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Effectiveness of E-Auction Programmes in Emerging Economies – Case of India

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Abstract

Local governments typically finance their infrastructure needs through leveraging their assets through auctions. Though auctions are popular in the sale and lease of government land world over, emerging economies are hampered by the lack of price and process transparency along with regulatory capture by private agents. Our primary research goal is to examine whether governments in emerging economies can increase revenues by selling land through e-auctions (anonymous auctions conducted online over a period of time) rather than through traditional “physical place” auctions. Using a quasi-natural experiment on land auctions of residential plots in the city of Bengaluru, India, we find that e-auctions have better differences in price discovery, transparency and lesser collusive behaviour of market participants and draw implications on whether technology can overcome systemic issues prevalent in developing economies.

Key words: E-Auction, Price Transparency, Real estate pricing, Hedonic modeling

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1. Introduction

Local governments typically finance their infrastructure needs through leveraging their assets. In countries where land is owned by the public sector, land is likely to be the single largest asset held by the government (Peterson, 2009).¹ Selling land and land-rights is a major option for financing urban infrastructure investment. The mechanism of monetising land and land-based assets has been variously dealt with by different countries - through public-private partnerships, through outright sales, or through land leasing.

Many municipal and local governments have used auction mechanisms to obtain the best possible value for alienation of rights in public land. Notwithstanding the multiple structures adopted by countries for land auctions, it is considered by-and-large as a very efficient method to extract values from land. Auctioning land is slated to lead to better price discovery, reduce collusion amongst market participants, reduce petty corruption at the hands of state officials and lead to more efficient land use. The primary advantage of the auction mechanism is that it allows governments to attain efficiency in allocation even in the absence of accurate knowledge of the value of the resource.

However, the efficiency of the auction process depends on how effective price discovery happens for these assets – i.e., the ability to generate open competition in the bids. In developed economies, it is easier to determine this effectiveness as there is a great deal of price and process transparency. In developing economies such as in India, lack of transparency combined with corruption makes it harder for governments to extract the best possible value for these assets, in spite of the auction mechanism. Even where auction mechanisms have been used for price discovery, it is not certain whether the process attained the necessary allocative efficiencies, or was subverted by vested interests. The auctioning of the 2G spectrum in India is a case in point.

Though auctions are popular in the sale and lease of government assets² such as the sale of spectrum, mining rights (Chan, Laplagne and Appels, 2003), the lack of price and process transparency along with regulatory capture by private agents in emerging economies make them less effective. Particularly, auctions that disclose the bidders' identity provide ample space for implicit collusion at the expense of the government for instance, the spectacular telecom spectrum scam in India (Kumar, 2010³; Cramton et al, 2000⁴, Mead, 1967⁵). Information about other bidders' prices could be made privately available by auction officials to create comparative advantage. In “physical place” auctions, bidders are required to be physically present

¹ Peterson, G. E. (2009). *Unlocking land values to finance urban infrastructure*(Vol. 7). World Bank Publications.

² Chan, C., Laplagne, P., & Appels, D. (2003). The role of auctions in allocating public resources. *Productivity Commission Staff Research Paper*, (1723).

³ Kumar, A. (2010). 3G Spectrum Auctions in India: Have We Learnt the Right Lessons?. *Available at SSRN 1545045*.

⁴ Cramton, P., & Schwartz, J. A. (2000). Collusive bidding: Lessons from the FCC spectrum auctions. *Journal of regulatory Economics*, 17(3), 229-252.

⁵ Mead, W. J. (1967). Natural resource disposal policy-Oral auction versus sealed bids. *Nat. Resources J.*, 7, 194.

which could promote collusion possibilities among a few to the detriment of others. These issues are compounded in developing economies where corruption is high and enforcement is weak.

Among the several methods that have been suggested to improve the integrity of the auctions, replacing “physical place” auctions with technology aided e-auctions seems simple and cost effective. It brings in bidders from far and wide who are less likely to collude and makes private information sharing harder through encryption technologies and anonymous identities. It is also less onerous to collect and store audit trail of the bidding process making it easier to ensure compliance.

Though e-auctions have started being used by governments, it is not clear whether the structural weaknesses that exist in developing economies also render them ineffective. We seek to examine whether governments can mitigate some of this rent seeking behaviour by conducting auctions in cyberspace where bidders’ identity can be more securely protected.

Our primary research goal is to examine whether governments in emerging economies can increase revenues by selling land through e-auctions (anonymous auctions conducted online over a period of time) rather than through traditional “physical place” auctions (auctions where buyers and sellers come together in physical space and time). We study differences in price discovery, transparency and collusive behaviour of market participants in the two methods and draw implications on whether technology can overcome systemic issues prevalent in developing economies.

We use a natural experiment in the Indian land market to answer this question. Using data on land auctions from the growing city of Bengaluru (the fifth largest metropolis in India), we ask a set of pertinent questions: Have auctions in land actually changed the nature of price discovery in land markets? Are auctions designed in an efficient manner, so as to lead to lesser corruption by the state agencies and lesser collusion by the market participants? In a country like India, where prices are opaque and rent seeking is rampant, does the auction mechanism manage to introduce process efficiency and price discovery?

Our interest in this research stems from ‘auctions’ being touted as the best method to elicit price discovery in India, as seen in a variety of instances recently - the spectrum auction and the coal auction in India, for instance. Though auctions are popular in the sale and lease of government assets, there are certain other factors that modify the auction outcomes. The lack of price and process transparency as well as the ‘regulatory capture’ by private agents interfere in the price discovery process. Particularly, where participants are in a position to know, or guess at the identity of other bidders, implicit collusion among bidders would occur at the expense of the government. We seek to examine whether governments can alter buyers collusion by conducting auctions in cyberspace where bidders’ identity can be kept anonymous.

Our study contributes to literature in multiple ways. By comparing price discovery in the physical auction and e-auction regimes, we calculate the cost of collusion

amongst buyers, or instances of public official's connivance with the bidders, in a market with high levels of rent-seeking behaviour and paucity of land information. The results of our study would directly provide evidence on how governments, especially in emerging economies, could use innovative practices to sidestep endemic corruption and weak systems to increase revenues for basic services.

This paper is interesting because, apart from being one of the first papers discussing the land auction market in India, it has significant policy implications for improving auction designs. Improved auction design will have an important role in reducing collusion. Also, this paper will seek to develop an understanding of the factors (like different auction designs, and through premiums/discounts for auctions vs. private treaties) that affect price discovery in an opaque land market like India.

The first section deals with the land market in Bengaluru, India, and the role of the development authority in releasing land for development. Section three then presents the data and methodology, followed by the discussion of our hypotheses for the research study. The last section presents the empirical findings next and the final section concludes with a discussion of results, analyses and policy implications.

2. Literature Review

Land auctions are commonly used to dispose land by various levels of government as a mechanism of 'land finance'. The World Bank (1999, 2000) advocates that cities in developing countries capitalise on their land holdings to raise monies for meeting their infrastructure needs, and may public-private partnerships take the form where the private agency brings in the expertise and the management whereas the state agency (public agency) provides the land and other land-related development. Peterson (2009) documents various methods by which governments have capitalised on their land holdings across India, Ethiopia and China to generate funds for municipal finance and infrastructure provisions. Urban development authorities in India, which are in charge of development and disposal of land holdings routinely undertake land financing activities to meet the government's needs for finance.

Auctions are commonly used to generate the highest value for land parcels, especially where land is sold by the government or its agents. Land is only one of the many assets auctioned by the government. Auctions may be used for any scarce resource such as spectrum, conservation rights, foreclosed business assets etc. (Cramton et al 2002; Klemperer 2002; Milgrom, 2004). Well-designed auctions are shown to have higher allocative efficiency compared to other methods used by governments, including 'beauty contests', lottery, 'first-come, first-served' and negotiation (Cramton 2001; McMillan 1995)

China has a well-documented history of auctions since 2002, where government land is leased through auction mechanisms rather than through negotiated treaties to reduce corruption and collusion amongst officials and bidders. (Xie et al 2002⁶; Cao

⁶ Xie, Q., Parsa, A. G., & Redding, B. (2002). The emergence of the urban land market in China: evolution, structure, constraints and perspectives. *Urban Studies*, 39(8), 1375-1398.

et al 2008⁷). Cai et al 2013⁸ document the transition from negotiated treaties or 'beauty contests' to the auction mechanism by local governments in China and indicate that corruption may still be present in the two stage auction model, the English auction model usually followed for most properties probably faces reduced scenarios for corruption and collusion. Qu and Lui (2012)⁹ suggest that while auction definitely has led to increased prices, and thereby higher government revenue, there may be social and economic implications in terms of decreasing housing affordability due to inflated prices being paid by certain segments of buyers. Hongkong has a market for government sales of land holdings (Lai and Wang, 1999)¹⁰; Singapore again has very efficient markets for government auctions of land, auctions though the structure of the land market is marginally different (Ooi et al, (2006)¹¹, Ooi et al (2011)¹²). Property and land may be auctioned off under many circumstances. Apart from land leasing or sales by local governments, several countries have a well-developed property auction market where REO/ foreclosed properties are sold. Property markets behave quite differently from land markets, though there are some underlying similarities. Mayer (1995)¹³ showed in a theoretical mode that quick sales through auctions lead to a decrease in prices since there is a poor match between the buyer and the property. The model also predicts that the discount would be higher in a down market to attract more buyers.

Mayer (1998)¹⁴, as well as Allen and Swisher (2000)¹⁵ test this empirically in the US and find results consistent with a discount. However, Lusht (1994)¹⁶ corroborates this, whereas other studies from Australia and New Zealand prove contradictory - Lusht (1996)¹⁷ establishes that in Melbourne, auction properties do have a premium, as do properties in New Zealand (Dotzour, Moorhead, and Winkler, 1998¹⁸) and in Ireland (Stevenson and Young (2004)¹⁹). This result has not proved to be generalized since all samples considered seem to have suffered from biases of either economic nature or in property selection.

⁷ Cao, G., Feng, C., & Tao, R. (2008). Local "land finance" in China's urban expansion: challenges and solutions. *China & World Economy*, 16(2), 19-30.

⁸ Cai, H., Henderson, J. V., & Zhang, Q. (2013). China's land market auctions: evidence of corruption?. *The Rand journal of economics*, 44(3), 488-521.

⁹ Qu, W., & Liu, X. (2012). Assessing the performance of Chinese land lease auctions: evidence from Beijing. *Journal of Real Estate Research*, 34(3), 291-310.

¹⁰ Lai, N., & Wang, K. (1999). Land-supply restrictions, developer strategies and housing policies: the case in Hong Kong. *International Real Estate Review*, 2(1), 143-159.

¹¹ Ooi, J. T., Sirmans, C. F., & Turnbull, G. K. (2006). Price formation under small numbers competition: evidence from land auctions in Singapore. *Real Estate Economics*, 34(1), 51-76.

¹² Ooi, J. T., Sirmans, C. F., & Turnbull, G. K. (2011). Government supply of land in a dual market. *Real Estate Economics*, 39(1), 167-184.

¹³ Mayer, C. J. (1995). A model of negotiated sales applied to real estate auctions. *Journal of Urban Economics*, 38(1), 1-22.

¹⁴ Mayer, C. J. (1998). Assessing the performance of real estate auctions. *Real Estate Economics*, 26(1), 41-66.

¹⁵ Allen, M., & Swisher, J. (2000). An analysis of the price formation process at a HUD auction. *Journal of Real Estate Research*, 20(3), 279-298.

¹⁶ Lusht, K. M. (1994). *Forecasting and Investment Selection in Property Markets*. University of Western Sydney, Hawkesbury, Faculty of Management.

¹⁷ Lusht, K. M. (1996). A comparison of prices brought by English auctions and private negotiations. *Real Estate Economics*, 24(4), 517-530.

¹⁸ Dotzour, M., Moorhead, E., & Winkler, D. (1998). The impact of auctions on residential sales prices in New Zealand. *Journal of Real Estate Research*, 16(1), 57-72.

¹⁹ Stevenson, S., & Young, J. (2004). Valuation accuracy: A comparison of residential guide prices and auction results. *Property Management*, 22(1), 45-54.

The study of auctions in land markets has mostly been for the developed land markets such as the US, due to readily available data and information transparency. One of the most challenging research issues, especially for land auctions, is whether auctions are better at price discovery compared to private treaty. The answer depends a lot on the type of market, the situation at which the auction is conducted, as well as the design of the auction. For instance, Case & Shiller 1989, 1990 in one of the earliest studies, conclude that auction markets are suboptimal, and indicate that the large transaction costs and the thinness of the real estate market are causes for sub-optimal auctions in land. Others, who argue that in US markets, auctions are a last resort action for properties that are not sold, claim there is an endogeneity problem in the properties that are chosen for auction (Vanderporten 1992); in the absence of endogeneity, Ashenfelter and Genesove (1992) indicate that prices tend to be upto 13% higher in auction markets, though Mayer, 1998, declares that prices are lower on average in auction land markets.

Auction mechanisms also have an impact on the price. Though the revenue equivalence theorem (Vickrey 1961)²⁰ suggests that the English auction (also known as the oral, outcry, or ascending-bid auction), the Dutch (or descending-bid) auction, the first-price sealed-bid auction and the second price sealed-bid (Vickrey) auction would all result in the same price, these have not been proved empirically in land markets. The nature of real estate markets are more common value markets than independent value markets, so each bidder's estimate of value is not truly independent of subjective valuation of other bidders, as per McAfee (2002)²¹. Therefore, the design of the auction, the number of bidders, bid increments, initial valuations and reserves, all has an impact on the final price realised in real estate auctions. Also, real estate auctions are simultaneous auctions of heterogeneous goods with complementarity (in adjacent parcels of developed land are auctioned) and substitutability (where one parcel is partially substitutable for another). Refer Milgrom (2004)²², Klemperer (1999)²³; Klemperer (2002)²⁴; Klemperer (2004)²⁵ for a study of auctions in practise and elements of auction design.

The pitfalls with various types of auctions are well-discussed in literature. Milgrom and Weber (1982)²⁶ and Quan (1994)²⁷ indicate that the English Auction where bidders are known to other bidders (open bidding takes place), information sharing and collusion across bidders is quite common. The cost of retaliation to non-compliers is cheap, so repeated bidding with the same set of bidders is strongly collusive in nature (Cramton et al, 2000). Seow et al (2005)²⁸ discuss the impact of bidder turnout on auction prices. Auction processes are efficient in price discovery if

²⁰ Vickrey, W. (1961). Counterspeculation, auctions, and competitive sealed tenders. *The Journal of finance*, 16(1), 8-37

²¹ McAfee, R. P., Quan, D. C., & Vincent, D. R. (2002). How to set minimum acceptable bids, with an application to real estate auctions. *The Journal of Industrial Economics*, 50(4), 391-416.

²² Milgrom, P. R. (2004). *Putting auction theory to work*. Cambridge University Press.

²³ Klemperer, P. (1999). Auction theory: A guide to the literature. *Journal of economic surveys*, 13(3), 227-286.

²⁴ Klemperer, P. (2002). What really matters in auction design. *The Journal of Economic Perspectives*, 16(1), 169-189.

²⁵ Klemperer, P. (2004). Auctions: theory and practice. Available at SSRN 491563.

²⁶ Milgrom, P. R., & Weber, R. J. (1982). A theory of auctions and competitive bidding. *Econometrica: Journal of the Econometric Society*, 1089-1122.

²⁷ Quan, D. C. (1994). Real estate auctions: A survey of theory and practice. *The Journal of Real Estate Finance and Economics*, 9(1), 23-49.

²⁸ Seow, O., Kenneth, L., & Chee, M. (2005). Factors influencing auction outcomes: bidder turnout, auction houses and market conditions. *Journal of Real Estate Research*, 27(2), 177-192.

there are more number of bidders such that the marginal impact of adding one extra bidder does not dramatically change the price (or bring new information to the process). From this perspective, number of bidders is considered very important for auction to be efficient in allocation.

Certain other environmental variables are important in the auction, such as the location of the land. Asabere and Huffman (1992), as well as Deboer, Conrad and McNamara (1992) discuss the importance of locational characteristics. The state of the market is important (Seow et al (2005)²⁹) - auctions tend to do better in better economic conditions; the discounts are higher in down markets (Mayer, 1998). Timing of auctions is important - both as the time during the auction (Ashenfelter 1989; Ashenfelter and Genesove, 1992; and Lusht, 1994), as well as the time between auctions (Asabere and Huffman, 1992; and Vanderporten, 1992). Auctions both absorb information from the markets in terms of valuations that bidders place on the land, they also complete a feedback loop by relaying hidden valuations of land back to the market. (Chau et al (2010)³⁰)

In practice, it's hard to arrive at an efficient price level for goods because of imperfectly competitive markets. Therefore the markets suggest sale by Auctions, a viable method for price discovery of goods. All forms of auction mechanisms can be traced back to four basic forms from which others can be designed and derived. Any complex auction format follows the basic structural environment as proposed by these four basic forms (English, Dutch, First-Price Sealed, Vickrey). The English auction format is of the most common type (McAfee and McMillan, 1987). In our study, we refer to physical or English auction format where the price trajectory follows an ascending pattern. The bidding rises until only one bidder remains, and the last remaining bidder (the winner) takes the good at the price bid by him (Chan et al, 2003).

The e-auctioning process aids the bidding procedure using technology, usually through the internet, while keeping the process and structure of the auction the same. Due to this difference, it becomes a part of the wider literature dealing with online auctions. The online auctions can be designed based upon different methodologies. Our study analyses the online auctions in comparison with the physical auctions, taking the case of auctioning procedure adopted by the Bangalore Development Authority for its land auctions.

The online auctioning market has mushroomed in the recent years with multinational organizations such as eBay taking the lead. The literature proposes that there are several advantages while shifting from physical to the online auctions. The online environment reduces the transaction costs and allows for the participation of a large number of bidders. The anonymity and free entry in the online auctioning system make bidder coordination and communication more difficult than the offline auction environments (Ockenfels, Reiley and Sadrieh, 2006).

²⁹ Seow, O., Kenneth, L., & Chee, M. (2005). Factors influencing auction outcomes: bidder turnout, auction houses and market conditions. *Journal of Real Estate Research*, 27(2), 177-192.

³⁰ Chau, K. W., Wong, S. K., Yiu, C. Y., Maurice, K. S., & Pretorius, F. I. (2010). Do unexpected land auction outcomes bring new information to the real estate market?. *The Journal of Real Estate Finance and Economics*, 40(4), 480-496.

Our basic aim is to explore the differentiating factors between the properties of English Auctions performed physically and electronically. Ariely and Simonson, 2003 give an introduction to online auctions and enlist various characteristics which distinguish them from physical auctions. They discuss advantages of e-auctions such as the elimination of geographical limitations and wider bidder participation. Regarding duration, internet auctions spread over a longer period (weeks or even months). The operational costs are lower in electronic auctions than in physical auctions where huge costs are involved in setting up the venue and infrastructure. More importantly, the authors differentiate online auctions on three fundamental factors i.e. multi-stage process happening over a period leading to dependent price estimations, when a unique good is under consideration. Second, different types of value signals or cues present in an online environment (when taking into account auctioning environments like ebay). Third, decision dynamics suggests that earlier decisions impact subsequent decisions of other bidders.

Broadly, two major differences remain between the two auction formats under study, bidder anonymity, and length of the auction. Literature proposes that online auction sales help curtail the problem of collusion by concealing the bidder identity, making any intra-auction communication between bidders difficult. There is sufficient evidence in the literature which points towards ill-effects of physical English Auctions because of revealed bidder identity. Transparency in oral auctions leads to collusive behaviour, aggressive bidding by larger bidders, retaliatory bidding, to point out a few. Therefore, anonymity plays a prominent role in conducting efficient auctions.

Fullbrunn and Neugebauer, 2009 provide experimental evidence in an independent private model, where they two different cases. In case 1, bidders were given anonymity treatment i.e. the bidder identity was held confidential. In case 2, the bidders knew each other's names and could identify who is bidding. They found that prices were not significantly lower in the friends' treatment. However, they report that there was no collusion in the anonymity treatment but some collusion in the friends' treatment. The study was conducted under laboratory conditions, an environment which might differ from the real world scenario. In another study, Cramton and Schwartz, 2000 discuss the costs of reporting bidder identities. They argue that reporting bidder identity discourages competitive bidding. Also, with bidder identities revealed, there is a tendency to suppress an average bidder by aggressive and retaliatory bidding by large bidders. Therefore deterring entry of potential bidders into the auction and hindering the efficient process of price discovery. Bajari and Yeo, 2009 provide evidence that anonymous bidding in FCC spectrum auctions has significantly brought down the collusion practices. They base their analysis on the auction data collected from 4 FCC auctions with different rules. They find that cases where bidder identity is public i.e. where there is more transparency, collusive practices are more prominent in such cases.

The online auctions are open for bidding through a window of generally a few months or weeks, whereas physical auctions are less spatial and happen over a shorter period (a few hours). This alienates the online auctions from physical ones structurally, where the former shows characteristics of multi-staged auctions. Literature has been inconclusive as to which of the two situations generate higher

revenue for the seller and provides favourable conditions for efficient auctions to take place. A few empirical studies have been done in this regard. Reiley et al, 2007 argue that most bidding occurs at the final minutes of an auction. Their results claim that longer auctions tend to fetch higher prices. Comparing 3, 5, 7 and 10 day auction formats, they find that 10-day auction bid prices are 42% higher, on average. They also find that longer auctions tend to attract a higher number of bidders. Melnik and Alm, 2002 also test the hypothesis that duration or length of the auction might have an impact on the price. Their results suggest that length of auction time does not have a significant impact on the prices. Similar results are shown by Hasker and Sickles, 2009. In most of these studies, the time-scale comparison is made between auctions of the same format (i.e. online ebay auctions) whereas our study demands a comparison between two different type of formats, physical auctions (shorter duration) and online auctions (longer duration).

Co-operative behaviour amongst bidders acts as one of the most common hindrances to competitive auctioning. We also try to explore empirical methods used in the literature to capture and measure the collusive behaviour of bidders in auctions. The empirical literature on detecting and capturing collusive behaviour in auctions is very limited, and most studies are modelled on the independent values assumption. Kagel and Levin, 2014 point out that it is difficult to study collusion under laboratory conditions because of side payments between bidders, which are almost impossible to mimic in the laboratory. Baldwin et al, 1997 consider the low winning bids as a possible indicator of collusive behavior during auctions. However, they attribute the lower price of winning bids to a variety of factors.

Athey, Levin and Seira, 2011 also assess US Forest Service timber auctions and make comparisons between open and sealed bid auctions on select parameters such as sales, bidder entry, sale price, etc. They assume that FPSB auctions are protected from collusion and are competitive, using it as a benchmark. They use data from FPSB auction to estimate model parameters and finally predicting the sales price from uniform value distributions of bidders. The predicted outcomes are then compared with the actual bid data for sealed as well as open auctions. The relationship between prices and number of participating mills is studied. The predicted prices happen to be more than the actual price when two or more bidders are participating and comparable when there is only one or no bidder. This hints at collusive practices in the market.

3. Government and Public Assets

Mechanisms for auctioning public assets have traditionally been different. During private auction sales, the fundamental objective of the seller is to generate revenues, whereas in the case of public assets the state needs to optimize market efficiency as well as maximize revenues. (Janssen, 2004) discuss public asset disposal under different scenarios. They argue that the objective of a government, unlike private companies, is to raise revenues alongside fair allocation of public assets. Governments around the world face a common problem of insufficient information about costs of resources at their disposal. Therefore, auctions come handy as a

policy tool for price discovery with healthy and fair competition, and allocating resources to the most deserving candidates.

(Chan, Laplagne, & Appels, 2003) discuss theory and detail the role of government in the allocation of public resources and how it is very different from general market environments. The public sector is traditionally associated with certain market characteristics such as natural monopoly, common property, externalities, which makes efficient allocation more difficult (McMillan, 2004). As the circumstances change, different mechanisms can be deployed based on the objectives and problems associated with market environments surrounding the asset.

We follow the hypothesis that electronic auctions help alleviate drawbacks associated with the physical auctions. Taking the case of BDA land auctions, which has recently shifted from physical to electronic for its land auctions. We assess the question whether this transformation helps in conducting more efficient auctions. Literature suggests that efficient processes or the success of new initiatives result more from organizational commitment than technical capacity. (Bartle & Korosec, 2003) review the role of the state in facilitating procurement of goods. They discuss the institutional requirements for the efficient functioning of the government procedures. The administrative setup of institutions helps in making the best use of information technology. A similar case is made by (Daly & Buehner, 2003) taking the case of introduction of P-card procurement programs in Florida, USA. The technology of P-cards was introduced to enhance process efficiencies in purchasing public goods. Due to various reasons, the P-card systems failed to achieve the desired outcomes. The authors argue that to alleviate internal resistance to the new technology more organizational commitment was required. We assume in our study that the BDA is sufficiently motivated to conduct fair and efficient auctions.

The electronic platform has many potential benefits well-documented in the literature, it saves transaction costs, is more transparent, has efficient procedures, wider bandwidth of bidders, etc. The use of technology enabled procurement, its advantages and disadvantages are discussed by (Moon, 2005). On the contrary, (MacManus, 2002) explore if the electronic procurement reaps the same benefits as proposed in the literature. They show that e-procurement processes have lagged behind in the public sector than the private sector and have failed to catch up with private internet portals such as e-bay. The author discusses the bottlenecks to implementation of e-procurement services. They argue that the government is endowed with responsibilities of effectiveness and equity as compared to only bigger profits in the private sector, which makes it difficult to devise a unique mechanism which fits all scenarios.

Real Estate assets are usually considered as public assets, however, transactions can also happen privately but not without the approval of the government. Many real estate markets have shifted towards the auction market mechanisms. (Dotzour, Moorhead, & Winkler, 1998) provide evidence from New Zealand's real estate markets that auctions can result in premium sale prices. In all the cases they study, private-treaty sale prices are always lower than the auction prices. (Ashenfelter & Genesove, 1992) provide a different explanation to the escalated prices from the

auctions mechanism. They empirically prove that the bidders' exposure to winner's curse led to higher prices of land sold. They show this by tracking the sales of the same land post-auction in a face to face negotiation, which fetches a lower price than auctioned price. This not only results in increased revenues for the seller but also lost surplus on the buyer side. The post-auction phenomena is also studied in real estate markets of Singapore by (Ong, 2006).

On the other hand, the counter argument holds, as there are other aspects unique to auctions in real estate markets. The auction sales are restricted to a limited number of buyers present at the time when auction is happening. Also, in a negotiated sales scenario the seller can search for buyers over multiple periods of time. The likely outcome is that the auction prices are discounted. (Mayer, 1998) test this hypothesis in auctions conducted in two cities in the USA. They find that the markets which they study, the auction prices are discounted and usually sell at a discount of 0% to 21%. However, they do find some cases when a premium in auction prices was noticed; this is attributed to "winner's curse" and buyers' inexperience.

The discounted auction sales price may also be a result of lack of market information on buyer's side. Distortions due to information asymmetry are discussed by (Levitt & Syverson, 2008). In their study, they argue that real estate agents, who have a comparative advantage in market information, manage to sell their properties for 3.7% more than others. Also, agents tend to stay on the market for an average 9.5 days longer. In our study, we assume that the agents/bidders are well informed and there is not information asymmetry in the markets.

The design structure and theoretical characteristics of land auctions are very well documented in (Quan, 1994). They explore the effect of certain auction features which shape the outcomes and processing of real estate auctions. First, they argue that agent valuations in real estate markets can either be independent or common value, given the nature of the land being auctioned. For example, in the case of development contracts, cost estimation of developers differs due to lack of perfect information. Therefore, development contracts traditionally considered common-value might not subscribe to the same. Second, features such as reserve price, bidding strategy, winner's curse all have a significant impact on the bidding pricing in the real estate markets as well. A unique attribute of the real estate auctions is the Linkage Principle where bidder's informational rent is transferred to the seller.

4. Auctions in the Bangalore Development Authority – Context

The study is set in the city of Bengaluru, which is the fifth largest city in India with a population of about 9 million (Census, 2011) and a land area of slightly above 800 sq.km. Bengaluru has a vibrant economy built upon emerging technologies such as IT and health care, with a GDP of about \$83 billion. Bengaluru's land use is about 8.5% for public and semi-public uses, 40% for residential uses and 30% for parks and open spaces and 3% for commercial and industrial uses.

The Bangalore Development Authority (BDA) is the nodal agency in charge of all urban development activities in Bengaluru such as providing infrastructure, town

planning and developmental works. The BDA was set up in 1976 through a statute called the Bangalore Development Authority Act (1976). The BDA, as the planning and development agency for Bengaluru city, is responsible for conversion of agricultural land to developed urban land for various land uses.

As part of its development activity, the BDA works on various "development schemes" to provide for residential, commercial, industrial, civic amenity / social infrastructure sites, as well as on construction of housing for economically weaker sections. A typical development scheme involves the stages of land acquisition, development, and sale of developed land. The BDA, through its eminent domain status, acquires large tracts of farmland/government land at the rural-urban periphery, which it then converts to developed land with complete access to physical infrastructure such as water, sewerage, roads etc. These large tracts of developed "layouts" (sub-divisions) are then sold to residents through a system of lottery (allotment) as well as auctions.

Since one of the major duties of the BDA is to provide for affordable residential housing, a majority of the developed subdivisions/plots are allotted by a system of lottery at a price that just covers the acquisition and development costs of the layout with a 15% administrative cost margin. The BDA (Allotment of Sites) Rules, 1984 governs the qualification of the allottee, mechanism through which these sites may be allotted, the infrastructure that needs to be in place before allotment and the price at which such sites may be allotted.

Apart from the regular allotted sites, there are some 'stray' sites and sites with unique features. The BDA (Allotment of Sites) Rules, 1984 define a stray site as "a site which was once allotted but subsequently the allotment was either cancelled by BDA or surrendered by the allottee, or a site which has been formed on account of readjustment in the plan, subsequent to the issue of notification inviting applications for allotment of sites". Sites with unique features include corner sites (which adjoin two roads or streets); sites facing a park or other water-body; uneven sites or odd lots; sites facing the main access road or highways; sites that are earmarked for civic amenities or social infrastructure. These stray sites and corner/commercial sites can be disposed either through auction, or through special allotment under other criteria (such as for famous sportspeople, artists, members of the government etc.) A certain proportion of these stray and unique sites³¹ (upto 30% of these sites) that have attractive characteristics and can command a premium are reserved for sale through auction. The BDA (Disposal of Corner Sites and Commercial Sites) Rules, 1984, governs the types of sites that can be auctioned, the mechanism of auction, etc.

Prior to 2010, the BDA used to auction its sites in the physical auction format, which typically used to occur in its premises in Bangalore. The location of the auction, the time of auction and the sites that were to be auctioned were announced about ten days in advance through advertisements in prominent English and vernacular newspapers. Reserve prices were mentioned for properties since the late 90's and participants had to bring an 'Earnest Money Deposit' per site- a gate price for

³¹ While there is data on the total number of BDA sites, there is no verifiable data on the number of auctioned properties till date, or the universe of properties that may be auctioned, since these depend on returns by land owners, inability to pay betterment charges or taxes, etc.

participating in the auction, to make sure only serious participants would be involved. The duration of the physical auction was usually within the day - the best price achieved above the reservation price was accepted. In case the price was not met, the auctioned property would be taken off the block and re-auctioned with the next set of properties.

Since the physical auction was an English auction format with open outcry, price discovery was contingent on the number of bidders and the heterogeneity of valuations. The number of participants was also limited by the physical space constraints and participants were admitted on first-come-first-served basis. There were various allegations that such an auction mechanism was keeping out buyers, and led to collusion amongst regular buyers and corruption by officials conducting such auctions.

The physical auction was modified to the e-auction form in late 2010, to counter these allegations of corruption and collusion. In the e-auction format, the BDA advertises for sale of sites through e-auctions similar to that in physical auctions. The participants need to register on the e-auction site and provide their deposit money to participate in the auction. The auction is kept open for a specified period of time (about one month currently) and all bids received before the cut-off time are evaluated. Bidders can see others bid prices and are allowed to bid until the last minute of the auction. The format is similar to that of an English Auction except that the entire exercise is technology enabled.

The electronic auction format was proposed in 2010, based on an English Auction format with open ascending bid pattern and called into practice in late 2010. Since then the BDA has followed the e-auction format for its land auctions. The auctions are advertised in a similar manner with the help of English and vernacular newspapers.

The electronic auctioning format typically lasts for about a month. This provides a reasonable amount of time to register a wide number of participants for the auction. The BDA advertisement lays out the guidelines for registration. It brings important parameters such as length of the auction (start and end date with time), bid increment value, earnest money deposit, the reserve price and sitemap into public domain before the auction process. In comparison with the physical auctions, most of the parameters revealed before auctions remain the same.

The BDA notification directs the participant to the website where a comprehensive list of sites open for auction is at the display. The participants can choose from the list and sign up on the website to create a username and password for logging in. The username acts as an alias and is used to represent the bidder in the online auctioning environment.

Here, there is a fundamental deviation in the procedure of online auctions from traditional physical English format auctions. For online auctions, bidder identity is not revealed to other bidders, whereas in physical auctions the bidders are present in person and there is every possibility of intra auction bidder communication. However, the participant is required to reveal his identity to the BDA (seller) by furnishing documents such as address proof, proof of identity, personal tax number, unique

identity card, etc. Therefore, in the e-auction format, the identity of the bidder is entirely revealed to the seller. This has its drawbacks since it fails to keep a check on corruption amongst state officials of BDA. There is enough anecdotal evidence pointing towards corrupt practices amongst BDA officials and collusion with property builders.

There are other design elements which might or might not affect the bidding pattern. Out of which post-auction procedures play an important role. The BDA stipulates that successful bidders should remit 25% of the total cost (including EMD) within three days/72 hours from the closing time of the e-auction or otherwise the EMD will be forfeited. Also, the remaining amount must be paid within the next 45 to 60 days.

After verification of the documents and deposit of EMD, the bidder is allowed access to the online portal on which bidding happens. The auction screen mentions the reserve price for the site and bid increments allowed (100 per sq. m.). In addition, it mentions the last price bid by the bidder and price bid by other competitors bidding for the same plot/site. The remaining time is mentioned on the same screen of the portal. These characteristics form the basic electronic environment of BDA e-auctions.

The bidding closes on the day and time mentioned in the auction notification. However, in recent auctions, a delta time of 5 minutes is provided. The delta time acts as a buffer period to register bids at the last moment towards the closing of the auction. The buffer period is allowed for a smooth closure of the bidding process. On the last day of the auction when the remaining time has elapsed, the auction end time is extended by five minutes. If no bid is received during this time, the bidding ends. However, if someone bids during the delta time the bid closing time is recalibrated and time left for bidding is reset with an extension of five minutes. The literature mentions that hard close gives bidders incentive to bid late. Therefore, with the addition of delta time, it becomes interesting to analyse the bidding behaviour when we make allowance for flexible closure timings.

Once the final bids are received and the cut-off time is reached, the auction winner is announced. The auction winner is expected to pay the final price of the auction within a period of ten days from the announcement. In case the auction winner is unable to produce the final consideration value, he forfeits his initial deposit and the property is re-auctioned at a subsequent time.

5. Data and Methodology

a. Auction Site data

The data comprises about 809 points of physical auction conducted between the years 2007 and 2010 and another set of about 522 e-auctions conducted between the years 2010 and 2013. Since the change-over from physical to e-auction took place in 2010, an even three year period on either side was considered to study the impact of change from physical space auctions to e-auctions.

The physical auction data set has details on the plot (site) that is auctioned, dimensions of the plot, and the final price of the auction, the name of the buyer and the date of auction. There are no details on the intermediate bids of the physical auction. In the physical auction, we do not have data on how many sites were offered, and on what the off-take was.

Physical auctions are advertised through popular media including local and national newspapers, advertisement links on websites.

The e-auction data set comprises 813 sites that were e-auctioned. Of these about 522 sites were auctioned with a clear winner above the reserve price, about 279 sites were not auctioned due to prices below the reserve price and about 11 odd sites which were lost due to insufficient data to make any conclusions

E-auctions are advertised through the same channels i.e. all major newspapers, national and local, and also through electronic media. The advertisement in the print and electronic media is released at least one month prior to the auction date. The advertisement contains details on the auction lot number, the total number of sites offered per round of e-auction and the location and characteristics of the site (sometimes including a map of the site to be auctioned); the period for which the e-auction is open; the deposit amount for participating in the e-auction; the reserve prices of each site. The authors had access to 1673 auction lots through e-auction advertisements during the period³².

The descriptive of the bid information are as follows

- Tree structure
- Total number of auctions
- Split into (physical) | (e-auctions)
- Within each year (year)
- Within each location

b. Auction bid data set ³³

The bid data set obtained from the Bangalore Development Authority was provided scrubbed to anonymize bidder information. The bid data set contained details on the each bid that was generated for each auction lot, the timing of the bid, duration of auction; the status of the bid (intermediate or finalised); the final bid amount and the timing of the final bid; the anonymized identifier of the eventual winner.

There were some challenges in harmonizing the bid data. This was due to system-generated bids that were introduced in the bidding data due to system processes to open and close bidding on each site. These system-generated bids were identified and removed from the data set. Certain sites had been auctioned in multiple lots, due to issues in previous auction lots (mis-reporting

³²The advertisements are public information that was collated by the authors.

³³ Applicable only to e-auctions

of site dimensions, Earnest money deposit, mis-valuation of reserve prices, etc) or due to inability of the winning party to pay the balance funds within stipulated time. In these cases, the prior sets of auction were discarded and only last set of bids for the auctioned lot were considered. Other issues that one had to contend with was the issue of extra time being provided for certain auction lots, where bidding had occurred in a structured manner beyond the end time of the auction. Clarifications provided by the department indicate that these could be because of server downtime, inability of bidders to access the systems due to power cuts or due to other system disruptions. The bid table consists of the following details:

- Total number of bids
- Average bids per site
- Frequency distribution of bids (number of sites with 1 bid, 2 bids and 3-4 bids, maximum number of bids)
- Modal bids

c. Market value matching

Registration data set was created for each land sale as per Karnataka Stamps and Registration Act. Each sale and lease in land to be registered we take only sale values, not lease values. Registration data predominantly contains the total area, the property schedule, the guidance value and the consideration value.

However the consideration values which are there in registration data cannot be taken as genuine sale values due to black money, underreporting and perverse tax incentives. To reduce underreporting, government has guidance values which are known as market values for the registration of properties. Most sales happen at the guidance value since institutions are unable to estimate the correct /genuine price of land transactions.

Guidance value is published annually or in some cases once in 2 years. We understand two revisions were made over the period of this study.

To ascertain market value, unlike other economies, India suffers from price opacity due to these reasons. Therefore, we need to use other proxies for market value.

As per our own study on Stamp Duty³⁴, we did the 95% of registration value is an accurate estimate of market value. The top 5% of registration values that are higher than guidance values are used as an estimate of true market value.

Synthesis of all data sets above to create large set which tracks auction all the way from information that was in the advertisements such as location, reserve price, property description, date of auction, auction duration etc to bid information for e-auctions for each auction, guidance value (from registration data and from guidance value booklets; market value;

³⁴ Panchapagesan, V., Venkataraman, M., *Can Governments Increase Revenues By Lowering Taxes? A Study of Competing Policies To Reduce Tax Evasion During House Purchase in India*, IIMB-WP no. 594/2019

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6. Analysis and Results

1. Auction prices relative to market

Hypothesis: auctions are premium or discount

Table 1: Overall summary of prices and auction premium

Descriptives	Average/Mean	Standard Deviation	Min	Max
Auction Price	61599.77	29967.44	20100	209000
Guidance Value	27899.24	11787.39	3640.538	97368.52
Market Value	63783.58	33954.6	8502.536	178427.6
Auction Premium Percentage	.1101831	.5377456	-.8280584	2.9159

T-Test Result

Variable of interest = Ratio of Auction Premium over Market Value

H0: The mean premium is equal to 0

H1: The mean premium is not equal to 0

One-sample t test

Variable	Obs	Mean	Std. Err.	Std. Dev.	[95% Conf. Interval]	
-----+-----						
Auction~m	429	.1637359	.0257557	.5334604	.1131125	.2143593

mean = mean(AuctionPremium) t = 6.3573

Ho: mean = 0 degrees of freedom = 428

Ha: mean < 0

Ha: mean != 0

Ha: mean > 0

Pr(T < t) = 1.0000

Pr(|T| > |t|) = 0.0000

Pr(T > t) = 0.0000

2. Relative efficiency of auction types

Hypothesis – e-auctions or physical auctions are better?

Table 2: Summary: Physical Auctions

Descriptives	Average/Mean	Standard Deviation	Min	Max
Auction Price	42087.65	16664.86	20100	160000
Guidance Value	22290.69	11324.46	3640.538	97368.52
Market Value	48081.93	28014.09	8502.536	175059.4
Auction Premium Percentage	.0566303	.537296	-.8280584	2.571819

Table 3: Summary e-Auctions

Descriptives	Average/Mean	Standard Deviation	Min	Max
Auction Price	81111.89	27518.18	39100	209000
Guidance Value	33507.79	9322.432	10740	56707.2
Market Value	79485.24	32085.78	20137.5	178427.6
Auction Premium Percentage	.1637359	.5334604	-.5398694	2.9159

T - test Results

One-sample t test

Auction Type: Physical

Variable	Obs	Mean	Std. Err.	Std. Dev.	[95% Conf. Interval]	
-----+-----						
Auctio~m	429	.0566303	.0259409	.537296	.0056429	.1076177

mean = mean(AuctionPremium) t = 2.1831

Ho: mean = 0 degrees of freedom = 428

Ha: mean < 0

Ha: mean != 0

Ha: mean > 0

Pr(T < t) = 0.9852

Pr(|T| > |t|) = 0.0296

Pr(T > t) = 0.0148

Variable of interest = Ratio of Auction Premium over Market Value**H0: The median premium is equal to 0****H1: The median premium is not equal to 0 (for two-tailed likewise)**-> auc_type = Electronic

Sign test

sign	observed	expected
-----+-----		
positive	194	214.5
negative	235	214.5
zero	0	0
-----+-----		
all	429	429

One-sided tests:

Ho: median of AuctionP~m = 0 vs.

Ha: median of AuctionP~m > 0

Pr(#positive >= 194) =

Binomial(n = 429, x >= 194, p = 0.5) = 0.9788

Ho: median of AuctionP~m = 0 vs.

Ha: median of AuctionP~m < 0

Pr(#negative >= 235) =

Binomial(n = 429, x >= 235, p = 0.5) = 0.0267

Two-sided test:

Ho: median of AuctionP~m = 0 vs.

Ha: median of AuctionP~m != 0

Pr(#positive >= 235 or #negative >= 235) =

min(1, 2*Binomial(n = 429, x >= 235, p = 0.5)) = 0.0533

Based on the above results we are inclined to conclude that e-auctions are better in price discovery due to higher bidding. Also, premium in e-auctions is higher.

3. E-auctions Design

Probit model: To identify which sites are sold and which ones are not.

Iteration 1: With reserve price and market value taken separately

Dependent Variable : (1 if auction is sold and 0 if no bids received)

Probit regression

Number of obs = 538

LR chi2(15) = 245.20

Prob > chi2 = 0.0000

Log likelihood = -247.17865

Pseudo R2 = 0.3316

dep	Coef.	Std. Err.	z	P> z	[95% Conf. Interval]
-----+-----					
SupplyLocLot	-.0008793	.0077173	-0.11	0.909	-.0160049 .0142463
Duration	-.0670131	.0233533	-2.87	0.004	-.1127847 -.0212414
res_pr	-.0000248	.0000246	-1.01	0.314	-.0000729 .0000234
mktval	-1.00e-05	5.15e-06	-1.94	0.052	-.0000201 1.04e-07
loc_id					
1	0 (empty)				
2	0 (empty)				
3	0 (empty)				
4	-.7907728	1.030187	-0.77	0.443	-2.809901 1.228356
5	0 (empty)				
6	0 (empty)				
7	3.541148	1.158502	3.06	0.002	1.270525 5.811771
8	2.818021	1.426827	1.98	0.048	.0214921 5.61455
9	0 (empty)				
10	2.779705	.8608635	3.23	0.001	1.092443 4.466966
11	.8918491	1.13742	0.78	0.433	-1.337453 3.121152
12	0 (empty)				
13	-.1026477	.9508031	-0.11	0.914	-1.966188 1.760892
14	0 (empty)				
15	.67186	1.068432	0.63	0.529	-1.422228 2.765947
16	0 (empty)				
17	0 (omitted)				
18	0 (empty)				

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time_id						
1	0 (empty)					
2	0 (empty)					
3	0 (empty)					
4	1.156784	.4978606	2.32	0.020	.1809951	2.132573
5	.7217083	.6025416	1.20	0.231	-.4592516	1.902668
6	0 (omitted)					
Area	-.0018164	.0007616	-2.39	0.017	-.0033091	-.0003238
1.Corner	1.114622	.5206435	2.14	0.032	.0941793	2.135064
_cons	1.353089	1.808859	0.75	0.454	-2.19221	4.898387

Iteration 2: With market premium (Market Value – Reserve Price) taken as one of the variables.

Dependent Variable : (1 if auction is sold and 0 if no bids received)

Probit regression Number of obs = 538

 LR chi2(14) = 242.63

 Prob > chi2 = 0.0000

Log likelihood = -248.46695

Pseudo R2 = 0.3281

dep	Coef.	Std. Err.	z	P> z	[95% Conf. Interval]
SupplyLocLot	-.0071235	.0064452	-1.11	0.269	-.019756 .0055089
Duration	-.0713057	.0236032	-3.02	0.003	-.1175671 -.0250443
res_prm	-.0000119	5.08e-06	-2.34	0.019	-.0000218 -1.92e-06
loc_id					
1	0 (empty)				
2	0 (empty)				
3	0 (empty)				
4	.0619628	.8491554	0.07	0.942	-1.602351 1.726277
5	0 (empty)				
6	0 (empty)				
7	3.795416	1.158833	3.28	0.001	1.524145 6.066686
8	3.396515	1.374958	2.47	0.014	.7016459 6.091383
9	0 (empty)				
10	2.697418	.8314884	3.24	0.001	1.067731 4.327105

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```

11 | 1.17103 1.10067 1.06 0.287 -.9862441 3.328305
12 | 0 (empty)
13 | .7243792 .7585879 0.95 0.340 -.7624256 2.211184
14 | 0 (empty)
15 | 1.60957 .8672692 1.86 0.063 -.0902461 3.309387
16 | 0 (empty)
17 | 0 (omitted)
18 | 0 (empty)
time_id |
1 | 0 (empty)
2 | 0 (empty)
3 | 0 (empty)
4 | 1.745631 .3305375 5.28 0.000 1.097789 2.393472
5 | 1.293724 .4818372 2.68 0.007 .3493403 2.238108
6 | 0 (omitted)
Area | -.0020887 .0007405 -2.82 0.005 -.0035401 -.0006374
1.Corner | .9435621 .5047917 1.87 0.062 -.0458115 1.932936
_cons | -.9858201 .975729 -1.01 0.312 -2.898214 .9265737

```


Stage 2: Regression using the expected value from the probit model

Dependent Variable: Auction Premium Percentage

Independent Variables: Supply Location by Lot, Duration, Area, Corner, Location ID, Time ID, number of bids, probit coefficient (when dependent==1)

Auc prm_perc	Coef.	Std. Err.	t	P> t	[95% Conf. Interval]	
-----+-----						
Supply Loc Lot	.0009882	.0013409	0.74	0.462	-.0016503	.0036267
Duration	.0476232	.0073101	6.51	0.000	.0332393	.0620071
Area	.000804	.0003753	2.14	0.033	.0000656	.0015425
1.Corner	-.2412133	.1224825	-1.97	0.050	-.4822186	-.0002081
loc_id						
4	-.122288	.2200888	-0.56	0.579	-.5553503	.3107743
7	-2.675873	.3222554	-8.30	0.000	-3.309965	-2.04178
8	-2.248191	.3690071	-6.09	0.000	-2.974275	-1.522106
10	-2.402028	.2492567	-9.64	0.000	-2.892483	-1.911573
11	-.5746325	.2544725	-2.26	0.025	-1.075351	-.0739143
13	-1.473708	.1616618	-9.12	0.000	-1.791805	-1.155611
15	-1.625216	.1884772	-8.62	0.000	-1.996077	-1.254355
17	-.5029766	.3391298	-1.48	0.139	-1.170272	.1643192
time_id						
4	-.0454546	.1595436	-0.28	0.776	-.3593839	.2684746
5	.0390052	.172395	0.23	0.821	-.3002115	.3782219
6	.7825844	.1559107	5.02	0.000	.4758035	1.089365
No of Bids	.0208536	.0052311	3.99	0.000	.0105606	.0311466
imr	-1.4975	.2321958	-6.45	0.000	-1.954385	-1.040615
_cons	1.630428	.3239044	5.03	0.000	.9930911	2.267766

The above results help us conclude that where market price is lesser than reserve probably don't get sold.

7. Conclusion

Using a quasi-natural experiment on land auctions of residential plots in the city of Bengaluru, India, we find that e-auctions have better differences in price discovery, transparency and lesser collusive behaviour of market participants and draw implications on whether technology can overcome systemic issues prevalent in developing economies.

DRAFT