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Does the WTO Government Procurement Agreement Deliver What It Promises?

Abstract: We examine the impacts of the World Trade Organization (WTO) Government Procurement Agreement (GPA) on government procurement practices in the European Union (EU). We empirically analyse whether the WTO GPA is effective in promoting non-discriminant, open, transparent, competitive, and efficient government procurement. To study this question, we use a unique data set recently released by the EU, covering more than three million tenders conducted in the European Economic Area, Switzerland, and Macedonia during the years 2006 to 2016. We find that the WTO GPA promotes competition by increasing the probability of awarding a contract to a foreign firm. The WTO GPA significantly lowers corruption risk by decreasing the number of contracts with a single offer and decreasing the winning ratio of firms.

JEL Codes: D73; H57; F14

Keywords: World Trade Organization; Government Procurement Agreement; Competition

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1. Introduction

Countries crafting a sound public procurement system must balance several goals. Of these, competition, transparency, non-discrimination, and integrity are probably the most important. The economic literature emphasizes the importance of competition for achieving optimal allocation of resources. Competition leads to lower prices and higher-quality products for a given price. In public procurement, the main issues are preserving free entry and ensuring the absence of collusion. Competition can be promoted in procurement markets by prohibiting discrimination, adopting transparent procedures, standardizing procedures for awarding procurement contracts, opening procurement markets to international trade, and preventing collusion among alternative suppliers.

The concept of transparency in the context of procurement involves five main elements: (i) public disclosure of the rules that apply in the procurement process; (ii) publication of procurement opportunities; (iii) prior determination and publication of what is to be procured and how submissions are to be considered; (iv) visible conduct of procurement according to prescribed rules and procedures; and (v) existence of a system to monitor that these rules are being followed. The major aim of transparency is to ensure that the rules are followed and that non-compliance can be identified and addressed. The effect of transparency is a higher level of competition. Since contracting authorities must make procurements publicly known, more suppliers can be aware of opportunities. Furthermore, some suppliers will come up with proposals that are competitively superior to those of their opponents. This method helps ensure that the contracting authority will pick the best possible proposal.

The principles of equal treatment and transparency are closely related to the principle of non-discrimination. Equal treatment requires that comparable situations are not treated differently. Thus, a contracting authority must act fairly in the course of public procurement, and all competitors must have an equal opportunity to compete for the contract. Finally, we note that discrimination against foreign firms in an international trade context includes price preferences, outright bans on foreign bidders, local-content-related restrictions such as offsets, and standards adopted in the procurement process that raise the costs of foreign firms. If the non-discrimination principle in public procurement is observed, these practices will be avoided.

Integrity in procurement involves both the avoidance of corruption and abuse and the notion of personnel involved in procurement acting ethically and fairly in avoiding conflicts of interest. Corruption practices involve different forms of collusion between government and

bidders, such as awarding contracts based on bribes; awarding contracts to firms in which one has a personnel interest; awarding contracts to firms in which one's friends, family, or business acquaintances have an interest; and awarding contracts to political supporters. Such corruption, which can occur in executing as well as in awarding contracts, may prevent the government from achieving value for money in their acquisitions.

The revised World Trade Organization (WTO) Government Procurement Agreement (GPA), which came into force on April 6, 2014, stands outside the system of 'Single Undertaking', in that it is not binding for all WTO Members, but only for Signatory Parties. The WTO GPA provides the Signatory Parties with a framework for ensuring that procurements scheduled under the Appendix to the WTO GPA are conducted in a competitive, non-discriminatory, and transparent manner, satisfying the conditions on integrity. The WTO GPA allows opening covered procurements to international competition. The provisions on contract awards, supplier qualifications, and conditions on the procurement process ensure achieving the transparency and non-discriminatory conditions of competition between suppliers, resulting in cost savings to procuring governments. In addition, access to the WTO's dispute settlement mechanism helps enforce fair and non-discriminatory competition in public procurement. As a result, the WTO GPA is expected to bring about lower prices, better quality, and efficiency gains, and to reduce corruption and rent-seeking tendencies.

In this paper we analyse empirically whether the WTO GPA is effective in promoting non-discriminant, open, transparent, competitive, and cost-effective government procurement. The paper is organized as follows: Section 2 provides an overview of the literature and Section 3 describes the data set used in the paper. Section 4 analyses the effect of the WTO GPA on openness of government procurement markets, and Section 5 investigates whether the WTO GPA promotes competition. While Section 6 examines corruption risk, Section 7 analyses the effect of WTO GPA on procurement cost-effectiveness. Finally, Section 8 concludes.

2. Literature Overview

There is a vast literature studying the effects of WTO GPA. In this section we restrict ourselves to the discussion of rather recent contributions by Shingal (2011), Rickard and Kono (2014), Fronk (2015), Shingal (2015), Kutlina-Dimitrova and Lakatos (2016), and Gourden and Messent (2017).

Shingal (2011) examines whether the WTO GPA has fulfilled its intended purpose of non-discrimination. Noting that governments frequently discriminate against foreign suppliers in favour of domestic ones, the author studies whether WTO GPA has led to greater market access for foreign suppliers. His analysis reveals that the WTO GPA has not been effective in increasing or even sustaining market access for foreigners in the services procurement markets of Japan and Switzerland.¹

Rickard and Kono (2014) noting that home-biased government procurement is a pervasive phenomenon, and that measuring domestic bias is difficult since it is not directly observable, measure discrimination in government procurement by estimating the impact of procurement spending on the imports of goods and services. According to the authors, an increase in procurement shifts spending from the private to the public sector. Regressing the natural logarithm of imports ($\ln(\text{Imports}_{ij})$) between two country pairs i and j on the natural logarithm of contestable government procurement spending by country i ($\ln(\text{Procurement}_i)$), and controlling for other determinants of imports, they obtain the elasticity of imports to procurement spending.² The estimated coefficient should range from zero to negative, with larger negative coefficients suggesting higher levels of domestic bias. When the coefficient is zero there is no home bias. On the other hand, when the government is more discriminatory

¹ In his study of the effects of WTO GPA Shingal (2011) concentrates on public purchases of services for Japan and Switzerland derived from annual Japanese and Swiss submissions to the WTO's Committee on Government Procurement over the period 1997-2003. The author considers 25 service sub-sectors in the case of Japan and 26 service sub-sectors in the case of Switzerland. He uses two metrics: (i) the value of contracts awarded to foreigners as a proportion of total above threshold contracts; and (ii) the value of contracts awarded using a non-limited tendering method as a proportion of total above-threshold contracts. Referring to the period 2002-03 as the present time period and to the period 1997-98 as previous time period, the author calculates for each service sub-sector the counterfactual values of the contracts using the average values of the two metrics for the present and previous time periods and the actual values of above threshold contracts during the present time period. His aim is to compare the actual outcomes with counterfactuals. The author obtains the value of the counterfactual at the present time period by multiplying the value of the metric in the previous time period with the actual value of above-threshold contract during the present time period. Thereafter, he subtracts from the counterfactual the actual value of the contract. In case the value of the metric declines over time, the difference is positive, and it is read as the 'unrealized foreign market access' in the case of the first metric, and as 'unrealized internationally competitive bidding' in case of the second metric. Calculations reveal that in the case of Japan unrealized foreign market access amounts to \$1.96 billion and unrealized competitive bidding to \$21.3 billion. Since the value of above-threshold contracts during the present time period amounted to \$11.1 billion, and the share of contracts awarded to foreigners as a proportion of total above-threshold contracts during the present time period was 1.1%, the author asserts that foreign service procurement in 2002-03 would have been more than 15 times higher. Similarly, he finds that the value of contracts open to internationally competitive bidding would have been almost three times larger. Thus, according to the author there has been significant discrimination against foreign bidders in the government procurement services markets in Japan. Similar considerations hold in the case of Switzerland.

² Contestable procurement spending means government spending on goods and services less compensation of employees and defence expenditures.

than the private sector, procurement spending will lower import demand because the government buys fewer imports than the private sector. Hence when the estimated coefficient is negative there is home bias, indicating government discrimination. Next, the authors ask whether the WTO GPA reduces discrimination against foreign suppliers. The authors, using a gravity model of trade and making use of annual data for 74 countries over the period 1995 to 2013, show that the coefficient on procurement spending is negatively signed and statistically significant. Their results indicate that the WTO GPA does not significantly reduce discrimination in public procurement.

A different approach has been adopted by Fronk (2015) who is concerned with the estimation of the impact of procurement disciplines in bilateral and multilateral agreements, which he calls national treatment agreements (NTA). He employs a theoretical model incorporating elements from the political economy, international trade, and auction theory to derive estimating equations. Then, he empirically analyses the effects of NTAs on procurement awards. He concentrates on the case of the US and makes use of data obtained from the US Federal Procurement Data System. Using annual observations on federal contracts during the period he obtains a rich data set for the period 1996-2010. In the data set he obtains for each procurement information on contract value, place of performance, contract year, and nationality of the supplier. Since thresholds vary widely among US's NTAs he considers the minimum value of these thresholds and concentrates on those procurements above this minimum value. He notes that until 2007 foreign firms were awarded less than 1% of procurement contracts, and that only in the final few years of the sample foreign firms began to increase their share. Fronk (2015) using a probit selection model finds that signing national treatment agreements with the US increases countries' procurement awards, both in terms of contracts and in total value.

Shingal (2015) using the dataset from the WTO's notifications on domestic and foreign purchases by Japanese and Swiss governments at the sector level over the period 1990-2003 undertakes econometric analysis of the determinants of procurement home bias using variables inspired by the political economy, trade-macroeconomic and procurement literatures. The empirical results reveal that the coefficient on the WTO GPA is statistically insignificant indicating that the disciplining mechanisms of the WTO GPA may not have led to greater foreign access to the governments' goods procurement market.³

³ When conducting the econometric analysis of home bias in government procurement Shingal (2015) concentrates on public purchases of goods and services for Japan and Switzerland derived largely from annual Japanese and Swiss submissions to the WTO's Committee on Government Procurement over the

Recently Kutlina-Dimitrova and Lakatos (2016) have analysed the impact of a set of selected explanatory variables on the probability of awarding public procurement contracts directly cross-border using a multivariate logit model. The explanatory variables include contract value, number of offers, GDP per capita, trade-to-GDP ratio, scope of public enterprises, regulatory protection of incumbents, barriers to FDI, and type of tender procedure. The authors have obtained procurement related data from Tenders Electronic Daily (TED) based on contract award notices in EU Member States for the 2008-2012 period. After removing from the dataset extreme values and large number of reporting errors due to non-compliance, the authors end up with approximately 1.2 million observations. Empirical results reveal that the value of a contract has a positive influence on the probability of cross border win, implying that high-value contracts are more likely to be awarded to a foreign company. In addition, the results point to a negative influence of the number of offers on the probability of a cross-border win.⁴

Finally, Gourdon and Messent (2017) making use of TED data for the period 2009-2014 study the impact of a set of selected explanatory variables on the probability of awarding public procurement contracts directly cross-border. The explanatory variables include GDP, import, distance, government procurement share in GDP, common border, common language, colony and remoteness. In addition, the authors include dummies if the reporting and partner

period 1990-2003. Since these data have been collected regularly after 1995, the database for analysis during 1990-1995 has been assembled manually. The author considers 26 goods sub-sectors in the cases of Japan and Switzerland, 24 services sub-sectors in the case of Japan, and 26 services sub-sectors in the case of Switzerland. As the dependent variable he uses the share of foreign in above threshold procurement by value. He regresses the dependent variable on WTO GPA dummy which takes the value of one 1996 onwards and zero otherwise. As control variables he uses the average product of labour, the share of exports in output, the number of export destinations, annual rate of GDP growth, annual percentage changes in real effective exchange rate, dummy variables for election years, and dummy variables for the year preceding the election. Empirical analysis reveals that the coefficient of WTO GPA dummy is statistically insignificant when both goods and services data are taken into consideration. He concludes that the disciplining mechanism of the GPA may not have led to greater foreign access to government procurement markets.

⁴ In the empirical analysis when the authors consider the odds ratio defined as the probability of cross border procurement divided by the probability of domestic procurement, the results reveal that the odds of awarding a contract cross-border grow by 1.6 % as the value of a contract increases by € 1 million; and that the odds of awarding to a foreign contractor decrease by 26.7 % with the log of number of offers. In addition, the results indicate that GDP per capita of the awarding country impacts the probability of a cross-border award positively; that trade-to-GDP ratio of the awarding country impacts the probability of a cross-border award positively; that of all types of awarding authorities, it is local governments that have the lowest propensity to award contracts to cross-border providers; and that utility providers have the highest propensity to award contracts to cross-border providers.

countries are both in the WTO GPA or have signed an agreement with procurement disciplines to assess the efficiency of such agreements. The authors show that a country's membership of the WTO GPA increases the probability of their firms being awarded a procurement contract in the EU through the cross-border mode of supply. While under WTO GPA membership foreign suppliers may win a greater share of available contracts, the authors show that the procurement pie is not expanding. Noting that procurement will be discriminatory if foreign firms cannot contest the procurement market through foreign direct investment or if government entities differentiate among firms based on their nationality, the authors investigate also the role of investment agreements. Using Rickard and Kono's basic (2014) framework, the authors show that FDI barriers reduce the effectiveness of the WTO GPA in increasing the chance of a cross-border award, and that to maximize gains from WTO GPA accession, a country should also undertake investment liberalization.⁵

To emphasize the added value of the present paper compared to existing literature we note that the paper uses TED micro-level data released recently by the EU, covering more than three million tenders conducted in the European Economic Area (EEA), Switzerland, and Macedonia over the period 2006 to 2016.⁶ A very interesting feature of this data set is the variable *B_GPA*, which records whether the contract is covered by the WTO GPA. Using this data set, we examine the following research questions:

- Does the WTO GPA foster openness of government procurement markets by increasing the probability that a foreign firm will win a contract?

⁵ Gourdon and Messent (2017) when analyzing the impact of international agreements on the elasticity of import of goods to procurement spending use a bilateral gravity model of imports. The data used in the analysis consists of annual bilateral import data from UN Comtrade covering the period 1995-2013. The sample comprises 74 countries. 44 of these countries have bilateral agreements with procurement disciplines with at least one other country in the sample, 32 countries have investment agreements, and 35 countries are GPA signatories. In the regression equation while the dependent variable is the value of import between country *i* and *j*, explanatory variables include besides the WTO GPA dummy variables such as size, GDP, tariffs, distance, common border, common language, colony and remoteness. To investigate the role of investment agreements the authors add to the regression equation variables representing joint procurement and investment agreement and joint GPA membership and investment disciplines. Empirical analysis reveals that GPA reduces home bias in general and even more when signatory countries have international investment disciplines.

⁶ The data set is open to the public and can be downloaded at <https://data.europa.eu/euodp/en/data/dataset/ted-csv>. Note that while Kutlina-Dimitrova and Lakatos (2016) in their analysis use TED micro-level data covering the period 2008-2012 and Gourdon and Messent (2017) use TED micro-level data covering the period 2009-2014 we use extended TED data covering the period 2006 to 2016.

- Does the WTO GPA promote competition by increasing the number of offers submitted?
- Does the WTO GPA lower corruption risk in government procurement?
- Does the WTO GPA improve procurement cost-effectiveness by lowering the probability that procurement price is higher than the estimated cost of the procuring authority?

The TED contains detailed information on public procurement contracts that allow us to examine the above research questions. Our empirical analysis provides the following results: First, we show that the WTO GPA reduces barriers for foreign countries to win government procurement contracts by analysing the winning probability of a foreign firm using a multivariate logit model. Second, we find that the WTO GPA promotes competition. Third, we find that corruption risks, measured in two different ways (below), are lower in WTO GPA auctions:

- The first measure is the probability of being a single-bid auction.
- The second measure is the number of recurrent wins by a single firm.

Finally, we show that the WTO GPA improves procurement cost-effectiveness by lowering the probability of procurement price being larger than the estimated cost.

3. Main Features of the TED Data Set

The TED data set contains data about 3,562,829 government procurement contracts conducted in 33 countries during the years 2006-2016. As stated in TED (2016), the source of the data is contracting authorities and entities across Europe. The data is extracted from the contract notice and contract award notice standard forms filled by the authorities.⁷ Public authorities are obliged to publish their tender invitations on TED for all contracts exceeding EU public procurement thresholds. However, as emphasized by Kulina-Dimitrova and Lakatos (2016) contract awards below the threshold are also reported on TED since authorities are in general not prevented from announcing the tender on TED even if the tender's value is below

⁷ The standard forms of the EU are available at "<http://simap.ted.europa.eu/web/simap/standard-forms-for-public-procurement>

the threshold, and since tenders are often awarded to the most economically advantageous bidder, i.e. even though the initial contract value is above or at the threshold, the final award value might be well below the threshold.

To conduct the empirical analysis, we employ the TED award notices data. 1,936,456 of these contracts are covered by the WTO GPA and 1,626,373 are non-WTO GPA contracts indicating that 46% of the procurements in the TED dataset are non-WTO GPA contracts. Note that the coverage schedules are a critical part of the WTO GPA.⁸ The EU 'SIMAP'⁹ form for public procurement contains question IV.1.8 that asks whether the procurement is covered by the WTO GPA. In the empirical part of the paper we use this information to examine the effects of WTO GPA on government procurement. Table 1 displays the distribution of the contracts across countries, and we present average contract values for each country in the Online Appendix.¹⁰ We note that firms from 201 different countries have won at least one contract.^{11,12} Finally, note that while Armenia, Canada, EU member countries, Hong Kong, Israel, Republic of Korea, New Zealand, Chinese Taipei, and the US are parties to the WTO GPA, some of the important trade partners of the EU such as Australia, Egypt, India, Malaysia, Mexico, Pakistan, Russian Federation, Thailand, and Turkey are not.¹³

{Insert Table 1}

⁸ Article II of WTO GPA describes the scope and coverage of the agreement. For more details see the Online Appendix.

⁹ Acronym for information system for public procurement (fr. système d'information pour les marchés publics).

¹⁰ Procurements conducted in France and Poland constitute a significant percent of the data set, 23% and 27% respectively. The TED documentation states that "Generally, the data consists of tenders above the procurement thresholds. However, publishing below threshold tenders in TED is considered good practice, and thus a non-negligible number of below threshold tenders is present as well." Compared to other countries, French and Polish authorities regularly report contracts below the threshold value. We conduct the empirical analysis by using the complete data set with all countries and by using a narrower data set excluding France and Poland. When we examine all countries, we use separate dummy variables for France and Poland to control for the asymmetric representation of these countries. Empirical results are similar with and without these dummy variables.

¹¹ Tables OA.3 and OA.14 in the Online Appendix display the distribution of winner countries.

¹² We manually processed the countries with unlikely number of winner firms. For example, Afghanistan has 203 contracts. Although the total amount of exports from Afghanistan to the EU is 417 million Euros for the 2006-2005-time period, it might be excessive that 203 firms from Afghanistan win an EU public procurement contract. The TED data set also contain the names and addresses of the firms. We matched the names and corrected winner country information. These modifications do not change the results since they make up 0.0001 % of the data set.

¹³ We present the number of successful firms in EU tenders from selected countries in the Online Appendix.

Each contract in the data set is identified by a unique contract ID number. The year of the contract, contracting authority name, contracting authority country, CPV sector code, winner firm name and winner firm country are available for each contract.¹⁴ We use this information to examine the likelihood of a foreign firm to win a contract and to construct the network structure of firms in each country. We identify the sector of procurement using the first two digits of the CPV code noting that there are 72 major sectors.¹⁵

Government institutions implement different procurement procedures. The most common procedure is ‘open tender’ with 1,405,288 GPA covered and 1,234,645 non-GPA contracts awarded using the open procedure. Additionally, authorities implement negotiation, restricted auction and competitive dialogue procedures.¹⁶ TED data set also provides information about procurement results, namely procurement price, estimated cost determined by the procuring authority and number of offers received.

Figure 1 displays market concentration statistics. We identify firms by their names and base-countries. One of the unique features of the TED data set is the availability of firm names and the countries they are located. We use that information to calculate total number of wins by a single firm. There are 414,917 unique firms that have won at least one contract. 90% of the firms have won 10 or fewer contracts. When we consider only the WTO GPA covered procurements we note that 258,647 unique firms have won on average 7.48 contracts. In comparison, when we consider non-WTO GPA contracts the average number of wins is 8.38 by 193,981 firms. Figure 1 displays the histogram of total number of wins showing that more than 50% of the firms win only one contract.

{Insert Figure 1}

4. Effect of the WTO GPA on the Openness of Government Procurement Markets

To analyse the effects of the WTO GPA on openness of government procurement markets we consider three cases. First, calling a firm foreign whenever the country of the procuring authority is different from the country of the firm we examine whether the WTO GPA eliminates

¹⁴ One of the irregularities that we observe is about total number of wins by each firm. 20 firms out of 414,917 have won more than 10,000 contracts in the TED data set. These firms operate in multiple sectors.

¹⁵ Detailed summary statistics for each sector are provided in the Online Appendix.

¹⁶ We provide detailed information about procedure types in the Online Appendix.

barriers for foreign firms to win government procurement contracts. Next, we consider a different definition of foreign firm, and define a firm foreign whenever the procuring authority is in an EU Member State and the country of the firm is a non-EU State. We then examine whether the WTO GPA promotes non-EU firms.¹⁷ Finally, the third case investigates whether the WTO GPA encourages competitive tendering procedures.

4.1 Effect of WTO GPA on the Probability that a Foreign Firm Will Win a Contract

In this sub-section, we examine whether the WTO GPA eliminate barriers for foreign firms to win government procurement contracts by estimating the following logit regression specification:

$$Prob(C_{irt} = 1|x) = F(x'_{irt}\beta) \quad (1)$$

where C_{irt} is a dummy variable, that is, 1 if procurement is awarded to a foreign firm¹⁸ when the authority and winner countries are different. $F(x'_{irt}\beta)$ is a logit probability function of $x'_{irt}\beta$ and x'_{irt} contains the explanatory variables GPA_{irt} , P_{irt} , and FE . GPA_{irt} is the dummy variable, which is 1 if the procurement is covered by the WTO GPA. The coefficient of GPA_{irt} provides us the impact of the WTO GPA on the probability that a foreign firm wins a government procurement contract in EU countries.¹⁹ P_{irt} contains dummy variables for procurement method (type), and dummy variables for type of contracting authority. C_{rt} are country-specific factors such as trade-to-GDP ratio and GDP per capita. We obtain these variables from the World Development Indicator database of the World Bank. Finally, FE contains fixed-effects dummy variables for the years 2007 to 2016 and sector dummy variables, identified by the first two

¹⁷ EU directives regulate intra-EU procurement but if the EU does not have an FTA with procurement market access commitments with a country that is a party to the GPA - US, Japan, Armenia - then the access to EU markets by these firms under GPA schedules will likely affect intra-EU procurement due to more bids = competitive pressures etc.

¹⁸ We follow Kutlina-Dimitrova and Lakatos (2016) when identifying foreign firms. We call a firm foreign if the country of the procuring authority is different from the country of the firm. For 2813 contracts, there is no information on the winner's name or country, and for 37,512 contracts, information is missing on the CPV code. We do not examine these contracts and remove them from the data set.

¹⁹ We also estimate alternative regression specifications with additional control variables: country-specific factors such as trade-to-GDP ratio and GDP per capita and procurement-specific variables such as number of offers, contract value. We display the estimation results in the online appendix.

digits of the CPV codes.²⁰ Note that foreign firms have been awarded 61,889 contracts: 37,516 covered by the WTO GPA and 24,373 non-GPA contracts.²¹

Table 2 conducts multivariate logit regression and instrumental variable (IV) GMM linear probability model estimation to examine the effect of WTO GPA on the probability that a foreign firm wins a contract. The first three columns of Table 2 examine the data set excluding France and Poland, 1,793,764 contracts. As presented in Table 1, 44% of GPA covered and 54.79% of non-GPA contracts are conducted in France and Poland. Over representation of these countries might alter the results. Accordingly, we conduct the empirical analysis using the complete data set and excluding France and Poland to assess the robustness of the results. In the second column, we focus on the contracts with estimated contract values above the thresholds determined by the EU, namely 1,413,379 contracts. Specifically, we eliminate contracts where the estimated contract values are not known and the contracts below EU threshold levels.

The third column considers that the WTO GPA covered variable might be endogenous. There might be unobserved factors that authorities use to determine whether tenders are covered by the WTO GPA. These unobserved factors might also be related with the probability that a foreign (or non-EU firm) wins a contract. In that case, the WTO GPA covered variable will be correlated with the error term and this endogeneity problem will affect the results. We employ an instrumental variable GMM methodology to consider possible endogeneity of GPA covered variable. Lewbel (2018) shows that a linear probability model can be estimated using heteroscedasticity based instrumental variables (IV) of Lewbel (2012) when the dependent variable is binary and explanatory variable is potentially endogenous. Accordingly, we correct for possible endogeneity of the WTO GPA covered variable by implementing the IV generalized method of moments (GMM) methodology of Lewbel (2012) to the linear probability model in equation (2).²²

²⁰ Additionally, we use a dummy variable for France and Poland in our empirical analysis to control for the asymmetric representation of these countries.

²¹ We display the total number of wins by foreign firms for each country in the Online Appendix Tables OA.3 and OA.14.

²² Lewbel (2012) constructs valid instrumental variables that are independent of the error term using the heteroskedasticity structure of the error term. Previously, Rigobon and Sack (2003) use a similar identification technique to assess the reaction of monetary policy to the stock market. Lewbel (2012) generalizes this identification technique. Accordingly, it can be applied to data sets with different structures like the TED data set. The method developed by Lewbel (2012) identifies structural parameters by constructing instruments as functions of the model's data when valid instrumental variables do not exist. This approach provides an unbiased and consistent estimate of parameters when the regression model contains endogenous or mismeasured regressors, or when the model suffers from the omitted-variable bias. The Monte Carlo results and numerous empirical applications presented in Lewbel (2012) show that the estimator works very well compared to the two-stage least squares method

$$C_{irt} = \beta_0 + \beta_1 GPA_{irt} + X'\theta + \varepsilon_{irt} \quad (2)$$

where C_{irt} is a dummy variable as described in equation 1. β_1 in equation 2 measures the effect of WTO GPA on the probability that a foreign firm wins a contract. X' contains the control variables as described above.

{Insert Table 2}

In Table 2 columns 4-6 investigate all countries, 3,524,060 contracts. Column 5 focuses on the contracts with estimated contract values above the EU thresholds. Finally, column 6 implements the IV-GMM methodology to all contracts.²³

The coefficient of the WTO GPA-covered variable is significant, with a positive sign for all regression specifications. Accordingly, we conclude that foreign firms are more likely to win government procurement contracts when the contract is covered by the WTO GPA. This result indicates that the WTO GPA is successful in lowering the barriers for foreign firms to win government procurement contracts in EU Member and affiliated countries.

4.2 Effect of the WTO GPA on the Probability that a non-EU Firm Will Win a Contract

In this sub-section, we consider a different definition of ‘foreign firm’ and examine whether the WTO GPA promotes non-EU firms. We note that during years 2006-2016 13,591 non-EU firms had won 29,045 government procurement contracts in the EU. We conduct multivariate logit regression and IV-GMM linear probability model estimation to examine the effect of the WTO GPA on the probability that a non-EU firm wins a contract. We estimate the following logit regression specification and linear probability model:

and to GMM when good instrumental variables are not available. The methodology uses the heteroskedasticity of the errors to construct valid IVs and consistent and unbiased parameters of the empirical model can be estimated by employing these IVs in an IV-GMM setting.

²³ We also estimate different regression specifications with different sets of explanatory variables to assess the robustness of our results. These results are available in Table OA.5 in the Online Appendix.

$$Prob(NEU_{irt} = 1|x) = F(x'_{irt}\beta) \quad (3)$$

$$NEU_{irt} = \beta_0 + \beta_1 GPA_{irt} + X'\theta + \varepsilon_{irt} \quad (4)$$

where NEU_{irt} is a dummy variable that is 1 if procurement is awarded to a non-EU foreign firm. $F(x'_{irt}\beta)$ is a logit probability function of $x'_{irt}\beta$. x'_{irt} and X' contains the explanatory variables described above. The coefficient of GPA_{irt} provides us the impact of the WTO GPA on the probability that a non-EU firm wins a government procurement contract in the EU Member and affiliated countries.²⁴

{Insert Table 3}

Table 3 above displays the results of the multivariate logit regression estimation of equation 3 and IV-GMM linear probability model estimation using Lewbel (2018) methodology as in equation 4. Like Table 2, the second and fifth columns focus on contracts with estimated contract values above the EU thresholds. The coefficient of the WTO GPA covered variable is significant with a positive sign for all regression specifications. Accordingly, we conclude that non-EU firms are more likely to win government procurement contracts when the contract is covered by the WTO GPA. The WTO GPA opens the EU government procurement market to non-EU firms.

4.3 Effect of the WTO GPA on Procurement Method: Multinomial Logit Regression Analysis

The WTO GPA encourages competitive tendering procedures. Procurements must be carried out in a transparent and impartial manner avoiding conflict of interest and preventing corrupt practices using methods such as open tendering, where any supplier may respond to a published call for tenders, or selective tendering, where bids are restricted to prequalified suppliers who have demonstrated that they meet technical competence norms. Limited tendering, under which potential suppliers are directly solicited to bid by the procuring entity, is non-competitive and may be used in only following circumstances: situations in which no tenders were submitted; no tenders that conform to the essential requirements of the tender documentation were submitted; no suppliers satisfied the conditions for participation; or the tenders submitted have been collusive. In this section, we investigate the effect of the WTO GPA

²⁴ We also estimate alternative regression specifications with additional control variables: country-specific factors such as trade-to-GDP ratio and GDP per capita and procurement-specific variables such as number of offers, contract value. We display the estimation results in table OA.5 in the online appendix.

on methods of procurement. We study whether the WTO GPA promotes openness by affecting the choice of the procurement authorities on procurement types.

We implement a multinomial logit regression analysis. We determine ‘award without prior publication of a contract notice’ and ‘negotiated without a call for competition’ as the base outcomes. Accordingly, we investigate the effect of the WTO GPA on the probability of competitive and open procedures compared to procedures without competition.²⁵ We find that the WTO GPA significantly increases the probability that authorities implement open and competitive procedures like open (first-price auction) procedure, competitive dialog and restricted first-price auctions. The coefficients of WTO GPA dummy variables for competitive dialog, open and restricted open procedures are significant and positive.

5. Effect of the WTO GPA on Competitive Environment

In this section, we examine whether the WTO GPA improves the competitive environment by increasing the number of offers submitted for a contract. We implement a negative-binomial regression methodology, as suggested by Bajari and Hortacsu (2003), to assess the determinants of the number of bidders. Specifically, we examine the following regression equation:

$$N_{irt} = \alpha + \rho GPA_{irt} + \theta C_{rt} + \beta X_{irt} + \delta FE + \varepsilon_{irt} \quad (5)$$

where N_{irt} is the number of bids submitted for each contract.²⁶ We exclude France and Poland and examine contracts from remaining EU countries. We present the empirical results with all countries in Table OA.7 of the Online Appendix.²⁷ The second column of Table 4 examines tenders with estimated contract values above EU thresholds consisting of 1,283,658 contracts. The coefficient of the WTO GPA-covered variable is significant, with a positive sign for all regression specifications. This result indicates that significantly more firms submit offers to WTO GPA-covered procurements. Hence, we conclude that the WTO GPA improves the level of competition in government procurement auctions.

²⁵ We display multinomial logit regression results in Table OA.6 in the Online Appendix.

²⁶ Of the contracts we examine, 4919 had no information about the number of offers, so we do not include them in our calculations.

²⁷ We also estimate alternative regression specifications with additional control variables: country-specific factors such as trade-to-GDP ratio and GDP per capita and contract value. We display the estimation results in table OA.7 in the Online Appendix.

{Insert Table 4}

6. Corruption Risk in Government Procurement and the WTO GPA

Cost-effective government procurement requires a competitive and transparent procurement system. Corruption limits competition and artificially increases procurement prices above a competitive level. Therefore, to be able to improve procurement cost-effectiveness, authorities should conduct appropriate competition policy actions to deter collusion in public procurement. Hence, collusion prevention is one of the goals of the WTO GPA. In this section, we investigate whether the WTO GPA manages to limit collusion.

We first construct collusion measures to gauge collusive risk in government procurement in the EU. Fazekas et al. (2014) calculate a proxy indicator of corruption by using signs of limited competition such as a single bid received and the same company winning recurrent contracts. Ishii (2009) provides details about the operational structure of bidding rings that manipulate public procurement auctions. Bidding rings determine the winning firm by considering the previous intentional losses of a bid member. Accordingly, ring members that do not win a contract for a certain period of time are more likely to win the next rigged auction. This indicates that bidding ring members tend to win higher number of contracts compared to non-ring members. We employ the arguments stated by Ishii (2009) and use the total number of contracts by a firm as a potential indicator of collusion. We examine the impact of the WTO GPA on corruption by assessing how the WTO GPA affects two red flags of limited competition: contracts with a single bid and a firm's win ratio.

6.1 Contracts with Single Bids

Of all procurements in the time period we study, 762,813 (21%) contracts were conducted when there was only one offer. Of this total 21%, namely 285,905 contracts were WTO GPA covered and 476,908 were not. We estimate a multivariate logit regression, where the response variable is the dummy variable, that is, 1 when there was only one offer in a contract. We estimate the following regression specification:

$$Prob(SB_{irt} = 1|x) = F(x'_{irt}\beta) \quad (6)$$

where SB_{irt} is the single-offer procurement dummy variable and equals 1 if procurement was conducted with only one offer. x'_{irt} contains the explanatory variables GPA_{irt} , C_{rt} , P_{irt} , and FE , as described above in Section 4.

Last two columns of Table 4 display the regression results using all contracts and using contracts with estimated values above EU thresholds.²⁸ The table shows that the probability of a one-offer procurement is significantly lower for WTO GPA-covered procurements. The coefficient of the WTO GPA-covered dummy variable is negative and significant at the 1% significance level. In other words, it is more likely that WTO GPA-covered procurements attract more than one offer. Accordingly, we conclude that the WTO GPA helps governments promote a competitive procurement environment that is less susceptible to collusive behavior. Table OA.8 in the Online Appendix estimates equation 6 using complete data set with all EU countries and employs additional control variables. The WTO GPA covered variable is significant with a negative coefficient in OA.8. The magnitude of the coefficient is lower (-0.16 compared to -0.27 in Table 4) when we examine all EU countries.

6.2 Firms' Winning Ratios

The second measure that Fazekas et al. (2014) use to gauge corruption risk is the number of recurrent wins by a single firm. To evaluate recurrent wins, we calculate the percentage of a firm's total number of wins in a specific sector and country. For example, if the percentage value of a firm is 50, then that firm has won half of the contracts in a sector and country. Therefore, a higher percentage value indicates that fewer firms manage to win contracts and the corruption risk is higher.

We present the summary statistics of the total number of wins by each firm in Table OA.9 in the Online Appendix. The maximum value is 100 percent, and the table shows that in some countries all contracts are won by a single firm in a sector. WTO GPA-covered procurements are won by firms with a slightly lower average number of total wins: 0.65 compared to 0.67. The difference between WTO GPA-covered and non-covered procurements is statistically significant, with a p-value of 0.002.

²⁸ We also estimate alternative regression specifications with additional control variables: country-specific factors such as trade-to-GDP ratio and GDP per capita and contract value. We display the estimation results in the online appendix.

The above considerations reveal that corruption risks, measured first by the probability of being a single-bid auction and second by the probability of recurrent wins by a single firm, are lower in WTO GPA auctions.

7. Does the WTO GPA Improve Procurement Cost-Effectiveness?

Finally, we examine the impact of the WTO GPA on the cost-effectiveness of government procurement. We measure cost-effectiveness using the ratio of procurement price to estimated value. We can use only 1,116,249 observations for this analysis since the estimated value is missing for a substantial number of contracts. Additionally, we have eliminated the outliers by implementing Billor et al.'s (2000) BACON methodology (blocked adaptive computationally efficient outlier nominators) to identify the outliers.²⁹ Although both the contract price and the estimated cost should have been entered in Euros, some observations have been entered in local currencies. Additionally, the contract price may be for one unit; however, the estimated cost may represent the total amount, which causes the ratio to be unrealistically small.³⁰ We identify these entries as outliers and eliminate them.³¹ We display the ratio's summary statistics in the Online Appendix Table OA.11. On average, the ratio is equal to 0.89, indicating that the contract price is 89% of the estimated cost. Some contracts are very inefficient, in that they are significantly higher than the estimated cost.³²

We follow the description of OECD (2012) to identify inefficient procurements. As stated by OECD (2012) "value for money" can be assessed by comparing the procurement price and estimated costs. Specifically, procurement prices that are higher than the engineering cost

²⁹ Table OA.11 in the Online Appendix present the summary statistics with and without outliers. The ratio of procurement price and estimated cost has very unrealistic values like 2.5e+15 compared to 1.87 when we eliminate outliers. Table OA.10 presents the regression results with outliers. The extreme values most likely caused by error produces significantly biased results with unrealistic coefficients.

³⁰ For example, the procurement price might be entered as 10,000 Euros for one car, but the estimated cost might be 1,000,000 Euros for a fleet of 100 cars. Therefore, ratio of 10,000/1,000,000 will be unrealistically small.

³¹ We removed 145,465 observations that were identified as outliers by the BACON methodology.

³² As stated by Conley and Decarolis (2016, 6) the estimated cost "is the maximum (the public authority) is willing to pay." Conley and Decarolis (2016) analyze auctions held between 2000 and 2010 by Italian public administrations to procure contracts for simple roadworks in Northern Italy. They find that on average the contract price (winning bid) is 13.4 percent lower than the estimated cost. Similarly, Ishii (2009) shows that the ratio of winning bid to estimated cost is between 0.95-0.8 in Okinawa Prefecture road construction auctions in Japan. Onur et al. (2012) find similar results for Turkish public procurement auctions. Winning firms provide significant discounts compared to the estimated cost. Inefficient procurement has significantly higher ratios compared to the average ratio of 0.89 in TED procurement. We display this statistic in Table OA.11 in the online Appendix. Minimum ratio is 0.25 and maximum is 1.87 for EU public procurement in the TED data set.

estimates are not cost-effective. OECD (2012) suggests that public authorities should investigate these procurements. We identify the tenders with procurement prices larger than estimated costs (ratio of price and estimate is larger than one). We determine 225,837 (17.45%) procurements that are not cost-effective since their procurement prices are larger than their estimated costs.

We conduct several regression analyses to investigate whether WTO GPA lowers the probability that a tender is inefficient (ratio of price and estimate is larger than one). We also examine the impact of collusive behaviour on procurement efficiency by analysing the effects of single-offer procurements. Specifically, we estimate the following regression specifications:

$$Prob(inefficient_{irt} = 1|x) = F(x'_{irt}\beta) \quad (7)$$

$$inefficient_{irt} = \beta_0 + \beta_1 GPA_{irt} + X'\theta + \varepsilon_{irt} \quad (8)$$

where $inefficient_{irt}$ is a dummy variable that is 1 if the procurement price is larger than the estimated cost. $F(x'_{irt}\beta)$ is a logit probability function of $x'_{irt}\beta$. x'_{irt} and X' contains the explanatory variables described in Section 4.

We consider the endogeneity of the number of bidders and of the GPA dummy variable when conducting the regression analysis.³³ As stated by Estache and Iimi (2010) and Onur et al. (2012), the existence of factors that might simultaneously influence bidders' participation decisions and the winning bid might cause the OLS estimates to be inconsistent. Ohashi (2009) argues that unobserved attributes of the procurement process are represented in the error term, and that bidders' participation decisions are likely to be correlated with these unobserved procurement attributes. Accordingly, potential correlation between the error term and number of bidders might cause an endogeneity problem. Additionally, authorities might determine WTO GPA covered tenders based on these unobserved attributes represented in the error term. Therefore, both number of bidders and the WTO GPA dummy variables might be endogenous.

Table 5 below displays the results of the multivariate logit regression estimation of equation 7 and IV-GMM linear probability model estimation using Lewbel (2018) methodology as in equation 8.

³³ One might argue that the exclusion process might cause an endogeneity problem. Accordingly, we treat both the number of bidders and the GPA variables as potentially endogenous when conducting the regression analysis. An alternative regression specification, where we treat the GPA dummy variable as exogenous, rendered similar results. Table OA.12 in the Online Appendix display the Ordinary Least Squares results.

Columns 1-4 in Table 5 display the estimation results excluding France and Poland. Columns 5-8 analyse all EU countries. All regression specifications in Table 5 show that the WTO GPA-covered dummy variable is significant with a negative coefficient. The WTO GPA lowers the probability that procurement price is larger than estimated cost. Accordingly, WTO GPA covered tenders are significantly more likely to be cost-effective.

{Insert Table 5}

In addition to the impact of the WTO GPA on procurement efficiency, Table 5 provides consequential results about the effect of competition and potential corruption. We find that competition plays a consequential role for improving procurement efficiency. The coefficient of the number of offers is negative and significant in all regression specifications. An increase in the number of bidders significantly lowers the probability that procurement price is higher than estimated cost. The second, fourth, sixth and eighth columns of Table 5 examine the impact of potential corruption on procurement efficiency. We consider the proxy for potential corruption, namely single-bidder procurement as described in section 6.1. We conclude that corruption significantly lowers government procurement efficiency. The single-bidder dummy variable has a significant positive coefficient. Hence, single-bidder contracts have significantly higher probabilities that procurement price is larger than estimated cost. These results display the importance of competition as well as the importance of eliminating corruption in achieving government procurement efficiency.

8. Conclusion

This paper uses a unique data set provided by the EU, covering more than three million tenders conducted in the EEA, Switzerland, and Macedonia between 2006 and 2016. It analyses empirically whether the WTO GPA is effective in promoting non-discriminant, open, transparent, competitive, and efficient government procurements. The main results of the paper are summarized below:

- The WTO GPA significantly increases the probability that a foreign firm will win a government procurement contract in EU Member and affiliated states.
- The WTO GPA promotes a competitive environment by increasing the number of offers.

- The WTO GPA significantly lowers corruption risk by decreasing the number of contracts with a single offer, and by decreasing firm's winning ratios.
- The WTO GPA promotes cost-effective public procurement.
- The level of competition in the procurement environment is a significant determinant of government procurement efficiency. An increase in the number of offers decreases the contract price with respect to the estimated cost.
- Single-offer procurements have significantly lower efficiency; the procurement price for these contracts is higher compared to procurements conducted with multiple offers.

The empirical results displayed above have many policy implications. Non-WTO GPA countries could use the results to convince their constituents to accede to the WTO GPA. Empirical analysis presented in the paper show that WTO-GPA promotes competition and probability that foreign firms win procurement contracts. Higher levels of competition significantly lower procurement prices. Finally, the paper shows that public authorities should closely monitor single-bid procurements since these contracts have significantly higher procurement costs.

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