assume countries grant full weight to domestic firms' profits and divide the analysis into cases based on potential parameter relationships. Simulation results indicate that bilateral agreements may increase symmetric partners' total welfare 0.5–2.5 percent and reduce government expenditure 1.0–3.5 percent. Effects on firm profits may range from a fall of 4 percent to a rise of 6 percent, depending on the

countries' comparative advantages. Plurilateral agreements may improve symmetric entrants' welfare by 0.6–3.4 percent, incumbents' welfare by 0.01–0.08 percent, and reduce non-members' welfare by 0.01–0.02 percent.

To empirically test the model's predictions, I introduce a new data set created using publicly-available data gathered from national reporting agencies and regional organizations. The data include 68 countries and span 21 years, from 1990 to 2010. I use the relationships suggested by the theory to predict whether an NTA would be feasible for every country pair in the data. The results of this exercise correctly predict 75 percent of existing NTA relationships. I also construct a reduced-form estimating equation; the resulting coefficients confirm the relationships predicted by the theory. Additionally, predictions based on these regression coefficients explain 84 to 90 percent of existing NTAs and 79 to 99 percent of non-agreements. The remainder of the chapter explains the process by which these results were obtained and places the research in context to the wider literature.

1.2 Government Procurement: A Primer

Most procurement NTAs exist as chapters in bilateral free trade agreements. Each agreement sets a minimum value threshold above which the terms of the NTA come into force. For contracts with values above threshold, procuring agencies must publish a notice in the treaty partner's appropriate trade bulletins inviting interested suppliers to submit tenders. Partner firms that do submit bids are to be granted all preferences normally accorded to domestic firms. Bilateral agreements are generally comprehensive, meaning that they cover all goods and services for which the govern-

ment contracts.[1] The plurilateral Government Procurement Agreement has similar threshold and national treatment provisions, but differs from bilateral agreements in its product coverage: each member state may include an annex to the treaty with a negative list of excluded goods and a positive list of included services.

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.[2] In practice, this is rarely the case.

Procurement accounts for a significant portion of total world demand for goods and services. The OECD estimates that member countries annually spend 12 percent of GDP on public procurement. When state-owned utilities are also considered, this figure rises to 14–20 percent of GDP.[3] In 2008, contestable government procurement—the portion of government contracting with the potential to be opened to international competition—represented over $1.4 trillion among OECD members alone.[4] Procurement spending is even greater outside the OECD, where it accounts for an estimated 14.5 percent of GDP.[5] Today, most countries reserve the vast majority of their procurement spending for domestic contractors; however, it has been estimated that the combined value of all procurement that could potentially be opened to international competition is nearly a third as large as the total value of world trade.[6]

[1] While comprehensive, thresholds often vary depending on whether the contract's deliverable is a good, service, or construction project. These thresholds generally range from $50,000 to $280,000 for goods and services and into the millions for construction.

[2] Or best-valued bidder, taking into account differences in product quality.

[3] OECD (2000)

[4] OECD (2011)

[5] WTO (2011)

[6] Audet (2002)

1.3 Literature Review

Research on the trade effects of domestic preference regimes has generally followed one of three models. The most cited in the literature is the neoclassical model first introduced by Baldwin (1970, 1984) and Baldwin and Richardson (1972). Their model assumes perfect competition and small government demand; consequently, any preference which skews government purchases toward domestic firms will be perfectly offset by consumers' shifting their purchases to foreign suppliers. Thus, one would observe no net effect on domestic price, total imports, output, employment, or welfare. This result is referred to in the literature as the Baldwin-Richardson neutrality result. The exception is if government demand exceeds domestic supply, in which case shifting demand to domestic producers will increase domestic production, raise prices, and reduce imports, resulting in a net welfare loss.

Miyagiwa (1991) evaluates the Baldwin-Richardson neutrality result in the context of perfect substitutes in imperfectly competitive markets and finds that neutrality continues to hold under a variety of market organizations. The critical requirement is that the price paid by the government is structured as a premium over the price paid in the consumer market.

Most large government procurement projects are for differentiated products—such as the Boeing 747 versus the Airbus A380 or Blackberry versus Apple cellular products—often customized for government use. Moreover, awards are determined through competitive tender. Generally, the government describes a set of conditions that must be met and interested firms submit bids, from which the government ideally

selects the offer that best fulfills the contract at the lowest price. Procurement is thus better modeled as an auction with a limited number of potential bidders.[7]

The second model introduces a stripped-down auction framework with domestic preferences and is explored by Laffont and Tirole (1993). The federal government acts as the principal, while the procuring agent takes on the role of a supervisor. The supervisor reports information about quality, which it learns after expending some effort. Two firms bid. Their costs are common knowledge, but each firm has an additional quality parameter which is private knowledge. Given this framework, governments should impose price preferences in favor of higher quality firms. Vagstad (1995) reinterprets the model with one foreign firm and one domestic, and concludes that governments should discriminate in favor of domestic firms.

The third model was introduced by McAfee and McMillan (1989), consisting of two countries: foreign and domestic. Each country may have multiple firms, who draw cost parameters from country-specific distributions. Firms tender bids based on their private-knowledge cost realizations. The government selects the most welfare-improving bid. Rather than explicitly solve for a specific auction format, the authors make use of the revelation principle (Myerson, 1981), which insures that for any auction there exists an equivalent mechanism in which participants reveal their costs directly rather than submit bids. The results of their analysis indicate that governments should offer a price preference in favor of firms from countries with the comparative disadvantage.[8] If the government values domestic profits equally to government savings, then domestic firms always receive a price preference. This model's

[7]Indeed, as Mattoo (1996) notes in his survey of the economic literature regarding public procurement, "attempts to estimate the cost of procurement preferences without taking into account their effects on bidding behavior may produce biased estimates."

[8]A country has a comparative advantage over another if its cost distribution first-order stochastically dominates the latter's.

primary drawback is that it considers only the domestic effects of procurement policy. If foreign governments impose price preferences mirroring those of the domestic government, then domestic firms will be disadvantaged vis-à-vis foreign firms abroad. This reduction in expected profits earned abroad has the potential to offset any gains in domestic welfare earned by preferential treatment at home.

McAfee and McMillan's (1989) application of the revelation principle is felicitous; it turns out generating bid functions when bidders draw parameters from non-identical distributions is possible for only a limited number of distributions and under restrictive conditions.[9] Despite this, several efforts have been made to solve for bid functions in the presence of preference margins. However, each approach has sacrificed either the application of preference margins or the asymmetry (or independence) of cost distributions to arrive at a tractable system of differential equations from which to back out biding functions.[10] Indeed, Bajari (2001) describes the necessary first order conditions for auctions with both discrimination and asymmetric distributions and proves that no closed form solution can exist.[11] For this reason, I follow the lead of McAfee and McMillan (1989) and solve for the optimal auction mechanism using the revelation principle, rather than attempt to explicitly solve for bid functions under a specific auction format.

[9] See Griesmer and Levitan (1967), Holt (1980), Maskin and Riley (1983, 2000), Plum (1992), Güth et al. (2001), and Kaplan and Zamir (2012) for specific cases in which asymmetric distributions may have analytic solutions. Note that in each case, there is no preferential treatment allowed.

[10] Branco (1994) solves for the optimal design in both first and second price auctions with discrimination but does not allow for different supports or cost distributions among bidders. Hubbard and Paarsch (2009) use numerical methods to solve for the cost minimizing preference rate, ignoring social welfare effects but including endogenous participation decisions on the part of firms. Most recently, Cole and Davies (2014) are able to bypass this by substituting tariffs for preference margins and writing the foreign distribution as a tariff-length translation of the domestic distribution.

[11] This results from the fact that at the upper end of the distribution's support, bid functions become undefined, violating the Lipschitz boundary condition.

The Balwind-Richardson model and predictions have formed the basis of nearly all empirical analyses of the effects of discrimination on procurement markets. Baldwin and Richardson (1972), estimate that American domestic preference programs reduced imports in 1963 by roughly half a percentage point, or approximately $110 million. Lowinger (1976) also analyzes U.S. data and estimates that preferences cost the government $121 million in 1963 and predicts that imports by the U.S. government in the mid-1960s would increase by a factor of 7 if preferences were eliminated.[12] By comparing government import profiles to private consumtpion, Deardorff and Stern (1979) estimate that the welfare gains for industrialized countries from eliminating discriminatory procurement policies would exceed the gains from all tariff liberalizations in the Tokyo Round. Francois et al. (2000) evaluate the effects of the Government Procurement Agreement based on U.S. data disaggregated by sector and procuring agency from 1992–1993. They find that in most markets the U.S. accounts for less than 5 percent of total demand, but that in some sectors—such as maintenance and repair, construction, and office equipment—government demand iss large enough to affect market access. Delta and Evenett (2000) investigate the distributional effects of preference policies in the 1980s and find that welfare gains are at best marginal, as benefits from diverting purchases to domestic suppliers are offset by increases in costs.

All of these papers consider the government's discrimination decisions in a partial equilibrium framework, ignoring domestic firms' profits abroad and the possibility that countries may strategically discriminate. This chapter addresses these omissions.

[12]For the counterfactual, Lowinger (1976) supposes that the government and consumers have the same import propensity. Laird and Yeats (1990) suggest alternative strategies to quantify the effects of procurement preference regimes; however, they stop short of implementing any of them.

To the best of my knowledge, there are no published articles attempting to explain the pattern of NTA formation, despite the estimated magnitude of discrimination's effects on trade. Evenett and Hoekman (1999, 2005) come closest to addressing the issue. The authors' goal is to characterize the welfare effects of unilateral elimination of domestic preference policies. They assume perfect competition and model preference elimination as a shift in linear demand curves. Welfare effects are signed in the short run and long run. Their work differs from mine in that I adopt an auction framework of private information with country-specific cost distributions. Furthermore, my welfare function incorporates not only government cost savings and firms' profits domestically, but also firms' profits abroad in NTA-partner countries. Indeed, I find that it is never welfare-improving to unilaterally abolish preference margins, as long as governments place positive weight on domestic firms' profits.

1.4 Theoretical Framework

In this section I develop a theoretical model to predict the formation of national treatment agreements. The model is essentially an Eaton-Kortum Ricardian model in which firms differ by technology (as captured by differing exponential cost distributions) couched within a multi-country McAfee-McMillan auction framework. Governments award countracts via auction and 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. Individual firms' costs are private knowledge, but the distribution of costs within each country is known to all. Governments are free to systematically discount or preference bids in order to maximize social welfare;

however, the government's preferencing system is common knowledge to all potential bidders.

A government agency wishes to contract with a firm 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.[13]

The set of all countries Ω consists of N individual countries, each of which may conduct its own auctions, and whose firms may bid on auctions both domestically and abroad. Thus, from the perspective of the auctioneer in 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.[14]

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'

[13] 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 $k = 0, 1, 2, ...$

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

are valued equally to the government's cost savings. Procurement is funded through a non-distortionary lump-sum tax.[15]

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 functions $\{\Psi_i(c), J_i(c)\}$, where $\Psi_i(\cdot)$ is the probability of awarding the contract to firm i, $J_i(\cdot)$ is the expected payment dependent on the evaluated cost, and c is the vector of all true costs. McAfee and McMillan (1989) solve a similar problem, though omitting the variable weight on domestic profits, allowing for a divisible good, and permitting only two countries. I borrow liberally from their methodology in the following results.

The government's objective function is

$$W_n = \int_{\kappa} \left[v \sum\nolimits_i \Psi_i(c) - \sum\nolimits_i J_i(c) + \alpha_n \pi_n(c) \right] dG(c) \tag{1.4.1}$$

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

Each firm knows its own realized costs; however, from the perspective of country n, costs are unknown. Thus, in country n's welfare calculation, firm profits are given by

$$\pi_i(c) = E\left[J_i(c) - c_i \Psi_i(c)\right] = \int_{\kappa} \left[J_i(c) - c_i \Psi_i(c)\right] dG(c) \tag{1.4.2}$$

Note that the envelope theorem implies

$$\frac{\partial \pi_i(c)}{\partial c_i} = -E_{-i}\left[\Psi_i(c_i; c_{-i})\right] = \int_{\kappa_{-i}} \Psi_i(c_i; c_{-i}) dG_{-i}(c_{-i}) \tag{1.4.3}$$

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

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:

$$\pi_i(c) \geq 0 \quad \forall i \in N \quad \forall c \in \kappa \tag{1.4.4}$$

Note that (1.4.4) implies the IR constraint is satisfied as long as $\pi_i\left(\bar{c}_i; c_{-i}\right) \geq 0$. The incentive compatibility (IC) constraints require truth-telling to be profit-maximizing, and are given by

$$\pi_i(c_i; c_{-i}) \geq \pi_i(\tilde{c}_i; c_{-i}) \quad \forall i \in N \;\; \forall c_i, \tilde{c}_i \in \kappa_i \text{ and } \tilde{c}_i \neq c_i \tag{1.4.5}$$

Finally, the probabilities of winning the auction for all bidding countries must sum to less than or equal to unity (allowing for the chance that no firm wins) and each probability must be between zero and one. These feasibility constraints are given by

$$\sum\nolimits_i \Psi_i(c) \leq 1 \text{ and } 0 \leq \Psi_1(c) \leq 1 \quad \forall i \in N \quad \forall c \in \kappa \tag{1.4.6}$$

Rearranging (1.4.1), total welfare for country n is given by

$$W_n = \int\limits_{\kappa} \left\{ \sum\nolimits_i \left[\left(v - c_i\right) \Psi_i\left(c\right) \right] - \sum\nolimits_i \left[J_i\left(c\right) - c_i \Psi_i\left(c\right) \right] + \alpha_n \pi_n\left(c\right) \right\} dG\left(c\right) \tag{1.4.7a}$$

By rewriting in terms of firm profits, this can be expressed as

$$W_n = \int\limits_{\kappa} \sum_i [(v - c_i)\Psi_i(c)] dG\left(c\right) - \int\limits_{\kappa} \sum_{i \neq n} \pi_i(c) dG(c) - \int\limits_{\kappa} (1 - \alpha_n)\pi_n(c) dG(c) \tag{1.4.7b}$$

Or, equivalently

$$\begin{aligned} W_n = \int\limits_{\kappa} \sum_i [(v - c_i)\Psi_i(c)] dG\left(c\right) - \int\limits_{\kappa_{-i}} \left\{ \int\limits_{\kappa_i} \sum_{i \neq n} \pi_i(c_i) dG_i(c_i) \right\} dG_{-i}(c_{-i}) \\ - \int\limits_{\kappa_{-i}} \left\{ \int\limits_{\kappa_i} (1 - \alpha_n)\pi_n(c_n) dG_n(c_n) \right\} dG_{-n}(c_{-n}) \end{aligned} \tag{1.4.7c}$$

Next, I integrate by parts the second and third expressions and substitute using (1.4.3).

$$W_n = \int_{\kappa} \sum_i [(v - c_i)\Psi_i(c)] dG(c)$$
$$- \int_{\kappa_{-i}} \left\{ \sum_{i \neq n} \pi_i(c_i) dG_i(c_i) \Big|_{\underline{c}_i}^{\bar{c}_i} - \int_{\kappa_i} \sum_{i \neq n} \Psi_i(c_i) \frac{G_i(c_i)}{g_i(c_i)} g_i(c_i) dc_i \right\} dG_{-i}(c_{-i})$$
$$- \int_{\kappa_{-n}} \left\{ (1 - \alpha_n)\pi_n(c_n) \Big|_{\underline{c}_i}^{\bar{c}_i} - \int_{\kappa_n} (1 - \alpha)\Psi_n(c_n) \frac{G_n(c_n)}{g_n(c_n)} g_n(c_n) dc_n \right\} dG_{-n}(c_{-n}) \tag{1.4.7d}$$

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

$$W_n = \int_{\kappa} \left\{ \left(v - c_n - (1 - \alpha_n) \frac{G_n(c_n)}{g_n(c_n)} \right) \Psi_n(c_n) + \sum_{i \neq n} \left[\left(v - c_i - \frac{G_i(c_i)}{g_i(c_i)} \right) \Psi_i(c_i) \right] \right\} dG(c) \tag{1.4.7e}$$

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 $i^* = \arg\max_{i \neq n} \left(c_i + \frac{G_i(c_i)}{g_i(c_i)} \right)$

From (1.4.7e) it is possible to infer the form of the payment function $J_i(\cdot)$. The government's surplus is $v - c_i - \frac{G_i(c_i)}{g_i(c_i)}$ when a foreign firm wins the bid.[16] Thus, the government is paying the firm its revealed cost c_i plus information rents of the form $\frac{G_i(c_i)}{g_i(c_i)}$. In a result identitical to that of McAfee and McMillan (1989), the payment function satisfying the decision rule is given by

$$J_i(c_i) = c_i + \frac{G_i(c_i)}{g_i(c_i)} \tag{1.4.8}$$

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

$$z_i(c_i) = \begin{cases} c_i & \text{if } i = n \\ c_i + \frac{G_i(c_i)}{g_i(c_i)} + (1-\alpha_n)\frac{G_n(c_n)}{g_n(c_n)} & \text{if } n \neq i \end{cases} \tag{1.4.9}$$

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.[17] The maximum cost a firm may draw in country i is given by β_i; countries 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

[16] When the domestic firm wins, the surplus also includes the weighted value of the domestic firm's profits. This accounts for the presence of α in the expression $v - c_n - (1-\alpha_n)\frac{G_n(c_n)}{g_n(c_n)}$.

[17] Let s denote productivity and assume it is distributed Pareto, $f(s) = as_{min}^a z^{-a-1}$. Unit cost is then $c = \frac{w}{s}$, 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, $g(c) = ac_{max}^{-a}c^{a-1}$, and $G(c) = c_{max}^{-1}c^a I(c)_{[0,c_{max}]}$.

common across countries. Given this distribution, the payment function becomes

$$J_i(c_i) = \frac{1+\theta}{\theta} c_i \tag{1.4.10}$$

This in turn leads to a discrimination function of the form

$$z_i(c_i) = \Delta_{i,n} c_i \quad \text{where } \Delta_{i,n} = \begin{cases} 1 & \text{if } i = n \\ \frac{1+\theta}{1+\theta-\alpha_n} & \text{if } n \neq i \end{cases} \tag{1.4.11}$$

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 $J_i(\Delta_{i,n} c_i)$.

In the original McAfee and McMillan (1989) results, welfare gains come entirely from cost savings generated by the pro-competitive effects of favoring the country with the comparative disadvantage. For most potential cost distributions, this requires finely tuning preference margins for every partner. However, in reality most governments choose a single preference rate that is applied to all countries. The exponential distribution chosen here generates this desirable result: discrimination margins are independent of partner i and depend only on the (universal) shape parameter θ and country n's weight on domestic profits α_n.[18]

[18] It should be noted that the optimal discrimination margin under this setup does not vary with the number of current NTA partners. This is in contrast to the tariff literature, in which the number of FTA or cutoms union members and their relative characteristics affects the optimal external tariff.

This independence result obtains as a consequence of the exponential distribution. With this distribution, discrimination has no pro-competitive effect and is consequently entirely motivated by the weight on domestic profits. The optimal discrimination rate finds the balance between maximizing domestic revenues and maintaining the incentive for foreigner bidders to be truthful. Truthfulness incentives are not affected by the number of treaty partners; they are determined by the country's own distribution and the payment function. Thus, additional treaty partners essentially act as irrelevant alternatives.

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.[19] 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.[20]

Define $\hat{y} \equiv \min_i \tilde{y}_i$ as the minimum of $\tilde{y}_i$ over all bidding countries i. Furthermore, let $\Phi_n \equiv \sum_i \mu_i(\beta_i\Delta_i)^{-\theta}$. 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 $\rho_{i,n}$:

$$\rho_{i,n} = \frac{\phi_i}{\Phi_n} \tag{1.4.12}$$

If instead we imagine a cost distribution that implies pro-competitive effects to discrimination (for example, a uniform distribution), then the preference rate will be a function of the number and characteristics of countries with which an NTA already exists. This result obtains because the payment function, rather than being a constant percentage, becomes a function of the competitiveness of the environment.

[19] 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.

[20] 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.

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,[21] 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: $v \leq \min\{\beta_i\}_{i=1\ldots N}$.[22] The upper limit 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 $\hat{y}$

[21] 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.

[22] This simplifies the bounds of integration.

is given by

$$E_n(\hat{y}) = \Phi_n^{-\frac{1}{\theta}} \left(\rho_{\Omega_n}\gamma_{\Omega_n} + \rho_{-\Omega_n}\gamma_{-\Omega_n}\right) \tag{1.4.13}$$

where γ_{Ω_n} and $\gamma_{-\Omega_n}$ are incomplete lower gamma distributions for agreement partners and non-partners, respectively.[23]

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

$$E(\hat{c}) = \Phi^{-\frac{1}{\theta}}\gamma \tag{1.4.14}$$

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

The government's expected total cost consists of two parts: (1) the expected payment conditional on there being at least one bid submitted below the reservation cost v and (2) the forgone value of the project if the auction is unsuccessful. In the benchmark world of total market liberalization, this is given by

$$E(TC) = \tfrac{1+\theta}{\theta}\Phi^{-\frac{1}{\theta}}\gamma + ve^{-\Phi\left(\frac{v\theta}{1+\theta}\right)^{\theta}} \tag{1.4.15}$$

In the real-world case in which at least some countries discriminate, 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

[23] $\gamma_{\Omega_n} = \gamma[\frac{1+\theta}{\theta}, \Phi_n(\frac{v\theta}{1+\theta})^{\theta}]$ 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)

government pays $\frac{1+\theta-\alpha_n}{1+\theta}E_n(\hat{y})$. Under discrimination, the expected payment P_n from country n to the winning firm is given by

$$E_{\Omega_n}(J) = \Phi_n^{-\frac{1}{\theta}}\left(\tfrac{1+\theta}{\theta}\rho_{\Omega_n}\gamma_{\Omega_n} + \tfrac{\theta+1-\alpha_n}{\theta}\rho_{-\Omega_n}\gamma_{-\Omega_n}\right) \tag{1.4.16a}$$

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

$$E_{\Omega_n}(v) = v\rho_{\Omega_n}e^{-\Phi_n\left(\frac{v\theta}{1+\theta}\right)^{\theta}} + v\rho_{-\Omega_n}e^{-\Phi_n\left(\frac{v\theta}{1+\theta-\alpha_n}\right)^{\theta}} \tag{1.4.16b}$$

Expected total cost is the sum of (1.4.16a) and (1.4.16b)

$$\begin{aligned} E_{\Omega_n}(TC) = \Phi_n^{-\frac{1}{\theta}}&\left(\tfrac{1+\theta}{\theta}\rho_{\Omega_n}\gamma_{\Omega_n} + \tfrac{\theta+1-\alpha_n}{\theta}\rho_{-\Omega_n}\gamma_{-\Omega_n}\right) \\ &+ v\rho_{\Omega_n}e^{-\Phi_n\left(\frac{v\theta}{1+\theta}\right)^{\theta}} + v\rho_{-\Omega_n}e^{-\Phi_n\left(\frac{v\theta}{1+\theta-\alpha_n}\right)^{\theta}} \end{aligned} \tag{1.4.17}$$

Governments concerned with total welfare also consider their domestic firms' profits in foreign markets. Let m_n represent the number of auctions held annually by country n. This is an indirect measure of the size of the country's public sector: higher-spending countries hold more auctions. Conditional on successfully submitting the lowest bid, firms' profits are simply $\frac{G_i(c)}{g_i(c)}$. In the benchmark case, country i's combined profits are the sum across all prospective markets.

$$E_i(\pi) = \sum_n m_n \left\{ \int_0^{\frac{v\theta}{1+\theta}} \frac{G_i(c)}{g_i(c)} \prod_{n\neq i}[1 - H_n(c)]dH_i(c) \right\}$$

Which reduces to the simpler expression

$$E_i(\pi) = \frac{\bar{\rho}_i \Phi^{-\frac{1}{\theta}}\gamma}{\theta}\sum_n m_n \tag{1.4.18}$$

With discrimination, it is necessary to divide expected profits into two parts. The first reflects expected profits at home and in treaty partner countries. The second reflects expected profits in countries where i's firms still face discrimination.

$$E_i^d(\pi) = \tfrac{1}{\theta}\sum_{n\in\Omega_i} m_n\rho_{i,n}\Phi_n^{-\frac{1}{\theta}}\gamma_{\Omega_n} + \sum_{n\notin\Omega_i}\tfrac{\theta+1-\alpha_n}{(1+\theta)\theta}m_n\rho_{i,n}\Phi_n^{-\frac{1}{\theta}}\gamma_{-\Omega_n} \tag{1.4.19}$$

Governments base their NTA membership decisions on the following total welfare:

$$W_n = m_n[v - E_n(TC)] + \alpha_n E_n(\pi)$$

Without discrimination, this term becomes

$$W_n = m_n \left[\hat{H}\left(\tfrac{v\theta}{1+\theta}\right) v - \tfrac{1+\theta}{\theta}\Phi^{-\frac{1}{\theta}}\gamma \right] + \alpha_n \frac{\bar{\rho}_n \Phi^{-\frac{1}{\theta}}\gamma}{\theta} \sum_{s\in\Omega} m_s \tag{1.4.20}$$

and with discrimination

$$\begin{aligned} W_n^d = {} & m_n v \left(\rho_{\Omega_n} \hat{H}_n\left(\tfrac{v\theta}{1+\theta}\right) + \rho_{-\Omega_n} \hat{H}_n\left(\tfrac{v\theta}{1+\theta-\alpha_n}\right)\right) \\ & - m_n \Phi_n^{-\frac{1}{\theta}} \left(\tfrac{1+\theta}{\theta}\rho_{\Omega_n}\gamma_{\Omega_n} + \tfrac{\theta+1-\alpha_n}{\theta}\rho_{-\Omega_n}\gamma_{-\Omega_n}\right) \\ & + \alpha_n \tfrac{1}{\theta} \sum_{s\in\Omega_n} m_s \rho_{n,s} \Phi_s^{-\frac{1}{\theta}} \gamma_{\Omega_s} + \alpha_n \sum_{s\notin\Omega_s} \tfrac{\theta+1-\alpha_s}{(1+\theta)\theta} m_s \rho_{n,s} \Phi_s^{-\frac{1}{\theta}} \gamma_{-\Omega_s} \end{aligned} \tag{1.4.21}$$

These expressions give us the means of predicting which countries will sign NTAs and what their effects will be on welfare, government procurement expenditure, and domestic firms' profits.

Calibrating α and θ

Recall from Equation (1.4.11) that the discrimination margin is given by $\frac{1+\theta}{1+\theta-\alpha_n}$. The shape parameter θ is constant across countries, whereas α may vary and is therefore the source of variation in discrimination rates. The literature provides some guidance in choosing an appropriate value for θ. In their simulation analysis, Eaton and Kortum (2002) use values of θ between 3.6 and 12.86. Bernard et al. (2000) use values for θ of 3.6 and 8.28. Anderson and Van Wincoop (2004) set $\theta = 5$.

In this analysis, it is not reasonable for θ to assume any value greater than 4, as this would imply $\alpha > 1$ for some countries. A domestic-profits weight greater than one would drive the government to simply ban foreign participation and pay domestic firms the maximum feasible amount, since the welfare return on any dollar awarded

to a domestic firm would be greater than the welfare loss from spending the dollar. Given that the precedents in the literature have chosen 3.6 as a lower bound, it is reasonable to choose $3.6 \leq \theta \leq 4.0$.

Fifty-nine countries at some time have explicit positive preference margins, which range from 0 percent to 25 percent.[24] With θ bounded between 3.6 and 4.0, it is possible to calculate weights for all countries with explicitly declared preference margins, as shown in Table 1.1.

Table 1.1: Welfare Weight on Domestic Profits

Preference Margin	Countries	Weight on Domestic Profits (α) $\theta = 3.6$	$\theta = 4.0$
0 %	4	0.00	0.00
3 %	28	0.13	0.15
6 %	1	0.26	0.28
7 %	1	0.30	0.33
10 %	15	0.42	0.46
15 %	11	0.60	0.65
20 %	6	0.77	0.83
25 %	4	0.92	1.00

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

This implies that the United States places a weight of 0.26–0.28 on domestic firms profits, and the European Union places a weight of 0.13–0.15. Pakistan, on the other hand, places a weight of 0.92–1.00 on domestic profits in their welfare consideration.

It should also be noted that simulation results presented hereafter are robust to changes in θ.[25]

[24] Albania, Brazil, Colombia, and Pakistan have at some time each imposed a 25 percent inflation penalty on foreign bids. Bulgaria, China, and Mexico forbid the participation of foreign firms in procurement auctions, with the exception of treaty partners.

[25] $\theta \in [1, 4]$.

1.5 Unilateral Nondiscrimination

At least four countries have at some point unilaterally eliminated all preferential treatment for domestic firms. These include include Albania, Brazil, Chile, and Saudi Arabia.[26] In the absence of any weight on domestic firms' profits, it is indeed always in the interest of the government to unilaterally eliminate preference margins. Doing so increases the likelihood that the lowest cost supplier wins each procurement contract, minimizing government expenditures.

However, when countries grant strictly positive weight to domestic firms' profits, it is always welfare-reducing to unilaterally eliminate domestic preferences. In Figure 1.2, I simulate the resulting percent change in welfare for three different types of country. The solid line represents a country whose comparative advantage in procurement sectors is half the world average. The long-dashed line represents a country with comparative advantage equal to the world average. The short-dashed line represents a country with twice the world average in comparative advantage.

When weights on domestic profits are very small ($\alpha \to 0$) the welfare losses from unilateral nondiscrimination are similarly small. However, for countries approaching the maximum weight on domestic profits ($\alpha \to 1$), welfare losses range from 1.5 percent for relatively productive countries to 0.8 percent for relatively unproductive countries.

This ranking is determined by the trade-off between government cost reductions and domestic firms' profit losses resulting from increased competition after preference elimination. For countries with large comparative disadvantages, foreign firms

[26] Alabania eliminated preferences in 2004, while Brazil first introduced a 25 percent domestic preference margin only in 2010. Saudia Arabia instituted a margin of 10 percent in 1996. Chile continues to maintain no domestic preference.

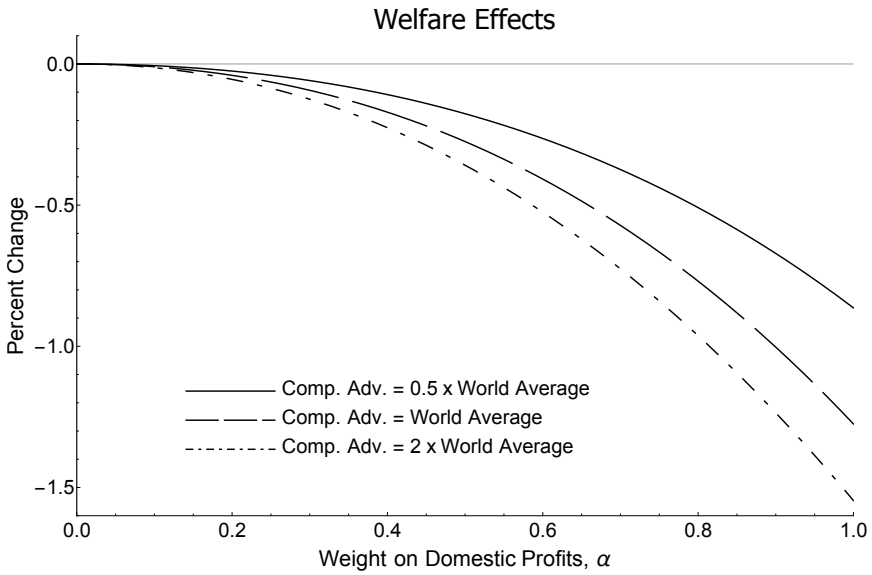

Figure 1.2: Unilateral Preference Elimination Welfare Effects

had been able to win contracts in the presence of the former preference margins. Eliminating preferences shifts only a few more contracts from domestic to foreign firms, with the offsetting benefit of significantly lower prices for the government on those contracts. For countries with large comparative advantages, the opposite is true. The prices paid by the government were already relatively low, so a small percent change in prices does not significantly raise welfare. However, each contract that formerly went to a domestic firm but post-elimination goes to a foreign firm represents a fall in welfare of the total value of firm profits. Thus, welfare impacts are large for relatively productive countries and small for relatively unproductive countries.

1.6 Bilateral Agreements

The majority of NTAs exist as chapters in bilateral preferential and free trade agreements. In such cases, welfare considerations are restricted to only the two potential

participants. Furthermore, any decision on the participants' part to enter into an NTA will have no effect on their domestic firms' profits in countries outside the agreement. It is possible to consider the total welfare of the countries prior to an NTA agreement and following an NTA as a world with only two countries.[27] Without an NTA, welfare is

$$W_1 = m_1 v \left[\rho_{1,1}\hat{H}_1\left(\tfrac{v\theta}{1+\theta}\right) + \rho_{2,1}\hat{H}_1\left(\tfrac{v\theta}{1+\theta-\alpha_1}\right)\right] - m_1\Phi_1^{-\frac{1}{\theta}}\left[\tfrac{1+\theta}{\theta}\rho_{1,1}\gamma_1 + \tfrac{1+\theta-\alpha_1}{\theta}\rho_{2,1}\gamma_{-1}\right] + \alpha_1 m_1 \tfrac{\rho_{1,1}\Phi_1^{-\frac{1}{\theta}}\gamma_1}{\theta} + \alpha_1 m_2 \tfrac{1+\theta-\alpha_2}{1+\theta}\tfrac{\rho_{1,2}\Phi_2^{-\frac{1}{\theta}}\gamma_{-2}}{\theta} \tag{1.6.1}$$

The first term is the government's contract valuation times the probability of a successful auction, which is the linear combination of the probability that a domestic firm wins plus the probability that a foreign firm wins. The second term is the expected payment, weighted in the same way. The third term captures domestic firms' total profits in domestic auctions, and the fourth term captures their profits in foreign auctions.

Welfare with an NTA is

$$W_1^{\mathrm{A}} = m_1\left[\hat{H}\left(\tfrac{v\theta}{1+\theta}\right)v - \tfrac{1+\theta}{\theta}\Phi^{-\frac{1}{\theta}}\gamma\right] + \alpha\left(m_1+m_2\right)\tfrac{\bar{\rho}_1\Phi^{-\frac{1}{\theta}}\gamma}{\theta} \tag{1.6.2}$$

The first bracketed term captures the government's surplus composed of the contract's valuation times the probability of a successful auction less the expected payment to the winning firm. The second term captures domestic firms' total profits from all auctions worldwide.

A sufficiently patient government will choose to sign an agreement if the total welfare under an NTA exceeds the welfare under mutual discrimination. I define a comparative advantage term $\omega_i = \mu_i\beta_i^{-\theta}$. This reduces the number of country-specific

[27] In the following expressions, welfare is given for country 1. Welfare expressions for country 2 are the same, simply with indices reversed.

variables to two and permits clearer exposition. Given the complexity of the welfare expressions, there is unfortunately no simple analytic solution to the question of which countries will sign agreements (i.e. $W_i^{\mathrm{A}} \geq W_i$ for $i = 1, 2$). I therefore turn to numerical methods to quantify welfare effects in four cases:

1. Countries of equal size: $m_1 = m_2$
2. Country 1 is larger than country 2: $m_1 \geq m_2$
3. Countries of equal productivity, neither has a relative comparative advantage: $\omega_1 = \omega_2$
4. Country 1 has a comparative advantage relative to country 2: $\omega_1 \geq \omega_2$

The following figures illustrate the parameter spaces in which potential trade partners would be willing to negotiate. Weight on domestic profits is assumed to be 1 and $\theta = 4$.[28] Size is in units of 10,000 contracts per year. Comparative Advantage is normalized such that $\omega < 1$ indicates a comparative disadvantage vis-à-vis the rest of the world and $\omega > 1$ indicates a comparative advantage.

[28] The choice of $\theta = 4$ is not critical to the results. The following relationships are robust to $\theta \in (0, 4]$, although values approaching 0 are unsupported by the literature. Lowering θ increases the effect of an NTA on welfare; for example, $\theta = 2$ results in a 30 percent rise in welfare, made up of roughly 15 percent increases in both government cost savings and firm profit increases. Reducing α reduces the magnitude of the welfare effects, but never their direction. For example, when $\alpha = 0.3$, welfare effects are cut roughly in half. When $\alpha = 0.1$, welfare effects are reduced by a factor of 10. This order of magnitude change results from the fact that a small α implies very little initial discrimination, and thus little gain from complete elimination of discrimination margins.

Case 1: Countries of Equal Size

The first set of figures evaluates the case in which countries are of roughly equal size; that is, countries annually conduct a similar number of procurement auctions ($m_1 \approx m_2$).[29]

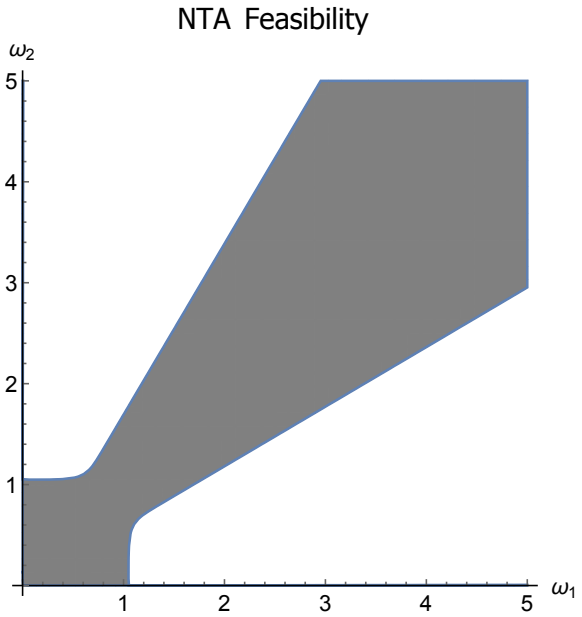

Figure 1.3: Feasibility: Countries of Equal Size

Figure 1.3 illustrates the combinations of comparative advantage for which signing a national treatment agreement is welfare-improving for both partners. The 45° line is included in the feasible region, implying that countries that are roughly identical in both size and productivity will always benefit from signing an NTA. This corresponds to the real world prevalence of North-North NTAs.

Figure 1.4 shows how welfare gains are distributed. The comparatively advantaged country experiences the greatest gains in total welfare, ranging from 0.5 percent up to approximately 2.5 percent over reasonable comparative advantage ratios. The second graph in the panel illustrates the cost savings that governments may expect

[29] Specifically $m_1 = m_2 = 50$, though the actual value of m has only a scaling effect on the value levels; it does not affect the sign or percentage changes shown in Cases 1 and 2.

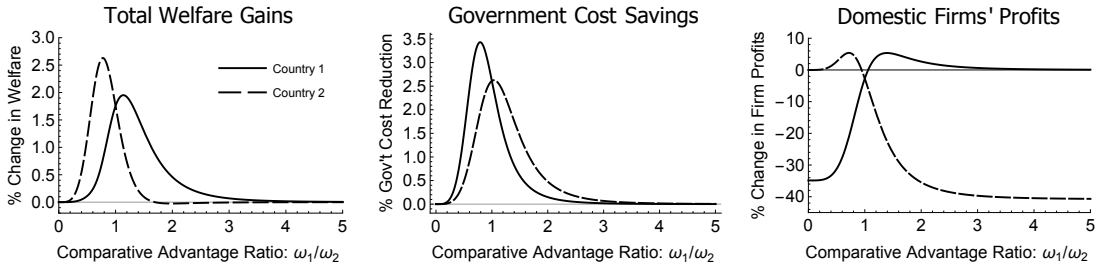

Figure 1.4: Welfare Effects: Countries of Equal Size

from increased competition. Once again, the greater gains accrue to the advantaged country, but even when countries are identical governments can experience price savings of up to 2.5 percent; with asymmetry, savings range from 0.5 to 3.5 percent.

The final graph shows how firms benefit—or lose—from their home country's membership in an NTA. The advantaged firms always have positive profits, but there is no point at which both partners could expect increases in domestic industries' total profits. Identical firms will both experience losses of about 2.5 percent, which stands to reason: reductions in total government expenditures must result in equal reductions in total firm revenues.

Case 2: Country 1 Larger than Country 2

In the next set of figures, country 1's procurement market is larger than country 2's. Specifically, $m_1 = 4m_2$. Since procurement market size is strongly correlated to GDP, this can be thought of simply as a big country versus a small country.

In Figure 1.5, the feasibility region is rotated towards the axis of the larger country. At first this may seem counter-intuitive. We would expect smaller countries to fear that their procurement market could be swamped by firms from their much larger

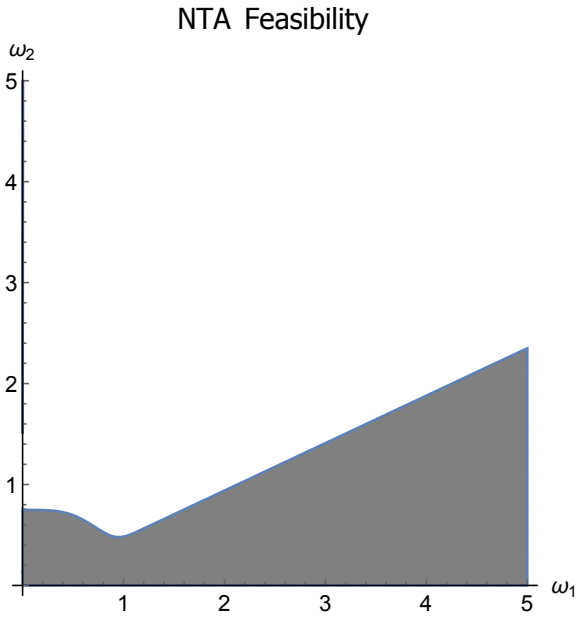

Figure 1.5: Feasibility: Countries of Unequal Size

partners, and thus only be willing to sign if they themselves held the productivity advantage. However, recall that the measure ω includes both an expected cost parameter β and a size of procurement industry parameter μ. A higher β lowers ω while a higher μ raises it. Indeed, it is not the smaller country that is the limiting factor; rather a larger country that is not sufficiently competitive would fear that its new partner's firms would win too many contracts in the large country while not offsetting these losses by providing enough opportunities for its own firms to win contracts in the smaller country.

In both Figures 1.5 and 1.3, the region of feasibility expands for country pairs that are at a comparative disadvantage in relation to the rest of the world (i.e. $\omega_i < 1$). This indicates that there is great scope for South-South agreements, which has yet to be realized in practice.

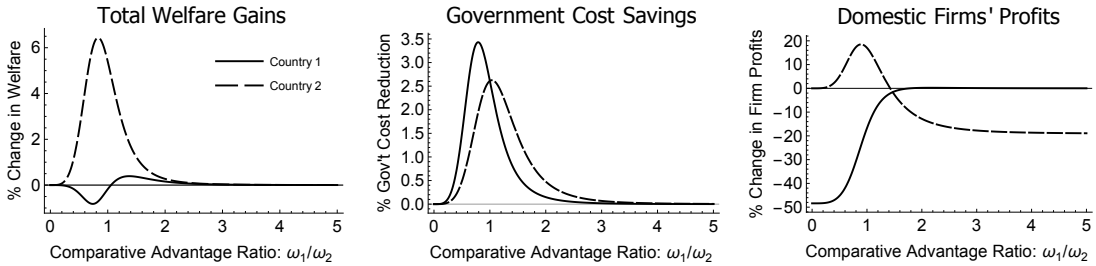

Figure 1.6: Welfare Effects: Countries of Unequal Size

Figure 1.6 shows how welfare gains are distributed. Relative to the case of equally-sized partners, country 1 can expect much more limited total benefits from an NTA, whereas its small partner can expect even greater welfare improvements. The cost savings in the second panel are identical to those of the first case. Country size does not directly affect the likelihood of winning any particular auction, so the percent savings per auction remain the same.[30] In absolute amounts, savings for the larger country will likely exceed those of the smaller.

The final graph of figure 1.4 shows how firms benefit–or lose–from their home country's membership in an NTA. The size of country 2 is fixed at 50. In real terms, that is 500,000 contracts a year, or roughly the number of contracts signed annually by the United States in the early 1990s. Notice that in the best case scenario for country 1's firms, their profits are largely unchanged by the agreement. Politically, this means that governments may face strong opposition from domestic firms when considering an NTA with a much smaller partner, especially if that partner is also comparatively more productive.

[30] Of course, there is an indirect effect in that larger countries will also likely have more domestic firms capable of supplying procurement goods and services. However, in the model, industry size is captured by the arrival rate μ, which is exogenous to m. For example, Iran likely has fewer firms in its procurement industry than has Ireland, despite its larger GDP.

Case 3: No Comparative Advantage

In this section, countries are roughly equal in comparative advantage relative to the world, thus neither has a comparative advantage over the other. That is, $\omega_1 \approx \omega_2 \approx 1$.

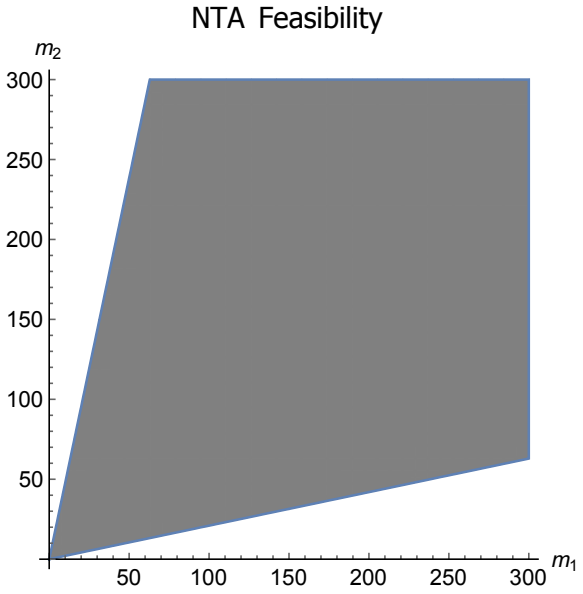

Figure 1.7: Feasibility: Equal Productivity

The region of NTA feasibility is straightforward: given equal productivity, the closer in size countries are to each other, the more likely an NTA. Indeed, the slope of the lines framing the region show that there is a constant ratio beyond which an NTA becomes untenable: If either country is more than roughly four times the size of its partner, then an agreement is not Pareto welfare-improving.

Figure 1.8 illustrates the distributional effects of an NTA. When reading the graphs, recall that $m2 = 50$. The first panel shows that the greatest percent increase in welfare accrues to the smaller partner, though welfare changes remain positive over a broad range.

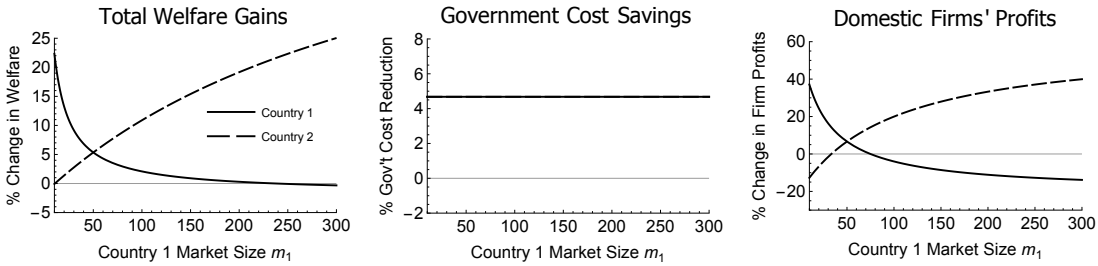

Figure 1.8: Welfare Effects: Equal Productivity

The second panel shows that given fixed productivity, market size does not affect the government savings per auction, which are approximately 4.3 percent. The average country spends between 8 and 14 percent of GDP on procurement, of which roughly half is potentially tradeable; this implies cost savings on the magnitude of 0.17 to 0.3 percent of GDP. For comparison, if instead $\alpha = 0.3$, government cost savings fall to 0.35 percent, implying savings of 0.03 to 0.05 percent of GDP.

The final panel shows the effect of the NTA on domestic firms' profits. The explanation of the reduction in firm profits for Figure 1.4 applies here as well, though it is important to point out that this in not always necessarily the case. The model incorporates the probability that either no bid is submitted or that all bids are too high. For relatively productive countries, this probability is negligible, and any fall in government costs necessitates a fall in total firm revenues. However, if partners were sufficiently unproductive (β sufficiently high) then we would expect to see both government costs fall and firm profits rise. For example, if both partners had productivity 30 percent of world average, government costs (including the opportunity costs of failed auctions) would fall by 0.6 percent and firm revenues would actually rise by 1.19 percent.

Case 4: Country 1 has a Comparative Advantage

In the final set of figures, country 1 has a comparative advantage and country 2 has a comparative disadvantage. Specifically, $\omega_1 = 1.5$ and $\omega_2 = 0.75$.

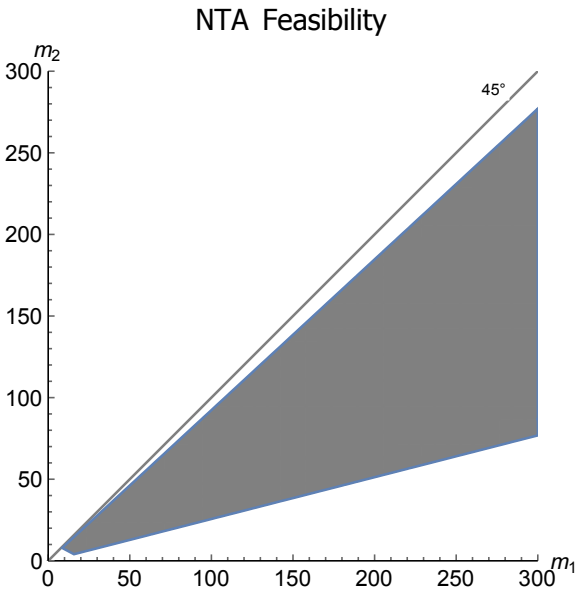

Figure 1.9: Feasibility: Unequal Productivity

In Figure 1.9, the 45° line makes it apparent that the disparity in productivity disinclines countries of equal size but differing productivity from signing an agreement. The region is rotated toward the advantaged country, meaning that country 1 will be willing to join only if it is also larger than country 2.

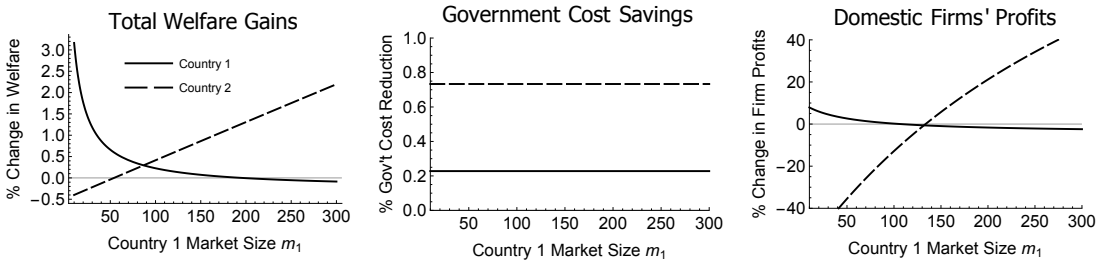

Figure 1.10: Welfare Effects: Unequal Productivity

Figure 1.10 illustrates the welfare, cost, and profit effects of signing an NTA. The first panel shows that it is country 2's welfare that bounds the feasibility region such that country 1 must be larger.[31] As in Case 3, government cost savings are constant, though also much more modest at only 0.76 percent. The final panel indicates that the change in domestic firms' profits for country 2 does not become positive until country 1 is about 2.5 times its size, after which profits ramp up quickly. The increase in profits for country 1 is generally less than 5 percent.

1.7 Plurilateral Agreements

There presently exists only one plurilateral agreement on government procurement: the aptly named WTO Government Procurement Agreement.[32] Given the existence of the GPA, it is possible to predict which current non-member countries would benefit from accession and the resulting welfare changes for incumbent members, the acceding country, and non-members.[33]

It is worth pointing out that the model can be extended to allow countries to have unique productivity parameters for each procurement-related industry. This format could then be used to explain the existence of annexes in the GPA which allow members to exclude specific industries from coverage under the agreement. However, for

[31] When $m_2 = 50$, any m_1 less than 50 results in a welfare loss for country 2.

[32] It could be argued that the European Union, EFTA, NAFTA, and other regional trade agreements with procurement chapters also constitute plurilateral NTAs. However, in each of these, signatories decide on membership based on a wealth of factors, ranging from tariff reductions to labor market integration to currency unions, among which procurement considerations most likely are of secondary or tertiary priority. As such, it is unclear whether the inclusion of a procurement chapter was sought by all parties or included at the behest of a subset of members. Only the GPA exists as a multi-country agreement entered into for the express purpose of procurement market liberalization.

[33] Using the theoretical model to predict the initial formation of the GPA would involve testing every combination of all countries on earth to ascertain which combinations provide positive welfare benefits to all prospective entrants. This is beyond the scope of this chapter, but remains a topic for future research.

the sake of simplicity and consistency, in this section I continue to assume a homogeneous procurement sector (and the existence of a second non-procurement sector) which can be characterized by a single comparative advantage term. Explaining the existence of GPA annexes remains a topic for future research.

Consider two groups of countries: Ω_{GPA} and Ω_{D}, where the former consists of R_{GPA} members to the agreement and the latter consists of R_{RoW} non-member countries, who comprise the rest of the world (RoW).[34] Country $N \in \Omega_{\text{RoW}}$ considers joining the GPA. To evaluate the welfare impacts of N's accession, it is necessary to make a number of simplifying assumptions. First, within each group, countries are identical in terms of productivity, cost parameters, and annual number of auctions. Country N is the sole exception and may have any combination of parameter values. Thus, in terms of country characteristics, we need only consider six parameters: ω_{N}, ω_{GPA}, ω_{RoW}, m_{N}, m_{GPA}, and m_{RoW}. Second, the current members of the GPA are almost exclusively rich, high-productivity countries, whereas non-members (though a more diverse group) tend to be smaller and less competitive in procurement industries. I thus set $\omega_{\text{GPA}} = 2$ and $\omega_{\text{RoW}} = 0.75$; that is, GPA members are twice as productive as world average while non-members are 75 percent as productive as world average. To approximately match the real procurement market volumes, I set $m_{\text{GPA}} = 80$ and $m_{\text{RoW}} = 20$, implying that the average GPA member conducts 800,000 procurement projects annually, while the average non-member conducts 200,000. Third, to approximately match the number of countries in each group, I set $R_{\text{GPA}} = 40$ and $R_{\text{GPA}} = 160$, implying 200 total countries in the world.

It is important to note that the specific values chosen above are not critical to the analysis. More important is the relationship between the parameters. Choosing

[34] The total number of countries in the world is thus $R_{\text{GPA}} + R_{\text{RoW}}$.

precise values does, however, permit us to analyze cases in which accession for country N is feasible, and to quantify the resulting welfare effects on each group.

Fixed Country Size m_N, Varying by Productivity ω_N

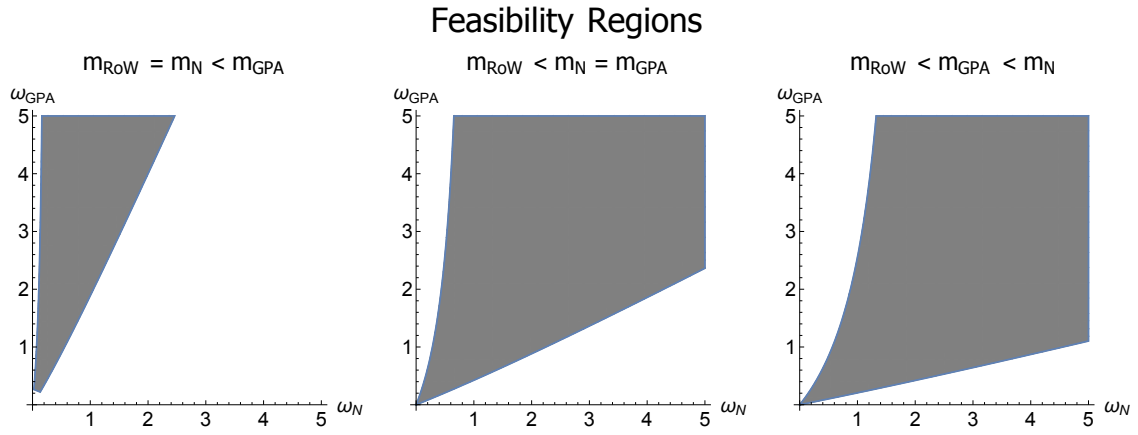

Figure 1.11: Plurilateral Accession Feasibility: Country Size

Figure 1.11 shows the ranges of accession feasibility. In the first panel, the acceding country is the same size as all other non members. There is a very limited range of productivity over which GPA members would benefit from the addition of a new smaller member. The second panel illustrates the case in which country N's procurement market is the same size as the GPA member average. It is this class of country that will be most likely to both benefit from the GPA and be welcomed by the current members: over all reasonable productivity ranges, accession will improve welfare of both the old members and the new. The third panel illustrates the case in which the potential new member is very large, for example India or China. In this case, unless the country is also well above-average in productivity, it will not benefit from joining the GPA, which may explain why neither of those two countries are members or have demonstrated any intention of exploring membership.

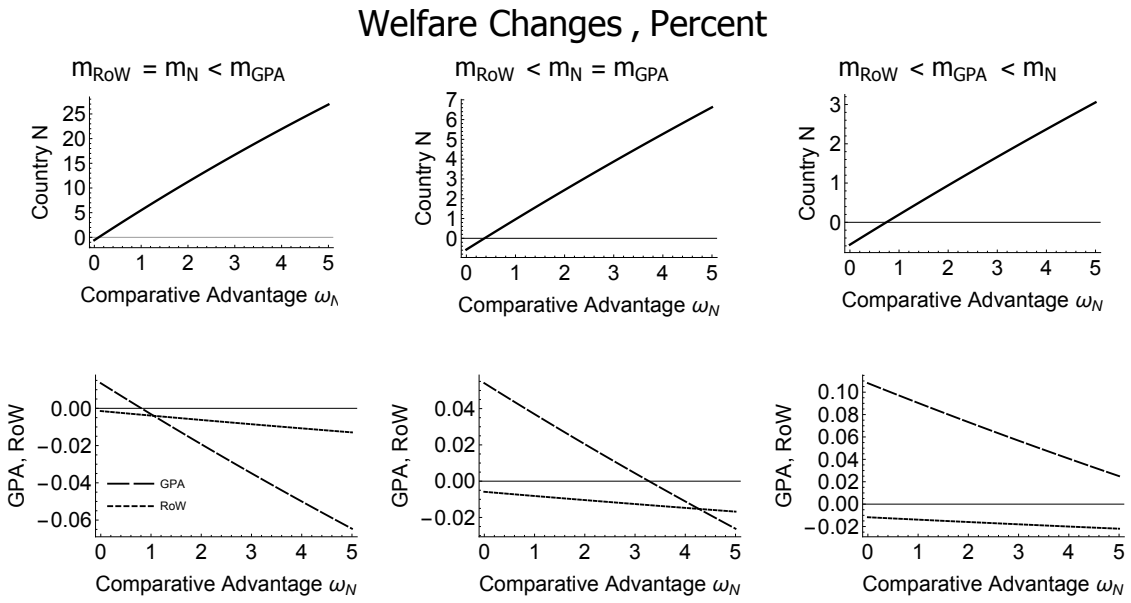

Figure 1.12: Plurilateral Welfare Effects: Country Size

Figure 1.12 presents the welfare effects of a new country's accession. The top row of graphs shows the acceding country's percentage change in welfare, while the bottom row shows welfare changes for the average GPA member and the average non-member, both in percentages. In the first case, in which country N is small, it is the welfare of GPA members that in large part bind ω_{N}, whereas in the last case, in which the acceding country is relatively large, it is more likely country N's welfare that is binding the range of accession ω_{N} values. In welfare terms, when accession is mutually welfare-improving, acceding countries can expect welfare improvements on the magnitude of 1 to 5 percent. For current members, welfare improvements are only marginal, in the range of 0.02 to 0.1 percent. Non-members can each expect a small fall in welfare on the order of 0.01 to 0.02 percent.

Fixed Productivity ω_N, Varying by Country Size m_N

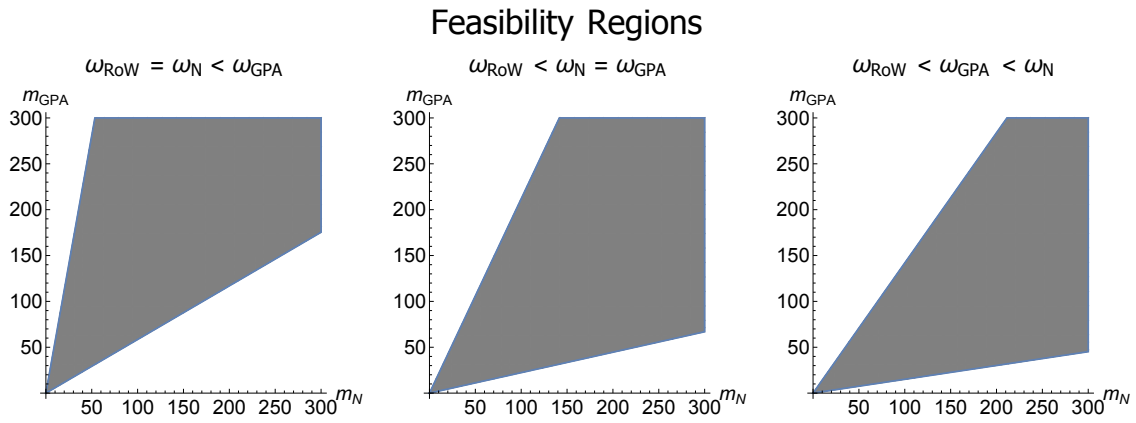

Figure 1.13: Plurilateral Accession Feasibility: Productivity

The three panels of Figure 1.13 illustrate the regions (in terms of m) in which current members and the potential entrant will both realize welfare gains. Values presented here range up to 3 million auctions annually. The three cases are comparable to those of the previous section: on the left, country N is at a comparative disadvantage (equivalent to other non-members), in the center it's productivity is equal to the average GPA member's, and on the right it has a strong comparative advantage both regards to the world and to the GPA members' average.

Graphically, the accession region rotates towards the entrant's axis as the entrant becomes more productive. As a country's comparative advantage in procurement industries grows, the size of its procurement market must also rise, else its accession is not Pareto improving. Intuitively, competitive countries are welcome only if they offer many new procurement opportunities to current members.

Figure 1.14 shows the welfare gains for entrants in the first row; welfare changes for current GPA members and the rest of the world are in the second row. The welfare gains within the zones of accession are of the same magnitude as those presented in the previous section. Entrants can expect welfare improvements of 1 to 5 percent,

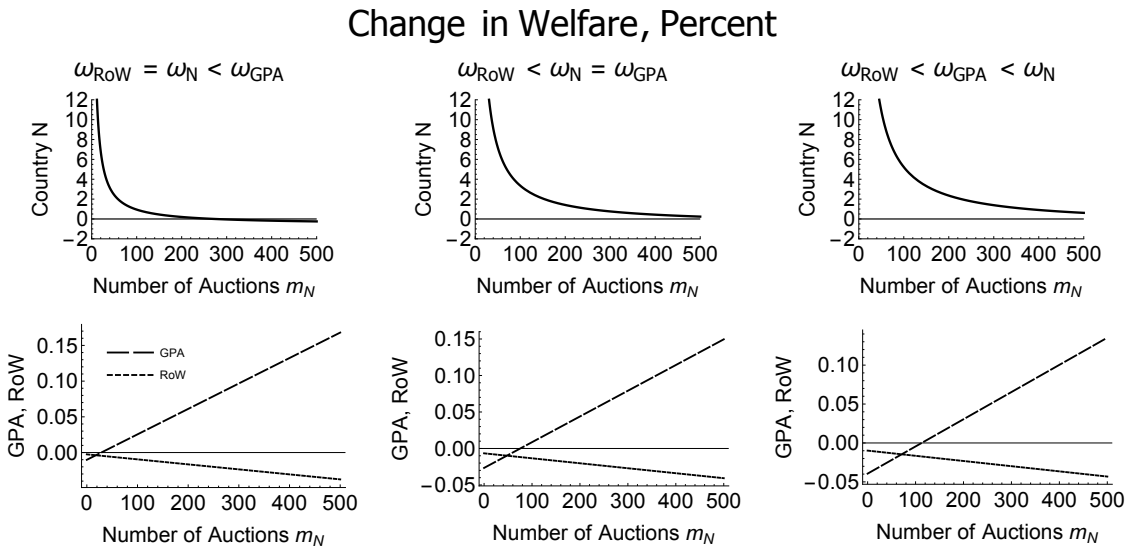

Figure 1.14: Plurilateral Welfare Effects: Productivity

while current members will gain between 0.02 and 0.1 percent. Non-members always lose out from the accession of a new country to the GPA, those these losses are on the scale of 0.01 to 0.05 percent.

A general result has been that countries similar in size and productivity to current GPA members will accede to the agreement. Imagine a world in which all countries are identical. This would eventually lead to a situation in which all countries joined the GPA and procurement liberalization was complete worldwide. This result is driven by the fact that each member of the GPA considers only its own welfare effects when deciding whether or not to support a new member's accession. If instead countries also considered the welfare of other member states, the GPA would then act as a single country whose size is the (weighted) sum of its member's markets. The GPA would eventually reach a total size such that it would prefer to exclude new members, even if potential entrants were of the same size and productivity as the current member

average. Plurilateral agreements would thus have a maximum size, determined by the weight accorded by countries to the welfare of their agreement partners.

1.8 Empirical Strategy and Data

1.8.1 Estimation Strategy

While research on the formation of procurement national treatment agreements is limited, there is a rich literature addressing the formation of free trade agreements. Baldwin and Venables (1995) chart the development of the discipline, from the perfect competition framework of Viner (1950) to static monopolistic competition models to more recent dynamic factor-accumulation approaches. Krugman (1991) and others[35] explore the political economy components of FTAs, as distinct from the purely economic forces considered by other models. Finally Baier and Bergstrand (2004) offers the first empirical investigation of FTA formation.[36]

While by no means matching the breadth of scholarship represented above, this chapter is the first to offer a model of procurement NTA formation accompanied by empirical analysis.

The theoretical model is, unfortunately, intractable for structural estimation. However, it does imply several testable relationships. Countries with greater weight on domestic profits will be less likely to sign national treatment agreements. Large differences in either comparative advantage or country size also reduce the probability of partners' signing an NTA. Furthermore, there is an interaction between the two characteristics such that if one partner is much more productive, it must also be the larger of the two for an agreement to be feasible. To test these relationships, I use two empirical approaches.

[35] See, for example, Grossman and Helpman (1993) and Rodrik (1995)

[36] Which the author returns to in Baier et al. (2014)

The first approach is a simple sign test. I assign each country pair in the data a predicted NTA status (1 or 0) based on its size and comparative advantage ratios.

The second approach uses estimating equations. These estimate the contributions of market size, comparative advantage, and preference margins on the likelihood of two countries' forming a national treatment agreement. To better isolate the effects of each determinant, I include standard gravity controls and year fixed effects.

Estimating Procurement

For the purposes of estimating the welfare impacts of liberalizing procurement, it is important to differentiate between tradeable and non-tradeable procurement. Tradeable government procurement includes the provision of goods and services that can be readily supplied across national borders. These include goods such as photocopy machines, dining utensils, and airplanes and services such as project consulting and construction management, among many others. Non-tradeable procurement consists of two broad categories: compensation to employees and defense spending. Employee compensation is not subject to the same auction environment described in this chapter and so is outside its purview. Defense spending is determined primarily by security concerns and is generally restricted to domestic suppliers and a handful of close military allies. While it is true that within this group of pre-qualified firms, contracts are often awarded through competitive bidding, the exigencies of defense considerations make it unsuitable for the simple model described herein. Tradeable procurement can therefore be thought of as total government spending less defense spending less employee compensation, or equivalently total government intermediate consumption spending plus gross fixed capital formation (i.e. spending on goods and services plus spending on physical capital and construction projects).

Attempts to estimate the size of national procurement markets have taken one of two approaches: a top-down method based on the System of National Accounts (SNA) or a bottom-up method incorporating data drawn directly from national authorities. The majority of studies have relied on SNA data and restricted their estimates to relatively brief time periods. The European Community published two reports[37] each offering estimates for a single year and reporting the value of tradeable procurement to be between 11.2 and 11.8 percent of GDP. Francois et al. (2000) looked at the United States for the 1993 fiscal year and estimated the total value of public procurement (tradeable plus non-tradeable) at 18.3 percent of GDP. Trionfetti (2000) estimates the procurement market for 9 OECD countries and arrives at two different value ranges depending on the data source: 7 to 9 percent based on UN data and 10 to 18 percent based on IMF data. Finally, the OECD (Audet, 2002) has estimated the value of tradeable government procurement in OECD countries to be roughly 9 percent of GDP. To the best of my knowledge, the only cross-country bottom-up approach is found in Hoekman (1997), which surveys 20 countries from 1993 to 1998 and estimates tradeable procurement at an exceptionally low 0.4 percent of GDP.[38]

The top-down approach has the advantage of utilizing standardized measurements and thus permits direct comparison across countries. However, The SNA does not include a specific measure of procurement spending, so this value must be estimated based on other SNA series. The two most pertinent series are Intermediate Consumption (IC) and Gross Fixed Capital Formation (GFCF). IC consists of gross consumption spending on goods and services, whereas GFCF represents government

[37] European Community (1988) and European Community (1997)

[38] Several other papers have included limited estimates of procurement markets. Hsu (2006) surveys the procurement policies of ASEAN and APEC members, but include no analysis. Kim (2009) studies the propensity of U.S. states to accede to the GPA. Shingal (2011) looks at services procurement in Japan and Switzerland.

expenditure on investment in new physical capital.[39] An approximation of total procurement is the sum of IC and GFCF minus their defense components.

Most procurement agreements bind only national governments.[40] Unfortunately, the corresponding SNA national level series are inconsistently reported, Instead, I use the general government time series. While these often include sub-national expenditures which are not covered by NTAs, they are far more complete.

The primary drawback of this top-down SNA approach is that it may not measure government procurement as defined by the reporting country. Every government determines which of its expenditures are conducted through competitive auctions, and there is little evidence to suggest that these standards are identical across countries. Thus, while the SNA appraoch makes it possible to compare the objective sizes of national procurement markets, it may not reflect the actual values used by governments to make decisions regarding NTA accession.

The bottom-up approach relies on procurement data reported by national authorities. Thus, it has advantage of representing the value of procurement as considered by each government. The downside is that there is no guarantee that the data are comparable across countries; indeed, it is likely the case that the components of total procurement vary widely. I assume that welfare-maximizing governments evaluating a potential NTA will use internal estimates of their procurement markets rather than

[39] Audet (2002) also uses Final Consumption Expenditure (FCE), which consists of all expenditures including employee compensation (EC), depreciation estimates (D), and indirect taxes (T) minus sales (S). This implies an equivalence with intermediate consumption wherein IC = FCE – EC – D – T + S. The FCE series is available for most countries, whereas IC is less common. However, EC, D, T, and S are often missing from country data series and so require estimation. To avoid this potential source of inaccuracy, I restrict attention to only those countries reporting both IC and GFCF series.

[40] The GPA includes provisions to bind sub-national units that opt in. For example, 37 U.S. states are covered to some degree, though many restrict participation to the executive branch or a few specific state agencies.

SNA estimates, which implies that the bottom-up approach is the most appropriate for this analysis.

I rely primarily on data gathered from national statistics agencies and procurement authorities. These observations fall into three groups. The first group consists of observations from those countries that publicly disclose annual procurement expenditures. The second group consists of those countries that disclose line item expenditures, but do not specifically break out procurement. For these, a best-faith effort was made to include the items relevant to procurement, following indications found on procurement authority websites whenever possible. The third group consists of estimates by nongovernment organizations specific to their respective countries or regions. Wherever possible, these data also include the published price preference accorded domestic firms in international tenders. Appendix A-5 records the source of each observation as well as notes on the methodology used in its construction, if applicable. Data come from the time period 1990–2010.

As a robustness check, I also include data gathered from the United Nations' SNA database.[41] As described above, these data are internally consistent and are available for a broad panel of countries. I follow the methodology of previous government procurement surveys in summing intermediate consumption and gross fixed capital formation (less defense) to arrive at a rough approximate of the total value of each country's tradeable government procurement market.

The two data sources have many overlapping observations, making it possible to evaluate the extent to which they internally agree, as seen in Table 1.2. About two-thirds of each data source's observations are also contained within the the other data set. However, from their low correlation value, it is apparent that there is indeed sig-

[41] United Nations Statistics Division (2014)

nificant differences between what national governments internally consider tradeable procurement, and what the SNA approach estimates.

Table 1.2: Correspondence of Data Sets

Measurement	Value
Observations in Common	574
Correlation	0.507
NS: Mean Procurement Value (billions)	91.90
UN: Mean Procurement Value (billions)	95.60

Note: Mean over observations common to both data sets

Between the two data sources, there are observations for 68 countries. However, as previously explained, it would not be appropriate to combine them. Statistics on the coverage of each data source are found in Table 1.3. The UN data is limited to 48 countries, but for those countries the data is mostly complete, with over half of the countries covered having observations for at least 18 years. The National Sources data covers more countries, 67 in total, but is far less complete for each, with half of the countries covered having observations for fewer than 11 years.

Table 1.3: Data Coverage Comparison

Data	Years	Total Obs	Countries	Min	Median	Max
National Sources	1990–2010	801	67	1	11	21
UN SNA	1990–2010	849	48	5	18	21

Cost, Arrival Rates, and Comparative Advantage

The theory calls for measures of maximum cost and arrival rate for each country. However, because these parameters are nonseperable for any structural estimate of the theoretical model, it is simpler to estimate Φ_i, which can be interpreted as country i's comparative advantage, inclusive of discrimination effects. For this I elect to use countries' revealed comparative advantage (RCA) in procurement industries, following the

methodology of Balassa (1965). Using data from the United States Federal Procurement Data System (FPDS), I rank each good by its total procurement value and record the top 1,354 four-digit HS codes. These together represent 90 percent of all goods procured by the United States. Given the size and diversity of the U.S. procurement market, I assume that these goods are representative of the worldwide procurement market. Based on this basket of goods and using trade values from the United Nations Comtrade Database[42], I generate a procurement industry RCA for each country as

$$\text{RCA}_i = \frac{\frac{x_i}{X_i}}{\frac{x_w}{X_w}}$$

Where x represents exports of procurement goods and X represents total exports. Subscripts i and w denote country and world, respectively.[43] This measurement has the drawback that it is limited to trade in goods, which accounts for just under half of all procurement for the United States. It is possible that a country could have a relatively weak presence in the world market for procurement goods while simultaneously being a powerhouse with regards to procurement services. In such a case, this goods-based measure would not be representative. On the other hand, many services are provided better locally by affiliates than remotely from abroad, in which case foreign direct investment would substitute for exports. This may mitigate the lack of services in the RCA.

The RCA has the added benefit of being a long-established and oft-used measure of comparative advantage. Vollrath (1991) discusses the theoretical merits of the Balassa index, and points out that it is subject to distortion from tariffs, subsidies, and the other trade barriers. In using the RCA to estimate a country's natural comparative

[42]United Nations (2014)

[43]Here, "world" is actually defined as the set of 68 countries in the data

advantage, these distortions are indeed problematic. Fortunately, for the purposes of measuring a country's comparative ability to supply procurement goods and services, it is actually appropriate to incorporate tariffs and other barriers, as these affect firms' capacity and likelihood to export. Thus the RCA is a reasonable approximation of comparative advantage, despite its drawbacks. Empirically, I predict that the greater the disparity in RCA between two potential partners, the less likely they are to form a procurement agreement.

Summary Statistics

For the empirical analysis, the observational unit is a country dyad-year. I construct measures of tradeable procurement and revealed comparative advantage as described above. I also collect data on published preference margins from a variety of national sources. Using United Nations and World Trade Organization resources, I construct bilateral indicators for free trade agreements and national treatment agreements.[44] Gravity controls include GDP, population-weighted distance values, WTO/GATT membership, common language, contiguity, and common currency variables, which come from the CEPII database.[45]

Table 1.4 contains the summary statistics for the national sources data set based on the bottom-up approach. Tradeable procurement averages nearly $80 billion per country per year. This is roughly 13.5 percent of GDP. While the average preference margin is almost 6 percent, almost half of all country pairs are part of a national treatment agreement, for whom the margin would not apply.

This NTA rate is much higher than the true world average. Developed nations are the most likely to publicly disclose their procurement policies and spending. They

[44] (World Bank, 2014)
[45] (Head and Mayer, 2013)

Table 1.4: Summary Stastics, National Sources Data

Variable	Obs	Mean	Std. Dev.	Min	Max
Tradeable Procurement†	22342	79.79	125.95	0.08	787.63
Procurement, % of GDP	22342	13.59	8.78	1.02	59.43
NTA	22342	0.43	0.50	0	1
Preference Margin	22342	5.78	5.71	0	25
GDP†	22342	796	2,000	5.83	13,631
Revealed Comparative Adv.	22342	0.91	0.28	0.01	1.43
Distance, km‡	22342	6,445	5,086	115	19,539
FTA	22342	0.37	0.48	0	1
WTO Member	22342	0.99	0.09	0	1
Adjacent	22342	0.04	0.20	0	1
Common Language	22342	0.11	0.31	0	1
Colonial Heritage	22342	0.04	0.19	0	1
Common Currency	22342	0.07	0.26	0	1

Observations are trading pair-year. † Billions, 2005 USD
‡ Population-weighted

have also been the early movers in procurement agreements. Thus, the availability of country-level procurement data is biased in favor of countries with agreements, unfortunately an unavoidable aspect of the data.

Table 1.5 contains the summary statistics for the United Nations data set based on the top-down approach. The average procurement market size is similar to that of the national sources data set, though it represents a much more modest 8.7 percent of GDP. This results from the fact that the United Nations data is even more skewed towards developed countries, which report their annual statistics more reliably. As a consequence, even more observations report national treatment agreements. Developed nations also tend to be less protectionist than less developed countries, and this is reflected in the the lower average preference margin.

Table 1.5: Summary Stastics, United Nations Data

Variable	Obs	Mean	Std. Dev.	Min	Max
Tradeable Procurement†	19450	76.22	208.19	0.01	1,553
Procurement, % of GDP	19450	8.69	3.93	0.004	22.53
NTA	19450	0.49	0.50	0	1
Preference Margin	19450	5.43	5.11	0	20
GDP†	19450	851	2,066	5.83	13,631
Revealed Comparative Adv.	19450	0.94	0.22	0.25	1.38
Distance, km‡	19450	5,054	4,678	161	19,539
FTA	19450	0.42	0.49	0	1
WTO Member	19450	0.97	0.16	0	1
Adjacent	19450	0.06	0.24	0	1
Common Language	19450	0.09	0.28	0	1
Colonial Heritage	19450	0.04	0.19	0	1
Common Currency	19450	0.08	0.27	0	1

Observations are trading pair-year. † Billions, 2005 USD
‡ Population-weighted

1.9 Empirical Results

1.9.1 Sign Tests

I use the following two conditions, motivated by the theory, to predict whether a country pair will report a national treatment agreement. First, countries are similar in terms of productivity and procurement market size. That is, the more productive partner's revealed comparative advantage is no more than twice that of the less productive partner, and the larger partner's market is no more than three times the size of the smaller partner's market:

$$\frac{1}{2} \leq \frac{\text{RCA}_1}{\text{RCA}_2} \leq 2 \quad \text{and} \quad \frac{1}{3} \leq \frac{m_1}{m_2} \leq 3 \tag{1.9.1}$$

Second, if one partner is significantly larger, it is also significantly more productive. That is, if one partner is more than three times larger than the smaller, it is also

more than twice as productive:

$$\frac{m_1}{m_2} > 3 \quad \text{and} \quad \frac{\text{RCA}_1}{\text{RCA}_2} > 2 \tag{1.9.2}$$

where country 1 is the larger of the pair.

Overall success rates are high, as are successful predictions of non-agreements, despite the fact that these conditions explicitly ignore all other factors that could potentially contribute to the formation of a procurement agreement. The comparatively low success rate for predicting realized NTAs is not unexpected. NTAs are a relatively recent advent; it would be surprising if all countries had already formed every welfare-improving bilateral agreement possible. Furthermore, the formation of NTAs is almost certainly influenced by cultural and political factors independent of the purely economic factors in this model.

National Sources Data

Table 1.6 reports the sign test results for the national sources data set. Overall, the conditions generate a 75 percent success rate. They correctly predict 33 percent of existing NTAs and 85 percent of non-agreements. Success rates for countries vary greatly. Malta, Luxembourg, and the United States sign more agreements than predicted by the model. At the other extreme, Panama, Peru, Sweden, and Austria sign fewer.

United Nations Data

Table 1.7 reports the sign test results for the United Nations data set. Overall, the conditions generate a more modest 56 percent success rate. They correctly predict 30 percent of existing NTAs and 70 percent of non-agreements. Again, success rates vary across countries. For these data, the United Kingdom, Morocco, and Estonia are the

Table 1.6: Sign Tests: National Sources Data

Country	Success Rate			Country	Success Rate		
	Overall	NTA=1	NTA=0		Overall	NTA=1	NTA=0
Overall	**0.75**	**0.33**	**0.85**	Estonia	0.77	0.24	0.95
Panama	0.40	1.00	0.40	Peru	0.77	0.80	0.77
Luxembourg	0.49	0.18	0.78	Latvia	0.78	0.25	0.94
United States	0.56	0.18	0.84	Lithuania	0.78	0.25	0.95
France	0.56	0.23	0.82	Australia	0.78	0.47	0.79
Italy	0.58	0.29	0.81	Poland	0.78	0.47	0.89
United Kingdom	0.60	0.26	0.83	Slovakia	0.79	0.37	0.92
Germany	0.61	0.25	0.85	Oman	0.79	-	0.79
Belgium	0.61	0.49	0.72	Viet Nam	0.79	-	0.79
Israel	0.61	0.21	0.91	Morocco	0.80	0.00	0.80
Norway	0.62	0.28	0.86	UAE	0.80	-	0.80
Iceland	0.62	0.32	0.75	Cyprus	0.80	0.20	0.97
Hong Kong	0.63	0.21	0.87	China	0.80	-	0.80
South Korea	0.63	0.33	0.79	Hungary	0.80	0.39	0.92
Switzerland	0.63	0.41	0.77	Czech Rep.	0.81	0.42	0.93
Spain	0.63	0.33	0.84	Brazil	0.82	-	0.82
Ireland	0.63	0.40	0.80	Russia	0.83	-	0.83
Japan	0.64	0.40	0.78	Turkey	0.84	0.33	0.84
Portugal	0.65	0.41	0.81	South Africa	0.84	-	0.84
Netherlands	0.65	0.41	0.81	Colombia	0.85	0.00	0.85
Austria	0.65	0.50	0.76	Bulgaria	0.85	0.26	0.96
Singapore	0.65	0.21	0.90	Nigeria	0.86	-	0.86
Finland	0.66	0.41	0.82	Albania	0.86	0.32	0.93
Canada	0.66	0.41	0.82	Chile	0.90	0.23	0.92
Greece	0.66	0.45	0.82	Romania	0.90	0.46	0.97
Denmark	0.67	0.44	0.82	Philippines	0.91	-	0.91
Sweden	0.67	0.50	0.79	Costa Rica	0.92	0.00	0.94
New Zealand	0.68	0.42	0.69	Argentina	0.92	-	0.92
Mexico	0.71	0.29	0.86	Jordan	0.93	-	0.93
Malaysia	0.72	-	0.72	Ukraine	0.95	-	0.95
Venezuela	0.74	-	0.74	Indonesia	0.96	-	0.96
India	0.75	-	0.75	Georgia	0.99	-	0.99
Slovenia	0.76	0.24	0.94	Saudi Arabia	1.00	-	1.00
Malta	0.77	0.06	0.99	Pakistan	1.00	-	1.00

Note: Missing values indicate the country is not party to any NTAs

standouts, signing more agreements than predicted. New Zealand, Switzerland, and Sweden are the countries who sign the fewest relative to their predicted values.

Results for the United Nations data are not as strong as those of the national sources data. This supports my assertion that a bottom-up approach is more appropriate than a top-down approach for predicting countries' NTA decisions. Governments will use their internal reckonings of procurement market value, which may vary significantly from the international standard embodied by the System of National Accounts of what constitutes government procurement.

Table 1.7: Sign Tests: United Nations Data

	Success Rate				Success Rate		
Country	Overall	NTA=1	NTA=0	Country	Overall	NTA=1	NTA=0
Overall	**0.56**	**0.30**	**0.70**				
Luxembourg	0.31	0.13	0.65	New Zealand	0.56	0.50	0.56
United Kingdom	0.38	0.02	0.82	Switzerland	0.56	0.49	0.64
Iceland	0.43	0.32	0.51	Sweden	0.56	0.52	0.62
United States	0.44	0.19	0.78	Czech Rep.	0.56	0.41	0.64
Germany	0.44	0.25	0.69	South Africa	0.56	-	0.56
France	0.45	0.30	0.68	India	0.59	-	0.59
Spain	0.46	0.30	0.71	Hungary	0.59	0.40	0.69
Japan	0.47	0.15	0.80	Lithuania	0.60	0.18	0.82
Canada	0.48	0.28	0.70	Venezuela	0.61	-	0.61
Italy	0.48	0.28	0.77	Cyprus	0.61	0.18	0.83
Ireland	0.49	0.41	0.59	Colombia	0.61	0.17	0.62
Austria	0.49	0.37	0.66	Latvia	0.62	0.18	0.83
South Korea	0.49	0.43	0.56	Estonia	0.62	0.02	0.93
Turkey	0.51	-	0.51	Malta	0.62	0.10	0.92
Belgium	0.51	0.45	0.62	Chile	0.64	0.15	0.67
Netherlands	0.52	0.44	0.62	Bulgaria	0.64	0.21	0.78
Norway	0.52	0.47	0.59	Romania	0.64	0.43	0.70
Mexico	0.53	0.48	0.56	Russia	0.65	-	0.65
Portugal	0.54	0.36	0.77	Slovakia	0.66	0.09	0.94
Finland	0.54	0.41	0.70	Ukraine	0.67	-	0.67
Poland	0.55	0.48	0.58	Slovenia	0.69	0.13	0.98
Denmark	0.55	0.49	0.62	Brazil	0.69	-	0.69
Israel	0.55	0.48	0.65	Morocco	0.72	0.00	0.72
Greece	0.55	0.35	0.82	Saudi Arabia	0.85	-	0.85

Note: Missing values indicate the country is not party to any NTAs

1.9.2 Estimation Equation Results

I use the following empirical specification to predict the formation of national treatment agreements.

$$NTA_{ijt} = \beta_0 + \beta_1 W_{ijt} + \beta_2 (W_{ijt}{}^* M_{ijt}) + \beta_3 M_{ijt} + \beta_4 \alpha_{it} + \beta_5 \alpha_{jt} + \gamma Z_{ijt} + \tau_t + \epsilon_{ijt} \quad (1.9.3)$$

where $W_{ij} \equiv \frac{\omega_i}{\omega_j}$ is the comparative advantage ratio of country i to country j, $M_{ij} \equiv \frac{m_i}{m_j}$ is their procurement market size ratio, α is the country's domestic preference margin, and Z is a vector of standard gravity control variables. β_2 is the coefficient on the interaction term between comparative advantage and procurement market size, which is included to capture the nonlinearity of the two determinants' effects on NTA formation. Year fixed effects are given by τ. The error term ϵ is assumed to be normally distributed. All ratios are constructed such that a larger ratio indicates a greater disparity between countries.[46]

I propose two estimation methods: a linear probability (OLS) model and a probit model. The linear probability approach has the benefit of permitting use of country fixed effects; however, it is unbounded such that observations may have predicted probabilities outside the range of 0 to 1. The probit approach has the opposite characteristics: it produces predictions that are bounded between 0 and 1 (by imposing strong normality assumptions on the error term), but it precludes the use of country fixed effects. This latter aspect is an artifact of the data rather than of the probit model itself. Over a dozen countries in the data never participate in any NTA; therefore, country fixed effects would predict these observations perfectly, and their inclusion would produce unreliable estimates for the remaining coefficients.

[46] I take the absolute value of the natural log of the ratios. Thus it does not matter if the denominator or numerator is the greater of the two. This also implies that coefficients should be interpreted as the effect of a 1 percent rise in the ratio, rather than a 1 unit rise.

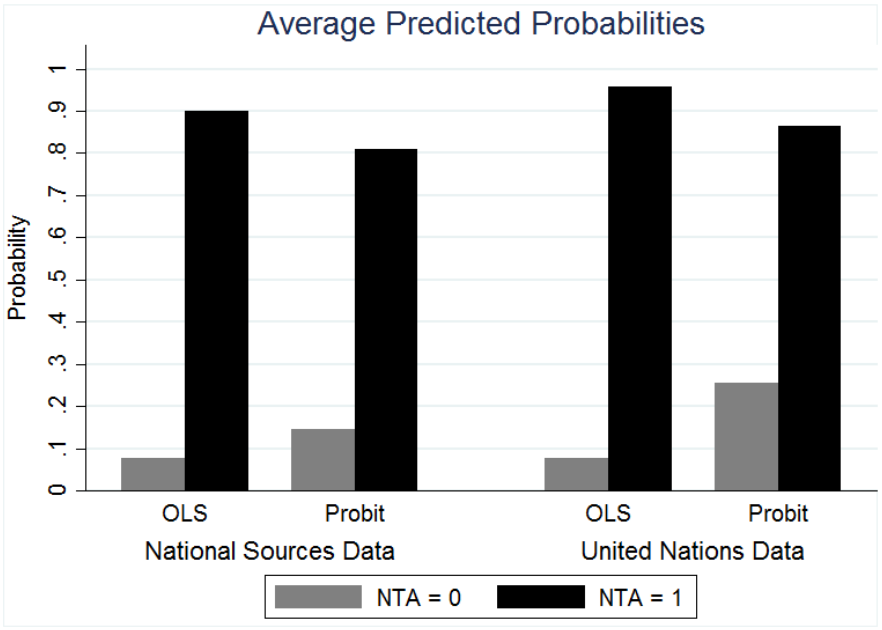

Figure 1.15: Predicted Probabilities of NTA and non-NTA Observations

The results of the regression analyses are encouraging. Theoretically-motivated regressors are generally of the expected sign and of reasonable magnitude. The overall success rate in predicting real-world NTA formation ranges from 86 to 98 percent, depending on the data set and model. I correctly predict 84 to 99 percent of existing NTAs and 79 to 97 percent of non-agreements.[47] Figure 1.15 graphically displays the predicted probability of signing an NTA averaged over those that do in fact participate in a bilateral national treatment relationship and those that do not. Predicted probabilities for those that do have NTAs are generally above 80 percent, while probabilities are generally below 25 percent for the non-agreement group.

[47] The complete table of prediction successes is found in Appendix A-6.

National Sources Data

Regression results for national sources data are found in Table 1.8. The first three models use a linear probability approach, while the final three models follow a probit estimation method. For both sets of estimates, the primary ratios of interest—RCA and Procurement—are statistically significant and of the expected sign. A greater difference in procurement market size or in comparative advantage correlates to a reduced likelihood of signing an NTA. Similarly, a country with a higher preference margin (indicating a greater weight on domestic profits) is less likely to sign an NTA agreement with any partner.

According to the theory, the interaction term should have a positive sign; that is, if there is a large disparity in one characteristic, the disparity's negative effect will be mitigated if there is also a large disparity (in the same direction) in the other characteristic. In the probit models, this prediction is substantiated; however, the OLS estimates offer conflicting evidence. In either case, the magnitude of the coefficient on the interaction term is small relative to the main ratios' coefficients, suggesting that it plays at most a minor role.

Models (1) and (4) use only the theoretical models to predict NTA formation. Because NTAs are so closely allied to free trade agreements, models (2) and (5) add FTA as an independent variable. Models (3) and (6) add the full set of gravity control variables. As more controls are added, the RCA Ratio coefficient weakens, whereas the procurement market ratio coefficient strengthens. Because the controls all contribute to a country's comparative advantage, it makes sense that their inclusion would reduce the absolute value of its coefficient. The addition of controls has no perceptible impact on the preference rate's effect.

Table 1.8: Regression Results: National Sources Data

Dependent Variable: NTA

	OLS			Probit		
	(1)	(2)	(3)	(4)	(5)	(6)
RCA Ratio	-	-	-	-	-	-
	0.19***	0.12***	0.10***	3.57***	2.76***	2.64***
	(0.008)	(0.007)	(0.007)	(0.082)	(0.090)	(0.099)
RCA*Procurement	-	-	-	0.17***	0.08***	0.13***
	0.01***	0.01***	0.01***			
	(0.002)	(0.002)	(0.002)	(0.027)	(0.030)	(0.033)
Procurement Ratio	-	-	-	-	-0.01	-
	0.02***	0.01***	0.03***	0.04***		0.29***
	(0.002)	(0.002)	(0.002)	(0.012)	(0.013)	(0.018)
Preference Rate	-	-	-	-	-	-
	0.01***	0.01***	0.01***	0.13***	0.10***	0.11***
	(0.001)	(0.001)	(0.001)	(0.002)	(0.003)	(0.003)
FTA		0.42***	0.34***		1.27***	0.87***
		(0.005)	(0.006)		(0.027)	(0.031)
ln(Dist)			-			-
			0.09***			0.58***
			(0.003)			(0.017)
GDP Ratio			0.03***			0.31***
			(0.002)			(0.015)
Contiguous			-			-
			0.10***			0.96***
			(0.008)			(0.074)
Com. Lang.			-			0.70***
			0.06***			
			(0.006)			(0.046)
Colonial			0.01			-
						0.26***
			(0.009)			(0.066)
Constant	0.10	-0.21**	0.42***	2.62***	1.47***	6.56***
	(0.104)	(0.090)	(0.091)	(0.052)	(0.059)	(0.167)
Observations	22,342	22,342	22,342	22,254	22,254	22,254
R-squared	0.751	0.813	0.821	0.479	0.559	0.616
Fixed Effects	Year, Country	Year, Country	Year, Country	Year	Year	Year

Robust standard errors in parentheses. Pseudo r-squared values for Probit regressions.
*** p<0.01, ** p<0.05, * p<0.1

United Nations Data

Regression results for United Nations data are found in Table 1.9.

Results are again consistent with theoretical predictions, though the interaction term and procurement ratio are only significant when there are no controls included. Comparative advantage differences have a consistently negative impact on NTA formation, as do preference margins. Adding controls weakens the effect of the RCA ratio, but has an ambiguous impact on the preference rate's effect.

Together, the results from the national sources and United Nations data sets support the theoretical predictions of the model. Differences in comparative advantage and procurement market size decrease the likelihood that two countries will be party to an NTA, as do larger preference margins, even when controlling for potentially conflating factors.

1.10 Conclusion

In this chapter I construct a theoretical model to predict the formation of international agreements on government procurement. These agreements accord national treatment to partners' firms, excepting them from what are today standard domestic-preferencing policies. The model addresses the feasibility of unilateral action, the formation of bilateral national treatment agreements, and the formation of and accession to plurilateral NTAs. I introduce a new data set of procurement market values and domestic preference policies; empirical tests using these data substantiate the model's predictions.

The primary results indicate that NTAs, when feasible, generate significant benefits to participants. Total welfare can rise by up to 2.5 percent, government savings may total 3.5 percent, and firm profits may soar by up to 6 percent. In the case of

Table 1.9: Regression Results: United Nations Data

Dependent Variable: NTA

	OLS			Probit		
	(1)	(2)	(3)	(4)	(5)	(6)
RCA Ratio	-	-	-	-	-	-
	0.32***	0.16***	0.14***	3.93***	2.43***	2.30***
	(0.014)	(0.012)	(0.012)	(0.091)	(0.094)	(0.101)
RCA*Procurement	0.02***	0.01	0.01	0.24***	0.03	0.01
	(0.003)	(0.003)	(0.003)	(0.028)	(0.030)	(0.033)
Procurement Ratio	-	-	0.01***	-	0.01	-0.02
	0.01***	0.01***		0.05***		
	(0.001)	(0.001)	(0.001)	(0.008)	(0.009)	(0.010)
Preference Rate	-	-	-	-	-	-
	0.03***	0.02***	0.02***	0.11***	0.07***	0.08***
	(0.001)	(0.001)	(0.001)	(0.002)	(0.003)	(0.003)
FTA		0.44***	0.42***		1.25***	1.06***
		(0.006)	(0.006)		(0.028)	(0.030)
ln(Dist)			-			-
			0.03***			0.35***
			(0.004)			(0.015)
GDP Ratio			-			0.08***
			0.02***			
			(0.002)			(0.012)
Contiguous			0.01			-
						0.36***
			(0.008)			(0.062)
Com. Lang.			-			0.73***
			0.05***			
			(0.007)			(0.050)
Colonial			0.01			-
						0.30***
			(0.009)			(0.065)
Constant	0.82***	0.39***	0.58***	1.58***	0.27	3.42***
	(0.060)	(0.053)	(0.059)	(0.365)	(0.425)	(0.459)
Observations	19,450	19,450	19,450	19,450	19,450	19,450
R-squared	0.740	0.803	0.806	0.392	0.470	0.499
Fixed Effects	Year, Country	Year, Country	Year, Country	Year	Year	Year

Robust standard errors in parentheses. Pseudo r-squared values for Probit regressions.
*** p<0.01, ** p<0.05, * p<0.1

plurilateral agreements, the accession of each new member increases welfare for the entrant (significantly) and incumbents (marginally), but reduces welfare for the rest of the world by approximately 0.05 percent.

Despite their potential benefits, procurement agreements are not feasible among all potential partners. Countries that are similar in market size and productivity always gain from NTAs, as do large productive nations. This explains the prevalence of NTAs among developed economies. Large, relatively unproductive countries almost never gain from NTAs and prefer discrimination, which accounts for the dearth of agreements among BRIC nations. Small countries, especially relatively unproductive ones, benefit most from NTAs with other developing nations. This implies that there exists untapped potential for welfare gains in the developing world through the formation of South-South NTAs.

This chapter represents the first attempt in the literature to explain the formation and distributional effects of procurement national treatment agreements. It suggests a number of policy implications regarding which countries should join in NTAs, and which prefer to remain outside. Yet it also raises several more important questions. How do firms decide whether to submit a bid on a project? How do governments decide on the weight accorded to domestic profits. What other economic political factors contribute to governments' accession decisions? As these agreements continue to proliferate, understanding their causes and effects will become evermore important.

Chapter 2

Effect of National Treatment Agreements: USA Case Study

2.1 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

[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

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 chapter 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 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

[2] Audet (2002)

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.

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

[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.

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

[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.

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 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

[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.

[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

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 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]

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

[11] See Federal Procurement Data System, `https://www.fpds.gov`

[12] See Office of Management and Budget, `http://www.whitehouse.gov/omb/budget/historicals`

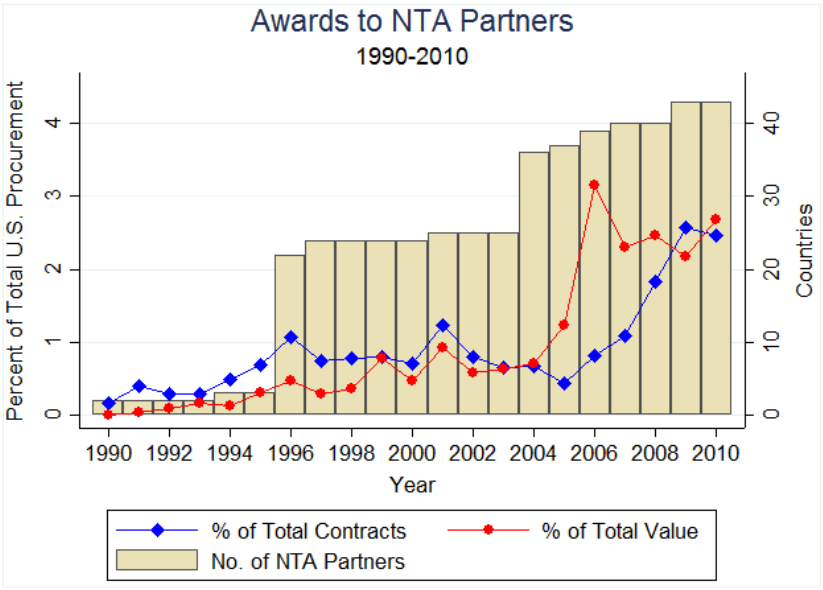

Figure 2.1: Awards to NTA partners, 1990–2010

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 2.1 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, firms from partner countries have secured an increasing share of

[13] (U.S. General Services Administration, 2014)

[14] A complete list of trade agreements and procurement agreements can be found in Appendix B-3

the U.S. procurement market. The purpose of this chapter is to investigate the degree to which national treatment agreements have influenced this trend.

2.3 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

[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.

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.

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

[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.

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 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

[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)

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 chapter 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.

2.4 Theoretical Model

The theoretical framework used in this chapter proceeds directly from that developed in Chapter 1. Rather than repeat the previous mathematical derivation in its entirety, I begin this section from the point at which this model diverges from that of the previous chapter.

The value of the minimum expected acceptable bid under complete non-discrimination, given by Equation (1.4.14) in Chapter 1, is reproduced here as a starting off point:

$$E(\hat{c}) = \Phi^{-\frac{1}{\theta}}\gamma \tag{2.4.1}$$

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

Under discrimination, the expected payment P_n from country n to the winning firm is given by

$$P_n = \Phi_n^{-\frac{1}{\theta}} \left(\tfrac{1+\theta}{\theta} \rho_{\Omega_n} \gamma_{\Omega_n} + \tfrac{\theta+1-\alpha_n}{\theta} \rho_{-\Omega_n} \gamma_{-\Omega_n} \right) \tag{2.4.2}$$

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 (1.4.12) 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,

$$Q_{i,n} = \frac{\mu_i \beta_i^{-\theta} \Delta_{i,n}^{-\theta} Q_n}{\Phi_n} \tag{2.4.3}$$

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

$$\mu_i \beta_i^{-\theta} = \frac{X_i}{\sum_s \frac{\Delta_{i,s}^{-\theta} Q_s}{\Phi_s}} \tag{2.4.4}$$

Rewriting (2.4.2) as Φ_n in terms of P_n and combining with (2.4.3) and (2.4.4) yields

$$Q_{i,n} = \frac{X_i Q_n \Delta_{i,n}^{-\theta} P_n^{\theta}}{\left(\tfrac{1+\theta}{\theta} \rho_{\Omega_n} \gamma_{\Omega_n} + \tfrac{1+\theta-\alpha_n}{\theta} \rho_{-\Omega_n} \gamma_{-\Omega_n} \right)^{\theta} \gamma_n^{\theta} \sum_s \frac{\Delta_{i,s}^{-\theta Q_s}}{\Phi_s}} \tag{2.4.5}$$

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

$$\begin{aligned} \ln Q_{i,n} = {} & \ln X_i + \ln Q_n - \theta \ln \Delta_{i,n} + \theta \ln P_n \\ & - \theta \ln \left(\tfrac{1+\theta}{\theta} \rho_{\Omega_n} \gamma_{\Omega_n} + \tfrac{1+\theta-\alpha_n}{\theta} \rho_{-\Omega_n} \gamma_{-\Omega_n} \right) - \ln \sum_s \frac{\Delta_{i,s}^{-\theta Q_s}}{\Phi_s} \end{aligned} \tag{2.4.6}$$

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

$$\frac{Q_{i,n}}{Q_{n,n}} = \frac{X_i}{X_n}\theta\Delta_{i,n}\frac{\sum_s \frac{\Delta_{i,s}^{-\theta}Q_s}{\Phi_s}}{\sum_s \frac{\Delta_{n,s}^{-\theta}Q_s}{\Phi_s}} \tag{2.4.7}$$

Writing in terms of natural logarithms, this becomes

$$\ln\frac{Q_{i,n}}{Q_{n,n}} = \ln\frac{X_i}{X_n} - \theta\ln\Delta_{i,n} + ln\sum_s \frac{\Delta_{i,s}^{-\theta}Q_s}{\Phi_s} - ln\sum_s \frac{\Delta_{n,s}^{-\theta}Q_s}{\Phi_s} \tag{2.4.8}$$

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 (2.4.8) 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 2.7 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.

2.5 Estimation Strategy

The primary empirical estimation model takes the form

$$\begin{aligned} \ln Q_i = \beta_0 + \beta_1 \text{NTA}_{i,t} + \beta_2 \ln \text{Exports}_{i,t} + \beta_3 \ln Q_{\text{USA},j,t} \\ + \beta_4 \ln \text{Price}_{j,t} + \beta_5 \text{Gravity}_{i,t} + \upsilon_j + \omega_t + \delta_i + \epsilon_{i,j,t} \end{aligned} \tag{2.5.1}$$

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 (2.4.6). Slightly rearranged, this is

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

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.[19]

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

[19]The number of NTA partners for each country for the example year 2010 is given in Appendix B-6.

government procurement expenditures. However, a survey of the countries with the most NTAs (containted in Appendix B-6) 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, 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.[20]

[20] See Heckman (1979)

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.

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 (2.4.8). 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

$$ln\left(\frac{Q_{i,j,t}}{Q_{US,j,t}}\right) = \beta_0 + \beta_1 \text{NTA}_{i,t} + \beta_2 \text{Exp Ratio}_{i,t} + \beta_3 \text{Gravity}_{i,t} + \upsilon_j + \omega_t + \delta_i + \epsilon_{i,j,t} \quad (2.5.2)$$

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 (2.5.1).

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.

2.6 Data

The U.S. Federal Procurement Data System (FPDS) offers a rich source of information on government contracting.[21] 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.[22] 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

[21] (U.S. General Services Administration, 2014)

[22] Appendix B-5 shows the percent of qualifying observations by year, both in terms of value and number of contracts.

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.[23]

Table 2.1: 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.

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.[24] For consistency's sake, I label all contracts with values

[23] 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.

[24] Appendix B-4 contains all relevant thresholds

less than $50,000 as small contracts, which 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 2.1 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 2.2: Procurement Locations

	% 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. Excludes awards to U.S. firms.

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 2.2 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 2.3: 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 2.3. 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.[25] The final 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 2.4: 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 2.4, 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.

[25] The empirical analysis is conducted in terms of log variables, in which zeros are omitted. I omit zeros from the reported averages for consistency and to allow direct application of regression results.

Table 2.5: 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.

Despite its many procurement agreements, the United States awards the vast majority of its procurement to domestic firms. As seen in Table 2.5, 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.

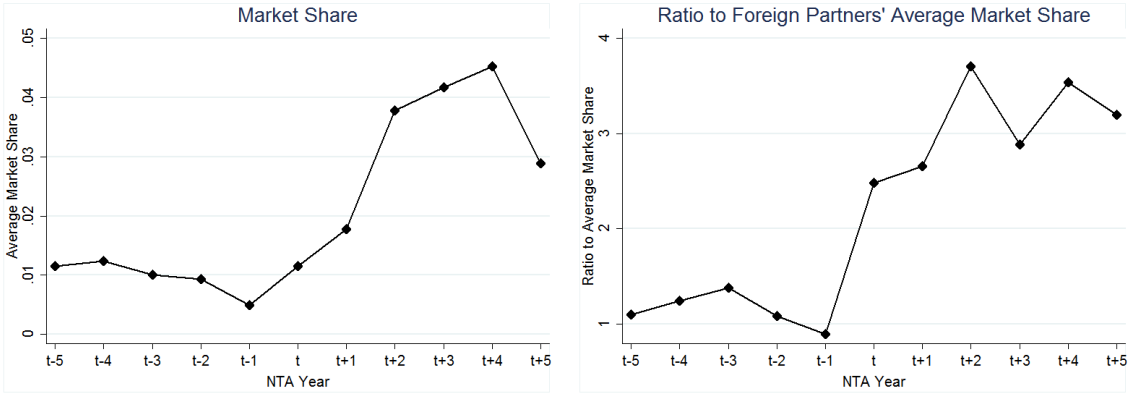

Figure 2.2: Average Market Shares of NTA Partners Before and After Agreement

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 2.2 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 2.2. 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 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.[26] 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.[27]

I construct a measure of exports of procurement goods by first generating a list of the 320 products[28] 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.[29]

In Table 2.6, I exclude U.S. data and report summary statistics for partner countries alone.[30] While only 24 percent of country-year observations in the sample include agreements with 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

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

Table 2.6: Summary Statistics

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 and exclude U.S. firms
† Observations are country-year ‡ Weighted by value

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.[31] If the primary consideration is location, then firms specialized in

[31]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.

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 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.

2.7 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.

2.7.1 Number of Contracts

National treatment agreements do indeed improve partner's procurement outcomes. Table 2.7 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.[32] 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.[33] 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 2.7. 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 B-8) 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

[32] 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 chapter, but are available from the author upon request.

[33] 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 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.

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).[34] 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 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.

[34]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.

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.

2.7.2 Total Value

National treatment agreements also improve outcomes in terms of revenue. Table 2.8 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.[35] 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 2.7, exports enter negatively, while in Table 2.8, 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

[35] 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.

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.

2.7.3 Market Shares

The results in Table 2.9 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 2.7 and 2.8 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 2.9 must be greater than their corresponding coefficients in Tables 2.7 and 2.8.

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.[36] 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

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

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 B-7). 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.

Table 2.7: Regression Results: Number of Contracts

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)
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 B-8. Regressions use data from foreign firms only, with the exception of model (4). Coefficients on indicators for NATO and NAFTA omitted.

Table 2.8: Regression Results: Value

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)
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 B-8. Regressions use data from foreign firms only, with the exception of model (2). Coefficients on indicators for NATO and NAFTA omitted.

Table 2.9: Regression Results: Market Share Ratios

Dependent Variable: Natural Log of Ratio of Partner Market Share to U.S. 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(Exp. Rat.)	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 B-8. Regressions use data from foreign firms only.

2.8 Conclusion

In this chapter, 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 for-

eign 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 dissertation 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.

Appendix A

Appendix to Chapter 1

Using GDP as a Proxy for Procurement Market Size

The sets of observation used in the national sources and United Nations data are limited to those countries for which I was able to record estimates of procurement market size and applied preference margins. As an alternative, I use GDP as a substitute for procurement market size and ignore preference margins. Table A-1 reports the correlation between GDP and procurement market value, as reported by national sources and the United Nations. GDP correlates only weakly with national sources data and correlates nearly perfectly with United Nations data. However, as it is unlikely that every country spends precisely the same share of its GDP on procurement, the high correlation between GDP and UN procurement estimates should be considered another sign that the top-down approach may be inadequate to measure procurement markets.

Table A-1: Correlation Between Procurement Market Value and GDP

Data Set	Observations in Common	Correlation
National Sources	801	0.526
United Nations	849	0.984

Note: Observations are country-year

Because of the lack of preference margins and the mediocre correlation between GDP and national sources data, results from the analysis based on GDP should be

considered more suggestive than conclusive. The summary statistics for the GDP-based data are contained in Table A-2.

Table A-2: Summary Statistics, United Nations Data

Variable	Obs	Mean	Std. Dev.	Min	Max
NTA	72636	0.202	0.401	0	1
GDP†	72636	636	1,645	2.60	13,631
Revealed Comparative Adv.	72636	0.872	0.286	0.005	1.638
Distance, km‡	72636	7,033	4,810	115	19,539
FTA	72636	0.156	0.362	0	1
WTO Member	72636	0.914	0.280	0	1
Adjacent	72636	0.036	0.187	0	1
Common Language	72636	0.082	0.274	0	1
Colonial Heritage	72636	0.026	0.160	0	1
Common Currency	72636	0.022	0.147	0	1

† Billions, 2005 USD ‡ Population-weighted

Note that the data set contains nearly three times as many dyad-year observations as either of the analyses contained in the main text. NTAs exist in only 20 percent of the observations, and 15.6 percent report free trade agreements. Averages for revealed comparative advantage and GDP are lower, reflecting the presence of a greater number of developing countries in the data.

Sign Test

The conditions suggested by the theoretical model still do remarkably well at predicting NTA formation when using GDP as a proxy for procurement spending. Overall, 58 percent of observations are correctly predicted. Broken out by group, 35 percent of existing NTAs and 63 percent of non-agreements are correctly predicted.

The model fairs most poorly in predicting NTA formation for Panama, Oman, and Luxembourg, and does not correctly predict any of Morocco's agreements. It

Table A-3: Sign Tests: GDP as Proxy for Procurement Market Size

Country	Success Rate	Success (NTA = 1)	Success (NTA = 0)	Country	Success Rate	Success (NTA = 1)	Success (NTA = 0)
Overall	**0.58**	**0.35**	**0.63**	Singapore	0.55	0.45	0.60
Panama	0.30	1.00	0.29	Sweden	0.55	0.58	0.53
Oman	0.37	-	0.37	Czech Republic	0.55	0.44	0.58
Luxembourg	0.42	0.16	0.67	Pakistan	0.55	-	0.55
Iceland	0.45	0.34	0.50	Malaysia	0.56	-	0.56
United Kingdom	0.47	0.05	0.75	Argentina	0.56	-	0.56
Spain	0.48	0.34	0.58	India	0.57	-	0.57
Poland	0.49	0.49	0.49	Colombia	0.57	0.17	0.58
Indonesia	0.49	-	0.49	Hungary	0.58	0.40	0.64
Italy	0.50	0.29	0.65	Venezuela	0.59	-	0.59
France	0.50	0.27	0.67	Philippines	0.60	-	0.60
Canada	0.50	0.34	0.59	Russia	0.61	-	0.61
South Korea	0.50	0.41	0.55	Nigeria	0.61	-	0.61
United States	0.50	0.28	0.66	Australia	0.62	0.11	0.63
Germany	0.50	0.20	0.71	Ukraine	0.64	-	0.64
Netherlands	0.50	0.42	0.57	Slovakia	0.64	0.31	0.75
Mexico	0.50	0.38	0.55	Viet Nam	0.65	-	0.65
Denmark	0.50	0.51	0.50	Romania	0.65	0.43	0.69
Hong Kong	0.51	0.49	0.52	Latvia	0.65	0.21	0.79
Japan	0.51	0.15	0.72	UAE	0.66		0.66
Greece	0.52	0.49	0.53	Slovenia	0.66	0.22	0.81
New Zealand	0.52	0.06	0.53	Brazil	0.66	-	0.66
Turkey	0.52	0.33	0.52	China	0.68	-	0.68
South Africa	0.52	-	0.52	Morocco	0.68	0.00	0.68
Ireland	0.52	0.45	0.57	Lithuania	0.69	0.21	0.84
Portugal	0.52	0.47	0.56	Estonia	0.69	0.22	0.86
Norway	0.53	0.52	0.54	Malta	0.71	0.11	0.90
Austria	0.53	0.56	0.52	Costa Rica	0.71	0.09	0.72
Israel	0.54	0.47	0.59	Bulgaria	0.71	0.22	0.80
Finland	0.54	0.49	0.57	Saudi Arabia	0.73	-	0.73
Peru	0.54	0.80	0.54	Cyprus	0.73	0.22	0.87
Switzerland	0.54	0.58	0.52	Albania	0.79	0.34	0.85
Belgium	0.54	0.55	0.54	Jordan	0.83	-	0.83
Chile	0.54	0.40	0.55	Georgia	0.88	-	0.88

Note: Missing values indicate the country is not party to any NTAs

does very well at predicting NTAs for Albania, Cyprus, and Bulgaria, and correctly predicts 80 percent of Peru's agreements.

Estimation Equation Results

The results from the GDP proxy analysis are consistent with those from the main text. Larger differences in comparative advantage and GDP correlate with decreased likelihood of NTA formation. Note that in chapter 1's regressions, when including the GDP ratio as a control variable it has a positive sign. This suggests that countries are more concerned with procurement market size than the total size of a potential partner's economy. Larger (i.e. more developed) economies tend to form more agreements, which may account for the positive coefficient on GDP ratio when used as a control variable. The interaction term's coefficient is generally positive and significant, again inline with expectations.

While GDP is an imperfect measure of procurement market size, these results indicate that it can be used as a proxy in the event that procurement data are unavailable.

Table A-4: Regression Results: GDP Data
Dependent Variable: NTA, GDP as Proxy for Procurement Market Size

	OLS			Probit		
	(1)	(2)	(3)	(4)	(5)	(6)
RCA Ratio	-0.12***	-0.08***	-0.08***	-2.77***	-2.20***	-2.12***
	(0.004)	(0.004)	(0.004)	(0.045)	(0.049)	(0.050)
RCA*GDP	0.00	0.01***	0.01***	0.38***	0.29***	0.28***
	(0.001)	(0.001)	(0.001)	(0.016)	(0.017)	(0.018)
GDP Ratio	-0.03***	-0.02***	-0.02***	-0.12***	-0.08***	-0.08***
	(0.001)	(0.001)	(0.001)	(0.006)	(0.006)	(0.007)
FTA		0.42***	0.41***		1.48***	1.30***
		(0.003)	(0.003)		(0.015)	(0.017)
ln(Dist)			-0.01***			-0.21***
			(0.002)			(0.008)
Contiguous			0.03***			-0.41***
			(0.006)			(0.034)
Com. Lang.			0.02***			0.35***
			(0.004)			(0.023)
Colonial			-0.03***			-0.00
			(0.007)			(0.039)
Constant	-0.05***	-0.06***	0.00	-0.81***	-1.31***	0.49***
	(0.019)	(0.017)	(0.021)	(0.095)	(0.115)	(0.134)
Observations	72,636	72,636	72,636	72,636	72,636	72,636
R-squared	0.500	0.597	0.598	0.209	0.347	0.359
Fixed Effects	Year, Country	Year, Country	Year, Country	Year	Year	Year

Robust standard errors in parentheses. Pseudo r-squared values for Probit regressions.
*** p<0.01, ** p<0.05, * p<0.1

Table A-5: National Sources

Country	Data Source	Web Location	Notes
Albania	Ministria e Financave	http://www.financa.gov.al	Total Consumption + Immovable Capital
Australia	AusTender	https://www.tenders.gov.au	
Austria	Eurostat	http://epp.eurostat.ec.europa.eu	
Belgium	Eurostat	http://epp.eurostat.ec.europa.eu	
Brazil	FGV Projectos	http://www.oecd.org/forum/issues	
Bulgaria	Eurostat	http://epp.eurostat.ec.europa.eu	
Canada	Statistics Canada	http://www.statcan.gc.ca	
Chile	Magister en Gestión y Politicas Públicas	http://www.mgpp.cl	
Colombia	Departamento Nacional de Planeación	http://www.dnp.gov.co	
Costa Rica	World Bank	http://documents.worldbank.org	
Cyprus	Eurostat	http://epp.eurostat.ec.europa.eu	
Czech Republic	Eurostat	http://epp.eurostat.ec.europa.eu	
Denmark	Eurostat	http://epp.eurostat.ec.europa.eu	
Estonia	Eurostat	http://epp.eurostat.ec.europa.eu	
Finland	Eurostat	http://epp.eurostat.ec.europa.eu	
France	Eurostat	http://epp.eurostat.ec.europa.eu	
Germany	Eurostat	http://epp.eurostat.ec.europa.eu	
Greece	Eurostat	http://epp.eurostat.ec.europa.eu	
Hungary	Eurostat	http://epp.eurostat.ec.europa.eu	
Iceland	Statistics Iceland	http://www.statice.is	Goods and Services + Capital Formation + Other
India	CUTS International	http://www.cuts-citee.org	
Indonesia	Center for International Private Enterprise	http://www.cipe.org	
Ireland	Eurostat	http://epp.eurostat.ec.europa.eu	
Israel	Cetral Bureau of Statistics	http://www1.cbs.gov.il	Goods and Services + Capital Formation
Italy	Eurostat	http://epp.eurostat.ec.europa.eu	
Japan	Cabinet Public Relations Office	http://japan.kantei.go.jp/procurement	
Jordan	Ministry of Finance	http://www.mof.gov.jo	

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Table A-5 – continued from previous page

Country	Data Source	Web Location	Notes
Korea	Digital Budget and Accounting System	https://www.digitalbrain.go.kr	
Latvia	Eurostat	http://epp.eurostat.ec.europa.eu	
Lithuania	Eurostat	http://epp.eurostat.ec.europa.eu	
Luxembourg	Eurostat	http://epp.eurostat.ec.europa.eu	
Malaysia	Ministry of Finance Malaysia	http://www.treasury.gov.my	NFPE + Statutory Bodies + Development expenditures + Supplies and Services
Malta	Eurostat	http://epp.eurostat.ec.europa.eu	
Mexico	Insituto Nacional de Estadistica y Geografia	http://www.inegi.org.mx	
Morocco	Ministry of Economy	http://www.maroc.ma	
Netherlands	Eurostat	http://epp.eurostat.ec.europa.eu	
New Zealand	The Treasurey New Zealand	http://www.treasury.govt.nz	
Nigeria	Bureau of Public Procurement	www.bpp.gov.ng	
Norway	Statistics Norway	https://statbank.ssb.no	
Oman	National Centre for Statistics and Information	http://www.ncsi.gov.om	
Pakistan	Pakistan Bureau of Statistics	http://www.pbs.gov.pk	Fixed capital + Intermediate Consumption
Panama	Comisión Económica para América Latina y el Caribe	http://estadisticas.cepal.org	Goods and Servvices + Other + Fixed Capital Development
Peru	World Bank	http://www.worldbank.org	
Philippines	World Bank	http://documents.worldbank.org	
Poland	Eurostat	http://epp.eurostat.ec.europa.eu	
Portugal	Eurostat	http://epp.eurostat.ec.europa.eu	
Romania	Eurostat	http://epp.eurostat.ec.europa.eu	
Russian Federation	Federal State Statistics Service	http://www.gks.ru	
Slovakia	Eurostat	http://epp.eurostat.ec.europa.eu	
Slovenia	Eurostat	http://epp.eurostat.ec.europa.eu	
South Africa	Statistics South Africa	http://beta2.statssa.gov.za	Goods and Services + Non-Financial Assets
Spain	Eurostat	http://epp.eurostat.ec.europa.eu	
Sweden	Eurostat	http://epp.eurostat.ec.europa.eu	

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Table A-5 – continued from previous page

Country	Data Source	Web Location	Notes
Switzerland	Office Fédéral de la Statistique	http://www.pxweb.bfs.admin.ch	
Taiwan	National Statistics Republic of China (Taiwan)	http://eng.stat.gov.tw	
Turkey	Public Procurement Authority	http://ihale.gov.tr	
Ukraine	International Organization for Migration	http://www.iom.int	
United Arab Emirates	National Bureau of Statistics	http://www.uaestatistics.gov.ae	Goods and Services + Development + Other + Domestic Investment
United Kingdom	Eurostat	http://epp.eurostat.ec.europa.eu	
United States of America	Federal Procurement Data System	https://www.fpds.gov	
Venezuela	Comisión Económica para América Latina y el Caribe	http://estadisticas.cepal.org	Goods and Servvices + Other + Fixed Capital Development
Viet Nam	General Statistics Office of Vietnam	http://www.gso.gov.vn	Total Expenditure - Social Services - Wages

Regression Prediction Success Rate

Table A-6: Success of Regression-based Predictions, in Percent

		National Sources Data	United Nations Data
OLS	Overall	97.99	98.27
	NTA = 1	99.32	99.70
	NTA = 0	96.98	95.56
Probit	Overall	87.12	86.38
	NTA = 1	84.08	90.09
	NTA = 0	89.47	79.35

Predictions are based on estimates from models (3) and (6) for both national sources and United Nations data sets. Probabilities are translated into predictions according to the rule: Prob $> 0.5 \Rightarrow$ Prediction $= 1$, else Prediction $= 0$.

Appendix B

Appendix to Chapter 2

Falsification Tests

In Chapter 2, I find that NTAs are correlated with a significant increase in awards won by foreign partners. I argue that this correlation is in fact causation; However, it is possible these results are due to some unknown third factor. To strengthen the argument for causation, I include the following two tables, which show that NTAs do not affect contracts which are not subject to treat provisions[1] to the same extent that they affect large, U.S.-based contracts.

Table B-1 shows the effects of national treatment agreements on the number of contracts foreign partners win over a range of procurement categories excluded from NTA coverage. Column 1 tests the effects of NTAs on small projects in the United States, and finds no significant effect. In columns 2–4, contracts are aggregated within location, which allows the inclusion of the "Local" variable indicating whether or not a contract takes place within the partner's country. In columns 5–7, contracts are aggregated across locations. Within the latter two categories, the model indicates whether only large, small, or the total number of contracts were included.

Results indicate that NTAs do not have a significant effect on procurement not covered by NTA provisions. The coefficient on NTA is significant only when small contracts are aggregated across locations; the significance of the coefficient in column

[1] Valued less than $50,000 USD and/or delivered outside the United States

Table B-1: Falsification: Contracts Not Subject to NTA Provisions

	In USA	Locations Separate			Locations Aggregated		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Small	Large	Small	Total	Large	Small	Total
NTA	0.352	0.119	0.0840	-0.0537	0.0541	0.704***	0.775***
	(0.484)	(0.261)	(0.0712)	(0.225)	(0.304)	(0.160)	(0.169)
ln(Exports)	-0.0782	0.269***	0.225***	0.0879	0.186**	-0.0165	-0.0302
	(0.142)	(0.0679)	(0.0202)	(0.0646)	(0.0806)	(0.0295)	(0.0267)
ln(US Proc)	1.381***	0.649***	0.591***	0.263***	0.691***	0.487***	0.316***
	(0.0780)	(0.0418)	(0.0178)	(0.0827)	(0.0938)	(0.105)	(0.0948)
ln(Price)		0.264***	0.228***				
		(0.0214)	(0.0150)				
Local		9.893***	8.384***	3.095***			
		(0.360)	(0.270)	(0.0657)			
FTA	0.257	0.00766	0.373***	0.114	-0.0660	0.173	0.225
	(0.243)	(0.163)	(0.0913)	(0.152)	(0.193)	(0.204)	(0.206)
ln(Dist)	-	-	0.0267	-0.200	-0.931	0.0422	0.0672
	7.854***	1.439***					
	(1.539)	(0.496)	(0.0520)	(0.506)	(0.615)	(0.0799)	(0.0765)
ln(GDP)	-0.741	-	0.186***	-0.336	-	0.375***	0.437***
		1.568***			2.679***		
	(0.469)	(0.270)	(0.0232)	(0.240)	(0.373)	(0.0414)	(0.0347)
Com. Lang.	-1.441	-1.406**	0.602***	-	-	0.123	0.149*
				2.406***	14.10***		
	(1.008)	(0.645)	(0.0470)	(0.808)	(1.714)	(0.0816)	(0.0768)
WTP	-0.698*	-0.187	0.171***	0.168	-0.138	0.0134	-0.119
	(0.407)	(0.174)	(0.0618)	(0.156)	(0.175)	(0.0901)	(0.0824)
NATO	-0.726*	-0.00590	0.513***	-0.314	-0.324	-0.106	-0.129
	(0.380)	(0.238)	(0.0656)	(0.217)	(0.366)	(0.154)	(0.163)
NAFTA		8.514***	0.0676	2.873**	7.861***	1.002**	1.211**
		(1.204)	(0.132)	(1.401)	(1.173)	(0.477)	(0.523)
Inv. Mills	1.283***	2.920***	2.488***	-	-0.228	-	-
				0.913***		0.496***	0.876***
	(0.317)	(0.136)	(0.100)	(0.203)	(0.143)	(0.175)	(0.124)
Constant	54.61***	-5.839	-	-0.133	4.255	-	-3.610**
			21.28***			6.618***	
	(14.99)	(4.420)	(0.940)	(4.831)	(5.763)	(1.959)	(1.746)
Observations	718	3,038	3,606	4,684	1,509	1,576	1,761
R-squared	0.757	0.678	0.549	0.585	0.744	0.455	0.477
Fixed Effects	Y, P	Y, P, L	Y, P, L	Y, P, L	Y, P	Y, P	Y, P

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. Columns 2–7 omit contracts delivered within the United States

7 is likely due to the presence of small contracts in the total. This contrasts sharply with the results found for NTA-subject procurement, which find significant effects on number of contracts across every specification.

Table B-2 does the same falsification tests using the value[2] of awards won by treaty partners as the dependent variable. The specifications are analogous to those of Table B-1.

In three of the seven specifications, the coefficient on NTA is not significant, paralleling the results for number of contracts. In column 6, we see that NTAs have a small positive effect on the total value of small contracts won when aggregated across locations. However, in columns 1, 4, and 5 we see that NTAs in fact have a negative effect on the value of procurement awards. This is particularly anomalous given the expectation that firms which have greater success in large, U.S.-based contracts may experience spillover benefits either through network effects or by learning-by-doing. In column 1, we see the largest effect: a 75 percent fall in revenues from small contracts. This may be merely an artifact of the data, or it may indicate a systemic result. If the latter holds true, then it may be that following the signing of an NTA, firms concentrate on larger projects and thus self-select out of small contracts. Alternatively, it may be that procuring agents seek to award a greater value of small contracts to domestic firms in order to offset the gains that foreign partners' firms realize for large projects following the signing of an NTA.

[2]natural logarithm

Table B-2: Falsification: Value Not Subject to NTA Provisions

	In USA	Locations Separate			Locations Aggregated		
	(1) Small	(2) Large	(3) Small	(4) Total	(5) Large	(6) Small	(7) Total
NTA	-1.380**	-0.430	0.372	-0.758***	-0.983***	0.547***	-0.126
	(0.651)	(0.396)	(0.263)	(0.137)	(0.381)	(0.154)	(0.389)
ln(Exports)	0.192	0.353***	0.344***	0.0671*	0.332***	-0.0478	0.349***
	(0.210)	(0.0956)	(0.0860)	(0.0394)	(0.104)	(0.0312)	(0.102)
ln(US Proc)	0.937***	0.702***	0.505***	0.0411	0.790***	0.270**	0.791***
	(0.0969)	(0.0493)	(0.0346)	(0.135)	(0.122)	(0.111)	(0.126)
ln(Price)		0.549***	0.205***				
		(0.0337)	(0.0232)				
Local		11.18***	9.307***	3.021***			
		(0.383)	(0.307)	(0.0901)			
FTA	1.128***	0.478*	0.120	0.887***	0.646**	0.278	0.421
	(0.386)	(0.266)	(0.173)	(0.172)	(0.280)	(0.190)	(0.287)
ln(Dist)	-8.767***	-1.021	0.601	0.444***	1.465*	-0.0245	0.922
	(2.138)	(0.717)	(0.556)	(0.0919)	(0.815)	(0.0841)	(0.871)
ln(GDP)	-1.475**	-1.274***	-0.933***	0.258***	-2.058***	0.390***	-2.511***
	(0.659)	(0.365)	(0.292)	(0.0472)	(0.431)	(0.0447)	(0.450)
Com. Lang.	-2.060	0.0543	-2.786**	-0.0294	-11.46***	0.181**	14.70***
	(1.497)	(0.835)	(1.265)	(0.104)	(2.044)	(0.0872)	(2.294)
WTP	-1.064	0.0478	0.207	0.300***	0.403*	0.00975	0.157
	(0.662)	(0.241)	(0.183)	(0.114)	(0.236)	(0.100)	(0.240)
NATO	0.333	0.767**	-0.424**	-0.0976	0.250	-0.177	-0.763*
	(0.479)	(0.357)	(0.195)	(0.140)	(0.399)	(0.146)	(0.435)
NAFTA		6.276***	9.839***	-0.0742	7.223***	0.873*	8.681***
		(1.665)	(2.102)	(0.249)	(1.418)	(0.465)	(1.438)
Inv. Mills	0.227	3.303***	2.631***	-0.279	0.0369	-0.671***	-0.969***
	(0.414)	(0.153)	(0.122)	(0.362)	(0.191)	(0.187)	(0.165)
Constant	76.48***	-5.091	-16.58***	4.478	-10.53	7.397***	-5.488
	(21.15)	(6.456)	(5.305)	(2.959)	(7.345)	(2.071)	(7.931)
Observations	718	3,038	3,606	4,684	1,509	1,576	1,761
R-squared	0.682	0.621	0.586	0.241	0.734	0.387	0.715
Fixed Effects	Y, P	Y, P, L	Y, P, L	Y, P, L	Y, P	Y, P	Y, P

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. Columns 2–7 omit contracts delivered within the United States

Table B-3: 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

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Table B-3 – Continued from previous page

Country Name	Procurement Agreement Year	RTA Year	GPA Membership
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	-
Poland	2004	-	2004
Portugal	1996	-	1996
Singapore	1997	2004	1997
Slovakia	2004	-	2004

Continued on next page...

Table B-3 – Continued from previous page

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

Table B-4: 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 B-5: 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 B-6: 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 B-7: Regressions Results: Ratio to non-NTA Countries

Dependent Var: Log of Market Share Ratio to non-NTA Country 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 B-8: 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	-	-1.270	0.194
				0.330***		
	(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	-	-	-5.201	-	-1.009	-1.688**
	7.349***	25.81***		0.508***		
	(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

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