Proceedings of ICFTBA 2024 Workshop: Finance's Role in the Just Transition
DOI: 10.54254/2754-1169/143/2024.GA18954

Current State and Countermeasures of Procurement Collusion: An Exploratory Study

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Abstract: Procurement collusion is a significant issue affecting both public and private sectors, typically characterized by suppliers and contractors manipulating competitive processes to inflate costs, reduce quality, or diminish competition. This exploratory study reviews key literature on the mechanisms of procurement collusion, including bid-rigging, market-sharing, and favor exchanges. The economic impact is substantial, particularly in public procurement, where corruption results in significant financial losses and erodes institutional trust. Technological solutions such as AI and blockchain show promise in detection and prevention, though these innovations must be supported by robust legal and regulatory frameworks. However, cultural acceptance of corruption, coupled with limited regulatory resources, poses operational challenges. This study suggests that procurement collusion can be effectively addressed through a multi-faceted approach, incorporating technological innovations, stronger legal frameworks, and institutional reforms.

Keywords: Procurement collusion, Bid-rigging, Blockchain technology, Public procurement, Anti-corruption measures.

1. Introduction

Procurement collusion is a pervasive issue that affects both public and private procurement markets. It typically involves coordinated actions by suppliers or contractors to manipulate the competitive process, leading to artificially inflated costs, reduced quality, or diminished market competition[1,2]. Given that procurement often involves substantial public funds, maintaining integrity in these processes is critical to ensuring economic stability and fostering public trust [3]. This literature review explores the dimensions of procurement collusion, its economic implications, and strategies proposed to counteract this widespread problem.

2. Nature and Mechanisms of Procurement Collusion

Procurement collusion tends to occur more often than not in markets that have been the subject of artificial constraint or maintenance of competition by corrupt means. Some of the most common mechanisms of collusion in procurement include bid-rigging, market sharing, and favour exchanges[4,5]. These schemes typically involve firms collaborating to pre-determine the outcome of competitive bids, often with the tacit or overt cooperation of procurement officials[6,7].

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2.1. Bid-Rigging and Favor Exchange

Ishii studied procurement auctions in Japan research study that looked at the details of various aspects of bid-rigging whereby firms coordinate to allow one among them to win a contract, often in exchange for promises of future benefits or participation in other rigged bids[8]. This exchange of favours keeps cycling around between companies. Yet, since such collusive schemes depend on long-term relations between firms, cooperation is sustainable during rather long periods when both parties win from it[4,8].

An empirical research into repeated auctions in Japan, as highlighted by Ishii, has demonstrated that the collusive behaviours are not only structured but also methodically exchanged with losing bidders making sham high bids to guarantee the winner's victory[8,9]. The study depicts how bid-rigging, through pre-bidding meetings, ensures that the prices remain artificially high with the sole aim of lowering the cost efficiency of a procurement process and incur massive losses on the part of the public sector[8,9].

2.2. Market Sharing and Collusive Cartels

The second most common way that collusion takes place in tendering situations, aside from bid-rigging, would be market sharing. Firms commonly agree to divide markets along geographical or product-type lines when competition is very scarce or nonexistent in specific regions or industries[10]. Lima et al. investigated this issue in various public procurement systems and demonstrated how the collusive cartels either simply rig bids or divide up sectors and territories with an explicit goal of avoiding competition altogether[11]. For the latter reduces market efficiency, increases prices, and lessens innovative pressure by removing competitive pressures[10,11].

2.3. Pharmaceuticals and Medical Equipment Sector

Collusion has had grave consequences in the health industry, especially in tendering processes involving pharmaceuticals and medical equipment. Corruption studies in pharmaceutical procurement by multinationals and domestic firms have indicated how collusion and corrupt practices between suppliers and government officials have resulted in inflated drug prices, which further limited access to essential medications[12-14]. It has also been observed that hospitals and medical institutions engage in corrupt procurement practices in favour of certain suppliers in return for kickbacks. Not only does this increase the costs, but it also compromises patient care, since procurement decisions become dependent on financial interest rather than product quality or efficiency.

3. Economic Impact of Procurement Collusion

Collusion in procurement causes enormous economic damage. Public procurement, estimated at 12% of global GDP, is remarkably exposed to corruption and collusion, which lead to great losses and wastes[5,15]. The estimated open loss due to corruption in procurement is estimated at 10 to 25% of the value of the contract, sometimes as high as 40-50%[16]. In this regard, governments all around the world spend about US$11 trillion every year in public procurement, which accounts for 29.1% of government expenditure in OECD countries; therefore, public procurement is an indispensable element for economic development and social well-being[5]. According to the Estimates by the International Monetary Fund, saving related to the reduction of procurement corruption is expected to be about 1.25% of world GDP, an overwhelming figure considering the wide diffusion of these phenomena[17].

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Additionally, in public sector impact, procurement collusion increases the cost of goods and services while also hampering trust in institutions. Corrupt practices present an environment where there is misappropriation of public funds as well as opacity of the procurement process, which stipulates the opposite of competition for new or smaller entities[5].

4. Detecting and Preventing Collusion in Procurement

4.1. Technological Solutions

4.1.1. Artificial Intelligence (AI) and Machine Learning (ML) Applications

One of the most promising approaches to detecting and preventing procurement collusion is the application of Artificial intelligence (AI) and machine learning (ML). Works such as that of Lima et al. illustrate how text-processing methods under natural language processing (NLP) techniques allow automatic detection of red flags in procurement documents. AI models can detect suspicious patterns, which usually are one of the early indications about collusion, like inconsistency in bidding behaviour or some other pretty unusual price, through the data analysis of procurement[11]. For instance, certain kinds of red flags, either about restrictive clauses or abnormal bid submissions, can be detected automatically during processes through AI, allowing for quicker and more effective fraud detection.

The added value in this approach for fraud detection comes from the capabilities of AI in processing unstructured data such as bid documents, contracts, and emails. Those models, especially fit for understanding the pattern of language-elaborated ones such as Bidirectional Encoder Representations from Transformers (BERT), flag bid-rigging behaviours by determining suspicious textual elements[11]. This can highlight certain streaks of text that might draw on fraudulent collusion, something that otherwise will have to be read by human auditors through thick volumes of documents. Automation of this manual work greatly increases efficiency and accuracy in fraud detection.

Other studies went further to show how machine learning algorithms identify collusions when analyzing large volumes in many sectors' auction outcome data. For example, Rodríguez et al. ran ML algorithms on procurement data from countries including Brazil, Japan, and Switzerland, and reported that the models were able to identify bid collusion by comparing bid dispersions and pricing patterns. Other machine learning algorithms, such as Random Forest and Support Vector Machines(SVM), also show excellent performance in identifying collusive auctions by picking up very minute repeating patterns of bids in an auction[1]. These systems do call for substantial volumes of historical data to function effectively but provide tremendous improvements over traditional techniques for manual collusive auction detection.

4.1.2. Blockchain Technology for Transparency

The application of blockchain technology forms another technological solution on preventing procurement collusion. Blockchain does this by allowing for a decentralized, tamper-proof ledger on which procurement transactions can be tracked and, therefore, guarantees total transparency along the entire value chain of procurement. Blockchain thereby records every transaction permanently and makes it visible for all stakeholders, which is an important aspect in making the bid processes more transparent and accountable. Different studies, such as those of the World Economic Forum, emphasize how blockchains have been piloted to bring in added levels of transparency in addressing public procurement. Due to the importance which underpins having effective procurement, such blocked technologies pilot tested the Programa de Alimentación Escolar (PAE) public-school meal program in Colombia[18]. The proof of concept showed just how blockchain can register and track procurement activities in real time, while all bid submissions, contract awards, and performance metrics are immutable and visible to all authorized parties.

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This is further enshrined in the ability of blockchain to let no retroactive data manipulation go through, since any record changes on the chain would require consensus among participants. In this respect, blockchain provides protection against many of the practices at the root of procurement collusion, such as bid rigging and contract manipulation. Further research by Lima also indicates that blockchain technology may be particularly effective because it could be combined with smart contracts, which themselves automate processes such as bid evaluation and contract awards. Because such systems are automated, the potential for human intervention is reduced, along with the opportunity for collusion between bidders and public officials to take place [11].

Moreover, it helps retain the integrity of data on the procurement process, from tender announcement right to contract execution, as, by definition, blockchain records are immutable. This makes any discrepancies or unauthorized changes in the bid documents or a variety of contract terms easily traceable. Because, according to a report by the World Economic Forum, blockchain could also inspire public involvement due to easy access to procurement data by journalists, citizens, and anti-corruption agencies that oversee procurement activities and raise suspicions on suspicious behaviour [18]. Combining blockchains with NLP tools further enhances fraud detection by automating the identification of red flags in procurement documents [11].

Essentially, blockchain can increase transparency in procurement since it will ensure that every step of the procurement process is recorded and verified on a public platform. It will be able to track the procurement activities and prevent collusive behaviour by providing a tamper-proof, transparent platform to which manipulations about bids and contracts would become almost obvious. But blockchain is no utopian panacea; there are challenges like scalability issues and integration with the present legal frameworks. The potential of blockchain has gradually been realized in reducing procurement fraud and collusion in a number of pilot projects undertaken across the globe.

4.2. Legal and Regulatory Frameworks

4.2.1. Strengthening Legal Frameworks

While technology plays an important role, so does the legal framework in procurement processes. The stringency of anti-collusion laws and the effectiveness of their enforcement mechanisms have enabled better control of procurement collusions. According to Ishii, anti-trust enforcement has to be strengthened, especially in markets characterized by traditional collusive vulnerability, for example, public procurement in infrastructure projects [8]. One such crucial tool in fighting collusion is whistleblower programs. These programs accordingly offer legal protections or financial rewards for insiders in support of reporting collusive activities [5].

For instance, in Japan's public-works auctions, collusion often features as an institutionalized favor-exchange system whereby firms regularly rotate winners. Strong building of the legal framework to deal with systemic collusion demands not just hard punishment but also enhancement in terms of increasing transparency in the process of submitting bids and awarding contracts[8]. Moreover, whistleblower programs have proven effective in other jurisdictions, for example, there is the famous Operation Car Wash in Brazil, developed due to whistleblower testimony on massive procurement fraud and bid-rigging[5]. Legal frameworks need to be designed to protect against retaliation from the whistleblowers, but at the same time, ensure that reports lead to meaningful investigations and sanctions.

Apart from that, Anderson pointed out the necessity of greater international collaboration in regard to reforming public procurement. This would be achieved by harmonizing procurement laws across borders because supplier collusion is global in nature and the legal frameworks will ensure that their natures are punitive and preventive. It will also include other preventive measures like obligatory audits and third-party reviews for those projects rated as high risk [5].

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4.2.2. Audits and Randomized Monitoring

Another effective approach in the detection of procurement collusion is the introduction of unannounced audits and data-driven monitoring systems. Unannounced audits, together with the ability to cross-reference patterns of behaviour manifested by bidders during various contracts, may show certain patterns that may give a hint as to collusive behaviour. One such successful example of this initiative on the part of developing countries is the data-driven monitoring system launched by the Chamber of Accounts of the Kyrgyz Republic, which has come on board with a risk-based auditing methodology with regard to public procurement. This Open Contracting Data-driven algorithm uses machine learning models to flag high-risk transactions, thus enhancing substantially the collusive behaviour detection [19].

These systems combined with regular audits enable the government to detect suspicious patterns without having to wait for a whistleblower or to review each and every transaction. Making this procurement data readily available denotes an increase in the level of transparency that governments can provide. As happened in the Kyrgyz example, whereby the Ministry of Finance pledged to make contract information public, enabling civil society and third-party organizations independently to follow procurement activities.

Another factor explored in Japanese public procurement auctions by Ishii is that randomized audits must be supplemented with a monitoring system to control the exchanges of favours underlying a bid-rigging scheme[8]. According to Ishii, audits conducted in a systematic way and supported by real-time monitoring may reveal patterns of unusually low bid variances or high win-reserve ratios, which are considered important signals of cartel activity. By automating parts of the monitoring process, governments can ensure more frequent and thorough audits, reducing opportunities for bidders to manipulate the system.

5. Challenges in Implementing Countermeasures

A significant challenge in implementing countermeasures against procurement collusion lies in the cultural acceptance of corrupt practices in certain regions or sectors. Even with stringent legal frameworks and the most technologically advanced control systems, it is challenging to uproot corruption in markets where collusion has been institutionalized [20]. Corruption and collusion often are systemic problems, linked to local ways of doing things and institutional weaknesses. Anderson highlight that corrupt networks among public officials and firms in some jurisdictions are so strong that even stringent laws cannot easily break such relationships [5,20]. It is a culturally accepted set of behaviours, and anti-collusion measures will have lesser impacts as the participants would see such actions as standard operating procedures rather than criminal activities.

Another big challenge is that too little resource is allotted to the regulatory and enforcement agencies. Anti-collusion requires very specialized techniques and quite sophisticated monitoring tools. In fact, most governments do not invest adequate funds or expertise in their regulatory bodies. Anderson et al. have argued that without adequate financial and technical support, regulatory agencies are often outgunned by sophisticated collusion schemes. Moreover, the enforcement of anti-collusion laws is weakened by weak institutional capacity or political will in countries where corruption has generally permeated the system. This, again, is reflected in cases when procurement officials are not trained to detect collusive behavior or are for retaliation and thus reluctant to report any irregularity [20].

A related but even more challenging issue is systemic corruption. This starts from the top to the grassroots level in several countries, not just being isolated incidents, but as a structural problem of governance. As Anderson et al. suggest, such a response to this form of corruption requires more than either legal or technological countermeasures, rather it calls for wholesale reforms which will

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transform cultural attitudes and incentives toward honesty [20]. This in general would involve professionalizing the procurement workforce and increasing transparency of procurement systems, as well as stimulating collaboration between the public and private sectors to break the vicious spiral of corruption.

6. Conclusion

Procurement collusion presents a complex, multi-layered challenge that affects both public and private sectors. This study has highlighted various mechanisms of collusion, including bid-rigging, market-sharing, and favor exchanges, and discussed their significant economic impact. Technologically driven solutions, such as artificial intelligence (AI) and blockchain, combined with robust legal frameworks and regulatory oversight, offer promising avenues for detecting and preventing such practices. However, cultural and institutional barriers remain a significant obstacle. The persistence of corrupt practices, coupled with limited regulatory resources, hampers effective implementation. Ultimately, collaboration between governments, the private sector, and civil society will be crucial to safeguarding public resources and restoring trust in procurement systems.

References

[1] García Rodríguez, M. J., Rodríguez-Montequín, V., Ballesteros-Pérez, P., Love, P. E. D., & Signor, R. (2021). Collusion detection in public procurement auctions with machine learning algorithms. Automation in Construction, 133, 104047. https://doi.org/10.1016/j.autcon.2021.104047

[2] Cerrone, C., Hermstrüwer, Y., & Robalo, P. (2021). Debarment and collusion in procurement auctions. Games and Economic Behavior, 129, 114–143. https://doi.org/10.1016/j.geb.2021.05.011

[3] Clark, R., Coviello, D., Gauthier, J.-F., & Shneyerov, A. (2018). Bid rigging and entry deterrence in public procurement: Evidence from an investigation into collusion and corruption in Quebec. The Journal of Law, Economics, and Organization, 34(3), 301–363. https://doi.org/10.1093/jleo/ewy011

[4] Carbone, C., Calderoni, F., & Jofre, M. (2024). Bid-rigging in Public Procurement: Cartel strategies and bidding patterns. Crime, Law and Social Change. https://doi.org/10.1007/s10611-024-10142-0

[5] Anderson, R. D., Jones, A., & Kovacic, W. E. (2018). Preventing corruption, supplier collusion and the corrosion of Civic Trust: A procompetitive program to improve the effectiveness and legitimacy of Public Procurement. SSRN Electronic Journal. https://doi.org/10.2139/ssrn.3289170

[6] Anderson, R. D., Jones, A., & Kovacic, W. E. (2024). Corruption and collusion in public procurement: Opportunities, incentives, and harm caused. Combatting Corruption and Collusion in Public Procurement, 19–42. https://doi.org/10.1093/law-ocl/9780192855893.003.0002

[7] Antitrust Division. (2021, February). Price fixing, bid rigging, and Market Allocation Schemes. Antitrust Division U.S. Department of Justice. https://www.justice.gov/d9/pages/attachments/2016/01/05/211578.pdf

[8] Ishii, R. (2009). Favor exchange in collusion: Empirical study of repeated procurement auctions in Japan. International Journal of Industrial Organization, 27(2), 137–144. https://doi.org/10.1016/j.ijindorg.2008.05.006

[9] Ishii, R. (2008). Collusion in repeated procurement auction: A study of a paving market in Japan. SSRN Electronic Journal. https://doi.org/10.2139/ssrn.1148064

[10] Dijkstra, P. T. (2015). Price leadership and unequal market sharing: Collusion in experimental markets. International Journal of Industrial Organization, 43, 80–97. https://doi.org/10.1016/j.ijindorg.2015.08.003

[11] Lima, W., Lira, R., Paiva, A., Silva, J., & Silva, V. (2023). Methodology for automatic extraction of Red Flags in Public Procurement. 2023 International Joint Conference on Neural Networks (IJCNN), 2017, 01–07. https://doi.org/10.1109/ijcnn54540.2023.10191683

[12] Wang, X., Zhang, T., Gong, H., Li, J., Wu, B., Chen, B., & Zhao, S. (2024). Game-theoretic analysis of governance and corruption in China's pharmaceutical industry. Frontiers in Medicine, 11. https://doi.org/10.3389/fmed.2024.1439864

[13] Kohler, J. C., & Wright, T. (2020). The Urgent Need for Transparent and Accountable Procurement of Medicine and Medical Supplies in Times of COVID-19 Pandemic. Journal of Pharmaceutical Policy and Practice, 13(1). https://doi.org/10.1186/s40545-020-00256-w

[14] Rose-Ackerman, S., & Tan, Y. (2014). Corruption in the procurement of pharmaceuticals and Medical Equipment in China: The incentives facing multinationals, domestic firms and hospital officials. UCLA Pacific Basin Law Journal, 32(1). https://doi.org/10.5070/p8321028003

DOI: 10.54254/2754-1169/143/2024.GA18954

[15] How large is public procurement?. World Bank Blogs. (2020, February 5). https://blogs.worldbank.org/en/developmenttalk/how-large-public-procurement

[16] Olaya Garcia, D., & Wiehen, M.H. (2006). How to Reduce Corruption in Public Procurement: The Fundamentals.

[17] Mauro, P., Medas, P., & Fournier, J. M. (2019, September 1). The true cost of global corruption – IMF F&D. IMF. https://www.imf.org/en/Publications/fandd/issues/2019/09/the-true-cost-of-global-corruption-mauro

[18] Lannquist, A., & Raycraft, R. D. (2020). Exploring blockchain technology for government transparency: Blockchain-based public procurement to reduce corruption. World Economic Forum.

[19] Case study: Data-driven monitoring of Public Procurement in the Kyrgyz Republic's Chamber of Accounts. Open Contracting Partnership. (2022, February 3). https://www.open-contracting.org/resources/case-study-sai-kyrgyz/

[20] Jones, A., Anderson, R. D., & Kovacic, W. E. (2024). Combatting corruption and collusion in public procurement: A Challenge for Governments Worldwide. Oxford University Press.