China’s Land Market Auctions: Evidence of Corruption?

by

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Abstract

In China, all urban land is owned by the state. Leasehold use rights for land for (re)development are sold by city land bureaus at auction. They are a key source of city revenue but are also viewed as a major venue for corruption. Corruption takes the form of a side deal between a favored developer and the land bureau official(s). There are two main types of auction: regular English auction and a type we call “two-stage auction”. The modeling suggests two-stage auctions are more corruptible, in the sense of enabling the favored developer to signal in the first stage that the auction is “taken” which deters entry of other potential bidders and raises the chances the favored developer wins the auction. The empirics suggest that, overall, sales prices are lower for two-stage auctions than English auctions. While prices could be lower because of negative selection on unobserved property characteristics into two-stage relative to English auctions, the theory and empirical evidence suggests that selection is positive: officials divert hotter properties to the more corruptible auction form. Lower prices under two-stage auctions are driven by the deterrence of competition, resulting in sales at reserve price with only one bidder.

Keywords: Land prices, auctions, corruption

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This paper studies the urban land market in China in 2003-2007. Urban land is owned “by the people” and its allocation done by the state.¹ In most cities, city officials are responsible for virtually all allocations of land, now done through public auctions of leasehold rights.² In China, land markets are viewed as corrupt, prompting a number of reforms over the years. We provide institutional context below, but two quotes illustrate that corruption is on-going. In 2004, the China Daily wrote

“China’s Ministry of Lands and Resources announced new measures to crack down on corruption and inefficiency in the land sector. The new rules forbid officials to receive personal benefits from parties under their administration [italics added]. It is estimated that in 2003, the country faced 168,000 violations of its Land Law.”

Yet in June 2008, the Asian Times reported

“Chinese government efforts to clean up land sales, a major source of official corruption…, face a rethink. …Illegal transfers, corruption in land deals,…are rampant in major cities, according to an investigation published by the National Audit Office (NAO) last week. …Governments in the 11 cities [studied by the NAO], including Beijing and Shanghai, were also found to have misused 8.4 billion yuan from land-grant fees, Zhai Aicai, of the NAO, said in the report. ….Some cities have given a flexible interpretation to the rules and the auction system has often existed in name only, resulting in a lack of competition among developers and the winning developer being able to secure the land at below its true market value [italics added].”

Today, after considerable reform, leaseholds are, in principle, all sold at public auction. There are two main types of auction in most cities: regular English auction and an unusual type of auction which we call a “two-stage auction.” The procedures governing these auctions are detailed later. A key element is that the first stage of a two-stage auction has a time interval where bids are delivered to the land bureau, the agency responsible for conducting auctions, and publicly posted in the order received; while the second stage is an English auction if more than one bidder is still competing at the end of the first stage. The raw data suggest that leaseholds sold at two-stage auctions sell at steep price discounts, relative to English auctions. Why are there these sales price differentials; and, related, how do city officials choose auction type for any particular property?

¹ Rural land is owned by the village and allocations done by the village leadership.
² The central government (national asset committee) and the military may control portions of city land in particular cases, as for example the national capital Beijing.
The paper argues that corruption in land markets in China takes the form of a side deal between a bidder and corrupt city official(s), rather than, say, bidding rings as in the USA. That side deal may include special help from the land bureau in developing the property as discussed below. Given a side-deal, in certain contexts, in maximizing her objective function, the corrupt land bureau official will choose to run a two-stage, as opposed to English auction, to enhance the chances that her corrupt partner wins the auction. A key aspect of this corruption will be lower prices paid by the buyer in two-stage auctions, relative to what the same property would sell for in an English auction. This price difference of course could occur because properties with poor unobserved characteristics are sold in two-stage auctions. However we will show empirically that selection in fact is positive. We will argue theoretically that corrupt land bureau officials are likely to divert “hot” properties to two-stage auctions and leave “cold” properties for English. Consistent with how we model the corruption process, the overall price differentials between auction types seem to be explained by the fact that two-stage auctions are much more likely to have just one (corrupt) bidder, or no competition (and no second stage). The theory and empirical evidence will suggest that the two-staging allows that bidder to signal that the auction is “corrupted” with an early first stage bid at reserve price.

As detailed below, we use data on 2302 auction transactions from 2003 to 2007 in 15 cities, which use both auction types (as opposed to having only two-stage auctions). In these cities English auctions account for 28% of auctions. In Figures 1 and 2 we present patterns in the raw data. Figure 1 shows the distributions of the “spread”, defined as the ratio of sales to reserve prices by auction type; and Figure 2 shows the corresponding distributions of unit sales prices (price per sq. meter). In Figure 1, two-stage auctions tend to be absolutely and relatively massed around 1.0 for spread, so sales equal reserve prices. For a particular sub-sample analyzed below where we know the number of bids, a ratio of 1 implies that there is just one bidder and thus no competition. Ratios larger than 1 in the sub-sample imply multiple bidders and what we term a competitive auction. A lack of competition is very surprising on its own. In these cities, auctions occur in a setting of rapid urban growth, with per capita urban incomes growing at about 10% a year and local population at 3-4% a year. Given national restrictions on conversion of rural to urban land at the city fringes, this suggests there should be a high demand for land for new development. In Figure 2 we show that the distribution of unit sales prices for English auctions is shifted to the right of that for 2-stage
auctions. Of course these patterns are influenced by property characteristics including reserve prices and issues of selection, and the modeling and econometrics is all about accounting for that. While the paper tells about an important public policy issue in China, we think it is of more general interest. We contribute to the methodology of studying corruption, by showing how simple theory and a variety of empirical evidence can be used to argue that corruption exists in a particular form. As a preview, empirical evidence will concern not just overall price differentials between auction types, but the nature of selection, the relevance of particular political instrumental variables in predicting choice of auction type, the evidence of signaling at reserve prices in two-stage auctions as opposed to jump bids (Avery, 1998), and the econometric separation of the effects of auction choice on the degree of competition versus, conditional on the degree of competition, the effect on prices. To frame the evidence, the paper models corruption in auctions in a new way which takes the form of (1) choice of auction type as opposed to corruption in a give auction format and (2) a side deal between a bidder and the auctioneer in an open auction context (as opposed to sealed bid), without a bidding ring. (c.f., McAfee and McMillan, 1992, Burguet and Che, 2004, Compte, Lambert-Mogiliansky and Verdier, 2005, Menezes and Monteiro, 2006). We believe our context has applicability in other auction contexts in other countries.

The paper is organized as follows. We start with essential background information on Chinese land markets and especially the two auction formats. We then present a conceptual framework to model the key differences between the auction formats. In section 3, we discuss the data and patterns in the data. Section 4 estimates a reduced form model of price differences between the two auction types, and discusses instruments for auction type used to estimate selection into auction type. In Sections 5 and 6, after accounting for joint selection into auction type and competition, we split the analysis of price differences into its two key components: whether a property is likely to have multiple bidders and sell competitively or not depending on auction type; and whether there are price differences across auction types, conditional on a property selling competitively. Concluding remarks are in Section 7.

1. Background

Until the mid-1980’s, land allocations in China were done by the state; land was not a commodity. Then came major reforms spread over 20 years (Ding and Knapp 2005, Valetta 2005). Starting in 1988, use rights for vacant land in the city were allocated through leaseholds, where, for a fixed
sum, users obtained a long lease for a specified use (e.g., 70 years for residential land). In the 1990’s, many of these allocations were done by “negotiation” in a hidden process, where reportedly leaseholds were often sold for a tiny fraction of market value. This had two consequences.

First, leasehold sales are a major source of revenue for many cities, in essence potentially being a full Henry George tax which allocates all “surplus” land rents to cities with no welfare cost. As a revenue source, for example, in 2004 and 2005 for Chengdu, Suzhou and Chongqing, after reforms which banned negotiated sales, leasehold sales revenues ranged from 2.6% to 5% of local GDP. Negotiated sales deprived cities of major revenues and forced the use of fiscal instruments with significant welfare costs.

Second, negotiated sales were corrupt, resulting in some indictments of corrupt officials and recent reforms, one of which in 2004 was quoted above. Another reform in 2002 banned the secondary market for “land development rights,” which had allowed large traditional holders (e.g., state owned enterprises) to, in effect, privately sell off their own land use rights (Zhu, 2004, 2005). Today the local government is supposed to be in charge of almost all allocations of land for (re)development. Finally and most critically for this paper, a third recent reform was a 2002 law which banned negotiated sales by the land bureau, with the last date for any negotiated sales being August 31, 2004. For the last 4 years at least, all urban land leasehold sales are to be done through public auctions, with details of all transactions posted to the public on the internet.

How does the land market work? While detailed procedures may differ somewhat across cities, the typical procedure works as follows. There is a local planning bureau which does long term land use planning. Based on these plans, each year a land use allocation committee decides the use and development (e.g., floor to area ratio) restrictions and the sequencing of sales of leaseholds on properties about to be available for (re)development during the year, from both acquisition of rural lands and assembly of urban lands. Each plot of land is large with, in our sample, a median area of 22,300 square meters and a median sales price of USD $7 – 8. The allocation committee is often a city-wide committee, with members such as the mayor and heads of relevant local bureaus (e.g., planning and land bureaus). Properties are then turned over to the land bureau for clearing (if necessary), choice of auction type and auction. Most critical to our analysis is the setting of reserve price. Each piece of property is appraised by an independent (private) appraiser, based on comparables as in the USA. Reserve price is set by the allocation committee given this appraisal (e.g., “minimum market value”), before the property is turned over to the land bureau and choice of
auction type is made. Indeed as we will see, conditional on property characteristics, reserve price is uncorrelated with both auction choice and the political variables we use as instruments later on in predicting choice of auction type.³

There are three types of auctions used in China’s land market.⁴ About 97% of sales in major cities are accounted for by two of these, with the third used almost exclusively in Beijing and Shanghai. We ignore this third type and our econometric specifications exclude Beijing and Shanghai.⁵ The two main types are guapai which we call two-stage auction and paimai which is an English auction. English auctions are standard ascending bid auctions, usually publicly announced 20 working days before the auction. At announcement, basic details (e.g., use restrictions, reserve price, location) are publicized; and potential bidders for a small fee can obtain more detailed information, as well as inspect the site. Participation in the auction requires “qualification”, the key part of which is a cash deposit, usually about 10% of the reserve price. This is a non-trivial requirement given the large sizes and sales prices of such properties. English auctions are public, often video-taped with the press present. Winning bidders in principle must develop the land themselves. For both types of auctions, participants cannot be arbitrarily excluded or their bids ignored.⁶ Once into the auction process itself, auctions are clean.

As with English auctions, two-stage auctions are announced about 20 working days in advance; details of the plot are made public; and a deposit is required upon participation in the auction. A key difference is the auction mechanism, where there are two stages. The first stage normally lasts 10 working days after the auction starts. In the second stage, at the end of the 10

³ Despite the clear sequence, we looked at the counterfactual possibility that reserve prices depend on auction type, in a MLE Heckman selection model where we allow auction type to be a determinant of reserve price. Controlling for selection effects of auction type yields an insignificant \( \rho \), suggesting no correlation between those unobservables affecting auction choice and those affecting reserve price.

⁴ We conducted surveys of the land bureau officials of 20 cities covered in our sample. In our survey, we asked questions regarding the differences in the mechanism between the two auction formats, in addition to differences in the pattern of bidding behaviors. We also asked how the land bureau chooses between the two auction formats for each piece of land for sale. Our theory conjectures in the next section are informed by our survey findings.

⁵ The third type is sealed bid, or zhaobiao auction. There, bidders submit sealed bids to the land bureau, which decides the winner according to a complicated score function, in which the submitted bid usually accounts for only 20-30% in weight. The remaining 70-80% of the weight goes to the credibility of the bidder and how much social responsibility the bidder is willing to take. Credibility concerns the quality and reputation of the projects the bidder has developed in the past, as well as the bidder’s financial capacity. As for social responsibility, this arises from Beijing’s recent attempt to curb rising housing prices. If a bidder is willing to commit to an upper bound on the housing price of the future development on this piece of land, then this bidder will get a higher score in terms of social responsibility.

⁶ In addition to cash deposits, qualification involves things like being a China-based firm, not having a criminal record, and not having a record (complaints) of shady development practices in dealing with consumers.
working days, if more than one bidder is competing for the property, the auction ends on the spot with an English auction where active bidders from the first stage participate. In the first stage during the 10 working days between the starting date of the auction and the potential ending English auction, people may enter the auction after obtaining qualification, and submit ascending bids in person or on-line. Bids as they arrive are immediately posted on the trading board of the land bureau, as well as typically on the internet (so that later potential bidders may decide whether to enter the auction or not based on previous bids posted), although the identity of bidders is not posted. If, at the end of 10 working days, there is only one remaining participant bidding, that bidder is assigned the property at his bid price (but not less than the reserve price). Otherwise, with competition, the auction is converted to an English auction.

We will argue the first stage allows for early signaling to non-corrupt potential bidders that the auction has been “corrupted” and will potentially be dominated by a corrupt bidder (in league with the land bureau). Early signaling will have a deterrence effect on entry of non-corrupt bidders. The signal is a bid at reserve price by the corrupt bidder, the instant the auction is announced. There are three fuzzy parts to the two-stage auction format which we think permit the corrupt bidder to signal with meaning. While the auction is announced about 20 working days in advance, the exact date of the start of the first stage of the auction may not be specified. Second, while bidders can apply during the announcement period before the first stage starts, approvals to participate, or qualification can be delayed until after the first stage is under way. Thus the corrupt bidder alone may know the exact time the first stage starts and he alone may be qualified to submit a bid at that time, so if there is a bid at reserve price when the auction opens, other bidders know the auction has been corrupted.

The third fuzzy part is that the signal in a corrupted auction must have meaning, or must communicate some real advantage to the corrupt bidder (given auctions are clean), so other bidders are deterred. That advantage may come in the form of special help the corrupt developer receives in developing the property from the land bureau. Such help includes better clearing of the site to be developed, better provision of local infrastructure, relaxed interpretation of development restrictions, and the like. The choice of auction format enhances the chances that the corrupt bidder wins the auction and that the deal with the corrupt official goes forward; and it has the side advantage that the corrupt bidder is more likely to get the property at reserve price.
In the next section we outline a simple model analyzing auctions under corruption versus non-corruption and exploring the hypothesis that, under corruption, there will be positive selection on unobservables into two-stage auctions. Then we turn to the data.

2. Conceptual framework
We start by stating some basic assumptions about the auction context and a brief review of some relevant known auction results. Then we specify the nature of corruption and analyze English and two-stage auctions under corruption. We end the conceptual analysis by a brief comparison of English versus two-stage auctions without corruption.

Basics of auctions
Assume for a leasehold auction there are \( N \) potential bidders, of which some endogenous number \( n \) pay an entry fee, \( C \), and become active bidders.\(^7\) A key issue is how the choice of auction format may influence \( n \). We assume auctions are independent private valuation. Specifically, a potential bidder \( i \)’s valuation is \( V_i = v_0 + v_i \), where \( v_0 \) is the (expected) common value that is the same for every bidder (based on property characteristics and local market conditions) and \( v_i \) is the private value component only known to bidder \( i \). \( v_i \)'s are i.i.d.\(^8\)

We make the standard assumption that all bidders are risk neutral and maximize their expected payoff. Let \( V_i \propto F(V) \) on \([0, \bar{V}]\) be the distribution function of the bidder \( i \)'s valuation, and let \( f(V) \) be the associated density function. A bidder’s payoff when winning the auction with a bid \( B_i \) is \( U_i = V_i - B_i - C \).

To inform the modeling below, we review some key results concerning English auctions without corruption. Given an English auction is outcome-equivalent to a second price Vickery auction, the setting is equivalent to that of Tan and Yilankaya (2006), who analyze a simultaneous move entry game in a second price auction with independent price valuations and participation costs. In a symmetric equilibrium of such a model a bidder will decide to enter the auction if and only if his valuation is above a certain value \( \hat{V} > r + C \), where \( r \) is the reserve price and \( C \) is the entry cost. For a bidder with valuation exactly equal to \( \hat{V} \), the only way he can get positive rent

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\(^7\) The entry fee consists of (i) cost of making cash deposit to qualify, (ii) cost of preparing documents to meet the qualification requirements, (iii) other transaction costs (e.g., time, consulting fee).

\(^8\) Since the (expected) common value is common knowledge to all participants, the auction is treated as one with independent private valuation.
from entering the auction is if he is the lone bidder in the auction, in which case he gets a rent of \( \hat{V} - r \). This case happens with probability \( F(\hat{V})^{N^{-1}} \), such that all other potential bidders have valuations below \( \hat{V} \). Therefore, the valuation threshold for entry \( \hat{V} \) must satisfy
\[
F(\hat{V})^{N^{-1}} (\hat{V} - r) = C .
\] (1)

From equation (1), we can solve for the valuation threshold for entry \( \hat{V} \) in equilibrium that depends on \( (r, C, N, \hat{V}) \). Clearly, \( \hat{V} \) is increasing in \( r, C, N \).

The probability of selling at the reserve price is \( NF(\hat{V})^{N^{-1}} [1 - F(\hat{V})] \). Other possible outcomes in the auction are (1) that there are no bidders, which occurs with probability \( F(\hat{V})^{N} \); and (2) that there are two or more bidders, so the auction is competitive with the winner being the highest valuation participant, \( j \), who pays the second highest valuation \( X_{2}^{*}(V_{j}) \) and makes an ex post rent \( V_{j} - X_{2}^{*}(V_{j}) \). One can derive expected rents of entrants and expected revenue from the auction, as detailed in Cai, Henderson and Zhang (2009).

Form of corruption

Based on our surveys of land bureau officials and discussions with people who work on the private side in urban land markets, as stated earlier, city officials cannot simply rig auctions, by, for example, arbitrarily completely excluding qualified bidders, or not recognizing certain bids once submitted. They can only operate in the less visible fuzzy areas noted earlier and in the choice of auction type. Given these notions, we model corruption in the following, stylized fashion.

Under a corrupt sale, the land bureau official(s) reaches an implicit agreement with a particular developer, say, developer 1, so that if he wins the land auction, she will provide special help in exchange for a bribery payment. Let \( Q \) be the value of the land bureau official’s help to developer 1, and let \( q \leq Q \) be the bribery payment developer 1 makes to the land bureau official, if he wins the auction. Define \( \kappa = Q - q \) as the net benefit to developer 1 from having an under-the-table deal with the land bureau official. We can also allow a bribe that is proportional to the buyer’s surplus when his valuation is known to the land bureau but it seems unrealistic to assume that the land bureau has this information.\(^9\)

\(^9\) In a more benign (in terms of welfare) interpretation, one could think of the land bureau official as being in league with the highest valuation potential bidder and getting a bribe dependent on the gap between valuation and sales price. The early bid is then a signal at reserve price that this is the highest valuation bidder, which is
Assume the corrupt land bureau official’s payoff function from the sale of a piece of land is given by

\[(1 - \lambda)ER + \lambda q \omega.\] (2)

In (2), \(ER\) is the expected revenue from the land auction (that goes to the city coffers). This will depend on what auction format the official chooses; whether developer 1 and the land bureau official are in league with each other; and, if they are, whether developer 1 participates in the auction. \(\lambda \in [0,1]\) measures how corrupt the official is. When \(\lambda = 0\), the official is non-corrupt and seeks to maximize the expected revenue from the sale of land. As \(\lambda\) becomes larger, the land bureau official cares more about her own expected bribery income, \(\omega q\), in the second term in (2) and less about the city’s fiscal revenue. \(\omega\) is the probability of the joint event that developer 1 and the official are in league and that developer 1 enters the auction and wins. In terms of whether developer 1 and the land bureau official are in league, we assume for any land sale this occurs with probability of \(p\). This reflects the likelihood the land bureau official in charge of a land sale is corrupt and she has a “partner” developer who is potentially interested in the land, where they must trust each other. Only the land bureau official and her partner know about any under-the-table arrangement, although other potential bidders may infer it once two-stage auctions are underway. But a priori, other potential bidders only know with probability \(p\) that the auction will be corrupted.

We expect the weight placed on corruption income by the auctioneer to differ by city and time. We believe that it is widely known in land markets in China that two-stage auctions are more amenable to corruption. We will see in the data it appears that, when under scrutiny, officials are much more likely to choose English auctions. Thus a land bureau official who is worried about career advancement or possible indictment, when under scrutiny may forgo corruption income in order to appear cleaner. In empirical work to follow, our instruments are chosen to indicate circumstances when land bureau officials are more worried about appearing clean and more likely to choose English auctions. An alternative formulation would be to add a penalty if caught in a corrupt sale, where again its magnitude would differ by city and time.

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then the special advantage that the land bureau offers her corrupt partner (a cheap signal and price for a high evaluation). Given the vast number of potential bidders, the lack of repeat winners, and heterogeneity of properties as discussed later, it seems implausible that the land bureau has such information on private valuations.
Why do we model corruption as involving the auctioneer? In the existing literature, scholars have studied corruption as involving collusion among bidders (bidding rings) in other auction settings (e.g., McAfee and McMillian, 1992, Bajari and Ye, 2003, and Athey, Levin and Seira, 2008). In China, a group of developers could attempt to rig an auction; and a generalization of the model would have developer 1 representing a ring of insiders, with the rest of potential bidders being outsiders. We don’t emphasize bidding rings for several reasons. One is that the government’s focus on corruption in land markets has not been on collusive bidding, but rather on corruption among officials. Correspondingly, as noted above, the instrumental variables for auction type used later relate to detection of corruption of government officials. Related, in China, it may be less appealing (more dangerous) for individuals to collude against the state per se, as opposed to collude with the state. Another reason is that there are relatively few repeat winners in land auctions, as noted below. With bidding rings we think of rotation of assigned winners from the bidding ring, in a setting where the same parties are interested in each auction. Leasehold sales in a city involve highly heterogeneous items with different sets of interested parties. Finally, there seems to be no reason why collusion among bidders would be more successful in two-stage auctions than in English auctions, so collusion among bidders would not explain the substantial difference in the likelihood of non-competitive bidding between the two-stage and English auctions observed in our data. In fact, collusion within a ring might be better enforced in public English auctions.

2.1 English auction under corruption

While all potential bidders still make entry decisions simultaneously before the auction starts, let there be a potential bidder 1, who may have an agreement with the land bureau official. Then with probability of $p$ the auction is corrupt and his total valuation is $V_1 + \kappa$; and, with probability of $1 - p$ the auction is not corrupt and his valuation is $V_1$. In this context, let $\hat{V}_{1p}$ be the valuation threshold for entry for bidder 1 when corrupt, and let $\hat{V}_{-1}$ be the valuation threshold for entry for all other bidders.

With the possibility that bidder 1 is corrupt, bidders make entry decisions in an asymmetric bidding game. The condition is similar to equation (1) except now a non-corrupt bidder must allow for the fact that there may be a corrupt bidder. Given that, $\hat{V}_{-1}$ must satisfy the following equation:
\[ F(\hat{V}_{-1})^{N-2} \left\{ p \left[ F(\hat{V}_{-1}) - F(\hat{V}_{1p}) \right] E \left[ (\hat{V}_{-1} - V_1 - \kappa) \mid V_1 \in [\hat{V}_{1p}, \hat{V}_{-1} - \kappa] \right] + p F(\hat{V}_{1p}) (\hat{V}_{-1} - r) + (1 - p) F(\hat{V}_{-1}) (\hat{V}_{-1} - r) \right\} = C. \]  

(3)

The bracketed expression on the left hand side represents a non-corrupt bidder’s expected rent in each of three cases: (i) the corrupt bidder enters but has an evaluation less than the non-corrupt entrant; (ii) the corrupt bidder 1 does not enter; and (iii) bidder 1 is not corrupt and does not enter. Note that the above equation assumes that if bidder 1 is not corrupt, he acts like any other bidder by using the same entry strategy.\(^\text{10}\) If there is a corrupt bidder, his valuation threshold for entry \(\hat{V}_{1p}\) satisfies

\[ F(\hat{V}_{-1})^{N-1} (\hat{V}_{1p} + \kappa - r) + \sum_{m=1}^{N-1} \hat{w}_m = C \]  

(4)

where \(\hat{w}_m\) is bidder 1’s expected rent when his valuation is \(\hat{V}_{1p} + \kappa\) and there are \(m\) other bidders, whose valuations are above \(\hat{V}_{-1}\) but less than \(\hat{V}_{1p} + \kappa\).

In evaluating the influence of corruption on a standard English auction, it can be shown that in equilibrium, \(\hat{V}_{1p} < \hat{V} < \hat{V}_{-1}\), where \(\hat{V}\) is the entry threshold absent corruption. The intuition is that thanks to the favor from the land bureau official, the corrupt developer 1 has a better chance of having the highest valuation. So he is more likely to enter (\(\hat{V}_{1p}\) is lower than \(\hat{V}\)). Facing the possibility that bidder 1 may be favored, the other potential bidders are less likely to win and thus are less likely to enter (\(\hat{V}_{-1}\) is higher than \(\hat{V}\)). The results can be shown as follows. Given equation (1) holds, by comparing equations (3) and (4), we have \(\hat{V}_{1p} < \hat{V}_{-1}\). If \(\hat{V}_{-1} \geq \hat{V}_{1p} + \kappa\), then for equation (1) to hold, equation (4) implies that \(\hat{V}_{-1} > \hat{V}\) (note then that all \(\hat{w}_m\)’s are zero). If \(\hat{V}_{-1} < \hat{V}_{1p} + \kappa\), then for equation (1) to hold, equation (3) implies that \(\hat{V}_{-1} > \hat{V}\) (note that the first term in the bracket is zero). Comparing equations (1) and (4) reveals that if \(\hat{V}_{-1} \geq \hat{V}\), then \(\hat{V}_{1p} < \hat{V}\).

We now turn to analyzing two-stage auctions under corruption. Then we compare the two auction formats under corruption, and examine whether corrupt land bureau officials are likely to steer hot versus cold properties to two-stage auctions.

\(^{10}\) This assumption holds when ex ante no one knows the identity of the potentially corrupt bidder. If everyone knows that bidder 1 is corrupt, he is more likely to enter than other bidders, even if in fact he does not have a deal. This is because only bidder 1 knows that no one else is corrupt and all other bidders are worried that bidder 1 is corrupt. This not that realistic and the analysis will not change much if we allow for this possibility.
2.2 Two-stage auction under corruption

In the two-stage auction, if the land sale is corrupted so that bidder 1 and the land bureau official are in league, bidder 1 acts as soon as stage 1 ensues. Since both would like to let all other potential bidders know that this land is “claimed,” a simple and natural way to send that signal is for bidder 1 to obtain qualification and to make a bid right after the auction is started, before other potential bidders are granted qualification to bid, and perhaps even before they know that the auction has actually started. Since bidder 1 is only signaling that he has the agreement with the land bureau official, bidder 1 only needs to signal the agreement, by bidding just the reserve price (to increase the rent from winning the auction). When the extra help he gets from the land bureau official, $\kappa$, is relatively large, such signaling by bidder 1, if believed by other bidders, will seriously deter entry by other bidders given an entry fee (c.f., Hirshleifer and Png 1990 and Ockenfels and Roth 2002), since they see little hope of outbidding bidder 1.

We consider the following equilibrium. Let $\tilde{V}_c$ be the minimum threshold in which bidder 1 will send a signal by bidding the reserve price. If seeing that bidder 1 bids at the reserve price right after the auction is announced, all the other potential bidders understand that bidder 1’s valuation is $V_1 + \kappa$, where $V_1 \in [\tilde{V}_c, \bar{V}]$. $\tilde{V}_c$ is the minimum valuation of the corrupt bidder so that he will bid in stage 1. As a simplification, other bidders decide simultaneously whether to enter. While other bidders could also decide in some arbitrary sequence in stage 1 whether to enter or not, we collapse that into a simultaneous decision to make calculations tractable. By construction, this staging also eliminates any potential snapping strategy by a non-corrupt bidder to also bid early, but such snapping is highly unlikely in the more general case if $\kappa$ is large.\(^{11}\) If $\tilde{V}_o$ is the valuation threshold for all other potential bidders, it satisfies

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\(^{11}\) The issue is whether a non-corrupt bidder would be tempted to mimic the behavior of bidder 1 to scare away other bidders. Even if this snapper could manage to bid at the reserve price before the true corrupt developer, the latter is likely to make a higher bid in order to reclaim the land as long as $\kappa$ is relatively large. In such a case, the snapper will lose the auction and waste his entry cost, with an example given in Cai, Henderson, and Zhang (2009) that this would not be an equilibrium strategy. When $\kappa$ is not sufficiently large, a non-corrupt bidder may try snapping when his valuation is very high with less fear of being outbid by a corrupt bidder. It is possible that in equilibrium, a non-corrupt bidder with very high valuation and a corrupt bidder are pooled in using the same strategy of bidding at the reserve price at the start of the auction (whoever manages to be the first is immaterial). In that equilibrium, a corrupt bidder who does not get the chance to submit a first bid will try to outbid the non-corrupt bidder only when he also has a quite high valuation. What is important, however, is that in such a pooling equilibrium, other bidders are seriously discouraged to enter, either by a very high valuation non-corrupt bidder or by a corrupt bidder.
\[
F(\tilde{V}_0 - \kappa)^{N-2} \left[ \frac{F(\tilde{V}_0 - \kappa) - F(\tilde{V}_C)}{1 - F(\tilde{V}_C)} \right] E \left[ (\tilde{V}_0 - V_1 - \kappa) | V_1 \in [\tilde{V}_C, \tilde{V}_0 - \kappa] \right] = C, \tag{5}
\]

where now a non-corrupt bidder knows if a corrupt bidder has entered \((V_1 \geq \tilde{V}_C)\). Second, \(\tilde{V}_C\) must satisfy an equation similar to equation (4) with \(\tilde{V}_C\) replacing \(\hat{V}_{ip}\) and \(\tilde{V}_0\) replacing \(\hat{V}_{-1}\), yielding
\[
F(\tilde{V}_0)^{N-1} (\tilde{V}_C + \kappa - r) + \sum_{m=1}^{N-1} \tilde{w}_m = C, \tag{6}
\]

where \(\tilde{w}_m\) is the corrupt bidder’s expected rent when his valuation is \(\tilde{V}_C + \kappa\) and there are \(m\) other bidders, whose valuations are above \(\tilde{V}_0\) but less than \(\tilde{V}_C + \kappa\). When no one bids at the reserve price right after the auction is announced, then bidders understand that the auction is not corrupted, in which case we have an ordinary English auction with \(N-1\) potential bidders.

**Comparison of English and two-stage auctions under corruption**

With a first day bid at the reserve price signaling a corrupted auction, non-corrupt bidders are less likely to enter a two-stage auction than an English auction and thus there is less likely to be competition. Correspondingly, bidder 1 is more likely to participate in a two-stage auction than an English auction. For the first we can show that \(\tilde{V}_0 > \hat{V}_{-1}\) and for the second that \(\hat{V}_{ip} > \tilde{V}_C\). The result can be derived by noting that, since equation (1), (4) and (6) hold, if \(\tilde{V}_0 > \hat{V}_{-1}\) then \(\hat{V}_{ip} > \tilde{V}_C\).

Suppose counterfactually \(\tilde{V}_0 \leq \hat{V}_{-1}\), then it can be shown that the left hand of equation (5) is less than that of equation (3), which yields a contradiction (since the right hand sides are the same).

The intuition is that, in the case of an English auction, other potential bidders do not know whether bidder 1 is corrupt. They only know that he is corrupt with probability \(p\), and they make entry decisions simultaneously with bidder 1. However, in the two-stage auction, the other potential bidders know for sure whether bidder 1 is corrupt or not. When he is corrupt, other potential bidders have a much smaller chance of winning the auction if bidder 1 has substantial advantages from having a higher expected valuation given government help and having signaled. This reduces the incentives to enter for other potential bidders. Given that, bidder 1 sees less risk of losing the auction and thus is more motivated to enter a two-stage auction than an English auction.

That the corrupt bidder is more likely but other potential bidders are less likely to enter a two-stage auction implies that the corrupt bidder has a better chance to win in a two-stage auction than in an English auction. In the Appendix we show that under different configurations of his
valuation relative to threshold values, the corrupt bidder is at least as likely to win in a two-stage auction and more likely in some configurations, compared to an English auction. Since the corrupt government official can get bribery income only if the corrupt developer wins, ceteris paribus, she is more likely to favor two-stage auctions as the weight, $\lambda$, on corruption income rises, and less likely to favor English auctions where competition with higher prices is more likely.

**Hot versus cold properties: positive selection**

Now we turn to the issue of positive selection on unobservables into two-stage auctions. The general idea is that, for hot properties, competition from non-corrupt developers makes it more difficult for the corrupt developer to win an English auction. As discussed above, the corrupt developer can fend off competition more easily in the two-stage auction by making a signaling bid. Therefore, a corrupt government official who cares sufficiently about her bribery payment is more likely to favor a two-stage auction over an English auction when the property to be sold is hotter. This suggests positive selection on unobservables into two-stage auctions.

Defining “hot” is non-trivial. The most straightforward way is to define it as the number of potential bidders, $N$, holding constant the common value and distribution function of valuations, and that is the example we use here. Another way would be to allow the common value to be uncertain to the land use allocation committee, but known to the land bureau official and bidders who operate daily in the market. For the same reserve price (related to the land use allocation committee’s estimate of the common value) hotter properties are those with higher realized common values. This asymmetry in information may not be plausible. Yet another way might be to have the corrupt bidder’s valuation, $V_1$, known to the land official before auction choice, and to define hotness based on the size of $V_1$ (noting by construction the expected highest valuation of all participants rises as $V_1$ rises), but again it seems implausible to assume the auctioneer knows $V_1$.

In using $N$ as the measure of hotness, in defining selection, the key idea is that we expect the positive difference in the probability that the corrupt developer wins the land between a two-stage and an English auction to rise with $N$, so that the gap in $\lambda q \omega$ terms in the land bureau official’s objective function between the two auction formats rises. However, this derivation (e.g., deriving $d\hat{V}_{11}/dN$ and $d\hat{V}_{1p}/dN$ from equations (3) and (4)) turns out to be very difficult for the general case, so we constructed two examples. First is a special case to illustrate the principle. Assume $\lambda$ is close to 1 so that the land bureau official is focused almost exclusively on corruption
income and that $\kappa$ is sufficiently large, so that we are at or near a corner solution for two-stage auctions where $\tilde{V}_0$ is near or greater than the upper bound on valuations, $\bar{V}$. In this case, non-corrupt bidders will not enter the two-stage auction once they believe that a corrupt developer has secured an agreement with the corrupt government official. In this case, $\tilde{V}_C = C + r - \kappa$, and the corrupt developer wins the land with probability one as long as his valuation is above $\tilde{V}_C$. The value of the official’s objective function under two-stage auctions doesn’t vary with $N$ (for $\lambda = 1$).

However things are different for English auctions. Note, from the analysis above that $\hat{V}_1 < \tilde{V}_0$, so that non-corrupt bidders’ entry point into English auctions may be well below $\bar{V}$.

Assuming $V_1 > \hat{V}_1 \rho$ so that the corrupt developer is motivated to enter the English auction despite potential entry by other bidders, when $V_1 < \hat{V}_1 - \kappa$, the corrupt developer wins the land in the English auction with probability of $F^{N-1}(\hat{V}_1)$. It can be shown that this is decreasing in $N$.

When $\hat{V}_1 \leq V_1 + \kappa$, the corrupt developer wins the land with probability of $F^{N-1}(V_1 + \kappa)$ in the English auction. Clearly, as $N$ becomes larger, the corrupt developer is less likely to win the land in the English auction. Thus the gap in corruption income for two-stage auctions over English auctions will grow as $N$ grows and there is positive selection on unobservables (the number of potential bidders) into two-stage auctions.

We then programmed a general example where non-corrupt bidders have some chance of entering either auction type and $\lambda$ can take all feasible values, comparing regimes where $N=2$ versus 3. Such calculations even just for $N=3$ are rather complex. In the Appendix we illustrate that, for low values of $\lambda$, English auctions are preferred while, for high values, two-stage auctions are preferred for both values of $N$, as discussed above. However there is an intermediate range where for $N=2$ English auctions are preferred, while for $N=3$ two-stage auctions are preferred. That is, there is positive selection into two-stage auctions. For comparative statics, as $\kappa$ rises, the ranges of $\lambda$ where two-stage auctions are preferred increases for both values of $N$. Similarly as entry costs rise, the range increases (signaling has a great deterrence effect).

**Auctions without corruption**

We briefly discuss a comparison of English versus two-stage auctions absent corruption, to suggest two things: (1) initial bids at greater than reserve price should be expected and (2) that negative selection into two-stage auctions may be likely. We have noted the basics of English auctions.
without corruption in the text above. Two-stage auctions without corruption are more difficult, although the analyses are related to the jump bidding literature (see Daniel and Hirshleifer 1997 for the case of private valuation and Avery 1998 for the case of common valuation). We detail analyses in Cai, Henderson and Zhang (2009) with some highlights in the Appendix here. The basic ideas are as follows. Now the first stage is a chance for a bidder, say bidder 1, to signal high valuation, not corruption. In that case, the bid will signal his actual valuation. We show in the Appendix that the bidding function is increasing in his evaluation. The signaling bid discourages subsequent potential entrants from entering, who might have drawn somewhat higher valuations, because they know that, if they enter, the prior signaler is prepared to bid up to his valuation. That inferred valuation then defines the minimum price they have to pay. Thus signaling reduces the expected rent of other potential entrants.

As with corruption, the probability of no sale is lower in a two-stage auction than in an English auction. Since bidder 1 can discourage entry by other potential bidders with her early bid, she is more likely to enter in a two-stage auction than in an English auction. And when bidder 1 does not enter, other bidders still are more likely to enter a two-stage auction than an English auction. The flip side of this is that the probability of competitive bidding (two or more active bidders) is lower in a two-stage auction than in an English auction, because the early entrant may deter later entrants. As a result, in terms of expected revenue, while a two-stage auction has a higher probability of sale, the likelihood of competitive bidding is smaller. Thus, depending on parameter values, the expected revenue of a two-stage versus English auction can be more or less.

In Cai, Henderson, and Zhang (2009), we use an example to conjecture that when land is cold, as defined in a particular fashion, the expected revenue of a two-stage auction is greater than that of an English auction. The intuition is that when land is cold, a two-stage auction has a relatively lower threshold entry for bidder 1 and greater likelihood of anyone entering. Thus any sale and some revenue are more likely under a two-stage auction and may generally be a better choice of auction for a revenue-maximizing land bureau. If land is “hot”, so a sale is very high probability, an English auction is likely to attract more bidders and competition, since two-stage auctions may still lead to entry deterrence. Thus we might expect a revenue-maximizing land bureau to steer hot properties towards English auctions. Thus overall, absent corruption, there would be negative selection on unobservables into two-stage auctions.
Other auction choice considerations
Another factor which would affect the comparison between English and two-stage auctions is the riskiness of the land to be auctioned. For different properties, the variance of the private value components could differ. For a given reserve price and same expected valuation, absent corruption, suppose for some reason, the land bureau assigns high variance properties to English auction. For a given reserve price, high variance properties generally have a lower probability of any valuation being over reserve price. Then, in fact we might expect the opposite assignment: when there are fat tails to the distribution of \( V_i \), the solution to equation (1) may be quite large, resulting in a low chance of a sale in an English compared to two-stage auction, with its lower entry threshold. Revenue is only realized if there is a sale. But assuming the assignment suggested, English auctions when a sale occurs would have a higher expected price, a possible explanation for our general results that properties sold by English auction bring a higher price. However, we note that, under this scenario, English auctions should also bring a higher expected price when the auction is competitive (has multiple bidders), something we do not find empirically. Nevertheless, we want to control for a number of observables which could be related to variance of valuations such as property type, size, and distance from the city center.

One additional issue we choose to ignore is the sequence of land sales in a city. First, while it is certainly true that developers can always bid on the next available land, land auctions differ from on-line auctions of staple goods. There is enormous heterogeneity of land for sale, as well as heterogeneity of developers. Any developer may not easily find readily substitutable pieces of land in a given year; and different pieces of land attract different bidders, so sequencing has little consequence. Second, it does not seem to us that the issue of the sequence of land sales would fundamentally change our arguments about auction choices with or without corruption.

Beijing: What we see in the data concerning potential signaling
In our data in the empirical section, we know only sales and reserve prices and nothing about the bidding process itself—sequence and number of bids. However for Beijing, which will not be part of the estimating sample because it doesn't have English auctions, we have a sample of 195 two-stage auctions, where we know the number of bids as well as the date when the first bid is submitted. From that data we learn several things. First, and most critically from Table 1, bidders do not signal valuations as they might in the absence of corruption. In all auctions with just one bid, almost all bids are within 0.5% of reserve price; this is consistent with our corruption story. Once
we have 2 or more bids then a spread develops. This becomes the basis for later defining whether an auction is competitive (has more than one bid) or not, based on spread. Note auctions can be highly contested: in 26 of the cases with 3 or more bids, there are reported to be over 65 bids in each of the auctions.

Columns 1 and 2 of Table 2 show that, conditional on property characteristics, having a first day bidder is negatively correlated with the number of bids. Having a first day bid, given 10 days to bid, might be expected to mechanically raise the number of bids (and a first day bid could indicate selection into better properties). Yet having a first day bid is associated with fewer bids. Similarly, in columns 4 and 5, having a first day bidder makes it less likely that the auction will be competitive, again consistent with the signaling story. But the first day bidder effects on competition in columns 4 and 5 are weak. In Beijing sometimes properties are sold which, contrary to national policy on auctions, have not been cleared for redevelopment. In Beijing, we have good data on clearance or not, with 155 of the observations having an entry for this variable. Being cleared increases the number of bids (column 3) and increases the chances of competition (column 6). Controlling for this variable sharpens the first day bidder variable in column 6.12

Finally we note that in Beijing there are not strong patterns of repeat winners, where such patterns might be expected if bidding rings are prevalent. From 2004 to 2007, 171 of 258 auctions involve non-repeat winners over the four years. This is consistent with the idea that properties are highly heterogeneous, each with a particular clientele. Twenty-one buyers repeat once, but most of those occur in the same and last year (2007), just before the Olympics at the height of construction frenzy. There are 7 people who win 3 times over 4 years, 2 who win 4 times, and 1 who wins 5.13

3. The data and basic patterns

For our econometric analysis, we have data for 15 cities from 2003-2007,14 from the Land Bureau of China (or its branches at the city-level).15 For each auction, the land bureau provides detailed information and posts it on its official website www.landlist.cn. Information includes: the address,
the area (in square meters), the use restriction (business, residential, mixed), the type of auction, the reserve price, the sales price if the sale is complete, the post date which is the first date bids are accepted, the sale date, and the buyer’s identity. Sometimes additional information is given, such as the maximum floor-to-area ratio, the building-density, the green coverage rate, and whether the property is cleared or not. For some items including the last, explicit information is only provided in a limited number of cases.

We also obtained the geo-economic characteristics of each piece of land for sale through bendi.google.com. Specifically, we locate each piece of land in the digital map of bendi.google.com using its street address. We then measure the line distance between the land and the CBD of the city. For the cities in the sample, we have no difficulty in identifying one central business district. We also create some dummy variables to indicate, whether within a 2.5 km. radius of the center of the property for sale, there is railway (including light rail and subway) or highway.

Our base data consists of 4016 listings, where a listing is a property put up for auction whether the auction is completed and results in a sale, or not. Our 4016 listings exclude industrial use land (about 7% of total listings). As in the USA, industrial land use has a low and highly variable unit price; regressions using USA data which examine the determinants of sales prices for industrial land have low explanatory power (DiPasquale and Wheaton, 1996). More critically in China, such properties are often sufficiently far from the city center stretching into peri-urban areas, that we couldn’t get location characteristics from bendi.google.com.

Of the 4016 listings, 607 remain unsold. Another 1107, while sold, do not have information on either reserve price or sales price, or both. We focus on the remaining 2302 which are completed auctions with full price information. In the Appendix we explore the effect of focusing just on this sample. Here we note some key findings from the Appendix. First, for properties that sell, those with full versus deficient price information have similar unit and reserve sales prices where information does exist on one or the other and only differ in observables in two minor ways: properties without full price information tend to be older listings and nearer the city center. The differences in samples for sales with full versus limited price information seem to be “innocent.” However, unsold properties compared to our working sample of 2302 show distinct differences. For example, the probability of a non-sale is 8% higher for an English auction, potentially evidence of positive selection into two-stage auctions; and, not surprisingly, to have been listed more recently. In terms of sales dates, we suspect unsold properties (i.e., those which didn’t sell 10 days
after posting) are eventually removed from public listing on the internet, perhaps rebundled, and then relisted, which makes statistical analysis of sale versus no sale difficult, since we don’t know which properties are being offered for the first versus second time.

**Differences across auction types**

Table 3 is summary of basic statistics about the data, for completed transactions by auction type. In Part a, compared to English auctions, two-stage auctions have significantly lower mean unit sales prices and are significantly less likely to sell competitively (have a spread greater than 1.005). However they have no significant difference in unit sales price, conditional on a competitive sale. This suggests the main effect of two-stage auctions on prices in through deterring competition.

We note two-stage auctions have a greater proportion of commercial properties. However, we decided that whether a property was designated as commercial was not an element on which we wanted to focus. As Part b of the table reveals, commercial relative to residential and mixed use (which are fairly similar) properties are more likely to be sold through two-stage auction and without competition (60% sold non-competitively versus 40% for residential and mixed use). However unit sales prices across uses are similar, both for those that are sold competitively and for those that are not.

**4. Baseline effect of auction type on sales prices**

In this section we explore the overall effect of auction type on unit sales prices. As we will see in Sections 5 and 6, we are in essence estimating a reduced form price equation. Based on the conceptual section, consider the specification

\[
\ln \ln (\text{sale price}) = \ln \text{common value} + f(\text{potential number of bidders}, \text{auction type}, \bar{e})
\]  

(6)

This specification follows the notion that there is a common value component to any bidders’ valuation. Given this common value, ex ante sales price then depends on the number of potential bidders and potentially the auction format, with the ex post sales price dependent on the actual drawings of private valuations (which \( \bar{e} \) encapsulates). In the data, the potential number of bidders and certain determinants of the potential number of bidders (e.g. certain property characteristics) are unobserved. Choice of auction format should be related to unobservables. With corruption, we have argued that there will be positive selection—the setting aside of “delectable morsels” for corrupt participants. We also conjectured that absent corruption, there may be negative selection on
properties sold by two-stage auction. Thus finding positive selection is both consistent with
corruption and may also indicate corruption.

In equation (6), we assume reserve price is proportional to common value, with an added
error component that is unrelated to any particulars of the sale (“evaluator error” in $\tilde{\epsilon}$). As noted
above, reserve price is set by an outside committee, using a formula based upon the valuation of the
land parcel carried out by an independent private land appraiser. In that sense reserve price is an
exogenous valuation of property based on characteristics of the property and general local market
conditions; the issue of possible non-exogeneity of reserve price will be addressed at various points
below. For the same common values to two different properties, the number of potential bidders
will vary with the city in question (number of active land developers, controlled below by city and
time fixed effects) and aspects of the property. For example, the potential number of bidders may
differ for certain types of uses or properties near or further from the city center.

We implement equation (6) with

$$
\ln \text{sale price}_{ijt} = \ln \text{ask price}_{ijt} + \tilde{X}_{ijt} \beta + d_{ijt} D + u_j + \delta_t + \epsilon_{ijt}
$$

(7)

for property $i$ in city $j$ which is sold at time $t$. $\tilde{X}$ ’s include observed property characteristics such as
use restriction, area, and distance to the city center which may be correlated with the number of
potential bidders and the variance of valuations, as well as seasonal dummies. Auction type, $d_{ijt}$, is
whether the land bureau chooses a two-stage auction (=1) or not (=0), so that $D$ is the effect of
auction type on sales price, which we would like to identify. The terms $u_j$ and $\delta_t$ capture city and
year fixed effects. The arguments in $\epsilon_{ijt}$ are unobserved time-varying city conditions or property
characteristics, which, controlling for common value, may increase the number of potential bidders.
These conditions may also affect selection of auction type.

4.1 Selection problem and instruments.

To deal with auction selection, for our baseline results, we estimate a Heckman (1978) endogenous
dummy variable model, as well as regular IV. Instrumental, or control function variables are ones
which we think affect selection of auction type by the land bureau, but not sales price conditional
on our covariates.

We have four sets of instruments which appear to influence choice of auction type, but in
the tables in the text we rely on just the two strongest. These are two political variables, which
induce the behavior of wanting to “appear clean” by substituting English auctions for two–stage
auctions where the latter are known to be corruptible. Each arises from a pattern in the data which is illustrated for the first set, as follows. In the month before a new party secretary takes office in a city, the land bureau switches more to using English auctions and then a month later it switches back, in fact switching away from English auctions (in effect, catching-up to its usual mix). Figure 3 illustrates for the 17 cases in which a party secretary turns over. Each case is normalized so the month of turnover is zero. We plot the ratio of English to two-stage auctions in our data for 7 months: the month of turnover and then lead and lag for 3 months. In Figure 3, the ratio of English to two-stage auctions is sharply higher in the month before turnover (and the month of turnover) and is sharply lower in the month after, than in other months.

We view the Figure 3 outcome as the land bureau being cautious: “cleaning-up” temporarily in the face of uncertainty about the new party secretary’s views on land market corruption; and then returning to business as usual. The use of this variable assumes that the timing of listings is largely exogenous and Figure 3 does not disguise some simple shifting of pre-set auction types across months. The political events affect auction type choices for properties coming up for listing. If we do a Poisson of the number of listings per month with city fixed effects, seasonal dummies, year dummies, and the instruments, as we will see in Table 4 below, while the month before and after a party secretary takes office strongly affects choice of auction type, it has no effect on the total count of auctions. In fact there is no time pattern in total auction counts around the party secretary taking office (over the 7 month span), other than total auctions dip in the month a party secretary takes office. That may be explained because nothing much happens in a city during that month with its extensive official and unofficial political and social requirements.

Similar arguments apply to the second set instruments, although the timing is different. For the second set, we have cases that relate to real estate corruption, reported on Google China. Such cases could involve the removal of a major local government official, the indictment of officials, the execution of officials, or a criminal investigation on land transactions. During a month when a case occurs, officials are more careful and schedule more English auctions. A month later they again revert and catch-up to business as usual. A few months after the case, a sanitized report on the case is announced on state run news agencies and picked up by Google China, with 27 cases in our data. The announcements on Google China appear to occur 3 months after the case, in the sense that 3 months earlier English auctions jump up, followed in the next month by a drop down. This
timing of the pattern of one month up followed by one month down is found by experimentation in the data, but it is a clear pattern in both situations.

We have two other types of instruments as well and include them in some experiments, especially in smaller sub-samples where there is insufficient variation in our 4 instruments across months within cities in the sub-samples. These results are in footnotes or mentioned in the text, but not in tables. We have a source on corruption investigations more generally, which is the number of news reports per month by the main state news agency in China, Xinhua, on corruption in any city $j$. Our hypothesized scenario is the city government, the local party, or the National Audit Office conducts an enquiry into local corruption, of which the local land bureau is fully aware. Again, during this month, officials are more careful and schedule more English auctions. A month later they again revert and catch-up to business as usual. A couple of months after the investigation, Xinhua reports on the investigation (the average is about .9 reports per city per month). Thus English auctions increase 2 months before the month of the news report and decrease the next month.

Finally, we have a measure of the pressure on the land bureau to raise more money through land sales. Cities have an expenditure budget and on-the-book revenues. On-the-book revenues account for about 70% of total expenditures. Leasehold sales revenues are mostly off-the-book revenues, which are used to effectively close the on-the-book deficit. We measure the gap between budgetary expenditures of the city $E_j$ and on-the-books revenue $R_j$. The instrument is the lagged growth in the relative deficit: $\left(\frac{E_{j,t-1} - R_{j,t-1}}{R_{j,t-1}} - \frac{E_{j,t-2} - R_{j,t-2}}{R_{j,t-2}}\right)$. With city fixed effects we would effectively be instrumenting with the lagged rate of change in this gap and are treating this growth rate as somewhat idiosyncratic and not connected to city demand conditions that would affect the current and future housing market (given city and year fixed effects). Higher lagged deficit growth rates induce more English auctions.

In summary, for the main results, we use just the first two sets of instruments: party secretary change and real estate corruption cases. There our vector of instruments $Z_j$ consists of dummy variables for any listing which occurs when a new party secretary takes office (one month lead and one month lag) and dummy variables for any listing which occurs when Google reports a land use corruption case (three months lead and two months lead). These are the strongest instruments. Growth in the relative city fiscal on-the-books deficit in the year before the listing is also a strong instrument at times but is potentially objectionable: it only varies annually and has the
potential to be related to real estate prices. In addition to our results in the tables using 4 instruments, we will report (the almost identical) results for key situations using all 7 instruments. And as noted, in some experiments not reported in tables, we use all 7 instruments. We now look at first stage results of how instruments affect auction choice.

**Choice of auction type**

We examine the choice of auction type, both to see the role of the instruments and to analyze the choice itself. Results are in Table 4, Columns 1 and 2 are the probit results, for 4 and 7 instruments respectively. In column 3, we also present linear probability results for 4 instruments. In the last two columns, we examine the (non) effect of instruments on total auctions per month and setting of reserve price. Focusing on the first two columns, in both, the effect of reserve price on auction type is essentially zero, which is consistent with the idea that reserve price setting is independent of auction choice. Choice of auction type is significantly influenced by land use, where the base case, commercial land, is much more likely to be sold in two-stage auction, consistent with Table 3. Commercial land consists of smaller plots, which may be of more interest to specialized neighborhood developers within the city and may have fewer potential bidders. Also, more likely to be sold at two-stage auction is land near rails (probably land urbanized in the Maoist era) but not near highways (land urbanized more recently).

Of particular interest is how instruments influence auction choice. In column 1, the variables for the change in party secretary and for announcements of land corruption cases have the hypothesized patterns and are generally significant. In column 1, the $F$-statistic based on the change in the value of the LLF from adding instruments to the probit is 8.1. For the linear probability model in column 3, the partial-$F$ is over 10.0. Although these partial-$F$'s are not as high as one would like, they are reasonable in a context where we have city fixed effects. In column 2 the other three instruments are added in and have the hypothesized effects as well. However, going to seven instruments lowers the 1st stage $F$-statistic, one reason for settling on four instruments.

Column 4 of Table 4 shows that the count of auction listings per month is uncorrelated with the instruments. In column 5, we look at what is correlated with unit reserve price. As urban models predict, reserve prices decline with distance from the city center; and they also decline with property size for these very large properties. Conditioning on other covariates, use type does not affect reserve price, so in essence there is equalization in unit valuations across uses. Most critically reserve prices are uncorrelated with the instruments. The number of auction listings and the setting
of reserve prices are determined by planning and assessment procedures outside the control of the land bureau. These political instruments affect just auction choice in the relevant months. As such the fact that these political events affect auction choice but not other aspects of the land allocation process itself is an indicator of corruption in the land bureau.

4.2 Sales Price Results

We estimated the sales price equation by OLS and by MLE where auction type is an endogenous dummy variable (Heckman, 1978). As specification checks, we also estimated the model by LIML (given relatively weak instruments) and experimented with allowing heterogeneous auction effects (Wooldridge, 2007).\textsuperscript{16} Sales price results are in Table 5. In all specifications, a 1% increase in reserve price raises sales price by just over 0.9%. Why is the elasticity less than 1? A higher reserve price also contains an effect to discourage entry of potential bidders (where we assume appraisers set a reserve price that is common value plus an idiosyncratic error component). Property characteristics are interpreted to affect the number of potential bidders, conditional on reserve price. Sales prices are distinctly lower for larger plots which may be less manageable and have fewer experienced developers who would try to utilize them.

The key variable concerns choice of auction type. In OLS estimation, prices are lower for two-stage auctions by 17%. With correction for selection, the coefficient has a much larger negative value. The Heckman MLE estimate is about -0.70, about 4 times larger in absolute value. The fact that the treatment effect coefficients are significantly larger than under OLS suggests positive selection: not accounting for selection understates the size of the treatment effect. Correspondingly, for direct evidence on selection, the coefficient on correlation of the error terms in the MLE results is positive and significant. The theory section suggested positive selection would be a marker of corruption, and the results indicate that positive selection into two-stage auctions is a significant force. A 2-step Heckman procedure also supports positive selection.\textsuperscript{17}

Because one might be concerned about the functional restrictions of the Heckman model, in the table we also show LIML results. The IV coefficient (standard error) when the first stage

\textsuperscript{16} We experimented with adding interactions of auction type with covariates to the IV specification, allowing auction effects to vary with covariates. But the effects are not instructive, especially given we already have a reduced form specification. In OLS the interactions are not significant. In the IV (2SLS) results, the interactions are somewhat statistically stronger and the average treatment effect rises from -.53 (with 7 instruments) to -.81. However there is little variation in treatment responses as covariates go from low to high values.

\textsuperscript{17} The selection terms are respectively $\phi(Z_{i\hat{y}})/\Phi(Z_{i\hat{y}})$ and $-\phi(Z_{i\hat{y}})/(1-\Phi(Z_{i\hat{y}}))$ where $Z_{i\hat{y}}$, $\hat{y}$ are the covariates and estimated parameters from the probit on auction type. The lambda coefficient (standard error) on selection is 0.140 (.069).
simply uses the 4 instruments (i.e., linear probability) is similar to MLE, -.646.\(^{18}\) While we are not sure how precisely we have estimated the coefficient on auction type, the OLS 17% surely serves as a lower bound, with positive selection being clearly indicated.

In terms of validity of instruments, if we add to column 1 (the OLS specification) our 4 instruments as covariates, the coefficient on auction type goes from -.1697 to -.1624, a tiny change. If instruments were correlated with unobservables affecting sale prices, assuming that auction type is correlated with unobservables, the added instruments should absorb some of the correlation of unobservables with auction type, affecting its coefficient. That the coefficient is unchanged and instruments are definitely correlated with auction type suggests that the instruments are orthogonal to unobservables. We also note that instruments have no significant effect on sales price, direct evidence that the instrumented events are not connected with economic events in the city that would influence sales prices. In IV estimation, the Sargan p-value of .15 is acceptable but low. We believe the low value is due to model specification error (see next section) rather than unsuitability of instruments per se.

Finally, we note that in early work we dropped the reserve price variable and used property characteristics (and city and time fixed effects) to represent both common value and demand considerations. In that specification, all coefficients become much more negative.\(^{19}\) For example, the OLS coefficient goes from -.17 (with a reserve price control) to -.34 (without a reserve price control); the MLE coefficient goes -.92; and the LIML coefficient is -.80. The \(\rho\) in MLE remains positive and significant. Results without a reserve price control also suggest positive selection.

### 4.4 The problem of the kink in the price equation

The problem with the reduced form specification is that, if an auction is non-competitive, price equals reserve price; a spread only emerges with competition. Further, we hypothesize that if multiple entrants emerge in the second stage of a two-stage auction, the outcomes for English and two-stage auctions for that property will be similar. In both cases once into the English auction portion, the sales price will simply be the valuation of the second highest valuation bidder. Corruption takes the form of inducing non-corrupt entrants to stay out of the two-stage auction, with the result that sales are at reserve prices. Of the 2302 auctions upon which estimation is based,

\(^{18}\) For this model the Kleibergen-Papp \(F\)-statistic on weak instruments is over 11.2. Also for robustness, with use of all 7 instruments, the MLE are almost the same as with 4 instruments (-.69).

\(^{19}\) These reported results are for 7 instruments.
only 1235 are ex post competitive, or have more than one bidder as inferred from the degree of spread. We already saw in Table 3 from the raw data that unit price differences between English and two-stage auctions become insignificant once we look just at auctions which are competitive.

To explore these issues, we examine the two components. How does auction type affect the probability that an auction will be competitive or not? Second, if auctions are competitive does the choice of auction format still affect sales price? The answers to these questions will help us study the revenue losses from use of two-stage auctions.

5. The effect of auction type on competition
What is the effect of auction type, on whether an auction will be competitive or not, defined as whether there appears to be more than one bidder because spread exceeds 1.005? A simple probit of competitive or not with auction type as a potentially endogenous dummy variable faces the same selection problem as in the sales price estimation. Properties may be negatively or positively selected into two-stage auctions, and such selection itself will affect the potential for competition. The literature handles this in different ways. We use the bivariate recursive probit (Greene, 1998, Evans and Schwab, 1995), as an MLE solution. As a robustness check we also performed LIML estimation for a linear probability model (Angrist, 1999), where we instrument for auction type with $Z$’s.

The bivariate recursive probit is a two equation MLE model where we model action type as a dummy endogenous variable which is a function of $X$ and $Z$, with auction type affecting the event: competition or not. That is,

$$d_{ijt}^* = Z_{ijt} \alpha + X_{ijt} \beta + u_{ijt},$$

(8)

$$s_{ijt}^* = X_{ijt} \lambda + d_{ijt} \gamma + v_{ijt},$$

(9)

with

$$d_{ijt} = \begin{cases} 1 & \text{if } d_{ijt}^* > 0, \\ 0 & \text{o.w.} \end{cases},$$

(10)

$$s_{ijt} = \begin{cases} 1 & \text{if } s_{ijt}^* > 0, \\ 0 & \text{o.w.} \end{cases}.$$  

(11)

where $d_{ijt}$ denotes whether an auction is two-stage (1), or not (0), and $s_{ijt}$ denotes whether an auction is competitive (=1) or not (=0). The $X$’s include city fixed effects, year dummies, seasonal dummies, and ln(ask price) and observed property characteristics in all equations (cf., equation 7).
The recursive structure allows identification in a standard bivariate probit framework (Greene, 1998). In the next section we will add a continuous equation, for sales price in competitive auctions; at that point we will offer more details on estimation.

Results are in Table 6. For the bivariate recursive probit, we show marginal direct and indirect effects. For the variable of interest, two-stage auction, there is only a direct auction effect. In the ordinary probit in column 1, the marginal effect of two-stage auction on the probability of being competitive is -.34, consistent with the raw data in Table 3. In the bivariate recursive formulation that marginal effect in column 3 is 26% stronger, at -.43. This is again suggestive of positive selection into two-stage auctions: the two-stage auction’s negative effect on competition is understated because properties with better unobservables are selected into two-stage auctions. Consistent with this, the \( \rho \) measuring the degree of correlation between the error terms is positive (.38), and significant. Finally we note that the auction effect when estimated by LIML in column 4 using a linear probability model (first and second stages) suggests an even bigger auction effect of -.650. This might suggest that the -.43 in the MLE is a conservative, reasonable estimate.

In terms of other variables, in columns 2 and 3, relative to the base case of commercial use, sales of residential and mixed use land are likely to be more competitive, while large properties away from the city center are less likely to have competitive bidding. Total marginal effects on competition or not include direct and indirect effects through the effect of covariates on auction type and hence competition. Indirect effects seem strongest for land use variables, reinforcing the fact that commercial use properties face fewer takers and are less likely to be competitive. Removal of reserve price as a covariate in both equations has little effect on results, consistent with the fact that its coefficient is insignificant in Table 6.

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20 Use of 7 instruments yields a negative effect to -.49.
21 Marginal direct effects are calculated based on the estimated coefficients in the second equation of the bivariate recursive probit, as well as the predicted probability of being competitive at the mean level of covariates, i.e., \( P=0.4817 \). For a continuous variable, its marginal effect is equal to the product of the density of normal distribution at \( P=0.4817 \) and its estimated coefficient. For a discrete variable, its marginal effect is equal to \( \Phi(\Phi^{-1}(0.4817) + \theta) - 0.4817 \), where \( \Phi(\cdot) \) (or \( \Phi^{-1}(\cdot) \)) is the cdf (or inverse of cdf) of the normal distribution and \( \theta \) is the estimated coefficient.
22 The marginal indirect effect of each covariate is obtained from the product of the estimated coefficient of two-stage auction in the second equation of the biprobit regression, the estimated coefficient of this covariate on auction type in the first equation, and the two pdf’s. We calculate the standard errors using the delta method approach. The variance-covariance matrix is obtained through post-estimation of the biprobit model.
6. Effect of auction type on sales prices, for competitive sales

If properties sell competitively, is there a remaining effect of auction type on sales price?

Examination of this question faces two problems. First there is the auction selection problem discussed earlier, but now there is a second selection issue. Being competitive is endogenous, and there is selection on unobservables into competition that are surely correlated with price. Such selection is mediated by the auction process, so it is not the standard problem in Lee, Maddala and Trost (1980), but rather one modeled in the labor literature (Fraker and Moffitt 1988, Goux and Maurin, 2000) and more recently in firm growth models (Reize, 2001).

We tackle the problem in two ways. We estimate a parametric specification of the two selection issues by MLE, as in the literature cited above. But these models impose a lot of structure. Thus, as a less parametric approach, we wanted to utilize the ideas from the literature on identification-at-infinity (Heckman, 1990), by examining auction effects for samples where the predicted probability of a non-competitive sale is small. This isolates a sample where, ex ante, we expect sales to be competitive regardless of auction type, so we only need to worry about selection into auction type not competition. The main issue in moving to such a sample is that we run out of cities which have competitive sales in both auction formats. Thus, instead we ended up focusing on the raw data; and, asking whether, conditional on the predicted probability of being competitive, prices diverge between auction types.

6.1. The raw data

For each auction type separately, we estimate the probability that an auction is competitive; specifically that the spread (ratio of sales to reserve price) is greater than 1.005. The covariates in these simple predictive probits are the X’s including reserve price and city fixed effects, but not the instruments (Mulligan and Rubinstein, 2007). Given estimation is separated by auction type, for two-stage auctions for example, the predicted probability of competition is made in the context of signaling and selection. We then look at the raw data on spread and unit prices in two ways. First, for each auction type, we order the predicted probabilities and break the two-stage auction rankings into 40 equal size bins and the English (with the smaller sample) into 20. For each bin, we calculate the average predicted probability and the median and mean spread and price. Results for the mean and median are similar and Figure 4 shows the plots for medians. Over the whole range of predicted probabilities, for spread in Figure 4a, in the relevant interval of predicted probabilities, the plots for two-stage and English auction spreads overlap each other. A key difference between
two-stage and English auctions is the lack of points for English auctions at low probabilities of being competitive and the lack at very high probabilities for two-stage auctions. Note how spread is 1 (price equals reserve price) until predicted probabilities hit about 0.5 and then spread rises with predicted probabilities. For unit prices, the plots for two-stage auction are actually higher than for English, although those price differences are not significant and the plots are noisy.

For the second analysis of raw data, in Table 7, we divide predicted probabilities into 0.05 intervals and ask whether there are significant differences in spread and prices between the two auction types. As Figure 4 suggests, we need to truncate the exercise in the lower half and at very upper end of the predicted probability range because of lack of observations of one auction format or the other. Note the extreme differences in counts of the two auction types in the tails of the predicted probability range. In general in Table 7, differences in median spread and price are not significant. Thus, the raw data suggests that, conditional on the predicted probability of being competitive, English auctions definitely don’t bring better prices.

For implementing identification at infinity, the problem is apparent from Table 7. There are just too few two-stage auctions to use a typical cut-off of greater than 0.8 probability of being competitive. Because there are too few cities left in the sample which use both auction types, our instruments (for auction type) loose their power. To have any power (but still relatively weak instruments), we could only first cut at the margin of the probability of competition exceeding .6, which definitely falls short of the margin of “almost certain” to sell competitively. Thus we turn to the more traditional parametric approach.

6.2 MLE estimation of the bivariate selection into competitive, two-stage auctions

To the model in equations (8) – (11), we now add a third equation for price

\[ y_{ij} = X_{ij} \beta + d_{ij} D + \varepsilon_{ij} \quad \text{if } s_{ij} = 1, \quad (7a) \]

where \( y_{ij} \) is sales price in logs. The structure imposes a trivariate normal error

\[
\sum = \text{Var} \begin{pmatrix} \varepsilon \\ u \\ v \end{pmatrix} = \begin{pmatrix} \sigma^2_u & \sigma_{eu} & \sigma_{ev} \\ \sigma_{eu} & 1 & \sigma_{ev} \\ \sigma_{ev} & \sigma_{uv} & 1 \end{pmatrix}, \quad (12)
\]

\[23\] This sample is 792 (out of possible 912 from Table 7) where 9 cities still have both auction types. Using all 7 instruments, the improvement in the LLF for the first stage probit on auction type of adding the instruments is still significant (\( \chi^2 \)- statistic of 28.5) but the implied \( F \)- statistic is low. \( \rho \) equals .028 (and is insignificant). Price discounts under OLS and MLE are both about -.3.
so as to estimate the parameter set \( \Theta = (\beta, D, \alpha, \theta, \lambda, \gamma, \sigma_e, \rho_{au}, \rho_{ev}, \rho_{aw}) \). The LLF is footnoted and uses results in Genz (2004). \(^{24}\) We estimate the model by MLE. \(^{25}\)

In Table 8, we present simple OLS price equation and MLE results for the 1235 competitive auctions. The OLS coefficient on auction type in column 1 is -0.03 and insignificant. Column 2 gives the MLE results for the price equation, along with the covariance structure. Estimates for the discrete choice part of the three-equation MLE model are almost identical to those in Table 6. They may be found in Cai, Henderson, and Zhang (2009). In column 2, the coefficient for the auction type effect on price in competitive auctions is small and insignificant as hypothesized. \(^{26}\) In the covariance structure, as before, there is strong positive selection into two-stage auctions. The error term on the price equation has low correlation with the error terms in the discrete events.

**Summary.** Whether we approach the problem as a parametric one with strong assumptions or use a non-parametric look at the raw data, it seems that, once auctions become competitive, price is not affected by auction format. Auction format matters at the margin of whether auctions are competitive or not, consistent with the corruption signaling hypothesis for two-stage auctions.

### 6.3 Review gains from switching to English auctions

What are the revenue gains if one was to require properties sold at two-stage auction to be sold at English auction, assuming that would solve the problem of potential corruption between the auctioneer and partner bidders. In our data the actual revenue from properties sold at two-stage

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\[ p_{ijt} = \frac{Z_{ijt} + X_{ijt} \theta + \rho_{aw} (y_i - X_{ijt} \beta - d_{ijt} D)}{\sqrt{1 - \rho_{aw}^2}}, \quad p_{iijt} = \frac{X_{ijt} \lambda + d_{ijt} \gamma + \rho_{ev} (y_i - X_{ijt} \beta - d_{ijt} D)}{\sqrt{1 - \rho_{ev}^2}}, \quad \text{and} \]

\[ \rho_{ai} = \frac{\rho_{au} - \rho_{aw} \rho_{ev}}{\sqrt{(1 - \rho_{au}^2)(1 - \rho_{ev}^2)}}. \]

\(^{24}\) The LLF is \( \ln L = \frac{\ln(\Phi_2[-Z_{ijt} \alpha - X_{ijt} \theta, -X_{ijt} \lambda - d_{ijt} \gamma, \rho_{aw})] - \ln(2\pi) - \ln(\sigma_e) - \frac{1}{2} \left( \frac{y_i - X_{ijt} \beta - d_{ijt} D}{\sigma_e} \right)^2 \text{ if } d_{ijt} = 0, s_{ijt} = 0}{\ln(\Phi_2[\rho_{ijt}, \rho_{iijt}, \rho_{ai}] - \ln(2\pi) - \ln(\sigma_e) - \frac{1}{2} \left( \frac{y_i - X_{ijt} \beta - d_{ijt} D}{\sigma_e} \right)^2 \text{ if } d_{ijt} = 1, s_{ijt} = 1}. \]

\( \Phi_2(\cdot) \) is the cumulative density function of the bivariate normal distribution. And

\[ Z_{ijt} = Y_{ijt} \alpha + X_{ijt} \theta + \rho_{aw} (y_i - X_{ijt} \beta - d_{ijt} D) \]

\(^{25}\) We thank Frank Reize for access to his STATA code on MLE estimation of the model, to check ex post against our STATA code, although in the end we reprogrammed the model in MATLAB. There seems to be a minor error in Reize (2001) in specification of the LLF.

\(^{26}\) The results are the same if we use 7 instruments.
auctions is 239.6 billion Yuan or about $34.2 billion. This is modestly higher than the expected revenue for these properties which is predicted from the estimated model, indicating the issue with mediating unit sales price predictions by lot sizes to get sales revenue per property. This predicted revenue if these properties are still sold at two-stage auction is 227.7 billion Yuan, about 5% lower than the actual. The unit sales price calculation is based on the predicted probability of selling competitively if sold at two-stage auction (\(\text{prob} (s_{ij} = 1|d_{ij} = 1)\)) times the predicted price if sold competitively, plus the predicted probability of selling non-competitively at two-stage auction times the reserve price. The predicted price if sold competitively is calculated from the usual price equation adjusted for the two selection terms as footnoted (using parameters from the MLE estimation).27

We compare the revenue from selling properties by two-stage auctions with the predicted revenue obtained if all properties sold by two-stage auctions in the data were sold at English auctions. This is the predicted probability of these properties selling competitively if switched to English auction times the predicted price when sold competitively, plus the predicted probability of not selling competitively if switched to English auction times the reserve price. The predicted probability of selling competitively is enhanced by the treatment effect of English auction on competition.28

The predicted revenue is 299.6 billion Yuan. This is 25% higher than the actual revenue and 32% higher than the model predicted revenue if sold by two-stage auction. Thus, use of two-stage auction with the associated reduction in degree of competition (through potentially signaling a corrupt sale) deprives cities of significant revenues.

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27 The price equation is \(\hat{y}_{ij} = X_{ij} \hat{\beta} + d_{ij} \hat{D} + \epsilon_{u,ij} \hat{\sigma}_u + \epsilon_{v,ij} \hat{\sigma}_v\), where \(\hat{\epsilon}_{u,ij}, \hat{\epsilon}_{v,ij}\) are the predicted values for the expressions

\[
c_{u,ij} = \Phi[Z_{ij}\alpha + X_{ij}\theta] \frac{\Phi[X_{ij}\lambda + d_{ij}\gamma - \rho_{u}(Z_{ij}\alpha + X_{ij}\theta)]/(1 - \rho^2_{u})^{1/2}}{\Phi_2[Z_{ij}\alpha + X_{ij}\theta, X_{ij}\lambda + d_{ij}\gamma, \rho_{u}]} \text{ if } d_{ij} = 1
\]

\[
= \Phi[-Z_{ij}\alpha - X_{ij}\theta] \frac{\Phi[X_{ij}\lambda + d_{ij}\gamma - \rho_{u}(Z_{ij}\alpha + X_{ij}\theta)]/(1 - \rho^2_{u})^{1/2}}{\Phi_2[-Z_{ij}\alpha - X_{ij}\theta, X_{ij}\lambda + d_{ij}\gamma, \rho_{u}]} \text{ if } d_{ij} = 0
\]

\[
c_{v,ij} = \Phi[X_{ij}\lambda + d_{ij}\gamma] \frac{\Phi[Z_{ij}\alpha + X_{ij}\theta - \rho_{v}(X_{ij}\lambda + d_{ij}\gamma)]/(1 - \rho^2_{v})^{1/2}}{\Phi_2[Z_{ij}\alpha + X_{ij}\theta, X_{ij}\lambda + d_{ij}\gamma, \rho_{v}]} \text{ if } s_{ij} = 1
\]

\[
= \Phi[Z_{ij}\alpha - X_{ij}\theta + \rho_{v}(X_{ij}\lambda + d_{ij}\gamma)]/(1 - \rho^2_{v})^{1/2} \Phi_2[-Z_{ij}\alpha - X_{ij}\theta, X_{ij}\lambda + d_{ij}\gamma, \rho_{v}]} \text{ if } s_{ij} = 0
\]

28 Let us denote the probability of selling competitively under the switch as \(\text{prob}[s_{ij} = 1|d_{ij} = 1, d'_{ij} = 0]\). Then \(\text{prob}[s_{ij} = 1|d_{ij} = 1, d'_{ij} = 0] = \Phi(\Phi^{-1}(\text{prob}[s_{ij} = 1|d_{ij} = 1]) - \hat{\gamma})\).
This gain in revenue is illustrated in Figure 5, which for two-stage auctions compares the predicted unit price in the model if sold still by two-stage auction, with that if switched to English auction. The 45° line is for model predicted prices if sold still by two-stage auction, while the scatter plot of points is for the predicted prices if these properties were sold by English auction. The difference reflects both the increase in probability of selling competitively for any property, as well as the fact that these properties have relatively good unobservables which enhances their competitive price.

7. Summary
To the best of our knowledge, this paper is the first to investigate empirically corruption in auctions beyond simple price-fixing among bidders, to allow corrupt auctioneers and signaling activity, which we believe has relevance in other contexts. The paper also builds a case based upon indirect evidence using both theory and empirics to argue that corruption exists in a particular form.
Consistent with corruption, two-stage auctions indicate first bids at reserve price, rather than the jump bids expected absent corruption and there is positive rather than negative selection of properties into two-stage auctions. We also see that officials switch to English auctions in contexts where it is important to appear clean. In this setting, we show that after controlling for observable land characteristics (and location and time trends), two-stage auctions lead to less competitive bidding and thus substantially smaller revenue than English auction in China’s land market, despite positive selection of properties into two-stage auctions.

Since urban land in large Chinese cities is very valuable and revenue from land auctions accounts for a large portion of city fiscal revenue, such corruption activities result in large losses of potential public funds. But losses are not merely transfers from city coffers to the corrupt officials and developers. They can lead to serious misallocations, as honest developers with higher valuations are deprived of the chances to develop the land.

China’s reform mandating auctions for land transactions was a big step in the right direction in fighting widespread corruption. However, our analysis of China’s land market shows that in a weak institutional environment, corrupt government officials and their partners can and will find cracks in the new fixes. In the context of China, recent studies have identified other “tricky” cases of corruption and illegal activities, for example, tariff evasion using entrepot trade (Fisman and Wei, 2004, Fisman, Moustakerski and Wei, 2008) and corruption and bribery using travel and entertainment expenses (Cai, Fang and Xu, 2009). Thus, fighting corruption in
developing countries like China is a long term process whose success relies on, and is a part of, the gradual improvement of the overall institutional environment. For the problem at hand a recommendation would be to use English auctions for all leasehold allocations. Local officials resist such a reform. One cited objection is that English auctions yield irrational bidding and too high prices. We have a different interpretation to such objections by local officials.

Appendices

Theory appendix:

1. Comparing English and two-stage auctions under corruption

We want to show that in all relevant cases the corrupt bidder has at least as good a chance of winning a two-stage auction as an English auction, and sometimes a better chance. When the corrupt bidder’s valuation, \( V_i \), is smaller than the entry threshold in the two-stage auction, \( \hat{V}_c \), then the corrupt developer will not enter no matter what auction format is chosen. For the case where \( V_i \geq \hat{V}_c \) but \( V_i \leq \hat{V}_{tp} \) (the entry threshold in the English auction), so the corrupt developer will enter only if the corrupt government official chooses the two-stage auction, the corrupt developer can win only if a two-stage auction is chosen. Then there is the case where \( V_i > \hat{V}_{tp} \) so that the corrupt developer enters no matter what the auction format is. Let \( X_{N-1}^i \) denote the highest valuation of all N-1 non-corrupt potential bidders. The probability of the corrupt developer winning the auction depends on the realized value of \( X_{N-1}^i \). If \( X_{N-1}^i \leq \hat{V}_{-i} \), where we recall \( \hat{V}_{-i} \) (\( \hat{V}_o \)) is the entry threshold of a non-corrupt bidder in the English (two-stage) auction, then none of the non-corrupt bidders will enter either auction format in this event and the corrupt developer wins the auction without contest. If \( \hat{V}_{-i} < X_{N-1}^i < \hat{V}_o \), then the non-corrupt bidder with the highest valuation will enter the English auction but not the two-stage auction. In this event, the corrupt developer wins without contest if the two-stage auction is chosen, but may face competition from some non-corrupt bidders and may lose the auction if \( X_{N-1}^i \geq V_i + \kappa \). Finally, if \( \hat{V}_o \leq X_{N-1}^i \), then the non-corrupt bidder with the highest valuation will enter to contest the corrupt developer under either auction format. No matter what the auction format is, whether the corrupt developer wins depends on whether \( V_i + \kappa \) is greater than \( X_{N-1}^i \). In summary, in all relevant cases, the probability of the corrupt developer winning the auction is not less and sometimes greater under the two-stage auction than under the English auction. Therefore, when \( \kappa \) is close to one, a corrupt government official will choose the two-stage auction over the English auction.
2. **Hot vs. cold property example, under corruption.**

For this example, for English auctions, equations (3) and (4) are used to solve for threshold values of $\hat{V}_{-1}$ and $\hat{V}_{1p}$. Equation (5) and (6) for two-stage auctions are used to solve for $\hat{V}_0$ and $\hat{V}_C$. For $N=3$, the expressions for equations (4) and (6) must account for the possibilities that any of bidders 1-3 may have the highest bid, that either of the remaining two may be the 2nd highest bidder, and that either or both of bidders 2 and 3 may enter. Once we have solved for threshold values, then the auctioneer’s objective function under each auction format must be evaluated. In the comparison, we examine the situation where the corrupt bidder 1 enters if it is a two-stage auction ($V_1 > V_C$) (but may or may not enter the English auction given $V_C < V_{1p}$). The auctioneer only gets bribe income if bidder 1 wins and the auction income depends on who enters and has the second highest bid if there are multiple entrants. For $N=3$, the expressions are very long, since they have to account for all the ways the corrupt developer can win and lose and all the relevant winning valuation and 2nd highest valuation possibilities.

We solve the example where $\nu = 9; r = 2; \kappa = 1.9, 2, 2.1; p = .8; C = .75, 1$ and 1.25; $q = 2.45$, and $\lambda$ lies between 0 and 1. The graph below shows the solution for $C = 1$ and $\kappa = 2$. The horizontal axis is $\lambda$ and the vertical is the value of the land bureau official’s objective function under English auction minus that under two-stage auction. As one can see, for low $\lambda$, English auctions maximize the auctioneer’s objective function, while, for high $\lambda$, two-stage auctions dominate for both values of $N$. However for a small interval of $\lambda$ values in the neighborhood of .7, English auctions are preferred if $N=2$ (see where the $N=2$ line intersects the horizontal line at 0), but two-stage are preferred if $N=3$.

\[ \text{Difference of } E(\omega) \text{ between English auction and two stage auction} \]

\[ \text{dotted curve: } N=2; \text{ starred curve: } N=3 \]

3. **Two-stage auctions without corruption**

In a non-corruption context, entrants, in arbitrary sequence, have a first opportunity to submit a bid. Sequencing could be based on the arbitrary times at which potential bidders learn the auction has started and decide to enter in the first stage, and have had their application to bid approved. Solving
the general case with endogenous first stage entry is daunting—whether an early entrant signals with what bid function, whether later entrants with higher valuations enter or not, and the complicated interactions between early and later signalers. We work with a special case where of the \( N \) potential bidders, only one randomly selected person, labeled bidder 1, has the option to enter and bid early. This case models the general situation in which \( N = 2 \) as typically formulated in the jump-bid literature (e.g., Daniel and Hirshleifer, 1997). In Cai, Henderson, and Zhang (2009), we solve for a separating, signaling equilibrium, where bidder 1 signals his true valuation. Here we give some highlights.

Bidder 1 chooses to enter in stage 1 by using a strictly increasing bidding schedule \( B(V_i) \) when his valuation is \( V_i \in [\bar{V}, \bar{V}] \). For \( V_i < \bar{V} \), bidder 1 will choose to not enter the auction. Suppose his valuation is exactly \( \bar{V} \). Based on the Riley argument in the signaling literature, bidder 1 will use the lowest possible signal, the reserve price \( r \). Once bidder 1 bids \( r \) and reveals that his valuation is \( \bar{V} \), other potential bidders will enter only if their valuation is above \( \hat{V}_{SV}(V) \), the solution to equation (1) with \( \bar{V} \) replacing \( r \) and \( N-2 \) replacing \( N-1 \). That is, for the other potential bidders, the effective reserve price increases to \( V_i = \bar{V} \). Bidder 1 can win the auction only if no other potential bidders enter, so \( \bar{V} \) satisfies

\[
F(\hat{V}_{SV}(\bar{V}))^{N-1}(\bar{V} - r) = C. 
\]  

(A1)

Note that, since \( \hat{V}_{SV}(\bar{V}) > \bar{V} + C \), comparing (A1) and (1) reveals that \( \bar{V} \) is smaller than \( \hat{V} \), so bidder 1’s threshold entry level is lower in a two-stage than English auction. If bidder 1 does not enter in the first stage, the other \( N-1 \) potential bidders play the same game as in an English auction, with a threshold for entry, denoted by \( \hat{V}_{NS} = \hat{V}(r, C, N-1, \bar{V}) \). Note that \( \hat{V} \) is increasing in \( N \), thus \( \hat{V}_{NS} < \hat{V}(r, C, N, \bar{V}) \), which is the equilibrium entry threshold in the case of an English auction with \( N \) potential bidders. So overall the two-stage auction greater chance of any sale.

What happens if bidder 1’s evaluation \( V_i \) exceeds \( \bar{V} \)? When bidder 1 has valuation \( V_i \in [\bar{V}, \bar{V}] \), he has a bidding function that is strictly increasing in \( V_i \) and truthfully reveals his valuation. Such a bidding function satisfies the single crossing property, so it isn’t beneficial for lower valuation bidders to pretend to be higher types. When bidder 1 enters in stage 1 with a bid \( B \), the other potential bidders can infer bidder 1’s valuation \( V_i > B_i + C \geq r + C \) from his bidding schedule \( B(V_i) \). Except for this, the same game is played by the other \( N-1 \) potential bidders as in the case of an English auction. The valuation threshold for entry can be solved as \( \hat{V}_{SV}(V_i) = \hat{V}(V_i, C, N-1, \bar{V}) \). Since \( V_i > r \), we have

\[
\hat{V}_{SV}(V_i) = \hat{V}(V_i, C, N-1, \bar{V}) > \hat{V}(r, C, N-1, \bar{V}) = \hat{V}_{NS},
\]

given the entry deterrence effect of bidder 1’s signaling.

For \( V_i \in [\bar{V}, \bar{V}] \), suppose for a bid of \( B \), other potential bidders other potential bidders believe his valuation is \( \bar{V} \). Then his expected payoff is

\[
U(V_i, \bar{V}, B) = F(\hat{V}_{SV}(\bar{V}))^{N-1}(V_i - B) - C.
\]

Clearly this payoff function is increasing in bidder 1’s true valuation \( V_i \) and the belief of the other potential bidders \( \bar{V} \), but decreasing in his bid \( B \). In equilibrium, bidder 1 should “tell the truth” by
bidding his equilibrium bid \( B(V_i) \) and we can show that this truth-telling constraint satisfies the single crossing condition, so lower valued bidders have no incentive to misrepresent their valuations. From the truth-telling constraint, the differential equation that characterizes the strictly increasing bidding schedule is

\[
\frac{dB}{dV_i} = \left[ \frac{(N-1)f(V_1)}{F(V_1)} \right] \frac{F(\hat{V}_S)}{F(\hat{V}_S) + (N-2)f(\hat{V}_S)(\hat{V}_S - V_1)}.
\] (A2)

where the second bracketed expression comes from applying the implicit function theorem to equation (1) and \( \hat{V}_S(V_i) = \hat{V}(V_1, C, N-1, V) \). Along with \( B(V) = r \), equation (A2) characterizes the strictly increasing signaling schedule.

**Data appendix.**

Comparing the estimating sample with samples of unsold properties and properties with incomplete information

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Two-stage auction</td>
<td>.72</td>
<td>.61</td>
<td>.69</td>
<td>5.11</td>
<td>1.66</td>
</tr>
<tr>
<td>Area (sq. m.)</td>
<td>54861</td>
<td>54113</td>
<td>53831</td>
<td>-.09</td>
<td>.25</td>
</tr>
<tr>
<td>Distance (km.)</td>
<td>19.3</td>
<td>46.4</td>
<td>13.4</td>
<td>-13.6</td>
<td>7.68</td>
</tr>
<tr>
<td>Unit sale price (10,000 yuan)</td>
<td>.62</td>
<td>n.a</td>
<td>.58 (n=824)</td>
<td>n.a.</td>
<td>.53</td>
</tr>
<tr>
<td>Unit reserve price (10,000 yuan)</td>
<td>.37</td>
<td>.21</td>
<td>.31 (n=200)</td>
<td>5.01</td>
<td>.50</td>
</tr>
<tr>
<td>Mixed use</td>
<td>.38</td>
<td>.52</td>
<td>.39</td>
<td>-6.03</td>
<td>-.54</td>
</tr>
<tr>
<td>Commercial use</td>
<td>.31</td>
<td>.27</td>
<td>.28</td>
<td>1.99</td>
<td>1.76</td>
</tr>
<tr>
<td>Residential use</td>
<td>.31</td>
<td>.21</td>
<td>.33</td>
<td>4.99</td>
<td>-1.14</td>
</tr>
<tr>
<td>No. quarters since listing until Dec. 2007</td>
<td>8.17</td>
<td>4.74</td>
<td>9.31</td>
<td>19.8</td>
<td>-6.25</td>
</tr>
</tbody>
</table>

The table above explores the differences in means of variables for the estimating sample versus other listings. A comparison of columns I and II (with tests of differences given in column IV) suggests unsold properties are more distant from the CBD with a lower reserve price; and are more likely to have been offered at English auction. A probit of auction type on sold or not, with controls for property characteristics including reserve price and city and year fixed effects, suggests two-stage auctions have a .076 higher probability of a sale. A comparison of columns I and III (with tests of differences given in column V) suggests sales with missing sale or reserve price data are similar to those in our estimating sample. They have similar auction type and use proportions and when data is available have similar reserve and sales unit prices.
References


Figure 1. Distribution of spread, the sale/reserve price ratio, by auction type
Orange (solid) is two-stage auction; white (blank) is English auction

Figure 2. Distribution of unit sales prices (in 10,000 yuan), by auction type
Orange (solid) is two-stage auction; white (blank) is English auction
Figure 3. Timing of party secretary turnover and auction choice

Ratio of English to total auctions

Figure 4. Conditional on the predicted probabilities of being competitive, spreads and prices for English versus two-stage auctions

a. Spreads: sale/reserve prices  (gold: two-stage; blue: English)
b. Unit sale prices (in 10,000 yuan; gold: two-stage; blue: English)

Figure 5. For two-stage auction sales: predicted unit price (in 10,000 yuan) if sold by two-stage (45° line) versus switching to English auction
Table 1. Beijing two-stage auctions

<table>
<thead>
<tr>
<th>Number of bids</th>
<th>Number of cases: Sales-reserve price ratio ≤ 1.005</th>
<th>Number of cases: Sales-reserve price ratio &gt; 1.005</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>104</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>3</td>
<td>6</td>
</tr>
<tr>
<td>3 or more</td>
<td>0</td>
<td>75</td>
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</table>

Table 2. Beijing count and spread estimations

<table>
<thead>
<tr>
<th>Bidder on first day, or not (167 of 195)</th>
<th>Poisson: Number of bids (robust s.e.'s)</th>
<th>Probit: Sales/reserve price ratio &gt; 1.005 (marg. effects)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Poisson: Number of bids</td>
<td>Probit: Sales/reserve price ratio &gt; 1.005</td>
</tr>
<tr>
<td>Bidder on first day, or not</td>
<td>-731** (.344)</td>
<td>-142 (.103)</td>
</tr>
<tr>
<td>Bidder on first day, or not</td>
<td>-638* (.338)</td>
<td>-144 (.111)</td>
</tr>
<tr>
<td>Bidder on first day, or not</td>
<td>-8.28** (.310)</td>
<td>-224* (.117)</td>
</tr>
<tr>
<td>Bidder on first day, or not</td>
<td>-8.28** (.310)</td>
<td>-144 (.111)</td>
</tr>
<tr>
<td>Bidder on first day, or not</td>
<td>-2.24* (.117)</td>
<td>-224* (.117)</td>
</tr>
<tr>
<td>Residential use</td>
<td>1.19** (.356)</td>
<td>1.04** (.352)</td>
</tr>
<tr>
<td>Residential use</td>
<td>1.19** (.356)</td>
<td>1.04** (.352)</td>
</tr>
<tr>
<td>Residential use</td>
<td>1.19** (.356)</td>
<td>1.04** (.352)</td>
</tr>
<tr>
<td>Residential use</td>
<td>1.19** (.356)</td>
<td>1.04** (.352)</td>
</tr>
<tr>
<td>Mixed use</td>
<td>.827* (.421)</td>
<td>.772* (.429)</td>
</tr>
<tr>
<td>Mixed use</td>
<td>.827* (.421)</td>
<td>.772* (.429)</td>
</tr>
<tr>
<td>Mixed use</td>
<td>.827* (.421)</td>
<td>.772* (.429)</td>
</tr>
<tr>
<td>Mixed use</td>
<td>.827* (.421)</td>
<td>.772* (.429)</td>
</tr>
<tr>
<td>Ln (area)</td>
<td>.205** (.092)</td>
<td>.131 (.085)</td>
</tr>
<tr>
<td>Ln (area)</td>
<td>.205** (.092)</td>
<td>.131 (.085)</td>
</tr>
<tr>
<td>Ln (area)</td>
<td>.205** (.092)</td>
<td>.131 (.085)</td>
</tr>
<tr>
<td>Ln (area)</td>
<td>.205** (.092)</td>
<td>.131 (.085)</td>
</tr>
<tr>
<td>Ln (distance to CBD)</td>
<td>-.631** (.252)</td>
<td>-.735** (.186)</td>
</tr>
<tr>
<td>Ln (distance to CBD)</td>
<td>-.631** (.252)</td>
<td>-.735** (.186)</td>
</tr>
<tr>
<td>Ln (distance to CBD)</td>
<td>-.631** (.252)</td>
<td>-.735** (.186)</td>
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<tr>
<td>Ln (distance to CBD)</td>
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<td>-.735** (.186)</td>
</tr>
<tr>
<td>Ln (reserve price)</td>
<td>-.247 (.173)</td>
<td>-.487** (.130)</td>
</tr>
<tr>
<td>Ln (reserve price)</td>
<td>-.247 (.173)</td>
<td>-.487** (.130)</td>
</tr>
<tr>
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<td>-.247 (.173)</td>
<td>-.487** (.130)</td>
</tr>
<tr>
<td>Ln (reserve price)</td>
<td>-.247 (.173)</td>
<td>-.487** (.130)</td>
</tr>
<tr>
<td>Property is cleared, prior to auction</td>
<td>1.63** (.591)</td>
<td>.292** (.135)</td>
</tr>
<tr>
<td>Property is cleared, prior to auction</td>
<td>1.63** (.591)</td>
<td>.292** (.135)</td>
</tr>
<tr>
<td>Property is cleared, prior to auction</td>
<td>1.63** (.591)</td>
<td>.292** (.135)</td>
</tr>
<tr>
<td>Property is cleared, prior to auction</td>
<td>1.63** (.591)</td>
<td>.292** (.135)</td>
</tr>
<tr>
<td>N</td>
<td>195</td>
<td>181</td>
</tr>
<tr>
<td>N</td>
<td>195</td>
<td>181</td>
</tr>
<tr>
<td>Pseudo Rsq</td>
<td>.030</td>
<td>.200</td>
</tr>
<tr>
<td>Pseudo Rsq</td>
<td>.030</td>
<td>.200</td>
</tr>
<tr>
<td>Pseudo Rsq</td>
<td>.030</td>
<td>.200</td>
</tr>
</tbody>
</table>

* significant at 10% level; ** significant at 5% level or higher
Table 3. Data on auctions

a) Two-stage vs. English auctions

<table>
<thead>
<tr>
<th></th>
<th>Two-stage auction: Mean (N=1661)</th>
<th>English auction: Mean (N=641)</th>
<th>Difference</th>
<th>t-stat.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unit sales price (in 10,000 yuan)</td>
<td>.47</td>
<td>1.0</td>
<td>-.53</td>
<td>-2.64</td>
</tr>
<tr>
<td>Proportion non-competitive</td>
<td>.574</td>
<td>.178</td>
<td>.396</td>
<td>-20.4</td>
</tr>
<tr>
<td>Unit price if competitive (in 10,000 yuan)</td>
<td>.73 (n =708)</td>
<td>1.13 (n = 527)</td>
<td>-.40</td>
<td>-1.62</td>
</tr>
<tr>
<td>Area (in sq. meter)</td>
<td>55289.96</td>
<td>53751.1</td>
<td>1538.86</td>
<td>.30</td>
</tr>
<tr>
<td>Distance to CBD (in km)</td>
<td>19.9</td>
<td>17.8</td>
<td>2.1</td>
<td>1.86</td>
</tr>
<tr>
<td>Commercial use</td>
<td>.38</td>
<td>.14</td>
<td>.24</td>
<td>13.3</td>
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</tbody>
</table>

b) Commercial vs. residential and mixed use properties

<table>
<thead>
<tr>
<th></th>
<th>Commercial: mean (N=716)</th>
<th>Residential and mixed use: mean (N=1586)</th>
<th>Difference</th>
<th>t-stat.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unit sales price (in 10,000 yuan)</td>
<td>.617</td>
<td>.615</td>
<td>.002</td>
<td>.026</td>
</tr>
<tr>
<td>Unit price if competitive (in 10,000 yuan)</td>
<td>.98 (n=289)</td>
<td>.88 (n=946)</td>
<td>.09</td>
<td>.55</td>
</tr>
<tr>
<td>Area (in sq. meter)</td>
<td>31354.72</td>
<td>65473.59</td>
<td>-34118.87</td>
<td>-8.52</td>
</tr>
<tr>
<td>Distance to CBD (in km)</td>
<td>18.47</td>
<td>19.67</td>
<td>-1.20</td>
<td>-1.03</td>
</tr>
<tr>
<td>Proportion two-stage auction</td>
<td>.88</td>
<td>.65</td>
<td>.23</td>
<td>13.17</td>
</tr>
<tr>
<td>Proportion non-competitive</td>
<td>.596</td>
<td>.403</td>
<td>.193</td>
<td>8.72</td>
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Table 4. Two-stage auction, or not

<table>
<thead>
<tr>
<th></th>
<th>Probit: marg. effects</th>
<th>Probit: marg. effects</th>
<th>Linear prob. model</th>
<th>Poisson count: Total listings per month</th>
<th>OLS, Ln (reserve price)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ln (reserve price)</td>
<td>-.040 (.031)</td>
<td>-.041 (.030)</td>
<td>-.031 (.026)</td>
<td></td>
<td>.050 (.083)</td>
</tr>
<tr>
<td>Dummy: Residential use</td>
<td>-.255** (.058)</td>
<td>-.250** (.055)</td>
<td>-.167** (.058)</td>
<td></td>
<td>.193* (.101)</td>
</tr>
<tr>
<td>Dummy: Mixed use</td>
<td>-.245** (.064)</td>
<td>-.241** (.062)</td>
<td>-.160** (.055)</td>
<td></td>
<td>.193* (.101)</td>
</tr>
<tr>
<td>Ln (dist. To CBD)</td>
<td>-.044 (.038)</td>
<td>-.044 (.037)</td>
<td>-.033 (.029)</td>
<td></td>
<td>-.571** (.043)</td>
</tr>
<tr>
<td>Ln (area)</td>
<td>-.0015 (.013)</td>
<td>-.0037 (.013)</td>
<td>-.0026 (.011)</td>
<td></td>
<td>-.145** (.043)</td>
</tr>
<tr>
<td>Dummy: railway within 2.5 kms.</td>
<td>.055* (.028)</td>
<td>.057* (.030)</td>
<td>.038* (.021)</td>
<td></td>
<td>.127 (.129)</td>
</tr>
<tr>
<td>Dummy: highway within 2.5 kms.</td>
<td>-.066** (.021)</td>
<td>-.069** (.022)</td>
<td>-.044** (.015)</td>
<td></td>
<td>-.158* (.084)</td>
</tr>
<tr>
<td>Lagged change in fiscal strain</td>
<td></td>
<td>-.544** (.236)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Xinhua corruption report, 2 month lead from listing</td>
<td></td>
<td>-.016 (.016)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Xinhua corruption report, 1 month lead</td>
<td></td>
<td>.021* (.012)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Party secretary turnover, 1 month lead</td>
<td>-.300** (.127)</td>
<td>-.314** (.131)</td>
<td>-.215** (.092)</td>
<td>.051 (.399)</td>
<td>.035 (.116)</td>
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<tr>
<td>Party secretary turnover, 1 month lag</td>
<td>.157** (.022)</td>
<td>.162** (.018)</td>
<td>.161** (.045)</td>
<td>-.253 (.253)</td>
<td>-.084 (.253)</td>
</tr>
<tr>
<td>Google report, Land corrupt. case, 3 month lead</td>
<td>-.212* (.136)</td>
<td>-.207* (.129)</td>
<td>-.211* (.112)</td>
<td>-.165 (.230)</td>
<td>.051 (.220)</td>
</tr>
<tr>
<td>Google report, Land corrupt. case, 2 month lead</td>
<td>.183** (.040)</td>
<td>.186** (.037)</td>
<td>.150** (.070)</td>
<td>.207 (.215)</td>
<td>.238 (.177)</td>
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<tr>
<td>Season, year, city dummies</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>N</td>
<td>2302</td>
<td>2302</td>
<td>2302</td>
<td>283</td>
<td>2302</td>
</tr>
<tr>
<td>(Pseudo) Rsq</td>
<td>(.37)</td>
<td>(.36)</td>
<td>.41</td>
<td></td>
<td>.40</td>
</tr>
<tr>
<td>Implied F-Statistic From adding instruments</td>
<td>8.1</td>
<td>6.6</td>
<td>10.0</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* significant at 10% level; ** significant at 5% or higher level.
All standard errors are robust clustered by city-code, except for LIML where errors are robust.
## Table 5. Baseline Case: Unite Sales Prices \[\ln(\text{sales price}/\text{area})\]

<table>
<thead>
<tr>
<th></th>
<th>OLS</th>
<th>Heckman MLE</th>
<th>IV  \ MLE-linear prob. 1st stage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dummy: two-stage auction [2SLS]</td>
<td>-.170** (.037)</td>
<td>-.707** (.217)</td>
<td>-.646** (.267)</td>
</tr>
<tr>
<td>Ln (reserve price)</td>
<td>.923** (.028)</td>
<td>.907** (.025)</td>
<td>.909** (.018)</td>
</tr>
<tr>
<td>Dummy: Residential use</td>
<td>.023 (.049)</td>
<td>-.068 (.078)</td>
<td>-.058 (.056)</td>
</tr>
<tr>
<td>Dummy: Mixed use</td>
<td>.078** (.034)</td>
<td>-.0091 (.059)</td>
<td>.0008 (.054)</td>
</tr>
<tr>
<td>Ln (dist. To CBD)</td>
<td>.0083 (.037)</td>
<td>-.010 (.037)</td>
<td>-.0083 (.021)</td>
</tr>
<tr>
<td>Ln (area)</td>
<td>-.069** (.011)</td>
<td>-.070** (.013)</td>
<td>-.070** (.011)</td>
</tr>
<tr>
<td>Dummy: railway within 2.5 kms.</td>
<td>-.025 (.035)</td>
<td>-.0034 (.035)</td>
<td>-.0059 (.028)</td>
</tr>
<tr>
<td>Dummy: highway within 2.5 kms.</td>
<td>-.067 (.038)</td>
<td>-.089* (.046)</td>
<td>-.087** (.025)</td>
</tr>
<tr>
<td>Season, year, city dummies</td>
<td>Yes</td>
<td>yes</td>
<td>yes</td>
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<tr>
<td>N</td>
<td>2302</td>
<td>2302</td>
<td>2302</td>
</tr>
<tr>
<td>Rsq</td>
<td>.85</td>
<td>.641** (.235)</td>
<td>{.15}</td>
</tr>
</tbody>
</table>

* significant at 10% level; ** significant at 5% level or higher.

All standard errors are robust clustered by city-code, except for LIML where errors are robust.
Table 6. Probability sale is competitive

<table>
<thead>
<tr>
<th></th>
<th>Ordinary probit</th>
<th>Bivariate recursive probit MLE</th>
<th>LIML, Linear Probability</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Marginal effects</td>
<td>Marginal indirect effects</td>
<td>Marginal direct effects</td>
</tr>
<tr>
<td>Dummy: two-stage auction</td>
<td>- .338** (.079)</td>
<td>n.a.</td>
<td>-.427** (.085)</td>
</tr>
<tr>
<td>Ln (reserve price)</td>
<td>-.016 (.027)</td>
<td>.085 (.067)</td>
<td>-.023 (.024)</td>
</tr>
<tr>
<td>Dummy: Residential use</td>
<td>.216** (.055)</td>
<td>.405** (.131)</td>
<td>.172** (.062)</td>
</tr>
<tr>
<td>Dummy: Mixed use</td>
<td>.205** (.049)</td>
<td>.405** (.156)</td>
<td>.161** (.069)</td>
</tr>
<tr>
<td>Ln (dist. To CBD)</td>
<td>-.028 (.021)</td>
<td>.094 (.085)</td>
<td>-.035* (.022)</td>
</tr>
<tr>
<td>Ln (area)</td>
<td>-.045** (.012)</td>
<td>.002 (.028)</td>
<td>-.045** (.011)</td>
</tr>
<tr>
<td>Dummy: rail within 2.5 kms.</td>
<td>.013 (.036)</td>
<td>-.123* (.076)</td>
<td>.023 (.039)</td>
</tr>
<tr>
<td>Dummy: highway within 2.5 kms.</td>
<td>-.019 (.029)</td>
<td>.137** (.067)</td>
<td>-.028 (.029)</td>
</tr>
<tr>
<td>Season, year, city dummies</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>N</td>
<td>2297</td>
<td>2297</td>
<td>2297</td>
</tr>
<tr>
<td>Rho</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rsq {Sargan p-value}</td>
<td>.22</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* significant at 10% level; ** significant at 5% level or higher. All standard errors are robust clustered by city-code, except for LIML where errors are robust

Table 7. Auction price differences under competition: data

<table>
<thead>
<tr>
<th>Probability of being competitive</th>
<th>No. of 2-Stage</th>
<th>No. of English</th>
<th>Spread: Difference in Medians. Chi sq p-value*</th>
<th>Price: Difference in Medians. Chi sq p-value*</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;0.40</td>
<td>805</td>
<td>20</td>
<td>.67</td>
<td>.83</td>
</tr>
<tr>
<td>0.4 - 0.45</td>
<td>120</td>
<td>10</td>
<td>.74</td>
<td>.74</td>
</tr>
<tr>
<td>0.45 - 0.50</td>
<td>142</td>
<td>10</td>
<td>.33</td>
<td>.74</td>
</tr>
<tr>
<td>0.50 – 0.55</td>
<td>122</td>
<td>16</td>
<td>.06</td>
<td>.18</td>
</tr>
<tr>
<td>0.55 – 0.60</td>
<td>91</td>
<td>23</td>
<td>.16</td>
<td>.64</td>
</tr>
<tr>
<td>0.60 – 0.65</td>
<td>89</td>
<td>12</td>
<td>.38</td>
<td>.38</td>
</tr>
<tr>
<td>0.65 – 0.70</td>
<td>76</td>
<td>20</td>
<td>.80</td>
<td>.80</td>
</tr>
<tr>
<td>0.70 – 0.75</td>
<td>60</td>
<td>41</td>
<td>.93</td>
<td>.75</td>
</tr>
<tr>
<td>0.75 – 0.80</td>
<td>63</td>
<td>56</td>
<td>.92</td>
<td>.002</td>
</tr>
<tr>
<td>0.80 – 0.85</td>
<td>40</td>
<td>78</td>
<td>.01</td>
<td>.33</td>
</tr>
<tr>
<td>0.85 – 0.90</td>
<td>35</td>
<td>88</td>
<td>.21</td>
<td>.21</td>
</tr>
<tr>
<td>&gt;0.90</td>
<td>14</td>
<td>240</td>
<td>.78</td>
<td>.78</td>
</tr>
</tbody>
</table>

*Yates continuity corrected
Table 8. Sales prices: “Competitive” sales only

All sales where spread > 1.0005

<table>
<thead>
<tr>
<th></th>
<th>OLS</th>
<th>MLE (selection on auction type and competition) (eqs. 7a – 11)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dummy: two-stage auction</td>
<td>-.031 (.071)</td>
<td>-.137 (.414)</td>
</tr>
<tr>
<td>Ln (reserve price)</td>
<td>.870** (.041)</td>
<td>.867** (.051)</td>
</tr>
<tr>
<td>Dummy: Residential use</td>
<td>-.157* (.075)</td>
<td>-.162 (.103)</td>
</tr>
<tr>
<td>Dummy: Mixed use</td>
<td>-.061 (.042)</td>
<td>-.065 (.068)</td>
</tr>
<tr>
<td>Ln (dist. To CBD)</td>
<td>.025 (.048)</td>
<td>.020 (.047)</td>
</tr>
<tr>
<td>Ln (area)</td>
<td>-.097** (.027)</td>
<td>-.098** (.032)</td>
</tr>
<tr>
<td>Dummy: there is railway within 2.5 kms.</td>
<td>-.049 (.052)</td>
<td>-.049 (.053)</td>
</tr>
<tr>
<td>Dummy: there is highway within 2.5 kms.</td>
<td>-.102 (.064)</td>
<td>-.110 (.077)</td>
</tr>
<tr>
<td>Season, year, city dummies</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>N</td>
<td>1235</td>
<td>1235</td>
</tr>
<tr>
<td>$\sigma_\varepsilon$</td>
<td></td>
<td>.510** (.060)</td>
</tr>
<tr>
<td>$\rho_{ue}$</td>
<td></td>
<td>.114 (.437)</td>
</tr>
<tr>
<td>$\rho_{ve}$</td>
<td></td>
<td>.088 (.212)</td>
</tr>
<tr>
<td>$\rho_{uv}$</td>
<td></td>
<td>.374** (.186)</td>
</tr>
<tr>
<td>Rsq</td>
<td></td>
<td>.82</td>
</tr>
</tbody>
</table>

Significant at 10% level; ** significant at 5% level or higher. OLS s.e.’s are robust, city clustered.