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Joint Bidding in Infrastructure Procurement

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Abstract

To utilize public resources efficiently, it is required to take full advantage of competition in public procurement auctions. Joint bidding practices are one of the possible ways of facilitating auction competition. In theory, there are pros and cons. It may enable firms to pool their financial and experiential resources and remove barriers to entry. On the other hand, it may reduce the degree of competition and can be used as a cover for collusive behavior. The paper empirically addresses whether joint bidding is pro- or anti-competitive in Official Development Assistance procurement auctions for infrastructure projects. It reveals the possible risk of relying too much on a foreign bidding coalition and may suggest the necessity of overseeing it. The data reveal no strong evidence that joint bidding practices are compatible with competition policy, except for a few cases. In road procurements, coalitional bidding involving both local and foreign firms has been found pro-competitive. In the water and sewage sector, local joint bidding may be useful to draw out better offers from potential contractors. Joint bidding composed of only foreign companies is mostly considered anti-competitive.

This paper—a product of the Economics Unit, Finance, Economics and Urban Development Department—is part of a larger effort in the department to understand and examine efficiency and effectiveness in public infrastructure procurement. Policy Research Working Papers are also posted on the Web at http://econ.worldbank.org. The author may be contacted at aiimi@worldbank.org.

JOINT BIDDING IN INFRASTRUCTURE PROCUREMENT

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JEL classification: D44, H54, H57, C21, D21.

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I. Introduction

Aid effectiveness largely rests on efficiency in the public procurement systems of recipient countries. Our companion paper (Estache and Iimi, 2008) suggests that promoting competition at auctions is a key to reduce procurement costs. The potential benefits that the developing world could receive are estimated at as much as 8.2 percent of total annual investment in infrastructure, including electricity, water and sewage, and roads.

An important policy question is how to intensify competition in procurement auctions for development projects. Joint bidding may be one of the solutions. In theory, however, it is expected to have both effects for and against competition at the auction level. Whether coalitional bidding practices have a pro- or anti-competitive effect defers to empirical analyses. It is potentially affected by underlying sectoral characteristics. This paper, using procurement data from official development assistance projects, explores the impact of joint bidding on the equilibrium bid function in three infrastructure sectors. It is shown that in a few segments a particular type of bidding coalition would be strongly pro-competitive, whence curbing project procurement costs.

The OECD Development Assistance Committee (DAC) member countries are spending about 12 billion U.S. dollars for assisting infrastructure development in developing countries every year. But this is far below the estimated financial requirements—such as 470 billion U.S. dollars by Fay and Yepes (2003), and about 360 billion U.S. dollars by our companion paper (Estache and Iimi, 2008).[1] Hence, it is essential to utilize the available aid resources more effectively and most efficiently (Iimi, 2006). It is indicated that to take full advantage of the positive competition effect, at least seven firms are required in the road and water sectors, and perhaps a fewer bidders for electricity projects.

[1] The underlying assumptions and estimation methods for these figures are different. For instance, Fay and Yepes (2003) estimates the demand for infrastructure including electricity, water, roads, railways and telecommunications and assumes that the individual unit costs are constant. On the other hand, our companion paper focuses on only electricity, water and roads but accounts for the potential efficiency gains from enhanced procurement competition.

Joint bidding has a large potential to intensify competition in procurement auctions. For instance, road projects are normally labor-intensive and not technically complicated. Suppose that individual local firms cannot meet the experience and financial requirements to apply for public contracts solely. If joint bidding is instrumental in pooling their business resources, a simple policy recommendation would be to encourage joint bidding and invite more local consortia to the public procurement process. Indeed, Asia Development Bank's guideline encourages prospective firms to complement their resources, if necessary, through the prequalification process.[2] But this may not be the case when complex development projects are considered, such as large-scale construction of a hydropower station. If no alliance firm within a coalition retains key expertise, such joint bidding does not help to increase their capability of implementing such a project.

In theory, the predicted effects of joint bidding vary depending on assumptions. As summarized by Iimi (2004), the resource restriction view expects that joint bidding would reduce the barrier to entry and increase the number of participating bidders. Hendricks and Porter (1992) find that the most profitable format in oil and gas development projects is a joint venture of large and fringe bidders. The plausible reason is that oil developers have to pool their financial and technical resources with each other to deal with a great risk involved and at the same time local information is important for successful discovery.

However, if firms are allowed to form bidding coalitions freely, the marginal impact of joint bidding may be nonexistent in equilibrium. This is referred to as the contestability view. Moreover, it is questionable why firms are motivated to make a coalition, because firms know their underlying private information—formally so-called signal. It means that if the resource restraint view holds, everyone knows that firms who are looking for coalitional

[2] *Prequalification of Bidders User's Guidelines* state that "[t]he [prequalification] process enable prospective bidders, who may be insufficiently qualified on their own, to avoid the expense, or to form a joint venture that may give a better chance of success." Moreover, "[prequalification] encourages local firms to form joint ventures with other local or international firms, thereby benefiting from their resources and experience" (ADB, 2006).

partners have unfavorable cost parameters. Hence, no bidding coalition could be agreed on. The situation resembles the famous “lemon market.”

Krishna and Morgan (1997) shows that in the common value paradigm, joint bidding could enhance competition. The idea is that bidders who are randomly assigned to bidding groups are supposed to obtain a more correct estimate of the true value, whence submitting more aggressive bids. In this regard, there must be a tradeoff between the benefit from informational aggregation and the reduction in competition. Under experimental circumstances, conversely, Mares and Shor (2008) demonstrate that the former is dominated by the latter. The bid price would increase—in our public procurement context—because of less competition. Cho *et al*. (2002), modeling an endogenous mechanism for potential bidders to decide to form joint consortia, suggests that they would likely divide themselves into two coalitions, but not a grand collation. This is a non-cooperative equilibrium. However, this spontaneous formation of joint ventures is practically indistinguishable from tacit collusion. The collusive bidding behavior aimed at reducing competition is surely anti-competitive (Bailey, 2007; Ware, *et al*., 2007).[3]

There are a few empirical efforts to quantify the effect of consortia bidding practices. Hendricks and Porter (1992) is supportive of the positive joint bidding effect as mentioned above. Moody and Kruvant (1988) also finds the positive net effect of joint bidding on offshore continental shelf (OCS) oil and gas lease prices, meaning that it encourages more participation and increases the government revenue. In large-scale ODA projects, local joint bidding seems particularly pro-competitive (Iimi, 2004).

An important issue ignored in the existing literature is that the motivation and effect of coalitional bidding behavior might be different across sectors. In technically difficult and large-scale public works, the effect of consortia bidding behavior is likely to be positive from

[3] As mentioned by Bailey (2007), “it can be difficult to distinguish anticompetitive bidding behavior from competitively neutral bidding behavior without a smoking gun.” Having said that, she proposes to account for the relevant factors that affect bid prices and identify a competitive benchmark in order to quantify the competitive effect of joint bidding.

the risk sharing point of view. Under different circumstances, however, the joint bidding strategy may be motivated for different reasons or not be motivated at all. For example, firms do not have to rely on joint bidding for simple road procurements. But if it is a high grade highway contract, they may prefer to collaborate with one another. By collecting data with detailed project-specific information from various infrastructure projects, the paper attempts to quantify the joint bidding effect separately in each of the three infrastructure sectors: roads, water and sewage, and electricity projects.

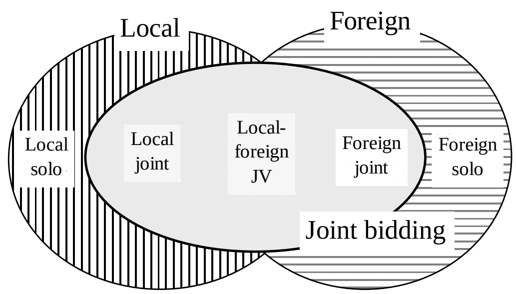
The remaining sections are organized as follows: Section II provides the overview of joint bidding practices in our sample auctions. Section III briefly presents the empirical model and several important econometric issues. Section IV discusses the estimation results and policy implications.

II. DATA

In practice, there are a large variety of coalitional forms in auctions in terms of who collaborates with whom, and why. In the context of public procurement for official development projects, the classification into local and foreign bidders is of particular interest. This is because they have different advantage and disadvantage and thus have different interest and motivation in adopting the joint bidding strategy. Local firms in developing countries may be crucially faced with lack of financial, technical and experiential capability for large development projects. However, they may have the advantage of proximity to local input and labor markets. They are also familiar with local administration and regulation. On the other hand, foreign firms, typically multinational enterprises, may have a considerable accumulation of development experience and an abundance of human and financial resources. But their labor costs are usually significantly high compared with local firms.

Based on this classification, there are five types of coalitional bidding (Figure 1). First, a local firm can solely participate in an auction. Second, local firms can collaborate with each other. Third, a local firm can also make a consortium with foreign firm(s). Fourth, it is possible that more than one foreign bidder submit a joint bid together. Finally, a foreign bidder may choose to participate in an auction alone.

Figure 1. Classification of Joint Bidding



Source: Author's illustration.

Our data on procurement auctions are collected from ODA-related infrastructure projects assisted by the Japanese Government and the World Bank. It contains 221 public contracts for road, water and sewage, and electricity projects in 29 developing countries. In 221 auctions, 862 firms and bidding consortia are identified（see Estache and Iimi (2008) for details).

These firms and consortia were composed by 1,656 individual firms.[4] Local firms who participated—either solely or jointly—in the procurement process amount to 60 percent in the road sector (Table 1). In the water and sewage sector the share of local firms reaches as much as 75 percent. By contrast, foreign firms are much dominant in the electricity sector; about 70 percent of bidders come from abroad.

The probability of a firm making a bidding coalition is highest in electricity projects and lowest in road procurements. Half of firms choose to jointly bid in the former sector. The

[4] If a firm participates in more than one auction, they are double counted. We accounted for different names of a single firm in our sample data, but only at the primary level, meaning that it is accounted for if they are clearly the same company (e.g., misspelling and abbreviation) or if a local firm clearly represents its parent company. However, we have *not* taken into account the potential capital relationships between firms because of technical difficulties. It is also ignored the possibility that some firms are intended to be subcontracted performance of part of the work by other firms.

probability of joint bidding is 37 percent in the latter. In the water sector about 44 percent of firms participated jointly in bidding processes. These shares look lower than those in the existing literature. Moody and Kruvant (1988) and Hoffman *et al*. (1991) report that the share of bidders following consortia bidding practices in the OCS oil and gas lease auctions is about 55–60 percent. This must be attributable to the nature of our sample projects. The majority of road procurements and some of water and sewerage projects are presumably not so complicated that firms could sorely enter the competition.

Not surprisingly, the majority of bidding coalitions are composed of only local firms in the road and water sectors—14 percent and 24 percent of total firms, respectively. To the contrary, in electricity projects, the likelihood of local firms collaborating with each other is minimal at less than 4 percent, while foreign firms' collaboration accounts for 33 percent in the case of electricity project contracts. Most interestingly, the probability of a firm forming a consortium composed of both local and foreign companies is equally about 14 percent across sectors.

These figures can be interpreted as follows: Local firms have relative advantage in road projects, because of their relatively high labor-intensity and relatively low skill requirements. But they may still need to pool their financial and managerial resources for obtaining road contracts. The same story can be applied to the water sector. On the other hand, electricity projects seem characteristic, requiring high technical experiences from firms. Local firms cannot meet those requirements easily. If local enterprises dare participate in competition, they are highly likely to form a bidding consortium with a probability of two third (i.e., 18.2 over 31.9). This figure is higher than the other two sectors (about half). Even foreign firms tend to rely on joint bidding in this area. Approximately 70 percent of them select to jointly bid for a contract. As a result, without doubt the degree of competition in electricity project auctions tends to be very limited.

Table 1. Probability of Joint Bidding Practices at Firm Level

	Roads		Water		Electricity	
	Obs.	Share	Obs.	Share	Obs.	Share
Local firm	778	60.0	546	74.9	313	31.9
Foreign firm	778	40.0	565	24.2	313	68.1
Forming joint bidding	778	36.8	565	43.5	313	50.8
Including local firm(s)	778	28.7	565	37.5	313	18.2
Including foreign firm(s)	778	22.4	565	19.8	313	47.0
All local firms	778	14.4	565	23.7	313	3.8
All foreign firms	778	8.1	565	6.0	313	32.6
Both local and foreign firms	778	14.3	565	13.8	313	14.4

Source: Author's calculation.

Table 2 shows the similar summary statistics of joint bidding practices but at the bidder level. In this table, there is no double count. About 70–80 percent of bidders include at least one local firm in procurement auctions for road and water projects. Only 35 percent of bidders involve local firm(s) in the electricity sector. Joint consortia commonly account for about 25–30 percent of total bidders. The shares of coalitions composed of both local and foreign companies are also not so different between sectors, ranging from 6.5 percent to 9 percent.

Table 2. Joint Bidding Practices at Bidder Level

	Roads		Water		Electricity	
	Obs.	Share	Obs.	Share	Obs.	Share
Including local firm(s)	394	70.3	329	79.6	139	35.3
Including foreign firm(s)	394	37.6	329	29.2	139	71.2
Joint bidding	394	23.4	329	25.8	139	31.7
Including local firm(s)	394	19.5	329	21.9	139	9.4
Including foreign firm(s)	394	11.7	329	12.8	139	28.8
All local firms	394	11.7	329	13.1	139	2.9
All foreign firms	394	3.8	329	4.0	139	22.3
Both local and foreign firms	394	7.9	329	8.8	139	6.5

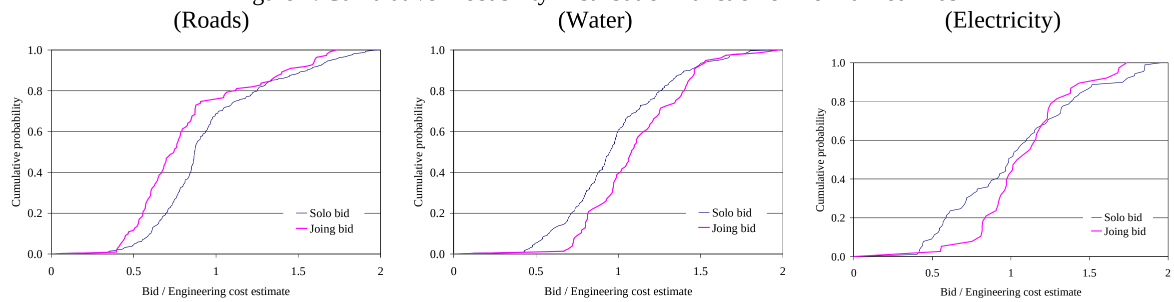
Source: Author's calculation.

In connection with submitted bids, joint bidders tend to submit lower bids on average in road procurements, but higher in the water sector. Figure 2 depicts the cumulative distribution functions of solo and joint bids relative to the engineering cost estimate.[5] In the road sector, the probability function of joint bids is dominant over that of solo bids. Regardless of solo or joint bids, the majority of bids are lower than the cost estimate; that is, the normalized bids are less than unity. In water-related auctions, solo bids tend to lower in general. The distribution is more centered on the unity. For electricity projects, neither solo bids nor joint bids are dominant. Normalized solo bids appear to be distributed widely with long tails. On

[5] Some outliers are excluded from the figures.

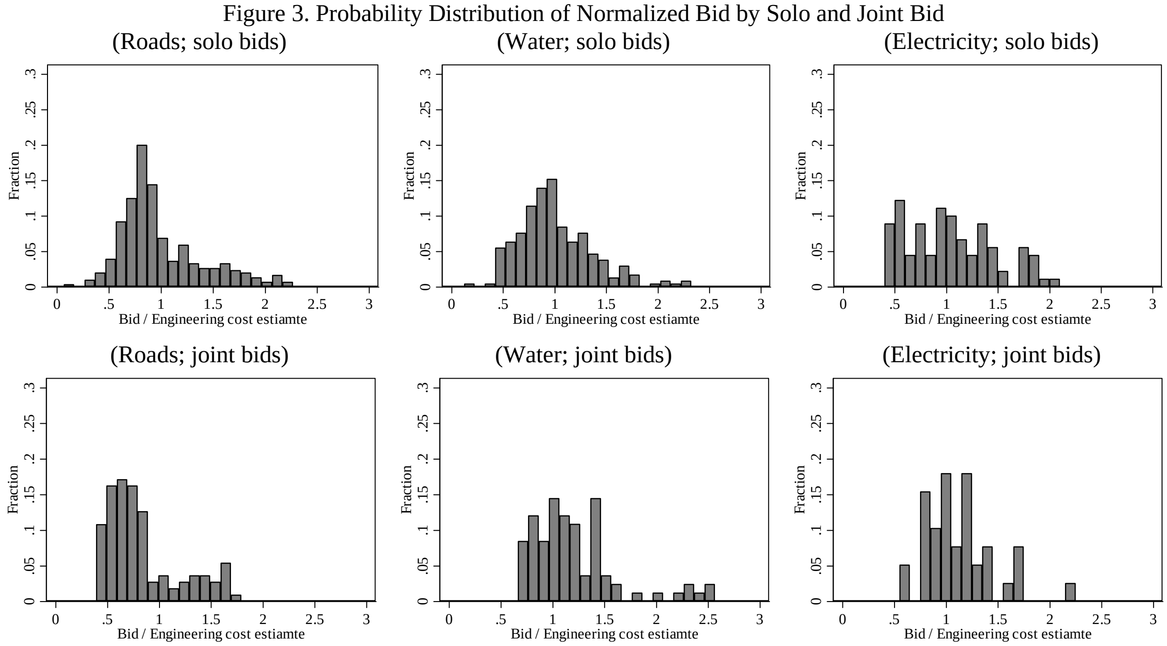
the other hand, the cumulative probability distribution of joint bids is highly concentrated on about one.[6] Figure 3 reflects different presentations of the relationship between normalized bids and joint bidding practices.

Figure 2. Cumulative Probability Distribution Function of Normalized Bids



Source: Author’s calculation.

Figure 3. Probability Distribution of Normalized Bid by Solo and Joint Bid



Source: Author’s calculation.

With relation to contract awards, joint bidding might increase the average probability of winning a contract in the water and electricity projects. Figure 4 reflects the statistics of joint bidding practices—but for winning and losing bidders separately. In the water sector 33 percent of winners are joint bidders; this is much higher than the share of joint bidders among

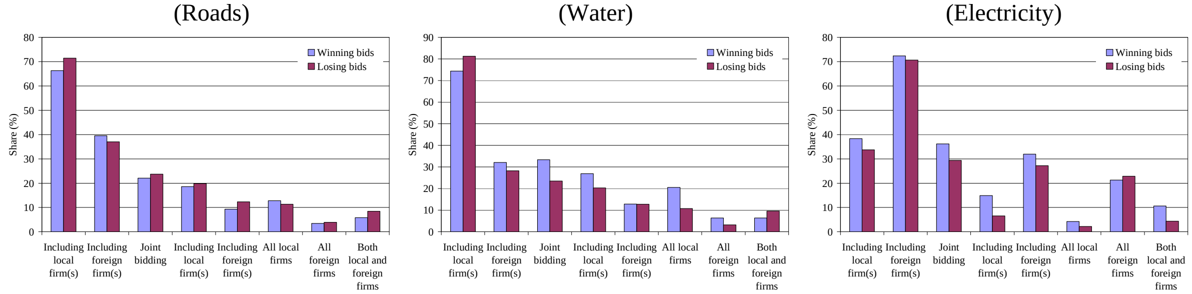
[6] The figure discards observations if normalized bids are above two.

losing firms (23 percent). Similarly, in electricity projects winners are more likely to form a bidding coalition than losing bidders. In road auctions, winning and losing bidders are equally likely to adopt the joint bidding strategy, meaning that such practices do not appear crucial—at least on a simple comparison basis.

These findings may look contradictory with to the above; for example, joint bidders in water project procurements submit less aggressive bids but they seem more successful. This suggests that besides engineering cost estimates, there must be omitted factors that are important to determine auction outcomes, such as the degree of competition. Moreover, the composition of firms constituting a joint venture may matter. In the water sector, joint bidding including local firms is considered particularly effective in Figure 4; 20 percent of winners use a form of purely local joint venture. Only 10 percent of losing bidders use this type of coalition. In the case of electricity projects, coalitional bidding by local and foreign companies exhibits a sharp contrast with the other two sectors; while 10.6 percent of awarded contractors in this area are constituted by local and foreign firms together, the share of this type of bidding format among losers amounts to only 4 percent.

Figure 4. Joint Bidding Practices by Winning and Losing Bidders

(Roads) (Water) (Electricity)



Source: Author’s calculation.

Is there any systematic difference in joint bidding behavior across project locations (countries)? There are a number of interesting findings. For infrastructure projects implemented in China, most firms have local legislation and participate solely in the bidding process (Table 3). In the road sector, the likelihood of firms’ jointly bidding is merely 6.9 percent. Foreign bidders are inactive in China’s road procurements. In other selected countries, such as Ethiopia and the Philippines, however, foreign firms may be dominant.

They do not normally form a bidding consortium for road projects. Notably, however, if they prefer to jointly bid—whatever the reason is—foreign firms tend to collaborate with each other in Ethiopian projects. In the Philippines, conversely, they seem to seek for opportunities to form an alliance with local firms.

In the water and sewage sector, local firms are predominant in most countries. In China, a small number of foreign firms are involved in the bidding process. The share of joint bidders varies from country to country. Firms following joint bidding behavior in Chinese projects amount to 30 percent. A third of the foreign bidders chose to team up with local partners. Local firms also collaborate with one another. In Thailand, the joint bidding share is the same as China but with more observations of joint ventures between domestic and foreign companies. In Mexico, it is common that local firms form bidding consortia with each other to secure public contracts.

In our sample, foreign firms are predominant in public procurements for electricity projects. Even in China, about 30 percent of applicants come from abroad; this is the highest presence of foreign firms among the three sectors in China. Moreover, about 70–80 percent of them adopt the consortium bidding strategy, except for several countries including China. It is not unusual for foreign firms to collaborate with each other in this sector. But it is rare that they cooperate with local firms.

Table 3. Probability of Joint Bidding at Firm Level in Selected Countries

	Roads			Water			Electricity		
	China	Ethiopia	Philippines	China	Mexico	Thailand	China	Kenya	Viet Nam
(No. of firms =	144	34	88	156	106	77	85	26	64)
Local firm	99.3	17.6	26.1	89.7	91.5	67.5	72.9	0.0	10.9
Foreign firm	0.7	82.4	73.9	10.3	8.5	32.5	27.1	100.0	89.1
Forming joint bidding	6.9	17.6	22.7	30.1	97.2	29.9	18.8	69.2	84.4
Including local firm(s)	6.9	0.0	13.6	27.6	95.3	29.9	14.1	0.0	17.2
Including foreign firm(s)	0.0	17.6	20.5	12.8	17.9	26.0	7.1	69.2	81.3
All local firms	6.9	0.0	2.3	17.3	79.2	3.9	11.8	0.0	3.1
All foreign firms	0.0	17.6	9.1	2.6	1.9	0.0	4.7	69.2	67.2
Both local and foreign firms	0.0	0.0	11.4	10.3	16.0	26.0	2.4	0.0	14.1

Source: Author's calculation.

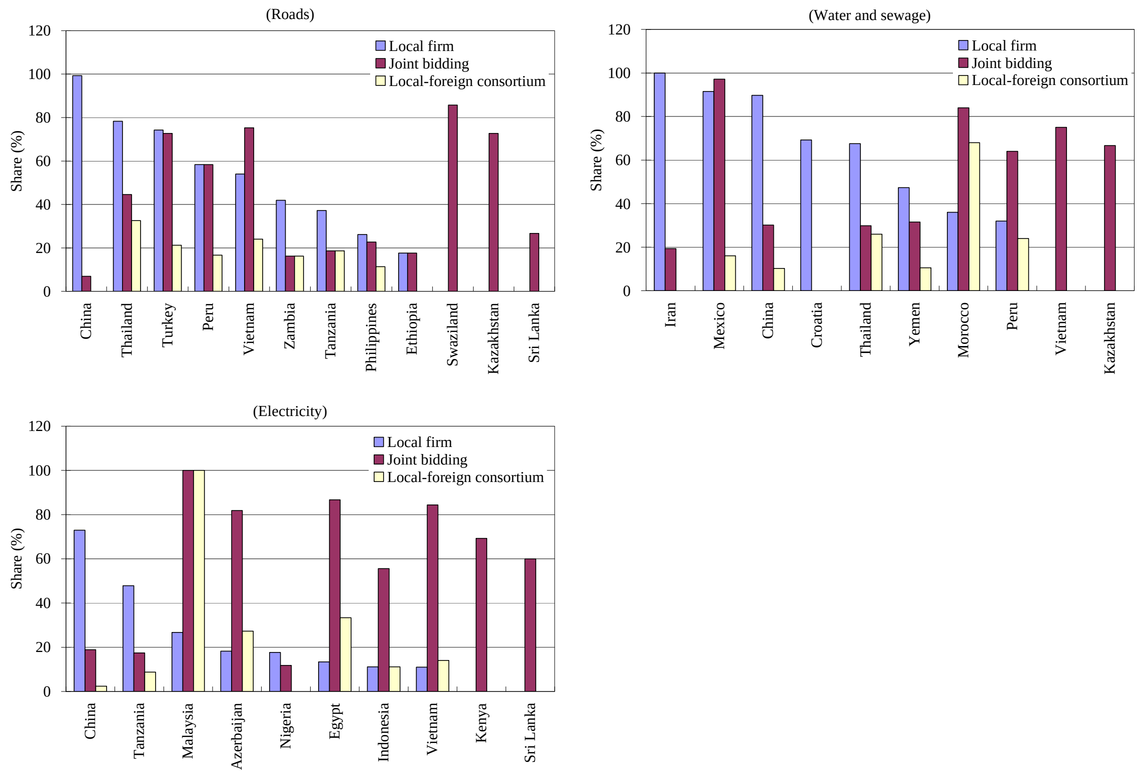
It is worth noting that our sample is *not* free of sample selection bias. Our data are by no means comprehensive in terms of country coverage. However, one might be able to agree on the following stylized facts: First, Chinese firms are mostly stand-alone, possibly because they are competitive enough and do not need to pool their resources with rival firms. As the result, the public procurement process in China and anywhere Chinese firms are active is considered much competitive.

Second, joint bidding seems to compensate for lack of mature local firms to a certain extent (Figure 5). Where the local participation rates are low, the share of firms who rely on joint bidding is relatively high. This is consistent with the resource restriction hypothesis.

Related to this, third, foreign bidders are playing an important role in ODA procurements, in particular in the electricity sector. Conversely, the presence of local firms is marked in the water and sewage sector. At the same time, there seem to be many opportunities for local and foreign companies to work together in this area. In road procurements, the importance of joint bidding practices is moderate.

Fourth, joint bidding by local and foreign firms seems to necessitate developed local business environment. Not surprisingly, without reliable local partners, no local-foreign collaboration would take place. In African countries, foreign bidders tend to be predominant in all sectors—as far as our sample data are concerned. In addition, foreign firms are rarely collaborating with local firms. Africa’s relatively high infrastructure development costs might be attributed to these backgrounds. Premature local business environment could be one of the important barriers to facilitate joint bidding, whence augment competition and reduce project costs.

Figure 5. Joint Bidding Practices by Sector



Source: Author’s calculation.

III. The Empirical Model

Our discussion in the previous section presents the trends of joint bidding practices and provides the insight that different bidding options have the relative advantage in different sectors. However, it is informal in the sense that the key question of whether such bidding behavior would affect auction efficiency is not really addressed. The following analysis formally investigates into the effect of joint bidding on the equilibrium bid function with project-specific characteristics controlled. Based on the conventional empirical auction literature (e.g., Porter and Zona, 1993; Gupta, 2002; Iimi, 2004; 2006), the following symmetric bid function is estimated:

$$b_{it} = \alpha JBID_{it} + X'_t \beta + Z'_i \gamma + \delta \ln N_t + \varepsilon_{it}$$

where b_{it} is *i*'s bid amount at auction *t*. The dependent variable is the bid amount of all bidders, i.e., both winning and losing bidders.[7] *N* is the number of bidders who participate in an auction, which is supposed to capture the competition effect. X_t is a vector of observable characteristics of individual contracts, such as engineering cost estimate, contract duration and other sector-specific technical attributes. To control bidder heterogeneity, the dummy variables for bidder nationalities are included in Z_i. $JBID_{it}$ is a binary variable for a particular form of joint bidding. Note that unlike the self-selection model, we observe both solo and joint bids, regardless of selection of joint bidding, i.e., $JBID_{it}$.

As pointed out by Moody and Kruvant (1988) and Iimi (2004), an important empirical issue is that the above equilibrium bid equation involves crucial endogeneity associated with bidders' joint bidding choice. One can expect that individual firms with low efficiency—or high cost parameters—would be more likely to form a bidding coalition if the resource constraint hypothesis is true. If the hypothesis holds only partly, perhaps they are still unlikely to win the contract. Obviously, such underlying cost preferences are private information. In our model, a bidder-specific observable is only their nationalities. Accordingly, the error term in the bid equation and the error term in the joint bidding decision may be correlated positively.

However, one might think conversely. High cost firms would be likely to be faced with great difficulties to find a bidding partner, because only inefficient firms are looking for opportunities to collaborate with someone else; no one desires to make a coalition with those who are unlikely to contribute to competitiveness improvement. If this is the case, weak bidders are less likely to engage in coalitional bidding and win the object, whence relating the two error terms to each other negatively. In the least squares method, the positive and negative correlations will translate into under- and over-estimation (in negative terms) of the true joint bidding effect, respectively.

[7] Losing bids are as informative as winning bids in estimating the equilibrium bid function, because he ODA-related procurement process normally relies on a first-price sealed-bid auction format.

To take this endogeneity problem into account, the treatment effect model is employed:[8]

$$JBID_{it} = \begin{cases} 1 & \text{if } JBID_{it}^{*} = W'_t\,\theta + u_{it} \geq 0 \\ 0 & \text{otherwise} \end{cases}$$

It is assumed that individual firms decide whether or not to make a bidding coalition, depending on project characteristics and their past award experience in relevant ODA projects. The underlying hypothesis is that firms would be more likely to be induced to cooperate with other companies if the size of contract is large. If a contract requires advanced technologies, the incentive to form a consortium with experienced multinational enterprises may be strong. These conditions are supposed to be captured by our engineering cost estimate and contract duration variables. On the other hand, the public procurement standard for infrastructure projects normally requires applicants to have had the similar type of work experience in the past. Hence, in theory, the total number of contracts awarded to each firm or consortium could be another explanatory variable in the joint bidding decision equation.[9]

The ordinary least squares (OLS) estimator would potentially generate a biased estimate, unless there is no significant correlation between the two error terms in the equations, u_{it} and ε_{it}, of which the covariance is defined as ρ. This is because the OLS coefficient captures the following unconditional effect of joint bidding:

$$E[b_{it} \mid JBID = 1] - E[b_{it} \mid JBID = 0] = \alpha + \rho\sigma_u \frac{\phi(W'_t\,\theta)}{[1 - \Phi(W'_t\,\theta)]\Phi(W'_t\,\theta)}$$

[8] Our case is exactly the same as the traditional self-selection bias problem associated with college education (see, for example, Greene, 1997). Consider an earning equation, which includes the dummy variable for college education. The OLS estimator must be biased, because this choice of going to college is dependent on the individual's unobservable abilities, which also affect their current earnings.

[9] To avoid the small sample problem, we calculate the number of contracts obtained by each entity using the data before the year of 2002, which account for roughly 20 percent of our sample. For the same reason, in addition, we assume that this variable is exogenously given and applicable to the entire sample. Notably, our sample covers a fairly short period.

Of particular note, if the estimated covariance ρ is not significantly different from zero, then the OLS provides an unbiased estimate of α. $\Phi(\bullet)$ and $\phi(\bullet)$ are the standard normal cumulative and density distributions, respectively.

Moreover, it is worth noting that the decision of joint bidding may potentially be endogenous but irrelevant to the number of bidders N, which is introduced to measure the conventional competition effect. In our setting, N is assumed to be given. Hence, in some sense, our analysis will be partial, because the dynamics may not be taken into consideration between the reducing effect of several firms' making a coalition on competition and the increasing competition effect of more firms' participating by joint bidding.

As discussed above, we examine six types of bidding consortia: (i) joint bidding (regardless of local or foreign), (ii) joint venture including at least one local firm, (iii) joint venture composed of only local firms, (iv) joint bidding including at least one foreign firm, (v) joint venture composed of only foreign companies, and (vi) coalitional bidding by local and foreign firms.

IV. Estimation Results and Discussion

First, the ordinary least squares (OLS) models are performed. Table 4 shows the results for road procurement auctions. It reveals that competition reduces the expected procurement price, since the coefficient associated with the number of bidders is significant and negative. This is one of the main findings in our companion paper (Estache and Iimi, 2008). Other implications are deferred to it.

Regarding the joint bidding effect, there is no strong evidence that joint bidding practices are pro-competitive, except for a few cases. In the road sector the coefficient associated with *JBID* is estimated at 3.01 with a 10 percent level significance, implying that joint bidding may be anticompetitive.[10] Especially if foreign firms rely on consortium bidding among themselves, their bids are likely to be much higher (than the baseline). Conversely, joint bidding involving local and foreign companies looks pro-competitive. The coefficient is estimated at -6.83. Moreover, the seventh column model with multiple joint bidding variables reveals the fact that local firms have the cost advantage in road procurements but joint bidding is not always a good option. If it involves at least one local firm, joint bidding is pro-competitive. When it is also composed of foreign firms, additional competitiveness could be realized.

A statistical concern is endogeneity associated with the joint bidding decision. To deal with this problem, the treatment effect models are performed. The first stage regressions are generally satisfactory in all sectors. Not surprisingly, the joint bidding strategy is motivated by the size of contract. As the engineering cost estimate increases, the probability of a firm bidding jointly—regardless of coalition types—tends to increase. To a lesser extent the probability of joint bidding increases with expected contract duration. In many cases, moreover, experienced firms with one or more awarded contracts in the past are prone to relying on joint bidding practices. This may be counterintuitive from the point of view of the resource restraint hypothesis. Rather, it is consistent with the "lemon market" view. This can be interpreted to mean that inexperienced firms are faced with a typical adverse selection problem, failing to find joint bidding partners.

The second stage results are shown in Table 5. It has been found that the OLS estimates were upwards biased, since the estimated covariance ρ is positive.[11] But the inferred bias may not be so serious; ρ is not statistically different from zero. It is confirmed that only the local and foreign collaboration is pro-competitive. Joint bidding involving only foreign companies

[10] Recall that this is consistent with the fact that joint bidding practices are relatively rare in road procurements (Figure 2).

[11] This means that the joint bidding effect estimated by OLS is underestimated. Recall that the true effect α is presumably negative if it is pro-competitive.

would lose competitiveness at auctions. The anti-competitive effect of general joint bidding turns out insignificant.

Interestingly, there is no evidence supportive of the prior expectation that bidding alliance among local firms would help to pool their resources and facilitate local procurement. The results can be understood to mean that joint bidding formed by only local companies is not effective enough, compared with solo bidding. Individual local firms can contract to implement relatively simple road development works. However, if they are faced with the needs to pool their resources, local joint ventures do not help much; something that no domestic firm can meet easily is missing. Local firms can depend on foreign enterprises for their financial, managerial and technical capabilities. On the other hand, foreign firms cannot be competitive enough by themselves, presumably because of their high operating costs.

Table 4. OLS Estimation: Road Sector

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Local bid	-43.01 **	-45.52 **	-43.65 **	-42.88 **	-53.59 ***	-36.18 **	-36.07 **	
	(18.26)	(18.36)	(18.39)	(18.34)	(18.31)	(18.27)	(17.33)	
Foreign bid	-6.83 **	-8.61 ***	-7.25 **	-6.49 **	-17.70 ***			36.07 **
	(2.69)	(3.13)	(2.86)	(2.80)	(6.29)			(17.33)
Joint bid		3.01 *					10.46 **	0.68
		(1.72)					(4.59)	(1.77)
Joint bid inc. local firm(s)			0.77				-9.77 *	
			(1.76)				(5.01)	
Local joint bid				0.77				
				(1.76)				
Joint bid inc. foreign firm(s)					10.47 ***			9.77 *
					(4.58)			(5.01)
Local foreign joint bid						-6.83 ***	-7.61 ***	-53.45 ***
						(2.69)	(2.96)	(18.39)
ln(*N*)	-4.70 ***	-4.88 ***	-4.74 ***	-4.74 ***	-4.69 ***	-4.70 ***	-4.73 ***	-4.73 ***
	(0.88)	(0.90)	(0.89)	(0.89)	(0.88)	(0.88)	(0.89)	(0.89)
Lot length (km)	0.06	0.07	0.06	0.06	0.06	0.06	0.06	0.06
	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)
Lot length^2 (km) 1/	-0.20	-0.22	-0.20	-0.20	-0.23	-0.20	-0.23	-0.23
	(0.31)	(0.30)	(0.31)	(0.31)	(0.29)	(0.31)	(0.29)	(0.29)
Lane	12.70 ***	13.15 ***	12.85 ***	12.85 ***	12.27 ***	12.70 ***	12.40 ***	12.40 ***
	(1.94)	(2.00)	(1.97)	(1.97)	(1.88)	(1.94)	(1.91)	(1.91)
Lane^2	-1.12 ***	-1.15 ***	-1.13 ***	-1.13 ***	-1.08 ***	-1.12 ***	-1.09 ***	-1.09 ***
	(0.18)	(0.18)	(0.18)	(0.18)	(0.17)	(0.18)	(0.17)	(0.17)
New roads	2.81	2.89	2.85	2.85	2.50	2.81	2.54	2.54
	(2.68)	(2.68)	(2.69)	(2.69)	(2.61)	(2.68)	(2.62)	(2.62)
Rehabilitation	0.89	0.54	0.82	0.82	0.60	0.89	0.54	0.54
	(1.93)	(1.98)	(1.94)	(1.94)	(1.91)	(1.93)	(1.92)	(1.92)
Engineering cost	0.54 ***	0.53 ***	0.54 ***	0.54 ***	0.52 ***	0.54 ***	0.52 ***	0.52 ***
	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)
Contract duration	-0.33 ***	-0.33 ***	-0.34 ***	-0.34 ***	-0.30 ***	-0.33 ***	-0.31 ***	-0.31 ***
	(0.08)	(0.08)	(0.08)	(0.08)	(0.08)	(0.08)	(0.08)	(0.08)
Donor 1	27.55	28.25	27.66	27.66	28.50 *	27.55	28.60 *	28.60 *
	(18.30)	(18.28)	(18.38)	(18.38)	(17.42)	(18.30)	(17.49)	(17.49)
Constant	9.62 **	10.25 **	9.94 **	9.17 *	18.01 ***	2.80	0.21	-35.86 **
	(4.61)	(4.61)	(4.70)	(4.69)	(6.16)	(4.31)	(4.59)	(17.74)
Obs.	394	394	394	394	394	394	394	394
R-squared	0.940	0.940	0.940	0.940	0.942	0.940	0.942	0.942

1/ For presentation purposes, the coefficients are multiplied by 1,000.

Note: The dependent variable is the bidding amount. The robust standard errors are shown in parentheses. *, ** and *** indicate the 10%, 5% and 1% significance levels, respectively.

Source: Author's calculation.

Table 5. Treatment Effect Model: Road Sector

	(1)	(2)	(3)	(4)	(5)
Local bid	-45.62 ***	-43.75 **	-42.90 **	-53.59 ***	-36.21 **
	(17.30)	(17.33)	(17.30)	(17.28)	(17.25)
Foreign bid	-8.64 ***	-7.29 ***	-6.49 **	-17.70 ***	
	(2.95)	(2.69)	(2.64)	(5.94)	
Joint bid	1.98				
	(2.22)				
Joint bid inc. local firm(s)		-0.42			
		(2.10)			
Local joint bid			0.07		
			(2.18)		
Joint bid inc. foreign firm(s)				10.40 **	
				(4.46)	
Local foreign joint bid					-7.76 ***
					(2.78)
ln(N)	-4.90 ***	-4.77 ***	-4.74 ***	-4.69 ***	-4.72 ***
	(0.85)	(0.84)	(0.84)	(0.83)	(0.84)
Lot length (km)	0.07	0.07	0.06	0.06	0.06
	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)
Lot length^2 (km) 1/	-0.22	-0.21	-0.20	-0.23	-0.20
	(0.29)	(0.29)	(0.29)	(0.28)	(0.29)
Lane	13.22 ***	12.94 ***	12.86 ***	12.27 ***	12.74 ***
	(1.90)	(1.87)	(1.86)	(1.78)	(1.84)
Lane^2	-1.16 ***	-1.14 ***	-1.13 ***	-1.08 ***	-1.12 ***
	(0.17)	(0.17)	(0.17)	(0.16)	(0.17)
New roads	2.89	2.86	2.86	2.50	2.80
	(2.53)	(2.54)	(2.54)	(2.46)	(2.53)
Rehabilitation	0.52	0.80	0.82	0.59	0.87
	(1.86)	(1.83)	(1.83)	(1.80)	(1.83)
Engineering cost	0.53 ***	0.54 ***	0.54 ***	0.52 ***	0.54 ***
	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)
Contract duration	-0.34 ***	-0.34 ***	-0.34 ***	-0.30 ***	-0.34 ***
	(0.08)	(0.08)	(0.08)	(0.08)	(0.08)
Donor 1	28.23 *	27.61	27.64	28.50 *	27.53
	(17.24)	(17.32)	(17.34)	(16.44)	(17.28)
Constant	10.29 **	9.91 **	9.13 **	18.02 ***	2.82
	(4.35)	(4.43)	(4.43)	(5.81)	(4.07)
Obs.	394	394	394	394	394
Wald chi2	10912.0	11981.3	12736.0	10904.8	12221.5
ρ	0.09	0.10	0.05	0.01	0.07
	(0.10)	(0.08)	(0.06)	(0.06)	(0.07)
Wald test statistics:					
$\rho = 0$	0.72	1.58	0.76	0.01	1.06

1/ For presentation purposes, the coefficients are multiplied by 1,000.

Note: The dependent variable is the bidding amount. The robust standard errors are shown in parentheses. *, ** and *** indicate the 10%, 5% and 1% significance levels, respectively.

Source: Author's calculation.

Similarly, the OLS and treatment effect models are estimated for the water and sewage sector (Table 6). Again, local firms have the strong cost advantage in general. In this case, the OLS estimates are found downward biased. The null hypothesis that ρ is indifferent from zero can be rejected strongly, implying that in this sector, the joint bidding decision is systematically dependent on unobserved bidder and contract characteristics; the two error terms are negatively correlated with one another. This is not incompatible with the "lemon market" view. Suppose that firm's efficiency for—or ability of—implementing a water contract is not observed. Only truly efficient firms are able to form a bidding consortium and submit systematically low bids, whence generating a negative correlation between the two equations.

Based on the treatment effect models, joint bidding is found generally anti-competitive. Particularly, this is true when foreign firms are involved in a consortium. High costs of foreign firms cannot be accommodated even under the bidding alliance with local firms. The impact of local joint bidding is inconclusive. While the incremental impact of local joint bidding may be positive in the model with multiple bidding option dummies, the effect is almost offset by the negative general joint bidding effect.

In electricity projects, there is no reliable evidence as to the joint bidding effect (Table 7).[12] Of particular note, the coefficients of local and foreign bidders are positive and negative, respectively, though both are statistically insignificant. Unlike the other two sectors, this may indicate that despite high cost parameters of foreign companies, they would have the comparative advantage against local firm in this area, because of advanced technical requirements. In our results, however, it is still debatable what the best bidding coalition is. Since there is no evident conclusion about the empirical effect in this area, auctioneers should assess the appropriateness of joint bidding with great caution. Although it is not sure that joint bidding would lead to greater efficiency, it is sure that joint bidding reduces competitive pressures in the auctions.

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[12] Our results have been found broadly robust against selected independent variables, particularly country and nationality dummies, some of which have strong explanatory power. Even if these are excluded from our specifications, the main results are unchanged.

There are several alleged reasons for the failure to find significant joint bidding effects in the electricity sector. First of all, our data may be poor in this area. More precisely, despite largely heterogeneous contract components, few control variables are available. Second, there are in fact a small number of players in the procurement process for electricity projects (see Estache and Iimi (2008)). The average number of bidders per auction is 4.6, but the majority of auctions attracted only two or three firms. This implies that technologies required for these projects are unevenly distributed. Therefore, simply flocking together may not always help improve firms' competitiveness. Related to this, finally, even if joint bidding per se leads to aggressive bidding behavior, its direct impact on reduction in competition cannot be overlooked given that competition is already limited in this sector. The positive joint bidding effect may be offset by the adverse competition effect.[13]

[13] Our analysis does *not* address this dynamic interaction in connection with bidder's entry decision. The number of bidders is assumed fixed in our framework.

Table 6. OLS and Treatment Effect Models: Water and Sewage Sector

	OLS	OLS	OLS	OLS	OLS	OLS	OLS	TE 1/	TE 1/	TE 1/	TE 1/
Local bid	-12.78	-14.32	-12.88	-24.26 **	-20.60 ***	-15.76 **		-16.91 **	-11.82	-28.04 ***	-19.60 ***
	(9.17)	(9.27)	(9.52)	(9.65)	(6.95)	(6.68)		(6.73)	(10.10)	(6.85)	(6.39)
Foreign bid	7.81	6.14	7.74	-8.47			15.76 **	3.49	8.79	-13.82 *	
	(5.53)	(6.10)	(5.91)	(9.35)			(6.68)	(5.75)	(6.61)	(8.45)	
Joint bid		3.22				20.61 **	-0.16	13.91 ***			
		(2.22)				(8.60)	(1.38)	(4.14)			
Joint bid inc. local firm(s)			0.11			-20.77 **			4.76		
			(1.45)			(8.63)			(15.19)		
Joint bid inc. foreign firm(s)				20.60 **			20.77 **			32.65 ***	
				(8.59)			(8.63)			(8.50)	
Local foreign joint bid					7.81	12.25 **	-24.28 **				16.27 **
					(5.53)	(5.98)	(9.64)				(6.87)
ln(*N*)	-3.08 ***	-2.53 ***	-3.06 ***	-2.20 ***	-3.08 ***	-2.22 ***	-2.22 ***	-2.30 ***	-3.00 ***	-1.89 ***	-2.95 ***
	(0.82)	(0.85)	(0.83)	(0.81)	(0.82)	(0.83)	(0.83)	(0.83)	(0.78)	(0.70)	(0.73)
Water	1.43	1.50	1.43	2.88	1.43	2.88	2.88	1.95	1.73	3.49 *	1.37 **
	(2.15)	(2.11)	(2.15)	(2.31)	(2.15)	(2.32)	(2.32)	(1.90)	(2.56)	(2.10)	(1.99)
Treatment plant	-59.41 ***	-58.28 ***	-59.38 ***	-57.54 ***	-59.41 ***	-57.58 ***	-57.58 ***	-52.08 ***	-57.07 ***	-52.85 ***	-58.86 ***
	(13.68)	(13.58)	(13.59)	(12.53)	(13.68)	(12.47)	(12.47)	(12.48)	(14.12)	(10.25)	(12.02)
Network	-8.37 *	-8.03 *	-8.38 *	-4.48	-8.37 *	-4.47	-4.47	-3.99	-7.96	-2.88	-8.06 **
	(4.38)	(4.61)	(4.34)	(5.03)	(4.38)	(4.99)	(4.99)	(4.73)	(4.14)	(4.60)	(4.04)
ln(*Treatment capacity*)	5.36 ***	5.29 ***	5.36 ***	5.03 ***	5.36 ***	5.03 ***	5.03 ***	4.89 ***	5.21 ***	4.58 ***	5.30 ***
	(1.23)	(1.22)	(1.23)	(1.10)	(1.23)	(1.10)	(1.10)	(1.10)	(1.21)	(0.90)	(1.09)
ln(*Tunnel network length*)	0.47 ***	0.47 ***	0.47 ***	0.27 *	0.47 ***	0.27 *	0.27 *	0.34 **	0.45 ***	0.21	0.46 ***
	(0.14)	(0.14)	(0.14)	(0.16)	(0.14)	(0.16)	(0.16)	(0.13)	(0.14)	(0.16)	(0.13)
ln(*Iron pipe network length*)	0.79 ***	0.76 ***	0.80 ***	0.50 **	0.79 ***	0.50 **	0.50 **	0.61 ***	0.78 ***	0.36 *	0.76 ***
	(0.16)	(0.17)	(0.16)	(0.21)	(0.16)	(0.21)	(0.21)	(0.18)	(0.15)	(0.20)	(0.14)
Contract duration	0.10 *	0.11 *	0.10	0.08	0.10 *	0.08	0.08	0.12 *	0.10 *	0.08	0.12 **
	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)	(0.07)	(0.06)	(0.05)	(0.06)
Donor 1	230.11 ***	17.88 *	230.08 ***	5.06	230.11 ***	5.13	5.13	203.73 ***	227.07 ***	207.64 ***	1.84
	(14.77)	(9.34)	(14.94)	(12.01)	(14.77)	(12.19)	(12.19)	(28.00)	(20.05)	(17.44)	(7.37)
Constant	101.60 ***	102.41 ***	101.68 ***	111.61 ***	109.41 ***	103.14 ***	87.37 ***	84.66 ***	96.61 ***	101.25 ***	108.04 ***
	(18.80)	(19.23)	(19.21)	(19.59)	(19.06)	(18.42)	(20.32)	(17.73)	(23.13)	(17.39)	(16.96)
Obs.	329	329	329	329	329	329	329	329	329	329	329
R-squared	0.913	0.914	0.913	0.922	0.913	0.922	0.922				
ρ								-0.83 **	-0.41	-0.84 ***	-0.60 **
								(0.15)	(1.24)	(0.10)	(0.27)

1/ Estimated by the treatment effect model.

Note: The dependent variable is the bidding amount. The robust standard errors are shown in parentheses. *, ** and *** indicate the 10%, 5% and 1% significance levels, respectively.

Source: Author’s calculation.

Table 7. OLS and Treatment Effect Models: Electricity Sector

	OLS	OLS	OLS	OLS	OLS	OLS	OLS	TE 1/	TE 1/	TE 1/	TE 1/
Local bid	7.57	6.47	12.17	5.56	13.17	14.65		6.64	12.09	5.68	13.18
	(7.29)	(7.21)	(9.64)	(7.17)	(11.12)	(10.91)		(5.97)	(8.03)	(5.92)	(9.32)
Foreign bid	-5.60	-6.66	-1.93	-8.31			-14.65	-6.48	-2.04	-8.17	
	(10.07)	(9.56)	(11.29)	(9.33)			(10.91)	(7.96)	(9.40)	(7.77)	
Joint bid		2.31				3.80	-4.17	3.29			
		(4.49)				(5.25)	(5.66)	(4.21)			
Joint bid inc. local firm(s)			-4.73			-7.96			-3.53		
			(5.69)			(7.31)			(4.76)		
Joint bid inc. foreign firm(s)				3.96			7.96			4.65	
				(5.22)			(7.31)			(4.72)	
Local foreign joint bid					-5.60	-1.17	5.52				-4.50
					(10.07)	(11.67)	(7.17)				(8.48)
ln(*N*)	-14.28 **	-14.28 **	-14.44 **	-14.43 **	-14.28 **	-14.57 **	-14.57 **	-14.27 **	-14.43 **	-14.41 **	-14.27 **
	(6.79)	(6.85)	(6.80)	(6.82)	(6.79)	(6.84)	(6.84)	(5.71)	(5.67)	(5.68)	(5.69)
Turbine	11.05	10.19	11.63	10.07	11.05	10.63	10.63	10.18	11.64	10.06	11.06
	(9.05)	(9.18)	(9.32)	(8.99)	(9.05)	(9.28)	(9.28)	(7.65)	(7.77)	(7.49)	(7.59)
Trans. dist. lines	5.48	5.67	5.24	5.59	5.48	5.37	5.37	5.61	5.23	5.55	5.49
	(14.53)	(14.63)	(14.82)	(14.84)	(14.53)	(15.10)	(15.10)	(12.19)	(12.36)	(12.36)	(12.17)
Substation	14.08 **	13.54 **	14.43 **	13.44 **	14.08 **	13.78 **	13.78 **	13.56 **	14.41 ***	13.46 ***	14.06 ***
	(6.50)	(6.67)	(6.74)	(6.63)	(6.50)	(6.86)	(6.86)	(5.56)	(5.62)	(5.52)	(5.45)
Civil work	14.32 ***	14.59 ***	14.04 ***	14.56 ***	14.32 ***	14.31 ***	14.31 ***	14.64 ***	14.04 ***	14.59 ***	14.31 ***
	(3.57)	(3.52)	(3.60)	(3.54)	(3.57)	(3.55)	(3.55)	(2.94)	(3.00)	(2.95)	(3.00)
Installed capacity 2/	-43.07 ***	-42.54 ***	-43.78 ***	-42.76 ***	-43.07 ***	-43.40 ***	-43.40 ***	-42.48 ***	-43.74 ***	-42.71 ***	-43.03 ***
	(8.21)	(8.54)	(8.35)	(8.44)	(8.21)	(8.60)	(8.60)	(7.12)	(6.96)	(7.05)	(6.88)
Number of turbines	5.18 ***	5.15 ***	5.14 ***	5.10 ***	5.18 ***	5.07 ***	5.07 ***	5.15 ***	5.14 ***	5.10 ***	5.18 ***
	(1.73)	(1.73)	(1.75)	(1.74)	(1.73)	(1.76)	(1.76)	(1.45)	(1.46)	(1.45)	(1.45)
Trans. line voltage 2/	2.91	3.83	3.01	4.57	2.91	4.58	4.58	3.90	3.04	4.61	2.90
	(41.08)	(42.02)	(41.64)	(42.75)	(41.08)	(43.22)	(43.22)	(35.02)	(34.72)	(35.63)	(34.42)
Trans. line length 2/	-5.25	-5.38	-5.51	-5.68	-5.25	-5.88	-5.88	-5.44	-5.52	-5.72	-5.25
	(11.72)	(11.87)	(11.96)	(12.06)	(11.72)	(12.27)	(12.27)	(9.92)	(9.98)	(10.07)	(9.82)
Engineering cost	1.21 ***	1.21 ***	1.21 ***	1.21 ***	1.21 ***	1.21 ***	1.21 ***	1.21 ***	1.21 ***	1.21 ***	1.20 ***
	(0.10)	(0.10)	(0.10)	(0.10)	(0.10)	(0.10)	(0.10)	(0.08)	(0.08)	(0.08)	(0.08)
Contract duration	-0.78 ***	-0.76 ***	-0.80 ***	-0.76 ***	-0.78 ***	-0.77 ***	-0.77 ***	-0.76 ***	-0.80 ***	-0.76 ***	-0.79 ***
	(0.24)	(0.25)	(0.25)	(0.24)	(0.24)	(0.25)	(0.25)	(0.20)	(0.21)	(0.20)	(0.21)
Donor 1	42.76 ***	42.27 ***	43.71 ***	42.71 ***	42.76 ***	43.54 ***	43.54 ***	42.30 ***	43.70 ***	42.72 ***	42.73 ***
	(12.39)	(12.74)	(12.84)	(12.63)	(12.39)	(13.10)	(13.10)	(10.65)	(10.71)	(10.55)	(10.37)
Constant	47.39 ***	47.95 ***	44.17 **	49.61 ***	41.79 ***	41.71 ***	56.37 ***	47.64 ***	44.31 ***	49.39 ***	41.87 ***
	(17.46)	(17.63)	(18.91)	(17.55)	(13.93)	(14.04)	(17.50)	(14.66)	(15.76)	(14.57)	(11.67)
Obs.	139	139	139	139	139	139	139	139	139	139	139
R-squared	0.976	0.976	0.976	0.976	0.976	0.976	0.976				
ρ								-0.06	-0.05	-0.04	-0.05
								(0.13)	(0.04)	(0.11)	(0.04)

1/ Estimated by the treatment effect model.

2/ For presentation purposes, the coefficients are multiplied by 1,000.

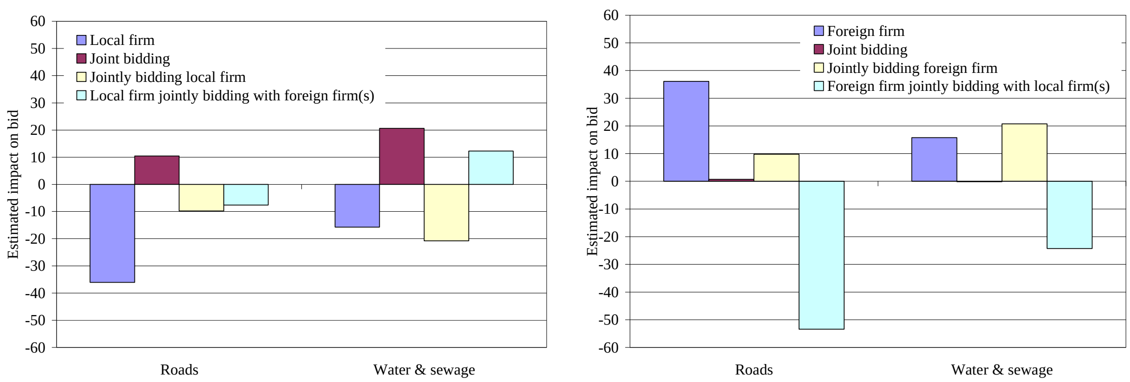
Note: The dependent variable is the bidding amount. The robust standard errors are shown in parentheses. *, ** and *** indicate the 10%, 5% and 1% significance levels, respectively.

Source: Author’s calculation.

To illustrate the way of thinking of the best bidding strategy, the OLS estimates involving multiple joint bidding variables are suggestive to represent where the potential competitive effect of joint bidding generates (Figure 6). In road procurements, local firms have the large cost advantage. If they prefer to form a joint bidding, some of this advantage would be lost. But if it is a coalition with other local firms, the cost advantage will be retained. In addition, if that coalition involves a foreign company, they would secure additional competitiveness. In the water sector, local firms also have the cost advantage, but not so large. Joint bidding will affect negatively. If it is a local consortium, then they could maintain their cost advantage. However, if it is a consortium between local and foreign firms, they would lose almost all cost advantage.

From the viewpoint of foreign firms, it is clear that they have the cost *dis*advantage. Joint bidding does not help much in both sectors. Even worse, it is costly to arrange a bidding coalition with other foreign firms. Only the way of improving their competitiveness is joint venture involving local enterprises. This would bring about sizable benefits, especially in road procurements.

Figure 6. Estimated Joint Bidding Effects



Source: Author’s calculation.

The policy implications are straightforward:

- Joint bidding practices are not always pro-competitive in infrastructure projects, except several cases. It means that auctioneers need to be cautious about amplified joint bidding practices in public procurement auctions. The JBIC procurement handbook stipulates that bidders are allowed to make a coalition after the prequalification process only if such joint bidding does not distort competition.[14] This type of competition policies needs to be emphasized once again.

- In road procurements, auctioneers should encourage local firms to collaborate with foreign companies and discourage foreign firms from making a bidding coalition with each other.
- In water projects, auctioneers may be able to expect the positive competition effect by encouraging local firms to collaborate with one another. But coalitional bidding involved only foreign companies would harm auction efficiency.
- The joint bidding effect remains far from conclusive in the electricity sector. This area is considered most difficult to manage, because competition is already limited and technical requirements are high. It is important to balance between the expected positive joint bidding effect and the adverse effect on reduction in competition.

V. Conclusion

Aid effectiveness depends on efficiency in public procurement. By increasing competition in procurement auctions for infrastructure projects, an abundance of aid resources are expected to be saved. Encouraging joint bidding practices are among the possible theoretical solutions to invite more bidders in an auction. Especially, if many local firms are prohibited from participating in the procurement process due to their individual resource limitations, joint bidding practices may be instrumental in pooling their resources with each other and actively competing for a public contract.

In theory, joint bidding potentially has both pro- and anti-competitive effects. It may enable firms to pool their resources and remove the barrier to entry. It may reduce the degree of

[14] This is one of the necessary conditions. Among other conditions, joint bidding shall be approved before the bidding stage. It is also required to be a voluntary decision by bidding firms.

competition. Still, one can expect that bidding consortia compete with one another intensively. Finally, joint bidding is indistinguishable from the collusive behavior.

The paper empirically addresses whether joint bidding is pro- or anti-competitive in ODA procurement auctions. It is found that in general there is no strong evidence that joint bidding practices are compatible with competition, except for a few cases. In road procurements, coalitional bidding involving both local and foreign firms has been found pro-competitive. In the water and sewage sector, local joint bidding may be useful to induce firms to submit lower offers.

Joint bidding composed of only foreign companies is largely anti-competitive, meaning that their bids tend to be systematically high. This indicates the possible risk of relying too much on foreign bidding coalition, suggesting the necessity of overseeing it in the procurement process more carefully and systematically, as some donor agencies do. The only way for foreign firms to improve competitiveness is to form a bidding alliance with local firms. However, it is also indicated that local and foreign collaboration would necessitate a developed local business environment. Without reliable local partners, such a coalition could not materialize.

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