Favouritism and corruption in procurement auctions *

Krishnendu Ghosh Dastidar†
Jawaharlal Nehru University

Sonakshi Jain‡
Centre for the Digital Future

April, 2022

Abstract

This paper analyzes the impact of favouritism and corruption in procurement auctions in an emerging economy. There are two firms: one is the favoured one and the other is not the favoured one. The firm that wins the contract needs to supply a good that meets a certain quality standard without which its payment would be withheld. There is also corruption in the system: if the measured quality falls short of the minimum stipulated one, the winner can pay a bribe to inflate the reported quality. The same amount of bribe will inflate the reported quality of the favoured firm by a higher magnitude as compared to the firm which is not favoured. We show that favouritism induces inefficient outcomes, reduces competition and leads to lower expected equilibrium quality. The favoured firm also earns a higher payoff.

Keywords: Procurement, favouritism, corruption, bribe

JEL Classification: D44, H57, L13

*The authors are deeply indebted to Sangeeta Bansal, Arunava Sen and Uday Bhanu Sinha for their comments. Some of the results are based on chapter 3 in the unpublished Ph.D dissertation of Jain (2021).

†email: krishnendu.dastidar@gmail.com, kgd12@yahoo.com

‡email: jainsonakshi13@gmail.com

1 Introduction

Public institutions as well as state-owned enterprises need to procure goods and services to carry out their responsibilities and duties. Public procurement is a key economic activity of governments that represents a significant percentage of the Gross Domestic Product (GDP) generating huge financial flows. In OECD countries, public procurement is estimated to account for 12% of GDP. In many non-OECD countries, that figure is probably higher.[1]

An effective procurement system plays a strategic role in governments for avoiding mismanagement and waste of public funds. Public procurement is one of the government activities which is most vulnerable to corruption. In addition to the volume of transactions and the financial interests at stake, corruption risks are exacerbated by the complexity of the process, the close interaction between public officials and businesses, and the multitude of stakeholders. There is a lot of literature around corruption in public procurement.[2]

Besides corruption, it is favouritism that puts the public procurement in peril. It may be noted that favouritism has been a part of human society, and it has existed within the social structure for millennia. Most government organizations have diversified stakeholders. Besides satisfying the voters, the ruling political party also favours some specific groups of people- industrialists, people belonging to a certain caste or social group etc.[3]

Favouritism and corruption coexist in almost all developing economies. Corruption thrives on the lack of commitment to basic morality and professional ethics. favouritism thrives either on kinship (family, same community, caste etc.) or on friendship (favouring politically connected actors in return for some favour).

This paper tries to theoretically analyse the effects of both favouritism and corruption in public procurements in an emerging economy. In our exercise there are two firms: one is the favoured one and the other is not the favoured one. The firms compete in a procurement auction to win the contract for building a public good. The lowest biider is declared the winner. The firm that wins the contract needs to supply a good that meets a certain quality standard failing which its payment would be withheld. There is also corruption in the system:

[1] See <<https://www.oecd.org/gov/public-procurement/>>

[2] See Dastidar (2017) and Dastidar and Jain (2021) for a survey of such papers reated to corruption in procurement.

[3] Nepotism and cronyism are two facets of favouritism. Nepotism essentially refers to the act of favouring family members or one's relatives. In brief, it means favouritism towards the members of one's kinship. Cronyism, on the contrary to nepotism, refers to the act of favouring a friend. Thus, this means favouritism based on friendship. Crony capitalism is an extension of the generic concept of cronyism as it applies to businesses and firms in a nation or society. It is a deliberate, systematic use of public policy to rig markets in ways that benefit politically connected actors. For example, a political party in power may favour specific business houses while dishing out lucrative government contracts. Crony capitalism breeds political entrepreneurs and stifles market entrepreneurs.

if the measured quality falls short of the minimum stipulated one, the winner can pay a bribe to inflate the reported quality. The same amount of bribe will inflate the reported quality of the favoured firm by a higher magnitude as compared to the firm which is not favoured. We show that favouritism induces inefficient outcomes, reduces competition and results in lower expected equilibrium quality. The favoured firm also earns a higher payoff. Our theoretical results resonate with the prevailing scenario in many emerging economies.

We focus on favouritism based on kinship. This kind of favouritism is common in an emerging economy like India. For example, if the owner (manager) of a firm has the same caste as the officer in the government department (who is in charge of giving the final approval for the contract), then such an owner (manager) is often provided some unfair advantage.[4]

We now proceed to provide a brief overview of our set-up and the main results.

1.1 Set-up and the main results

1.1.1 The set-up

A brief set-up of our exercise is as follows. The government in a corruption ridden emerging economy plans to build a public good (for example, a road or a bridge) of a certain quality. To implement this plan, it conducts a procurement auction where a firm which quotes the lowest bid wins the contract to construct the public good. There are two firms competing to get the contract. Firms differ in their efficiency, which is private information. The more efficient a firm is, the less costly it is to carry out production. The type of firm i is denoted by θ_i. Lower is θ_i, more efficient is firm i. The types θ_1 and θ_2 are identically and independently distributed over the interval $\left[\underline{\theta}, \overline{\theta}\right]$ with distribution function $F(.)$ and density function $f(.)$. This distribution of types is common knowledge. The cost of producing quality, q, for firm with type, θ, is $c\,(q\,\theta)$.

A condition of fulfilling the contract is that the quality of the construction should be at least as high as the minimum stipulated quality. More specifically, let k be the minimum stipulated quality fixed by the government. The choice of k is *exogenous* in the model. It is chosen according to some feasibility and technical requirements. For example, suppose the government wants to buy computers. In that case, it can specify the processor required, or in the construction of a building or road, it might make it mandatory the use of certain specific quality tested raw materials.

Let the winning firm choose quality, q. The vigilance department of the government verifies the quality after the construction is complete. If $q \geq k$ then the winning firm gets the

[4] There is a large amount of scholarly literature about caste ('jati') in India that spans disciplines ranging from history to sociology, and from anthropology to economics. See Thorat and Attewell (2007) for some discussion on this topic.

price it has quoted to win the contract. Rules stipulate that if $q < k$ then, as a punishment, the winning firm will not be paid anything. However, since there is corruption in the system, if $q < k$, then the winning firm has the option of bribing the vigilance department to inflate the reported quality to k. *That is, a bribe can be paid to manipulate the reported quality.* A bribe of amount b will increase the quality to be reported by bh_i. So, the *supplied quality*, q, will be *reported* as $[q + h_i b]$ where b is the bribe paid. If $q \geq k$ then no bribe is required to be paid. Note that higher is h_i, better is for the winning firm (as the same amount of bribe will increase the reported quality by the larger amount).[5]

As noted before, there are two firms. Without loss of generality, we assume that *firm 1 is more favoured relative to firm 2*: i.e. $h_1 \geq h_2$. For simplicity we also assume $h_2 = 1$. Note that if $h_1 = 1$ then there is no favouritism (as both firms are treated equally). When $h_1 > 1$ then firm 1 is the favoured firm. Note that $h_1 > 1$ means that when both firms offer the same bribe, b, and produce the same quality, q, then the quality of firm 1 (in case it is the winner) will be reported as $[q + h_1 b]$ and this will be strictly greater than firm 2's reported quality, $[q + b]$ (when firm 2 is the winner). We say h_1 *is the index of favouritism*.

Note that in our set-up a bribe enables the winning firm to escape the punishment (in case the quality threshold is not met). The favoured firm has an advantage. It can pay the same bribe and inflate the reported quality by a larger magnitude. We assume that there is no way to penalize the corrupt officers of the vigilance department. This is justified in emerging economies like India, Bangladesh, Pakistan, Brazil etc. where the law and order machinery and the criminal justice system is woefully inadequate.

It may be noted that in our story corruption and favouritism are intertwined. The favoured firm is required to pay bribe to escape punishment but the bribe it needs to pay is lower than the other firm (which is not the favoured one). To the best of our knowledge no other paper in the literature has taken this approach.

We model it as a three-stage game. In the first stage, the two firms quote a bid. The bidder with the lowest bid wins the contract. In the second stage, the winner chooses the quality and completes the construction. In the third stage the required bribe is chosen by

[5] In our exercise we assume that if the quality is found to be above the minimum standards (i.e. if $q \geq k$), then the vigilance department will report the quality truthfully. The department does nt deleberately undervalue quality. However, if $q < k$, then the vigilance department can ask for a bribe to inflate the reported quality. One way to view this situation is that there are two teams within a vigilance department. One is the technical team that measures the quality and is incompetent but honest. The other is the administrative staff that does the paperwork and makes reports. The administrative staff can be bribed to manipulate the quality when the news is bad from the firm's perspective (i.e. when $q < k$). The firm will pay the bribe if it observes that the monitored quality does not meet the standard. However, if a firm has satisfied quality requirement (i.e. $q \geq k$), it will have more bargaining power and will not be obliged to bribe. If the quality (as measured by the technical staff) is below the specified threshold, then it will have little bargaining power and it would have to pay a bribe to cover up for the poor quality.

the winner.

1.1.2 Main results

Our main results demonstrate the following. The optimal quality chosen by firm i (the winner), q_i^*, in the second stage, is such that $q_i^* < k$. *That is, it's better for the winner to supply a lower quality than the stipulated minimum level and pay a bribe.* This implies, in equilibrium, we always observe strictly positive bribe being offered by the winner in the third stage. This result is driven by the fact that the marginal cost of quality (evaluated at the minimum stipulated level) is high. It may be noted that the cost of doing business in many emerging economies like India is much higher than that in developed countries. For instance, estimates put India's logistics cost between 14 per cent of GDP compared to a ratio between 8-10 per cent for countries like the US, Hong Kong and France.[6]

For any type, θ, the quality, q_1^*, chosen by firm 1 (the favoured firm) in the event it is the winner, will be strictly lower than the quality, q_2^*, chosen by firm 2 (when it is the winner). Also, higher is favouritism (i.e. higher is h_1), lower will be the quality chosen by the favoured firm. We now proceed to discuss the first stage equilibrium, where firms compete to get the contract.

First, suppose there is no favouritism. That is, $h_1 = 1$. Then, in the first stage procurement auction, there will be a symmetric Bayesian Nash equilibrium (as the two firms are on a level playing field). In this case the equilibrium outcome will be efficient and the firm with the lower type (the more efficient firm) will always win the contract.

Now suppose that there is favouritism. That is, $h_1 > 1$. In this case we demonstrate the existence of an *asymmetric* Bayesian Nash equilibrium of the following form. All types of firm 1 (the favoured firm) quotes a bid, $p_1(\theta_1)$, where $\theta_1 \in [\underline{\theta}, \overline{\theta}]$. When $\theta_2 \in \left[\underline{\theta}, \hat{\theta}\right]$ firm 2 (which is not the favoured firm) quotes a bid, $p_2(\theta_2)$. Note that $\hat{\theta} < \bar{\theta}$. Firm 2 chooses *not to participate* if its type, $\theta_2 \in \left(\hat{\theta}, \overline{\theta}\right]$. We know that higher is θ_i, less efficient is firm i. Note that $\hat{\theta}$ is the *critical type* of firm 2. If the efficiency level of firm 2 is below a certain critical level (type is above $\hat{\theta}$) then firm 2 will not participate. *This means favouritism* ($h_1 > 1$) *drives a wage between the firms.* Note that if $h_1 = 1$ (no favouritism), then $\hat{\theta} = \bar{\theta}$ and all types of firm 2 will participate in the auction.

We also show that a higher h_1 leads to a lower $\hat{\theta}$. That is, a higher favouritism index forces more types of firm 2 to stay out of the auction. *This implies favouritism is discriminatory and reduces competition.*

We prove that when $h_1 > 1$, then for all $\theta \in \left[\underline{\theta}, \hat{\theta}\right]$, $p_1(\theta) < p_2(\theta)$. This means firm 1 (the

[6]See <<https://www.financialexpress.com/economy/ease-of-doing-business-taken-care-of-next-frontier-cost-of-doing-business/1796641/>>

favoured firm) is *more aggressive* in the procurement auction. This also means that when there is favouritism (i.e. $h_1 > 1$), then the equilibrium outcome need not be efficient. There is a positive probability that a more inefficient firm (i.e. a firm with a higher type, θ) will win the contract. *This indicates that favouritism induces inefficient equilibrium outcomes.*

Also, note that when $h_1 > 1$, *firm 1 is more likely to win the contract.* This stems out of two factors: (i) firm 1's bids are lower (given any type) and (ii) firm 2 does not bid if its type is above the critical level $\hat{\theta}$. Since, firm 1's quality choice (when 1 wins) is strictly lower than firm 2's quality choice (when 2 wins), the expected quality that will be observed in equilibrium will be strictly lower than in the case where $h_1 = 1$ (no favouritism). *This implies favouritism leads to lower expected equilibrium quality.*[7]

Lastly, we show that for any given type, the expected payoff of firm 1 (the favoured firm) is strictly greater than the expected payoff of firm 2. Note that for any given type, θ, both firms have the same efficiency level (same cost). Yet, favouritism ($h_1 > 1$) induces a higher payoff to firm 1. *This shows that favouritism is unfair. It also indicates some form of crony capitalism, where a favoured firm earns more than others.* There are many examples of such cases from emerging economies.[8]

1.2 Favouritism: some facts

Both favouritism and corruption are very prominent in developing economies and are major causes behind the poor infrastructure quality in such economies. Such problems afflict developed countries as well. For instance, the members of the European Union lose about a billion dollars due to corruption in procurement auctions.[9]

Corruption is practiced in various manners. It can take the form of a bribe in terms of monetary units to get favours, or it can take the form of bias, nepotism, or favouritism. Authority and power are often misused to extend favours to certain groups of people especially when the one in power is not accountable to masses in general. We provide a couple

[7] Emerick (2017) shows that favoritism of close peers in India severely limits the ability of social networks to allocate a new agricultural technology. This often leads to poor quality. This paper also shows the costliness of such caste-based favoritism.

[8] In an interesting exercise Faccio (2006) empirically demonstrated that political connections of firms are more common in countries that are perceived as being highly corrupt relative to those where legal institutions are more stringent. The paper also showed that corporate value (in terms of profit, share price, etc.) increases significantly owing to the political ties of the corporate firm. This provides empirical evidence for complementarity between cronyism and corruption. See Chaudhuri et al (2022) for further analysis.

[9] The paper by Kuhn and Sherman (2014) estimates this loss and shows that it distorts competition, reduces quality, and affects consumer satisfaction. Any observer of India knows that quality of construction work in most places is extremely low. Often, such poor quality of products leads to loss of life and property. Dastidar (2017) provides many such examples from emerging economies.

of examples below.

A small village in Libya by the name Sirte, was the birthplace of Libya's Colonel. Soon after the colonel came to the power, the parliament and most government departments shifted to this village. Similarly, Yamoussoukro, became the capital of Côte d'Ivoire. The only advantage with Yamoussoukro, was that it was the birthplace of the president. Democratic Republic of the Congo's dictator Mobutu Sese Seko created a "jungle paradise" in his hometown Gbadolite (see Smith, 2015). This shows that those in power often use it unfairly to benefit their kin. This is clearly an example of favouritism based on kinship.

favouritism also takes place in the form of crony capitalism. This is favouritism based on friendship (favouring politically connected actors in return for some favour). Strong allegations of corruption for "Indian Coal Allocation" were made against the ruling dispensation in India (during 2004-2014). Under the Indian Coal Scam, ministers and officers in the government were reportedly found to misuse the authority and were involved in the unfair allocation of coal mines.[10]

1.3 Related Literature

In our model bribes are paid to manipulate reported quality. It is a major form of corruption prevalent in many developing nations (see Lengwiler and Wolfstetter, 2006). Burguet (2017) in his study shows that fixed bribes versus bribes varying with the extent of quality manipulation affect the optimal contract and it is unlikely to eradicate corruption. The paper by Celantani and Ganuza (2002) show that an increase in competitiveness by having more firms may not reduce corruption. Compte et al (2005) find that, in the presence of quality concerns, it is difficult to have effective policies that can prevent corruption. Lengwiler and Wolfstetter (2010) argues that bids consisting of technical and financial proposals are more likely to have an element of corruption, and complete eradication of corruption is inevitable. Marjit (2012) argues that any auction process for sale of public assets will not be completely corruption-free but if properly designed and implemented it will actually minimize the likelihood of manipulation.[11]

While there is a lot of literature analyzing the effects of corruption in procurement, there are very few theoretical papers that analyses the effect of favouritism in procurement auction. Some exercises demonstrate that favouritism in the allocation of public contracts can lead

[10] https://countercurrents.org/2019/08/india-and-crony-capitalism

[11] In many procurement settings, the quality of the job is not easy to verify or is simply unobservable to the buyer. Thus, procurement involves an agent who is an intermediate between the buyer and the seller. Delegating the job of quality check to a third party brings with it the possibility of corruption as the intermediator has discretionary power in quality monitoring (Che and Gale, 2006).

to higher prices, the provision of low-quality goods and services, and reduced competition.[12]

In the context of procurement auctions, resource auctions, job promotions, college admissions there is evidence of preferential treatment. In an interesting theoretical exercise Pi (2020) shows that there may be an over-identification of favouritism in public procurement in the existing literature. Krasnokutskaya and Seim (2011) study preferential treatment in the case of highway procurement auctions. Safina (2015) analyses favouritism and nepotism in Russia and demonstrates how such things thwart the country's social and economic development. Decarolis. and Giorgiantonio (2014) analyse favouritism and inefficiency in public procurement in Italy. Chu et al (2021) provides some evidences of favouritism in China. Using an innovative big data methodology, Dávid-Barrett and Fazekas (2020) identify the effects of a change in government on procurement markets in two countries, Hungary and the United Kingdom, which differ in terms of political influence over these institutions. This paper finds that politically-favored companies secure 50–60% of the central government contracting market in Hungary but only 10% in the UK.

Kirkegaard (2013) models contests as an incomplete-information all-pay auction in which contestants are heterogeneous. The paper shows that when there is a diverse favoured group, it might be disadvantageous for some of the beneficiaries. The reason is that the other favoured contestants become more aggressive, which may outweigh the advantage that is gained over contestants who are handicapped. Do et al (2017) study patronage politics in Vietnam, to estimate officer's promotions' impact on infrastructure in their hometowns of patrilineal ancestry.

Hometown favouritism is pervasive across all ranks, even among officials without budget authority. The evidence suggests a likely motive of social preferences for the hometown. In a study by Stoll et al (2004), they found that black hiring agents receive more applications from blacks and they hire a larger proportion of blacks vis a vis whites. A study by Attewell and Thorat (2010) in the Indian context observed that for equally qualified scheduled caste (lower caste) and upper caste (about 4800 each) applicants, scheduled caste candidates had 67 percent less chance of receiving calls for an interview. What is more disturbing is that the high percentage of less qualified high caste candidates received calls compared with the more qualified scheduled caste applicants.

In this paper we study the impact of favouritism on bidder's equilibrium bids. Arozamena and Weinschelbaum (2009) study a two stage first price auction where in the first stage, bidders who are not favoured bid and in the second stage the favoured bidder bids. They show that favouritism may generate more, less or equal aggressiveness. Minchuk and Sela (2018) show that the head start results in raising unfavoured bidder's bids when they participate in a pre first price auction with a head start.

[12] See Bank (2016), Dastidar and Mukherjee (2014) and Hessami (2014).

We also study the impact of favouritism on efficiency of auctions. It is well known that asymmetry of bidders results in inefficiency in the first price auctions (see Krishna, 2010). Segev and Sela (2014) define efficiency as the probability that the bidder with higher valuation wins, and show that results can be efficient with multiplicative head start. Corruption can also be a cause of inefficiency. In a multi-dimensional procurement auction analysed by Burguet and Che (2004) it is shown that if agents have considerable manipulative power with them, then the auction format can lead to inefficient outcomes.

Kirkegaard (2012) shows that favouritism can result in Pareto improvement by introducing head start and handicap. On the contrary, Arozamena and Weinschelbaum (2009) and Corns and Schotter (1999) show that favoured bidder's welfare increases and unfavoured bidder's welfare decreases. Thus, there is no Pareto improvement.

We study the impact of favouritism and corruption on the quality and bids in a procurement auction. Our exercise extends the analysis in Jain (2021, Chapter 3).

Plan of the paper The second section discusses the model and assumptions. In the third section, we discuss the equilibrium analysis of the model where there are favouritism and corruption. The last section provides the concluding remarks.

2 Model and Assumptions

The government plans to procure a public good. To implement this plan the government conducts a procurement auction where the firm that quotes the lowest bid wins the contract (subject to the fulfillment of the minimum quality requirement). We model this scenario as a three stage game.

The players in our game are the firms: firm 1 and firm 2. Firms differ in their efficiency (termed as 'type' hereafter), which is private information. Each firm knows its type, but it does not know the type of the other firm. The efficiency of a firm affects the cost of the project. The more efficient a firm is, the less costly it is to carry out production. The type of firm i is denoted by θ_i. Lower is θ_i, more efficient is firm i. The types, θ_1 and θ_2, are identically and independently distributed over the interval $\left[\underline{\theta}, \overline{\theta}\right]$ with distribution function $F(.)$ and density function $f(.)$. Note that $\overline{\theta} > \underline{\theta} \geq 0$. This distribution of types is common knowledge.

Since the good in question has a quality attribute, the project's cost is affected by the quality delivered, denoted by q. Note that $q \in \left[\underline{q}, \infty\right)$ where $\underline{q} > 0$ is the minimum technically feasible quality. Higher is the quality, higher will be the cost of producing the good. The cost function of a firm with type θ is $c\left(q, \theta\right)$. Our first assumption puts some restrictions on the cost function.

Assumption 1 We assume that $\forall q \in \left(\underline{q}, , \infty\right)$ and $\forall \theta \in \left[\underline{\theta}, \overline{\theta}\right]$, $c_q(.) > 0$, $c_\theta(.) > 0$, $c_{qq}(.) > 0$ and $c_{q\theta}(.) \geq 0$.

remark 1 *An example of a cost function which satisfies all the above conditions is as follows:* $c(q, \theta) = q^2\theta$.

Any firm's objective is to maximise expected profit. The government is not an active player in our model. It's role is restricted to setting rules, a minimum quality level and checking whether the quality level has been supplied or not. The government not only wants to get the good constructed at a low price but also would like to ensure that the good is of a decent quality. As such, it sets a minimum quality level $k > \underline{q}$. As mentioned in the introduction, the choice of k is *exogenous* in the model.

Favouritism, Corruption and Bribe The minimum quality required is k. The winning firm chooses quality, q. The vigilance department of the government verifies the quality. The rules stipulate that the winning firm will be paid the price it has quoted only if the quality as reported by the vigilance department is at least k. That is, if $q \geq k$ then the winning firm gets the price it has quoted. If $q < k$ then, as a punishment, the firm will not get anything. However, since there is corruption in the system, if $q < k$, then the winning firm has the option of bribing the vigilance department to inflate the reported quality to k. That is, if produced quality, q, is less than the required minimum quality standard, k, then a bribe can be paid to manipulate the reported quality. A bribe of amount b will increase the quality to be reported by bh_i. So, the *quality*, q, will be *reported* as $[q + h_i b]$ where b is the bribe paid. We refer to h_i, as *quality manipulation index*. Note that if $q \geq k$ then no bribe is required to be paid.

Without loss of generality, we assume that *firm 1 is more favoured relative to firm 2*: i.e. $h_1 > h_2$. A higher h_1 relative to h_2 means that when both firms offer the same bribe, b, and produce the same quality, q, then firm 1's reported quality (as reported by the vigilance department) will be higher than firm 2's reported quality (as reported by the same department). We assume that there is no way to penalize the corrupt officers of the vigilance department. As noted before, this assumption is justified in many emerging economies where the criminal justice system is almost dysfunctional.

Assumption 2 For simplicity we assume $h_2 = 1$. We also assume that $h_1 \in \left[1, \bar{h}\right]$.

remark 2 *Since* $h_1 \geq 1$*, it captures the extent of favouritism. Higher is* h_1*, higher will be the favouritism. Note that when* $h_1 = 1$*, both firms are treated equally and there is no favouritism.* $\bar{h}$ *represent the highest possible level of favouritism.*

We now provide our next assumption.

Assumption 3 We assume that $0 < c_q\left(\underline{q}, \bar{\theta}\right) < \frac{1}{h}$ and $c_q\left(k, \underline{\theta}\right) > 1$.

Note that since $c_{q\theta}(.) \geq 0$, from assumption 3 we get that $\forall\theta \in \left[\underline{\theta}, \bar{\theta}\right]$, $c_q\left(\underline{q}, \theta\right) < \frac{1}{h}$ and $c_q\left(k, \theta\right) > 1$. In emerging economies the marginal cost of producing high quality goods is typically very high as there are many impediments of doing business.[13]

The three stage game

1. In the first stage, firms quote bids to win the contract for the construction of the public good. The firm that quotes the lowest bid wins the contract.

2. In the second stage, the winning firm constructs the public good and chooses the quality of construction, q.

3. The bribe, b, is chosen in stage three. If $q \geq k$ then no bribe is required to be paid. If $q < k$, then in the third stage the winning firm has the option of bribing the vigilance department to inflate the reported quality to k.

3 Equilibrium Analysis

We now proceed to derive the equilibrium outcome for the three stage game of incomplete information.

3.1 Stage Three

Let firm i be the winner of the procurement auction in the first stage. Suppose the winner's type be θ_i and its bid be p_i. Note that in the second stage, the winning firm constructs the public good and chooses the quality of construction, q_i. The cost, $c\left(q_i, \theta_i\right)$, is sunk in the third stage.

In stage three the winning firm chooses a level of bribe, $b_i \geq 0$. Rules stipulate that the minimum quality (which is chosen by the firm in the second stage) should be at least k. If the quality (as reported by the vigilance department) is below k then, as a punishment, the winner will not be paid its bid amount, p_i. If the reported quality is above k then the profit of the winner will be $\pi_i = p_i - c\left(q_i, \theta_i\right) - b_i$. The are two possible cases: case (i) $q \geq k$ and case (ii) $q < k$.

Case (i) First, suppose that the quality, q_i, chosen in the second stage is such that $q_i \geq k$. In this case no bribe is required to be paid. That is , $q_i \geq k \Rightarrow b_i^* = 0$, where b_i^* is the equilibrium bribe. In this case the profit of the winner will be $\pi_i = p_i - c\left(q_i, \theta_i\right)$.

[13] See Dastidar and Yano (2020 and 2021) for some related discussions around this topic.

Case (ii) Now suppose $q_i < k$. As mentioned before, if $q_i < k$, then in the third stage the winning firm has to pay a bribe to inflate the reported quality to k. If the winning firm wants to get the reported quality exactly equal to k, then it should choose a bribe, b_i, such that $q_i + h_i b_i = k \Rightarrow b_i = \frac{k-q_i}{h_i}$. Any bribe, $b_i > \frac{k-q_i}{h_i}$ is **not** possible in equilibrium, because such a choice will reduce the winner's profits. The total cost will go up (as bribe is higher than the required minimum) and revenue, which is price received, will be unchanged. Any bribe, b_i, such that $b_i < \frac{k-q_i}{h_i}$ will result in non-payment of the bid amount, p_i, and in this case the winner's profit would be $[-c(q_i, \theta_i) - b_i]$. Clearly, $b_i = 0$ is better than any b_i where $0 < b_i < \frac{k-q_i}{h_i}$. Note that if $b_i = 0$ then profit, $\pi_i = -c(q_i, \theta_i)$. If $b_i = \frac{k-q_i}{h_i}$ then, profit, $\pi_i = p_i - c(q_i, \theta_i) - \frac{k-q_i}{h_i}$. Clearly, a bribe, $b_i = \frac{k-q_i}{h_i}$ is optimal iff $p_i \geq \frac{k-q_i}{h_i}$.

Note that $h_1 \in \left[1, \bar{h}\right]$ and $h_2 = 1$. The above discussion implies that the following is the equilibrium *expost bribe*, b_i^*.

$$b_1^* = \begin{cases} \frac{k-q_1}{h_1} \; if \; q_1 < k \; and \; p_1 \geq \frac{k-q_1}{h_1} \\ 0 \quad if \; q_1 \geq k \; or \; if \;\; q_1 < k \; and \; p_1 < \frac{k-q_1}{h_1} \end{cases} \quad ----(1a)$$

$$b_2^* = \begin{cases} \frac{k-q_2}{h_2} = k - q_2 \;\; if \; q_2 < k \; and \; p_2 \geq k - q_2 \\ 0 \quad if \; q_2 \geq k \; or \; if \; q_2 < k \; and \; p_2 < k - q_2 \end{cases} \quad -----(1b)$$

Comment Note that in equilibrium the winner's bid, p_i (chosen in the first stage), would be such that $p_i > c(q_i^*, \theta_i) + b_i^*$, where q_i^* is the optimal quality chosen in the second stage. The intuition is obvious; as otherwise, the winner's expected payoff would be negative. In fact, we would precisely show this when we analyse the first stage game (see proposition 2). From (1a) and (1b) we get that $b_i^* \in \left\{0, \frac{k-q_i}{h_i}\right\}$. Since $p_i > c(q_i^*, \theta_i) + b_i^*$ we must have $p_i > \frac{k-q_i}{h_i}$.

Hence, in equilibrium we must have $b_i^* = 0$ if $q_i \geq k$ and $b_i^* = \frac{k-q_i}{h_i}$ if $q_i < k$. We report this as equations (2a) and (2b) below.

$$b_1^* = \begin{cases} \frac{k-q_1}{h_1} \; if \; q_1 < k \\ 0 \quad if \; q_1 \geq k \end{cases} \quad ----(2a)$$

$$b_2^* = \begin{cases} \frac{k-q_2}{h_2} = k - q_2 \;\; if \; q_2 < k \\ 0 \quad if \; q_2 \geq k \end{cases} \quad -----(2b)$$

3.2 Stage Two

In the second stage, the winning firm chooses the quality of construction, q_i. Now the winning firm would choose a level of quality such that it maximises its equilibrium profits. Suppose firm i has won the auction in the first stage with a price quote equal to p_i. Let the winner's type be θ_i. The equilibrium bribe chosen in the third stage is $b_i^* \geq 0$.

Hence, using (2a) and (2b) we get the following.

$$\begin{aligned}\pi_i &= p_i - c(q_i,\theta_i) - b_i^* \\ &= \begin{cases} p_i - c(q_i,\theta_i) & if\ q_i \geq k \\ p_i - c(q_i,\theta_i) - \frac{k-q_i}{h_i} & if\ q_i < k \\ where\ h_1 \in \left[1,\bar{h}\right]\ and\ h_2 = 1 \end{cases} \quad ---(3)\end{aligned}$$

We now proceed to provide our first main result.

Proposition 1 *$\forall\theta \in \left[\underline{\theta},\overline{\theta}\right]$, there exists a unique optimal quality, $q_i^* \in \left(\underline{q},k\right)$ chosen in the second stage. At such an optimum, $c_q(q_i^*,\theta) = \frac{1}{h_i}$.*

Proof Let firm i be the winner whose type is θ_i. Note that $k > 0$. Any quality choice, $q_i \geq k$ ensures that the firm will receive the price it has quoted to win the contract. Note that a choice of $q_i = k$ is strictly better than any choice where $q_i > k$. Any choice of quality strictly greater than k is suboptimal as it would just increase cost and decrease the profit (as revenue, which is price received remains unchanged). If the winning firm i chooses $q_i = k$ then its payoff would be $\pi_i = p_i - c(k,\theta_i)$.

If the winning firm i chooses $q_i < k$ then its payoff would be $\pi_i = p_i - c(q_i,\theta_i) - \frac{k-q_i}{h_i}$. In this case, the optimum quality q_i^*, solves the following.

$$\begin{aligned}\frac{\partial\pi_i}{\partial q_i} &= \frac{\partial}{\partial q_i}\left[p_i - c(q_i,\theta_i) - \frac{k-q_i}{h_i}\right] = -c_q(q_i,\theta_i) + \frac{1}{h_i} = 0 --- (4a) \\ \frac{\partial^2\pi_i}{\partial q_i^2} &= \frac{\partial}{\partial q_i}\left[-c_q(q_i,\theta_i) + \frac{1}{h_i}\right] = -c_{qq}(q_i,\theta_i) < 0 --- (4b)\end{aligned}$$

Since $c_{qq} > 0$ (assumption 1), the second order condition is always satisfied. From assumption 1 we have $c_{q\theta}(.) \geq 0$ and from assumption 3 we have $0 < c_q\left(\underline{q},\overline{\theta}\right) < \frac{1}{\bar{h}}$ and $c_q\left(k,\underline{\theta}\right) > 1$. Since $h_1 \in \left[1,\bar{h}\right]$, we have $\frac{1}{h_1} \in \left[\frac{1}{\bar{h}},1\right]$. Also, $h_2 = 1$. These two assumptions together imply the following : (i) $\forall\theta \in \left[\underline{\theta},\overline{\theta}\right]$, $c_q\left(\underline{q},\theta\right) < \frac{1}{h_i} \leq 1$ and (ii) $\forall\theta \in \left[\underline{\theta},\overline{\theta}\right]$, $c_q(k,\theta) > 1 \geq \frac{1}{h_i}$. Since $c_q(.)$ is continuous, by using the intermediate value theorem, we get that there exists a $q_i^* \in \left(\underline{q},k\right)$ such that $c_q(q_i^*,\theta) = \frac{1}{h_i}$. Since $c_{qq}(.) > 0$, such a q_i^* is unique.

The above analysis shows that if the firm chooses any $q_i < k$, the best choice is q_i^* where $c_q(q_i^*,\theta) = \frac{1}{h_i}$. We now show that such a q_i^* gives a strictly higher payoff to the winner than a quality choice of $q_i = k$.

Since $\forall\theta \in \left[\underline{\theta},\overline{\theta}\right]$, q_i^* is unique, we must have

$$\forall q_i \in (q_i^*,k), \quad p_i - c(q_i^*,\theta_i) - \frac{k-q_i^*}{h_i} > p_i - c(q_i,\theta_i) - \frac{k-q_i}{h_i}$$

Note that $\left[p_i - c(q_i, \theta_i) - \frac{k-q_i}{h_i}\right]$ is continuous in q_i. Now take q_i arbitrarily close to k. Then $\left[p_i - c(q_i, \theta_i) - \frac{k-q_i}{h_i}\right]$ is arbitrarily close to $[p_i - c(k, \theta_i)]$. This means

$$\left[p_i - c(q_i^*, \theta_i) - \frac{k - q_i^*}{h_i}\right] > [p_i - c(k, \theta_i)].$$

In other words , the optimal quality choice is always strictly less than k.■

remark 3 *Proposition 1 implies it's better for the firm to supply a lower quality than the stipulated minimum level and pay a bribe. The result ensures that in equilibrium we always observe strictly positive bribe equal to* $\frac{k-q_i^*}{h_i}$. *This result is driven by the fact that the marginal cost of quality (evaluated at the minimum stipulated level, k) is high. As noted earlier, due to many economic and social impediments (mostly bureaucratic), the cost of doing producing any item in many emerging economies is often much higher than that in developed countries.*

At such an optimum the following are true (these follow from 4a and 4b).

$$\begin{aligned} c_q(q_1^*, \theta_i) &= \frac{1}{h_1} - - - - (5a) \\ c_q(q_2^*, \theta_i) &= 1 - - - - (5b) \end{aligned}$$

Since $h_1 \in [1, \bar{h}]$ and $h_2 = 1$, from (5a) and (5b) we get that $q_1^* = q_1^*(\theta_1, h_1)$ and $q_2^* = q_2^*(\theta_2, h_2) = q_2^*(\theta_2, 1)$. We proceed to our next result.

Lemma 1 *(i)* $\forall i = \{1, 2\}$ *and* $\forall \theta \in [\underline{\theta}, \overline{\theta}]$, $\frac{\partial q_i^*}{\partial \theta_i} \leq 0$ *(ii)* $\forall h_1 \in [1, \bar{h}]$, $\frac{\partial q_1^*}{\partial h_1} < 0$. *(iii)* $\forall h_1 \in (1, \bar{h}]$ *and* $\forall \theta \in [\underline{\theta}, \overline{\theta}]$, $q_1^*(\theta, h_1) < q_2^*(\theta, 1)$.

Proof (i) Note that from 3(a) we get q_i^* implicitly by solving the following equation.

$$\frac{\partial \pi_i}{\partial q_i} = -c_q(q, \theta_i) + \frac{1}{h_i} = 0$$

Using implicit function theorem

$$\frac{\partial q_i^*}{\partial \theta_i} = -\frac{\frac{\partial^2 \pi_i}{\partial \theta_i \partial q_i}}{\frac{\partial^2 \pi_i}{\partial q_i^2}}$$

Since $\frac{\partial^2 \pi_i}{\partial q_i^2} = -c_{qq}(q, \theta_i) < 0$ we get that $\frac{\partial q_i^*}{\partial \theta_i}$ has the same sign as $\frac{\partial^2 \pi_i}{\partial \theta_i \partial q_i}$. Now

$$\frac{\partial^2 \pi_i}{\partial \theta_i \partial q_i} = -c_{q\theta}(q, \theta_i)$$

Since $c_{q\theta} \geq 0$ (assumption 1) we get that $\frac{\partial^2 \pi_i}{\partial \theta_i \partial q_i} \leq 0$. This implies $\frac{\partial q_i^*}{\partial \theta_i} \leq 0$.

(ii) Again, from 4(a) we get q_1^* implicitly by solving the following equation.

$$\frac{\partial \pi_1}{\partial q_1} = -c_q(q,\theta_i) + \frac{1}{h_1} = 0$$

Using implicit function theorem we get

$$\frac{\partial q_1^*}{\partial h_1} = -\frac{\frac{\partial^2 \pi_1}{\partial h_1 \partial q_1}}{\frac{\partial^2 \pi_i}{\partial q_i^2}} = \frac{\frac{\partial^2 \pi_1}{\partial h_1 \partial q_1}}{c_{qq}(q,\theta_i)}$$

Now

$$\frac{\partial^2 \pi_1}{\partial h_1 \partial q_1} = -\frac{1}{h_1^2} < 0.$$

Hence, $\frac{\partial q_1^*}{\partial h_1} < 0$.

(iii) From (5a) and (5b) it is clear that when $h_1 = 1$ then $\forall \theta \in [\underline{\theta}, \bar{\theta}]$, $q_1^*(\theta, h_1) = q_1^*(\theta, 1) = q_2^*(\theta, 1)$. Since $\frac{\partial q_1^*}{\partial h_1} < 0$ we must have if $h_1 > 1$ then $q_1^*(\theta, h_1) < q_1^*(\theta, 1) = q_2^*(\theta, 1)$. That is, $\forall h_1 \in (1, \bar{h}]$,and $\forall \theta \in [\underline{\theta}, \bar{\theta}]$, $q_1^*(\theta, h_1) < q_2^*(\theta, 1)$.■

Comment Although the increase in quality pushes up production cost, the increase in quality also pulls down the bribe payment (this is the benefit of a higher quality). At equilibrium the marginal cost, c_q, must be equal to the marginal benefit, $\frac{1}{h_i}$. Note that since $c_{q\theta}(.) \geq 0$ a higher θ implies that marginal cost of quality goes up while the marginal benefit, $\frac{1}{h_i}$, remains the same. In this case it is optimal for the firm to cut down on the quality. *This means, that more inefficient firms will supply lower quality.*

Now suppose there is an increase in h_1. This decreases the marginal benefit, $\frac{1}{h_1}$, for firm 1 while its marginal cost in unaffected. Since $c_{qq}(.) > 0$, in equilibrium the quality chosen must decrease to restore the equality of marginal cost and marginal benefit. That is, with an increase in favouritism (higher h_1), it is optimal for the *favoured firm* to cut down on the quality. This also implies when $h_1 > 1$, if firm 1 (the favoured firm) is the winner, then given any type, θ, the quality supplied by firm 1 will be strictly lower than the quality chosen by firm 2 (in the event when firm 2 is the winner). *Clearly, favouritism induces lower quality.*

We now provide our next result.

3.2.1 Equilibrium total costs

Let us define the following.

$$\begin{aligned} A_1(\theta, h_1) &= c(q_1^*(\theta, h_1), \theta) + \frac{k - q_1^*(\theta, h_1)}{h_1} - - - (6a) \\ A_2(\theta, h_2) &= A_2(\theta, 1) = c(q_2^*(\theta, 1), \theta) + k - q_2^*(\theta, 1) - - - - (6b) \end{aligned}$$

remark 4 *Note that for any $h_1 \in \left[1, \bar{h}\right]$, $A_1(\theta, h_1)$ is firm 1's equilibrium total cost. Similarly, $A_2(\theta, 1)$ is firm 2's equilibrium total cost.*

We now provide our next result.

Lemma 2 *(i) $\forall i \in \{1,2\}$ and $\forall \theta \in \left[\underline{\theta}, \overline{\theta}\right]$, $\frac{\partial A_i(.)}{\partial \theta} > 0$. (ii) $\forall h_1 \in \left[1, \bar{h}\right]$, $\frac{\partial A_1(.)}{\partial h_1} < 0$. (iii) $\forall h_1 \in \left(1, \bar{h}\right]$ and $\forall \theta \in \left[\underline{\theta}, \bar{\theta}\right]$, $A_1(\theta, h_1) < A_2(\theta, 1)$.*

Proof (i) Now

$$\begin{aligned}\frac{\partial A_1(.)}{\partial \theta} &= c_q\left(q_1^*(\theta, h_1), \theta\right)\frac{\partial q_1^*}{\partial \theta} + c_\theta\left(q_1^*(\theta, h_1), \theta\right) - \frac{1}{h_1}\frac{\partial q_1^*}{\partial \theta} \\ &= \frac{\partial q_1^*}{\partial \theta}\left[c_q\left(q_1^*(\theta, h_1), \theta\right) - \frac{1}{h_1}\right] + c_\theta\left(q_1^*(\theta, h_1), \theta\right)\end{aligned}$$

Using (5a) we know that $c_q\left(q_1^*(\theta, h_1), \theta\right) = \frac{1}{h_1}$. Using this in the above equation we get that $\frac{\partial A_1(.)}{\partial \theta} = c_\theta\left(q_1^*(\theta, h_1), \theta\right) > 0$. By a similar logic we get that $\frac{\partial A_2(.)}{\partial \theta} = c_\theta\left(q_2^*(\theta, 1), \theta\right) > 0$.

(ii) Note that since $c_q\left(q_1^*(\theta, h_1), \theta\right) = \frac{1}{h_1}$ (from 5a)

$$\begin{aligned}\frac{\partial A_1(.)}{\partial h_1} &= c_q\left(q_1^*(\theta, h_1), \theta\right)\frac{\partial q_1^*}{\partial h_1} + \frac{-h_1\frac{\partial q_1^*}{\partial h_1} - \left[k - q_1^*(\theta, h_1)\right]}{h_1^2} \\ &= \frac{\partial q_1^*}{\partial h_1}\left[c_q\left(q_1^*(\theta, h_1), \theta\right) - \frac{1}{h_1}\right] - \frac{k - q_1^*(\theta, h_1)}{h_1^2}. \\ &= -\frac{k - q_1^*(\theta, h_1)}{h_1^2}\end{aligned}$$

From proposition 1 we get that $k - q_1^*(\theta, h_1) > 0$. Hence, from the above equation we get $\frac{\partial A_1(.)}{\partial h_1} < 0$.

(iii) It is clear that when $h_1 = 1$ then $\forall \theta \in \left[\underline{\theta}, \bar{\theta}\right]$, $A_1(\theta, h_1) = A_1(\theta, 1) = A_2(\theta, 1)$. Since $\frac{\partial A_1(.)}{\partial h_1} < 0$ we must have if $h_1 > 1$ then $A_1(\theta, h_1) < A_1(\theta, 1) = A_2(\theta, 1)$. That is, $\forall h_1 \in \left(1, \bar{h}\right]$,and $\forall \theta \in \left[\underline{\theta}, \bar{\theta}\right]$, $A_1(\theta, h_1) < A_2(\theta, 1)$.■

Comment More inefficient is the firm, higher will be its total equilibrium cost. Also, higher is the favouritism index, h_1, lower will be the favoured firm's equilibrium cost. Both of these results are unsurprising. We now provide our last assumption.

Assumption 4 $\forall h_1 \in \left(1, \bar{h}\right]$, $A_2(\underline{\theta}, 1) < A_1\left(\bar{\theta}, h_1\right)$.

remark 5 *Note that $\bar{\theta}$ is the type which has the least efficiency and $\underline{\theta}$ is the type which has the highest efficiency. Assumption 4 demands that the favoured firm's equilibrium cost, when it is least efficient, is higher than the other firm's equilibrium cost when it is most efficient. Clearly, this is a very mild restriction. We now proceed to our next result.*

Lemma 3 *(i)* $\forall h_1 \in \left(1, \bar{h}\right]$*, there exists a unique* $\hat{\theta} \in \left(\underline{\theta}, \bar{\theta}\right)$ *such that.* $A_2\left(\hat{\theta}, 1\right) = A_1\left(\bar{\theta}, h_1\right)$*. (ii)* $\frac{\partial \hat{\theta}}{\partial h_1} < 0$.

Proof (i) Let

$$\alpha(\theta, h_1) = A_2(\theta, 1) - A_1\left(\bar{\theta}, h_1\right)$$

Note that using lemma 3 we get that $\frac{\partial \alpha(.)}{\partial \theta} > 0$. Since $h_1 > 1$, from lemma 3 (iii) we have $\forall \hat{\theta} \in \left[\underline{\theta}, \bar{\theta}\right]$, $A_1(\theta, h_1) < A_2(\theta, 1)$. This implies $\alpha\left(\bar{\theta}, h_1\right) > 0$. From assumption 3, we get that $\alpha(\underline{\theta}, h_1) < 0$. Using the intermediate value theorem there exists $\hat{\theta} \in \left(\underline{\theta}, \bar{\theta}\right)$ such that. $\alpha\left(\hat{\theta}, h_1\right) = 0$. Since $\frac{\partial \alpha(.)}{\partial \theta} > 0$ such a $\hat{\theta}$ is unique.

(ii) Note that we solve $\hat{\theta}$ by solving $\alpha(\theta, h_1) = 0$. Now using lemma (3) we have $\frac{\partial \alpha(.)}{\partial h_1} > 0$. From the implicit function theorem we get

$$\frac{\partial \hat{\theta}}{\partial h_1} = -\frac{\frac{\partial \alpha(.)}{\partial h_1}}{\frac{\partial \alpha(.)}{\partial \theta}}$$

Hence, $\frac{\partial \hat{\theta}}{\partial h_1} < 0$.■

We now proceed to analyse the bidding behavior in stage one.

3.3 Stage One

In the first stage the firms quote bids. The firm which quotes the lowest bid wins the contract. Note that any firm has an option of not participating in the auction. A firm's strategy $p_i(.)$ is a function of types.

$$p_i : \left[\underline{\theta}, \bar{\theta}\right] \to [0, \infty) \cup \{\textit{not participate}\}$$

We compute the equilibrium bids using standard results from auction theory[14].

3.3.1 Bayesian Nash equilibrium with no favouritism ($h_1 = 1$)

First suppose there is no favouritism. That is, $h_1 = 1$. In this case it is easy to demonstrate that in the first stage procurement auction, there will be a *symmetric* Bayesian Nash equilibrium. Then the equilibrium outcome will be efficient as the firm with the lower type (the more efficient firm) will always win the contract. We now proceed to analyse the equilibrium when there is favouritism ($h_1 > 1$).

[14] See Krishna (2010) for all the standard results on auction theory.

3.3.2 Bayesian Nash equilibrium with favouritism $(h_1 > 1)$

$$Let \ \ \bar{p} = A_1\left(\bar{\theta}, h_1\right) - - - - (7)$$

We now construct an asymmetric Bayesian Nash equilibrium where firm i with type θ chooses $p_i(\theta)$ with $p_i'(.) > 0$. All types of firm 1 participate and quote a bid. Firm 2 chooses a bid only when $\theta_2 \in \left[\underline{\theta}, \hat{\theta}\right]$ and chooses not to participate when $\theta_2 \in \left(\hat{\theta}, \bar{\theta}\right]$. We state this in terms of a proposition.

Proposition 2 *Suppose $h_1 \in \left(1, \bar{h}\right]$. In the procurement auction held in the first stage, there exists a Bayesian Nash equilibrium of the following form. (i) For all $\theta_1 \in \left[\underline{\theta}, \bar{\theta}\right]$ firm 1 chooses a bid $p_1(\theta_1)$ where $p_1'(\theta_1) > 0$ for all $\theta_1 \in \left[\underline{\theta}, \bar{\theta}\right)$. (ii) For all $\theta_2 \in \left[\underline{\theta}, \hat{\theta}\right]$ firm 2 chooses a bid $p_2(\theta_2)$ where for all $\theta_2 \in \left[\underline{\theta}, \hat{\theta}\right)$, $p_2'(\theta_2) > 0$. When $\theta_2 \in \left(\hat{\theta}, \bar{\theta}\right]$ firm 2 chooses <u>not</u> to participate. (iii) $p_1(\underline{\theta}) = p_2(\underline{\theta}) = \underline{p}$ where $\underline{p} < \bar{p} = A_1\left(\bar{\theta}, h_1\right)$. (iv) $p_1\left(\bar{\theta}\right) = p_2\left(\hat{\theta}\right) = \bar{p}$. (v) At the Bayesian Nash equilibrium the following holds true.*

$$\begin{aligned}
\forall\theta &\in \left[\underline{\theta}, \bar{\theta}\right), \quad p_1(\theta) - A_1(\theta, h_1) = p_2'\left(\phi_2\left(p_1(\theta)\right)\right)\left[\frac{1 - F\left(\phi_2\left(p_1(\theta)\right)\right)}{f\left(\phi_2\left(p_1(\theta)\right)\right)}\right] - - - (8a) \\
\forall\theta &\in \left[\underline{\theta}, \hat{\theta}\right), \quad p_2(\theta) - A_2(\theta, 1) = p_1'\left(\phi_1\left(p_2(\theta)\right)\right)\left[\frac{1 - F\left(\phi_1\left(p_2(\theta)\right)\right)}{f\left(\phi_1\left(p_2(\theta)\right)\right)}\right] - - - (8b)
\end{aligned}$$

where $\phi_i(.) \ = \ p_i^{-1}(.) \quad for \ i = 1, 2.$

Proof Suppose that the two bidders follow the strategy $p_1(\theta_1)$ and $p_2(\theta_2)$ respectively with the inverse bidding function given as $\phi_1 = p_1^{-1}$ and $\phi_2 = p_2^{-1}$ respectively. The types of the bidders are distributed over $[\underline{\theta}, \overline{\theta}]$.

We first show that $p_1(\underline{\theta}) = p_2(\underline{\theta}) = \underline{p}$. Here $\underline{p}$ is the minimum possible bid. If $p_1(\underline{\theta}) < p_2(\underline{\theta})$ then firm 1 when type $\underline{\theta}$ wins with probability one. In this case firm 1 can increase its payoff by choosing $p_1(\underline{\theta}) + \varepsilon < p_2(\underline{\theta})$, where $\varepsilon > 0$. This is because it still wins with probability one, but revenue will increase (as price increases) and cost remains unchanged (as it still produces the same quality). Similarly, we can rule out $p_1(\underline{\theta}) > p_2(\underline{\theta})$. Hence, we must have $p_1(\underline{\theta}) = p_2(\underline{\theta}) = \underline{p}$.

Let firm 2 follow the proposed strategy. Note that firm 2's bids lie in the interval $\left[\underline{p}, \bar{p}\right]$. Let firm 1's type be $\theta_1 = \theta$, where $\theta \in [\underline{\theta}, \overline{\theta}]$ and let firm 1 bid be $p_1(x) \in [\underline{p}, \overline{p}]$. Note that if $\theta_2 \in \left(\hat{\theta}, \bar{\theta}\right]$ then firm 1 always wins as firm 2 chooses not to participate. Now consider the case where $\theta_2 \in \left[\underline{\theta}, \hat{\theta}\right]$ (2 makes a bid if its type is in this range). In this case, firm 1 wins if $p_1(x) < p_2(\theta_2) \Leftrightarrow \phi_2(p_1(x)) < \theta_2$. Thus, firm 1 wins with a bid $p_1(x)$ whenever $\theta_2 \in \left(\left(\phi_2(p_1(x)\right), \bar{\theta}\right]$. Hence, firm 1's probability of winning is $[1 - F\left(\phi_2(p_1(x)\right)]$. The expected payoff of firm 1 is as follows.

$$E\pi_1(x,\theta) = [1 - F(\phi_2(p_1(x))] [p_1(x) - A_1(\theta, h_1)]$$

$$\frac{\partial E\pi_1(x,\theta)}{\partial x} = -f(\phi_2(p_1(x))\,\phi_2'(p_1(x))\,p_1'(x)[p_1(x) - A_1(\theta,h_1)] + p_1'(x)[1 - F(\phi_2(p_1(x))]$$

Since in equilibrium firm 1 chooses $p_1(\theta)$ for all $\theta \in [\underline{\theta}, \bar{\theta}]$ and firm 2 chooses $p_2(\theta)$ for all $\theta \in \left[\underline{\theta}, \hat{\theta}\right]$, we must have $\frac{\partial E\pi_1(x,\theta)}{\partial x} = 0$ at $x = \theta$. Also, note that $p_1'(\theta) > 0$ for all $\theta \in [\underline{\theta}, \bar{\theta})$. Using all these we get the following.

$$\forall \theta \in [\underline{\theta}, \bar{\theta}),\ -f(\phi_2(p_1(\theta))\,\phi_2'(p_1(\theta))[p_1(\theta) - A_1(\theta,h_1)] + [1 - F(\phi_2(p_1(\theta))] = 0 - - - (9)$$

Now, note that $\phi_2'(p_1(\theta)) = \frac{1}{p_2'(\phi_2(p_1(\theta)))}$. Using this in equation (9) we get

$$\forall \theta \in [\underline{\theta}, \bar{\theta}),\quad p_1(\theta) - A_1(\theta, h_1) = p_2'(\phi_2(p_1(\theta)))\left[\frac{1 - F(\phi_2(p_1(\theta)))}{f(\phi_2(p_1(\theta)))}\right] - - - (10)$$

By using a similar logic we can show that

$$\forall \theta \in \left[\underline{\theta}, \hat{\theta}\right),\quad p_2(\theta) - A_2(\theta, 1) = p_1'(\phi_1(p_2(\theta)))\left[\frac{1 - F(\phi_1(p_2(\theta)))}{f(\phi_1(p_2(\theta)))}\right] - - - (11)$$

Note that by construction, given firm 2's strategy, firm 1's optimal bid is $p_1(\theta)$ for all $\theta \in [\underline{\theta}, \bar{\theta}]$. Given firm 1's strategy, by construction, firm 2's optimal bid is $p_2(\theta)$ for all $\theta \in \left[\underline{\theta}, \hat{\theta}\right]$.

We now show that it is optimal for firm 2 not to participate if its type is $\theta \in \left(\hat{\theta}, \bar{\theta}\right]$. By choosing not to participate firm 2 gets zero. If it quotes a bid it cannot improve its payoff and the reason is as follows. Suppose firm 2's type is $\theta \in \left(\hat{\theta}, \bar{\theta}\right]$ and it quotes a bid $p \geq \bar{p}$. Then it wins with zero probability and gets zero expected payoff. If it quotes a bid $p < \bar{p}$, then its payoff conditional on winning, $[p - A_2(\theta, 1)] < 0$. The reason is $p < \bar{p}$ and $A_2(\theta, 1) > A_2\left(\hat{\theta}, 1\right) = \bar{p}$ for all $\theta \in \left(\hat{\theta}, \bar{\theta}\right]$. Hence, when 2's type is $\theta \in \left(\hat{\theta}, \bar{\theta}\right]$, its optimal action is not to participate.■

Comment Proposition 1 provides the Bayesian Nash equilibrium in the first stage auction game. All types of the favoured firm (firm 1) quotes a bid. favouritism ($h_1 > 1$) drives a wage between the firms and firm 2 (which is not the favoured one) chooses not to participate if its type $\theta_2 \geq \hat{\theta}$. Lemma 4 demonstrates that higher h_1 leads to a lower $\hat{\theta}$. That is, higher is the favouritism index, h_1, more types of firm 2 are forced to stay out of the auction process as the interval of types choosing not to participate, $\left(\hat{\theta}, \bar{\theta}\right]$, expands. *This means favouritism is discriminatory and it reduces competition.*

We now come to our next main result.

Proposition 3 *For all* $h_1 \in \left(1, \bar{h}\right]$ *and* $\forall \theta \in \left(\underline{\theta}, \hat{\theta}\right]$, $p_1(\theta) < p_2(\theta)$.

Proof Let $H\left(.\right) : \left[\underline{\theta}, \hat{\theta}\right] \to \mathbb{R}$ and $H\left(\theta\right) = p_1\left(\theta\right) - p_2\left(\theta\right)$ for all $\theta \in \left[\underline{\theta}, \hat{\theta}\right]$. Note that

$$p_1\left(\theta\right) = p_2\left(\theta\right) \Rightarrow \phi_2\left(p_1\left(\theta\right)\right) = \phi_2\left(p_2\left(\theta\right)\right) = \theta \text{ } and \text{ } \phi_1\left(p_2\left(\theta\right)\right) = \phi_1\left(p_1\left(\theta\right)\right) = \theta$$

Using this in (10) and (11) we get

$$\begin{aligned} p_1\left(\theta\right) &= p_2\left(\theta\right) \Rightarrow \ p_1\left(\theta\right) - A_1\left(\theta, h_1\right) = p_2'\left(\theta\right)\left[\frac{1 - F\left(\theta\right)}{f\left(\theta\right)}\right] - - - (12) \\ p_1\left(\theta\right) &= p_2\left(\theta\right) \Rightarrow p_2\left(\theta\right) - A_2\left(\theta, 1\right) = p_1'\left(\theta\right)\left[\frac{1 - F\left(\theta\right)}{f\left(\theta\right)}\right] - - - (13) \end{aligned}$$

Note that from lemma 3(iii) we get $\forall h_1 \in \left(1, \bar{h}\right],\ A_1\left(\theta, h_1\right) < A_2\left(\theta, 1\right)$. Therefore,

$$p_1\left(\theta\right) = p_2\left(\theta\right) \Rightarrow LHS \text{ } of \text{ } (12) > LHS \text{ } of \text{ } (13)$$

This means

$$p_1\left(\theta\right) = p_2\left(\theta\right) \Rightarrow p_1'\left(\theta\right) < p_2'\left(\theta\right) - - - - (14)$$

That is,

$$H\left(\theta\right) = 0 \Rightarrow H'\left(\theta\right) < 0 - - - - (15)$$

Since, $p_1'\left(\theta\right) > 0$ for all $\theta \in \left[\underline{\theta}, \bar{\theta}\right)$, we have

$$p_1\left(\hat{\theta}\right) < p_1\left(\bar{\theta}\right) = \bar{p} = p_2\left(\hat{\theta}\right) - - - - (16)$$

Hence,

$$H\left(\hat{\theta}\right) < 0.$$

We now show that $H\left(\theta\right) < 0$ for all $\theta \in \left(\underline{\theta}, \hat{\theta}\right)$. Since $p_1\left(\underline{\theta}\right) = p_2\left(\underline{\theta}\right) = \underline{p}$, $H\left(\underline{\theta}\right) = 0$. Hence, from (15) we get $H'\left(\underline{\theta}\right) < 0$. Note that since $H'\left(\underline{\theta}\right) < 0$,

$$\exists \varepsilon > 0 \text{ } s.t. \text{ } H(\theta) < 0, \forall \theta \in \left(\underline{\theta}, \underline{\theta} + \varepsilon\right] - - - (17).$$

We now show that $H\left(\theta\right) < 0$ for all $\theta \in \left(\underline{\theta} + \varepsilon, \hat{\theta}\right)$. Suppose on the contrary, $H(y) \geq 0$ for some $y \in \left(\underline{\theta} + \varepsilon, \hat{\theta}\right)$. Note that $H\left(\underline{\theta} + \varepsilon\right) < 0$ and $H\left(y\right) \geq 0$. Since $H\left(.\right)$ is continuous, by using the intermediate value theorem we get that $\exists s \in \left(\underline{\theta} + \varepsilon, y\right]$ such that. $H\left(s\right) = 0$.

$$Let \text{ } z = min\left\{t \mid H(t) = 0,\ t \in \left(\underline{\theta} + \varepsilon, y\right]\right\}$$

Since $H\left(z\right) = 0$, using (15) we get that $H'\left(z\right) < 0$. This implies

$$\exists \delta > 0 \text{ } and \text{ } z - \delta > \underline{\theta} + \varepsilon,\ s.t. \text{ } H(\theta) > 0,\ \forall \theta \in \left[z - \delta, z\right) - - - (18)$$

From (17) we get $H(\underline{\theta}+\varepsilon)<0$ and from (18) we get $H(z-\delta)>0$. Again, since $H\left(.\right)$ is continuous, by the intermediate value theorem,

$$\exists r \in \left(\underline{\theta}+\varepsilon, z-\delta\right) \ \ s.t. \ H\left(r\right)=0 - - - - (19)$$

This implies $r<z$. But this a contradiction as $z=min\left\{t \mid H(t)=0, \ t\in(\underline{\theta}+\varepsilon, y]\right\}$. Hence, $H\left(\theta\right)<0$ for all $\theta \in \left(\underline{\theta}, \hat{\theta}\right)$.■

In figure 1 below we provide the bidding strategies of both firms.

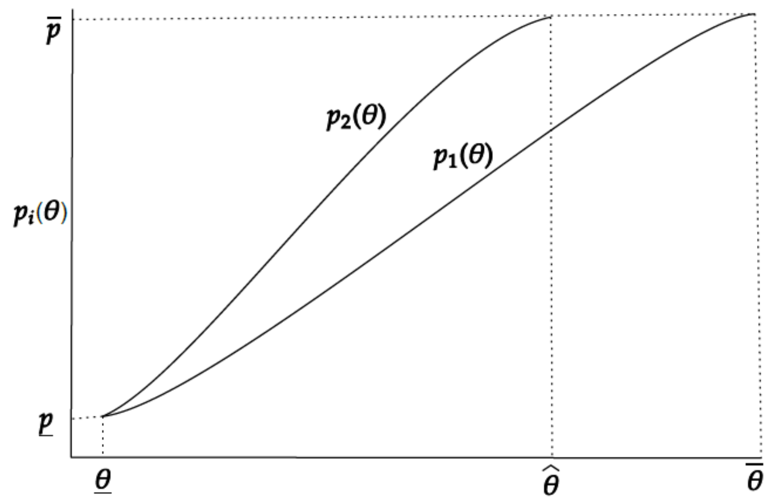

Figure 1: $p_1\left(.\right)$ and $p_2\left(.\right)$

Comment: A favoured firm bids less than the firm which is not favored. We can conclude that *favouritism leads to aggression*. A favoured firm is the one which gets benefitted more vis a vis less favoured firm for the same amount of bribe. Thus, it is relatively less costly for the favoured firm to bribe. Due to this, it bids lower than the firm which is not favored.[15]

Now suppose there is no favouritism. That is, $h_1=1$. Then, there would be a symmetric equilibrium and the equilibrium outcome will be efficient as the firm with the lower type (the more efficient firm) will always win the contract. However, when there is favouritism (i.e. $h_1>1$) then the equilibrium outcome is not efficient. There is a positive probability that a more inefficient firm will win the contract. Clearly, *favouritism breeds inefficiency.*

[15] Our results are in contrast with Krishna (2010, chapter 4). In his model of asymmetric distribution of bids, he shows that weak firm is the one which bids more aggressively. He defines a strong firm to be the one for which the distribution function of its values stochastically dominates the distribution function of values of the weak bidder. The bidder who bids more is considered to be an aggressive bidder. However, in our model of procurement auctions, an aggressive bidder is the one who bids lower. Thus, we see that the firm which is favoured more (strong firm) is more aggressive.

Also, note that when $h_1 > 1$, firm 1 is more likely to win the contract. This stems out of two factors: (i) firm 1's bids are lower (given any type) and (ii) firm 2 does not bid if its type is above the critical level $\hat{\theta}$. Since, firm 1's quality choice (when 1 wins) is strictly lower than firm 2's quality choice (when 2 wins), the expected quality that will be observed in equilibrium will be strictly lower than in the case where $h_1 = 1$ (no favouritism). *That is, favouritism leads to lower expected equilibrium quality.*

Note that in equilibrium, the expected payoffs are as follows.

$$\begin{aligned} E\pi_1(\theta, \theta) &= [1 - F(\phi_2(p_1(\theta))][p_1(\theta) - A_1(\theta, h_1)], \ \forall \theta \in [\underline{\theta}, \bar{\theta}] \\ E\pi_2(\theta, \theta) &= [1 - F(\phi_1(p_2(\theta))][p_2(\theta) - A_2(\theta, 1)], \ \forall \theta \in \left[\underline{\theta}, \hat{\theta}\right] \end{aligned}$$

We now proceed to our next proposition.

Proposition 4 *(i) $\forall h_1 \in \left(1, \bar{h}\right]$ and $\forall \theta \in \left[\underline{\theta}, \bar{\theta}\right)$, $E\pi_1(\theta, \theta) > E\pi_2(\theta, \theta)$. (ii) $E\pi_1(\theta, \theta)$ is strictly decreasing in θ for all $\forall \theta \in \left(\underline{\theta}, \bar{\theta}\right)$ and $E\pi_2(\theta, \theta)$ is strictly decreasing in θ for all $\forall \theta \in \left(\underline{\theta}, \hat{\theta}\right)$.*

Proof (i) Note that $p_1(\underline{\theta}) = p_2(\underline{\theta}) = \underline{p}$. This means $1 - F(\phi_2(p_1(\underline{\theta})) = 1 - F\left(\phi_2\left(\underline{p}\right)\right) = 1 - F(\underline{\theta}) = 1$. Similarly, $1 - F(\phi_1(p_2(\underline{\theta})) = 1$.

Hence,

$$\begin{aligned} E\pi_1(\underline{\theta}, \underline{\theta}) &= \underline{p} - A_1(\underline{\theta}, h_1) \\ E\pi_2(\underline{\theta}, \underline{\theta}) &= \underline{p} - A_1(\underline{\theta}, 1) \end{aligned}$$

Since from lemma 2(iii) we get $A_1(\underline{\theta}, h_1) < A_1(\underline{\theta}, 1)$ we must have

$$E\pi_1(\underline{\theta}, \underline{\theta}) > E\pi_2(\underline{\theta}, \underline{\theta}).$$

From proposition 2 we have $\forall \theta \in \left(\underline{\theta}, \hat{\theta}\right]$, $p_1(\theta) < p_2(\theta)$. Now

$$\forall \theta \in \left(\underline{\theta}, \hat{\theta}\right], \ p_1(\theta) < p_2(\theta) \Rightarrow \phi_2(p_1(\theta) < \theta < \phi_1(p_2(\theta) ----(20)$$

From (20) we get

$$\forall \theta \in \left(\underline{\theta}, \hat{\theta}\right], \ [1 - F(\phi_2(p_1(\theta)))] > [1 - F(\theta)] > [1 - F(\phi_1(p_2(\theta))] --- (21)$$

By the definition of Bayesian Nash equilibrium, $p_1(.)$ is the best response to $p_2(.)$. Given $p_2(.)$, the expected payoff accruing to firm 1, with type θ, when it quotes $p_1(\theta)$ is at least as large as the expected payoff in case it quotes $p_2(\theta)$ instead of $p_1(\theta)$. That is, $\forall\theta \in \left(\underline{\theta}, \hat{\theta}\right]$,

$$\begin{aligned}
E\pi_1(\theta,\theta) &= [1-F(\phi_2(p_1(\theta)))][p_1(\theta)-A_1(\theta,h_1)] \\
&\geq [1-F(\phi_2(p_2(\theta)))][p_2(\theta)-A_1(\theta,h_1)] \\
&= [1-F(\theta)][p_2(\theta)-A_1(\theta,h_1)] \\
&> [1-F(\theta)][p_2(\theta)-A_2(\theta,1)] \quad (since\ A_1(\theta,h_1) < A_1(\theta,1)) \\
&> [1-F(\phi_1(p_2(\theta))][p_2(\theta)-A_2(\theta,1)] \quad (using\ 21) \\
&= E\pi_2(\theta,\theta).
\end{aligned}$$

Note that $p_2'(\theta) > 0$ for all $\theta \in \left[\underline{\theta}, \hat{\theta}\right)$. Using (10) we get that $\forall\theta \in \left(\hat{\theta}, \bar{\theta}\right)$, $p_1(\theta) - A_1(\theta,h_1) > 0$ and $[1-F(\phi_2(p_1(\theta)))] > 0$. This means $\forall\theta \in \left(\hat{\theta}, \bar{\theta}\right)$, $E\pi_1(\theta,\theta) > 0$. Also, note that firm 2 does not participate if its type is $\theta \in \left(\hat{\theta}, \bar{\theta}\right]$. It's payoff is zero. Hence, $\forall\theta \in \left(\hat{\theta}, \bar{\theta}\right)$, $E\pi_1(\theta,\theta) > E\pi_2(\theta,\theta)$. Therefore, we have established that $\forall\theta \in \left[\underline{\theta}, \bar{\theta}\right]$, $E\pi_1(\theta,\theta) > E\pi_2(\theta,\theta)$.

(ii) From the proof of lemma 3(i) we have $\frac{\partial A_1(.)}{\partial\theta} = c_\theta(q_1^*(\theta,h_1),\theta)$ and $\frac{\partial A_2(.)}{\partial\theta} = c_\theta(q_2^*(\theta,1),\theta)$.

Note that

$$\begin{aligned}
\forall\theta &\in \left[\underline{\theta}, \bar{\theta}\right),\ \frac{\partial E\pi_1(\theta,\theta)}{\partial\theta} \\
&= \frac{\partial}{\partial\theta}[1-F(\phi_2(p_1(\theta)))][p_1(\theta)-A_1(\theta,h_1)] \\
&= -f(\phi_2(p_1))\phi_2'(p_1(\theta))p_1'(\theta)[p_1(\theta)-A_1(\theta,h_1)] + [1-F(\phi_2(p_1(\theta)))][p_1'(\theta)-c_\theta(q_1^*(\theta,h_1),\theta)] \\
&= -[1-F(\phi_2(p_1(\theta)))]c_\theta(q_1^*(\theta,h_1),\theta) \quad (using\ 9\ and\ the\ fact\ that\ p_1'(.) > 0) \\
&< 0 \quad (since\ c_\theta(.) > 0).
\end{aligned}$$

Similarly, $\forall\theta \in \left[\underline{\theta}, \hat{\theta}\right)$, $\frac{\partial E\pi_2(\theta,\theta)}{\partial\theta} = -[1-F(\phi_1(p_2(\theta)))]c_\theta(q_2^*(\theta,1),\theta) < 0.$■

In figure 2 below we provide the expected payoffs of both firms.

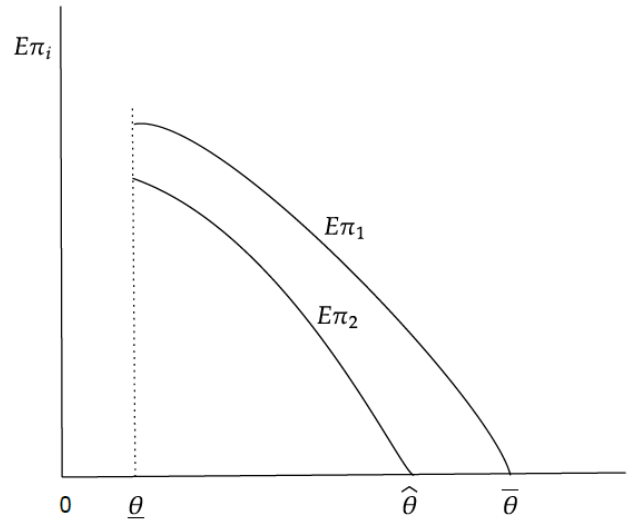

Figure 2: $E\pi_1(.)$ and $E\pi_2(.)$

Comment Note that for any given type, θ, both firms have the same efficiency level (same cost). Yet, favouritism ($h_1 > 1$) induces a higher payoff to firm 1. The reason is that favouritism drives a wedge between the firms and reduces the favoured firm's total equilibrium cost (see lemma 3). *This shows that favouritism is unfair.* This also indicates some form of crony capitalism and evidences from many emerging economies show that such is indeed the case (Chaudhuri et al, 2022 provide some real life examples from India).

4 Conclusion

In this paper we theoretically analysed the effects of favouritism and corruption in procurements in the context of an emerging economy. There are two firms: one is the favoured one and the other is not the favoured one. The firm that wins the contract needs to supply a good that meets a certain quality standard without which its payment would be withheld. There is also corruption in the system: if the measured quality falls short of the minimum stipulated one, the winner can pay a bribe to inflate the reported quality. The favoured firm can get away with a lower bribe as compared to a firm which is favoured less in case the quality threshold is not met. Such kinds of favouritism, often based on kinship, is widely prevalent in emerging economies like India. We show that favouritism is discriminatory and it reduces competition, induces inefficient outcomes and leads to lower expected equilibrium quality. We also demonstrate that the favoured firm earns a higher expected profit as compared to the firm which is favoured less. Our theoretical findings resonate with the prevailing scenario in many emerging economies.

This research can be further extended to design mechanisms that helps to overcome the effects of favouritism and ensure efficiency. Furthermore, in this paper we did not bring in the incentive structure for the agent that collects the bribe. One can explore the competition in bribes to see its impact on the equilibrium bids and quality.

References

1. Arozamena, L. and F. Weinschelbaum. (2009). "The effect of corruption on bidding behavior in first-price auctions". *European Economic Review*, **53**, 645-657.

2. Attewell, P., and S. Thorat. (2010). "Caste is not past". in *Discrimination in an Unequal World* (ed. by Centeno, M.A. and K.S. Newman) Oxford Scholarship Online. DOI:10.1093/acprof:oso/9780199732166.003.0012.

3. Bank, W. (2016). *Benchmarking public procurement 2016.* Washington DC: World Bank.

4. Burguet, R. and Y.K. Che. (2004). "Competitive procurement with corruption". *RAND Journal of Economics*, **35**, 50-68.

5. Burguet, R. (2017). "Procurement design with corruption". *American Economic Journal: Microeconomics*, **9**, 315-41.

6. Celentani, M., and J.J. Ganuza (2002). "Corruption and competition in procurement". *European Economic Review*, **46**, 1273-1303.

7. Chaudhuri, S., K.G. Dastidar and S. Mahata. (2022). "Cronyism and corruption in India: A game theoretic analysis". *Managerial and Decision Economics* (forthcoming) https://onlinelibrary.wiley.com/doi/epdf/10.1002/mde.3550

8. Che, Y. K., and I. Gale. (2006). "Revenue comparisons for auctions when bidders have arbitrary types". *Theoretical Economics*, **1**, 95-118.

9. Chu, J. R. Fisman, S. Tan, and Y. Wang. (2021). "Hometown favouritism and the quality of government monitoring: Evidence from rotation of Chinese auditors". *American Economic Journal: Applied Economics*, **13**, 176-201.

10. Compte, O., A. Lambert-Mogiliansky and T. Verdier. (2005). "Corruption and competition in procurement auctions". *Rand Journal of Economics*, **36**, 1-15.

11. Corns, A. and A. Schotter. (1999). "Can Affirmative Action Be Cost Effective? An Experimental Examination of Price-Preference Auctions". *American Economic Review*, **89**, 291-305.

12. Dastidar, K. G. (2017). *Oligopoly, Auctions and Market Quality*, Springer, Tokyo, Japan.

13. Dastidar, K.G. and S. Jain (2021). "Incompetence and corruption in procurement auctions" Available at SSRN: <<http://dx.doi.org/10.2139/ssrn.3890759>>

14. Dastidar, K. G. and D. Mukherjee. (2014). "Corruption in delegated public procurement auctions". *European Journal of Political Economy*, **35**, 122–127.

15. Dastidar, K.G. and M. Yano. (2020). "FCPA and Market Quality in Emerging Economies". *RIETI Discussion Paper Series 20-E-087.*

16. Dastidar, K.G. and M. Yano. (2021). "Corruption, market quality, and entry deterrence in emerging economies". *International Journal of Economic Theory*, **17**, 101-117.

17. Dávid-Barrett, E. and M. Fazekas. (2020). "Grand corruption and government change: an analysis of partisan favouritism in public procurement". *European Journal on Criminal Policy and Research*, **26**, 411–430.

18. Decarolis, F. and C. Giorgiantonio (2014). "favouritism and inefficiency in procurement: evidence from public works in Italy", In *Public Procurement's Place in the World (ed. by* Decarolis, F. and M. Frey), Palgrave Macmillan, London, pp. 155-183.

19. Do, Q. A., K. T. Nguyen and A.N. Tran. (2017). "One mandarin benefits the whole clan: hometown favouritism in an authoritarian regime". *American Economic Journal: Applied Economics*, **9**, 1-29.

20. Emerick, K. (2017). "The cost of favouritism in network-based markets" *IED Discussion Paper Series - Institute for Economic Development, Boston University* 2017 No.288 pp.65 pp. ref.39. <<https://www.cabdirect.org/cabdirect/abstract/20173158454>>

21. Faccio, M. (2006). "Politically connected firms". *American Economic Review*, **96**, 369-386.

22. Hessami, Z. (2014). "Political corruption, public procurement, and budget composition: Theory and evidence from OECD countries". *European Journal of Political Economy*, **34**, 372-389.

23. Jain, S. (2021). *Oligopolistic Interactions in the Presence of Public Goods.* Unpublished Ph.D Dissertation, Jawaharlal Nehru University, New Delhi, India.

24. Kirkegaard, R. (2012). "favouritism in asymmetric contests: head starts and handicaps". *Games and Economic Behavior*, **76**, 226-248.

25. Kirkegaard, R. (2013). "Handicaps in incomplete information all-pay auctions with a diverse set of bidders". *European Economic Review*, **64**, 98-110.

26. Krasnokutskaya, E. and K. Seim. (2011). "Bid preference programs and participation in highway procurement auctions". *American Economic Review*, **101**, 2653-86.

27. Krishna, V. (2010). *Auction Theory*, Second Edition, Academic Press/Elsevier Inc.

28. Kühn, S. and L. B. Sherman. (2014). "Curbing corruption in public procurement: a practical guide", *Transparency International,* Berlin, Germany.

<<https://knowledgehub.transparency.org/product/curbing-corruption-in-public-procurement-a-practical-guide>>

29. Lengwiler, Y. and E. Wolfstetter. (2006). "Corruption in Procurement Auctions", in *Handbook of Procurement* (ed. by Dimitri, N., G. Piga and G. Spagnolo.), Cambridge University Press, U.K. 412-429.

30. Lengwiler, Y. and E. Wolfstetter. (2010). "Auctions and corruption: An analysis of bid rigging by a corrupt auctioneer". *Journal of Economic Dynamics and Control*, 34, 1872-1892.

31. Marjit, S. (2012). "Auction and Corruption". *Economic and Political Weekly*, **47**, 24-26.

32. Minchuk, Y. and A. Sela. (2018). "Prebidding first-price auctions with and without head starts". *Mathematical Social Sciences*, **91**, 51-55.

33. Pi, J. (2020). "An investigation of seeming favouritism in public procurement" *Manchester School*, **89**, 128-137.

34. Safina, D. (2015). "favouritism and Nepotism in an Organization: Causes and Effects" *Procedia Economics and Finance*, **23**, 630-634.

35. Segev, E. and A. Sela. (2014). "Sequential all-pay auctions with head starts". *Social Choice and Welfare*, **43**, 893-923.

36. Smith, D. (2015). "Where Concorde once flew: The story of President Mobutu's 'African Versailles' ". *The Guardian, 10 February, 2015.*

Available at: https://www.theguardian.com/cities/2015/feb/10/where-concordeonce-flew-the-story-of-president-mobutus-african-versailles.

37. Stoll, M. A., S. Raphael and H. J. Holzer. (2004). "Black job applicants and the hiring officer's race". *ILR Review*, **57**, 267-287.

38. Thorat, S. and P. Attewell. (2007). "The Legacy of Social Exclusion" *Economic and Political Weekly*, **42**, 4141-4145.