Golfing for Information: Social Interactions and Economic Consequences

Sumit Agarwal[1,2], Yu Qin[2], Tien Foo Sing[2,3] , and Xiaoyu Zhang[2]

Dec. 3, 2019

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Keywords: information efficiency, social interaction, winners' curse, land auctions, corporate investment

JEL Codes: D71, D82, G31

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* We appreciate the comments from Sugata Ray, Mushfiq Mobarak, Allaudeen Hameed, Stuart Rosenthal and seminar participants at the SFS Cavalcade Asia-Pacific 2018, SMU Urban Conference 2018 and AREUEA-ASSA Conference 2019. All errors are our own.

[1] Department of Finance, Business School, National University of Singapore, 15 Kent Ridge Drive, Singapore 119245 (corresponding author)

[2] Department of Real Estate, School of Design and Environment, National University of Singapore, 4 Architecture Drive, Singapore 117566

[3] Institute of Real Estate and Urban Studies (IREUS), National University of Singapore, 21 Heng Mui Keng Terrace, Singapore 119613

Email: Sumit Agarwal: ushakri@yahoo.com; Yu Qin: rstqyu@nus.edu.sg; Tien Foo Sing: rststf@nus.edu.sg; Xiaoyu Zhang: e0001413@u.nus.edu

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Abstract This paper studies how company top managers acquire information through social interactions at golf courses to subsequently acquire land parcels at lower prices. Developers play golf together more often after the government makes a land sale schedule announcement. We find evidence rejecting the collusion hypothesis. The winning bids are 6% lower after interacting with top managers from other companies. However, the lower land prices by informed bidders generate negative spillovers on neighboring properties. Our results imply that social interactions enable developers to realize higher profits, while the government loses land sale revenues.

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1 Introduction

People acquire information through social interactions in social networks. Albeit not directly observable, the networks are found to be important to the development of the economy and the society (Guiso *et al.* 2000; Glaeser *et al.* 2003; Khwaja *et al.* 2008, 2011). Existing studies use shared working or educational experiences to indirectly measure the networks. However, less is known about how individuals interact with each other in social networks, and how such social interactions may facilitate information exchange and thus affect the related economic outcomes.

The paper fills the gap in the literature by examining the following questions: Do company directors and CEOs consciously exchange information through social interactions? How do such interactions affect the investment outcomes of the companies? Using a unique dataset containing the golf records of golf players who have golf club memberships in Singapore, we propose a new measurement of the social interactions among company directors and test the influences of the social interactions on corporate investment performances.

We proceed with the paper in the following steps. First, we show that golfing is a channel for information exchanges, and we observe that directors of real estate development firms change their golfing pattern after the announcement of the land supply schedule. We then test whether developers who golf together collude in the land parcel auctions or simply share information. And we provide evidence rejecting the collusion hypothesis by showing that the bidders who golf together cannot both be more likely to acquire land parcels after the golf sessions between them. Next, we compare the bidding outcomes of bidders who golf with another developer's directors from the announcements of land supply schedule to the auction opening dates (hereby after "golfing bidders" or "golfing developers"). We find the golfing bidders avoid overbidding. We also compare the outcomes of real estate projects built on land parcels acquired by golfing bidders to those parcels acquired by non-golfing bidders. Lastly, we study the spillover effects of land acquisitions conducted by the golfing bidders on neighboring properties.

Specifically, in the first part of the paper, using a difference-in-differences design where the golfers who do not work for real estate companies as directors are used as the reference group, we find that the golf pattern of developer directors changes significantly following the semi-annual announcements of the government's land supply schedules in Singapore. After the announcements, the golfers who are directors of land bidders play golf more regularly with directors of other bidders. Their likelihood of golfing with developer directors increases by 17% in the first week and 26% in the second week after the announcements relative to the reference week which is one week before announcements.

Next, we examine whether the golfers collude in the auctions of land parcels ("Collusion hypothesis") or simply share information among each other. When they collude, the cartel members could be taking turns to win with the designated winner submitting a serious bid, and others submitting fake bids. On average, they should be either more likely to win or they should maintain an average likelihood of winning while decreasing the winning bid. When they simply share information, they could be sharing "soft information" about the market in general or about the land parcels to be sold according to the land supply schedule. The winning likelihood could be higher or lower, with their bid closer to the fair market value and the bidders avoiding overbidding. We find that a pair of golfers who golf together are less likely to both win in one bidding cycle (the six months' period between two announcements of land supply schedules) and in two consecutive bidding cycles after the golf games, which rejects the Collusion hypothesis.

We then examine the bidding price of the golfers and the non-golfers. In addition, we find that the golfing bidders acquire land parcels at 6% lower price compared to other less informed or uninformed winning bidders. Losses in land sale revenue are estimated at more than SGD $138.75 million (around USD $100 million) per year from November 2010 to May 2014, which correspond to 0.2% of government revenue and 0.8% of total land sale proceedings, on average. In addition, the sale price for projects developed by golfing developers is 3% lower than that for other projects developed by non-golfing developers.

Lastly, we find that land transactions by golfing bidders generate short-term negative spillovers to other properties in the vicinity: neighboring projects sell for approximately 4.7% lower price within 90 days after the announcement of the land auction results where the golfing bidders win, which is likely to be an overreaction of the uninformed market participants to the lower land prices.

The paper makes three contributions to the literature. First, it shows evidence of corporate top executives using social interactions to acquire new information in response to market events. Our diff-in-diff empirical design clearly shows that the changes in the pattern of interactions are causal rather than correlations. Dyck *et al.* (2017) examines the relationship between the companies and the auditors and shows that the relationship leads to corporate fraud. The focus of this paper is different in that we focus on the relationship between the top executives of companies.

Second, this paper is the one of the first to directly observe the social interactions, instead of static connections, and empirically show how social interactions influence the investment outcomes of involved companies. The existing research either studies the effects of social interactions on individual outcomes (Bailey *et al.* 2018a; Bailey *et al.* 2018b) or focuses on the static network, especially the formal relationships (Fracassi & Tate 2012; Schmidt 2015; Gompers *et al.* 2016) as an indirect measurement of social interactions. One exception is Haselmann *et al.* (2018) which have detailed information on the new formation of social ties, thus even if they do not observe social interactions, there are exogenous variations in the social networks to identify the relationship between new social ties and credit supply. Shue (2013) is the only paper that observed dynamic social interaction and shows how informal interactions (alumni reunion) could influence managerial decision makings.

The paper is organized as follows. Section 2 reviews the literature. Section 3 introduces the data. Section 4 defines the informed bidders, explains the empirical strategies and introduces the results. Section 5 discusses the results and concludes the paper.

2 Literature Review

Social connections and social interactions are good measurements for information advantage. There is extensive literature on social connections and information exchange. Information exchange through connections can affect individual behaviors such as financial investments (Arrondel *et al.* 2018), online borrowing (Freedman & Jin 2014) and job search (Simon & Warner 1992). Connections also affect company outcomes (Adams & Ferreira 2007; Engelberg *et al.* 2012; Schmidt 2015) and the outcomes of the top executives (Glaser *et al.* 2013).

However, an underlying assumption of these studies is that people would interact with each other as long as they are connected, which is not necessarily true. Besides, existing literature mostly uses *static* network measurements which, as pointed out in Shue (2013) and Fracassi and Tate (2012), may suffer from endogeneity issue. In particular, static network measurements are likely to be endogenously determined and correlated with other individual characteristics. Shue (2013) uses the alumni reunion which is dynamic in nature to capture the social interactions and finds that the interactions may lead to inefficiencies in company policy-making. Our paper is different from Shue (2013) in that we focus on how the interactions may improve the firm investment performances. The recent two papers, Bailey *et al.* (2018a) and Bailey *et al.* (2018b), study how social connections affect housing expectations. We take a different approach by focusing on how social interactions improve information efficiency. Besides, we introduce a dynamic measurement of information advantage to study the relationship between social interactions and information efficiency.

3 Data

We use four datasets in this paper. The first dataset comprises the golf records of all golf players in Singapore from 2010 to 2014. The database contains 29,291 unique golfers and more than 400,000 golf records. The data are collected from the website of the Singapore Golf Association (SGA), a national body governing golf games. The SGA keeps the records of the most recent 20 golf sessions of the registered golf players, which reflect the players' golf skills. After matching the sample golfers to the firm directors' database, we identify that among golfers, 712 are directors of land bidding firms, 11,966 are directors of other non-bidders, and 16,613 are non-directors. Golf is a popular game among businesses executives to cultivate social networks. Many news report and articles in *The Economists* and *Financial Times* allude to the importance of golf for business networking purposes.

We use the information on golf games to identify informal interactions among top executives. Golf offers a good platform for them to communicate for many reasons. First, more than 40% of the golfers in the database are company directors. Playing golf is a social sport that offers opportunities to top executives to meet informally on golf courses with privacy. Second, golfing is an exclusive game for a small group of corporate elites in Singapore because of the high costs of playing golf there. Agarwal *et al.* (2016) find that a golfer is six times more likely to be a company board member than a non-golfer. These two reasons suggest that golfing is a useful sport for social networking because of the homophily of the golfers (McPherson *et al.* 2001). Another golf rule that makes Singapore suitable for this research is that it is mandatory to submit the golf score to the golf association after the game, while in some other countries, the score is voluntarily submitted by the golfers. This rule eliminates the selection problem in which the golfers playing for business are not willing to submit the score and make their golf record traceable.

The second dataset comprises Singapore's government land bidding records from 1990 to 2016, which are publicly available on the websites of Urban Redevelopment Authority and Housing and Development Board, the two government agencies responsible for the supply of state land in Singapore. To accommodate the shorter sample period of the golf dataset, we only use land transactions from November 2010 to May 2014, which comprise 103 land bids by 895 bidders.

In Singapore, more than 80% of the land is owned by the state; and the government makes land available for private development through land tenders. The releases of land supply schedules are made every six months usually in June and December, while the dates are exogenously chosen by the URA, and are hardly predictable to the public. The schedules contain details of land parcels to be sold during the subsequent six months and the approximate timing (usually in months) of each land sales. The land auctions included in the sample are held after the seven announcements from November 2010 to May 2014. See Table 1 for the descriptive statistics.

After the land supply schedule is released, the government puts up land for sales by tenders accordingly. The first price sealed bid auction (hereinafter referred to as "FPSBA") is the land bidding format adopted by the government. In each auction, there will be only one land parcel being sold. A complete auction starts from an opening day and ends on a closing date. On the opening day of the auction, the government starts to collect bidding from the public. The bids must be submitted before the closing date to be considered a valid bid. Each bidder is required to submit a sealed bid, and the highest bid wins after the close of the tender. On the closing day of each auction, the government release all the bid received and announce the bidder who submit the highest bid as the winners. There is a nonrefundable fee of around SGD $200 (approximately USD $150), which is payable by participating bidders before the auction. The data includes the names of all the tenderers, submitted bids in all the land biddings, and land attributes, which are used to control for heterogeneity of the land parcels.

Various types of land parcels are included in the government's land auctions, including residential land, commercial land, and industrial land. This paper, however, focuses only on bidding behaviors in residential land auctions, which constitute the largest proportion of government land sales by both the land area (more than 60% of the sold parcels) and the number of land bids (more than 70% of the sold parcels).

The third dataset includes transaction records of all private residential properties from 1995 until 2018. The property transaction records are matched to the land bidding data so that we can identify the property price on each land parcel. To save space, the descriptive statistics of the data is in Table A.3 in the Appendix. We collect the coordinates of the transacted properties using Google Map, such that the transacted units are matched to the land sales in the vicinity, and use the matched data to test for the externalities resulting from the land bidding results announcements on prices of neighboring properties.

[Insert Table 1 here]

The last dataset consists of data of company directors in all the registered companies in Singapore since the 1970s including details on names of the company directors and the dates of appointments and terminations. There are more than 1.3 million companies in the database. We use this data to identify the golfers who are company directors.

There are three steps involved in the data matching process. First, we match the company director data to the golf data based on the common names of directors and golfers in the two databases and identify golfers who serve as directors in land bidding firms. We filter out golfers and company directors sharing a name in the golf and company director databases, respectively, to avoid inaccurate or ambiguous matching between the two datasets. Then, we use the matched company names of golfers in the first matched dataset to match the land bidding data. We manually verify the company affiliations of all the land bidders and merge the subsidiary companies with the parent companies so that we can establish the relationships between golfers and these companies, as the information collected by the directors of parent companies could influence land bids submitted by the affiliated/subsidiary companies. Likewise, the information collected by directors of subsidiary companies could also influence land bids submitted by either the parent company or other subsidiaries in the same group of companies. Lastly, we match the land data to the property transaction data using the location of the land and the properties.

4 Empirical Strategies and Results

4.1 First Stage: Changes in Golf Patterns

We identify three types of golfers: (1) golfers who work as directors of firms that are potential land bidders; (2) golfers who work as directors of firms that are not potential land bidders—more specifically, firms not involved in real estate development and construction businesses; and (3) golfers who are not company directors. Table 2 summarizes the golf data. The golf data is structured as a golfer by event week panel, where event week is the seven days before or after the announcement of land supply schedules. For example, event week 0 is the first seven days after the announcement of land supply schedule. In the sample there are in total 29,291 players (712 developer directors, 11,966 non-developer directors and 16,613 non-developers). For each golfer, there are 84 event weeks, with 12 event weeks (8 weeks after and 4 week before the announcements) for each of the 7 events. Therefore, for each group of golfer, the number of observations is number of golfers in the group * 12 * 7.

In later empirical studies, we use this data to examine how the government announcement of land supply schedules affect the golfing behavior of real estate developers. The average number of golf sessions per week is around 0.06 times for all the golf players, which is around 3 times per year. The average likelihood to golf with developer directors in a week is 1.9% in the full sample and is higher for the developer directors than for the two control groups (5.6% for the developer directors, 1.6% for the non-developer directors and 2.0% for non-directors).

Figure 1 shows the golfers' network derived from the golf relationships among the bidders. Each node represents a developer who participated in land bids from November 2010 to May 2014. The green nodes represent the active bidders who have bid for more than eight times on land as of 2014. The grey nodes represent bidders who bid fewer than eight times until 2014. The size of the node is larger when the developers bid more during the sample period. The lines represent the golf relationships between the two bidders; two bidders who have played golf together, are connected by a line. The thickness of the line suggests the number of times they have played golf together.

[Insert Figure 1 here]

There is a notable pattern in the figure. The lines connecting two active bidders (green nodes) are darker than the lines connecting an active bidder with a less active (grey nodes) bidder. The pattern indicates that active bidders are more "closely" connected through golfing with other active bidders (green nodes) than they are with less active bidders (grey nodes). The evidence is consistent with the claim that cooperative equilibrium is more stable in repeated games where participants are aware of punishments for deviating from the collusive equilibrium (Niyato & Hossain 2008). Given that active bidders bid more regularly, they are more likely to share true information with other bidders because sharing false information may lead to punishments by other bidders in a repeated game. The evidence is also consistent with the claim that closely connected agents in a social network are more likely to write contracts and are less likely to renege on them (Karlan *et al.* 2009; Leider *et al.* 2009; Chandrasekhar *et al.* 2018).

In Singapore, the government announces the land supply schedules every half a year. The announcements include the approximate month when each land auction will be hold, and detailed information of each land parcel to be sold. We expect that after the announcements, the company directors of the potential land bidders should be more likely to gather on the golf course to interact over the auctions that are scheduled in the next six months. Figure 2 shows the changes in golf networks before and after the announcement of auction schedules. In Figure 2 (a), only bidders who golf together within one month *before* the land auction schedule announcements are connected by a line. In Figure 2 (b), only bidders who play golf together *after* the land supply schedule announcements and *before* the auction opens are connected by a line. There are fewer lines in Figure 2 (a) and the color of the lines is lighter than that of those in Figure 2 (b), which implies that the intensity with which development firms' director play golf together increases only after the land bidding has been announced.

[Insert Figure 2 here]

The two figures motivate us to conduct a difference-in-differences (DID) regression to examine the changes in the golf patterns after land bidding schedule announcements. We hypothesis that the developers play golf to exchange information or to collude after the announcement of land supply schedule. If the developer directors play golf to exchange information related to land biddings, they should play golf more with other developers' directors. For the golf players who are not company directors and for the players who work for non-real estate companies as directors, it is not necessary for them to play golf more with developers' directors because they do not need information about the land biddings. Thus, in the remaining part of the section, we examine the changes in the likelihood of playing golf with the developers' directors for golfers in three groups, (1) the golfers who are developers' directors, (2) the golfers who are other companies' directors and (3) the golfers who are not company directors. The latter two groups are the control groups that we use to control for the general changes in golf patterns. The treatment group is the developer directors who should be directly affected by the auction schedule announcements. We separately conduct two DID regressions with the two control groups while holding the treatment group unchanged.

We observe the date and the golf course in the data. Thus, two golfers are defined as "golf together", if they play golf on the same course on the same day. Inaccurate matching may arise from this matching method: Two golfers may appear on the same golf course on the same day while they do not have any interactions. To ensure the accuracy, we drop the golf sessions that are conducted on the golf courses visited by more than 100 golfers on one day.

Using seven land sale schedule announcements from November 2010 to May 2014 as exogenous shocks, we expect that golfers who are directors of developers should play golf more with other developer directors after the land auction schedule announcements, relative to the control group. Equation (1) is a typical DID regression, and equation (2) is a dynamic DID regression.

$$Golf\_with\_Developer_{i,n,j} = \beta_1 Developer_i * After_n + \beta_2 After_n + X_{n,j} + \pi_{n,j} + \lambda_i + \epsilon_{i,n,j} \quad (1)$$

$$Golf\_with\_Developer_{i,n,j} = \sum_{n=-4}^{7} \sigma_n * Week_{n,j} * Developer_i + \sum_{n=-4}^{7} \tau_n * Week_{n,j} + X_{n,j} + \pi_{n,j} + \lambda_i + \epsilon_{i,n,j} \qquad (2)$$

The golf records are restructured into a golfer by event week panel, where each observation represents the golf behavior of a golfer in an event week. In the sample there are in total 29,291 players (712 developer directors, 11,966 non-developer directors and 16,613 non-developers). For each golfer, there are 84 event weeks, with 12 weeks for each of the 7 events.

The dependent variable is a dummy variable equal to one if player *i* in week *n* plays golf with developer directors before or after the announcement *j* ($Golf\_with\_Developer_{i,n,j}$). If a golfer never plays golf in an event week, he will have the dependent variable equals to zero. If a golfer plays golf alone or plays golf with a golfer who does not work as a director in a real estate developer, he will also have the dependent variable equals to zero.

In terms of the independent variable, $Week_{n,j}$ is a dummy that identifies the *n*-th week after (or before, for negative *n*) the announcement *j*. $X_{n,j}$ stands for control variables for each event week, including the number of tournament games in the week, the number of days of public holidays in the week. $\pi_{n,j}$ stands for year-month fixed effects and λ_i stands for developer fixed effect. We run the two DID regressions using the two control groups for the periods covering 4 weeks before and 8 weeks after the announcements. The first control group is the non-bidder directors (Columns 1 and 2 in Table A.1), and the second control group is other golfers who are not directors (Columns 3 and 4 in Table A.1). The announcement dates are listed in Table A.9.

To save space, the regression coefficients for the DID regressions listed above are shown in Table A.1 in the Appendix. The coefficients of the dynamic DID regressions are visualized in Panel A of Figure 3. As expected, the bidders' directors play golf more regularly with the rival bidders' directors, with whom they can exchange information after the land auction schedule announcements.

In week -1, the reference week, the proportion of developer directors who played golf with other developer directors ($Golf\_with\_Developer_{i,n,j}$=1) is 4.6% for the developer directors. The treatment effects of the announcements are 0.8% (insignificant at 10% level) and 1.2% in week 1 and week 2, respectively, or 17% (=0.8%/4.6%) and 26% (=1.2%/4.6%) increase over the baseline. Although we should observe immediate increase in the likelihood of golfing with developer directors, the coefficient of the announcement week (week 0) and the first week (week 1) after the announcement are not significant. The insignificant effect may be explained by the time required to book an available time slot on the golf courses. The effect increases to as much as 2.9% in the eighth week after the announcement (week 7), more than 63% (=2.9%/4.6%) of the baseline average. In the dynamic DID regression, we find no significant difference in the golf before the announcements, which indicates that there is no pre-trend in terms of the golf patterns.

Besides the DID specification, we also conduct an event study where we run three separate regressions for the three groups of golfers to show the changes in the golfing patterns. The coefficients of the event study are shown in Table A.2, and are visualized in Panel B of Figure 3. The figure suggests that the developer directors are much more likely to play golf with one another after the announcement of the land auction schedule announcements. Although the golf patterns of the control groups also change, the increase is very marginal compared to that of the treatment group.

[Insert Figure 3 here]

4.2 Second Stage: Changes in Bidding Decisions and Collusion Behavior

In this section, we examine how bidding decisions and outcomes are affected by the golf sessions among the developer directors. From the bidding decisions and bidding outcomes, we can differentiate whether the bidders who golf together collude or compete after they golf together. We focus on the golf sessions among developer directors because those played with non-developer directors or with non-directors are less likely to be related to land auctions.

Collusive bidders should avoid each other in land auctions, therefore they should not be more likely to appear in the same land auction to avoid competition. However, simply not avoiding each other do not necessarily lead to collusion. Previous studies find that bidders collude by submitting cover bids that are intended to lose (Bajari & Ye 2003). Therefore, we could not rule out that a sophisticated cartel could still mimic the behaviors of competitive bidders. Besides, bidders avoiding each other could also result from their communication before the auctions. For example, they could interact with each other over their valuation of the land parcel, and the bidder with a lower valuation could choose to drop out. Therefore, we will also examine the bidding outcomes. Collusive bidders should not be less likely to acquire land parcels compared to the rest of the bidders, because in equilibrium, cartel members should be able to benefit. Those who cannot benefit will choose to drop out from the cartel. In this section, we test these two hypothesis related to the bidding participation and the bidding outcomes by examining the relation between the bidding participation/bidding outcomes and the golf behavior.

First, we examine whether bidding participation are affected by the golf sessions played. We define the half-year period from one supply schedule announcement to the next supply schedule announcement as a bidding cycle and structure the data into a bidder by bidding cycle panel. The bidders are those who submitted at least one bid during the sample period. For each bidder, there are seven observations, each represents a bidding cycle. The time interval represented by each observation is around half a year, depending on the bidding cycle, and at the beginning of which is the land supply schedule announcement. During each cycle, we identify whether the bidder golfs with other developer directors ($Golf\_With\_Developer_{t,i}$). And we also identify whether the bidder bids after his first golf session during the time interval ($Bid_{t,i}$). We control for bidder fixed effects and bidding cycle fixed effects. The regression results are shown in Column 1 in Table 3. We find that on average the golf sessions played do not affect the bidding decisions. However, it does not necessarily mean that golfing together has not effect on bidding participations, because a pair of golfers may act coordinately in the land auctions. For example, after the golf games, some bidders could be more likely to bid, while others could be less likely to bid. Therefore, it is necessary to examine this question at the level of bidder pairs, rather than at the level of bidders.

[Insert Table 2 here]

We pair all the bidders that submitted at least one bid during the sample period and construct a bidder pair by bidding cycle panel. There are 126 bidders in total, therefore we have 7,875 pairs of bidders (=126*125/2) in the regression. Each bidder pair has seven observations, each representing the pair of bidders’ golf behavior and the bidding participation in the seven bidding cycles. Thus, there are 55,125 (=7,875*7) observations in Columns (2) and (3). The regression specification is in equation (3).

$$Outcome_{t,p} = \beta Golf\ Together_{t,p} + \pi_t + \lambda_p + \epsilon_{t,p} \tag{3}$$

The subscript *p* refers to a pair of bidders *p*, and *t* refers to bidding cycle *t* which is around half a year. The control variable is a dummy indicating whether the two developers of the pair *p* play golf together during time *t* ($Golf\_Together_{t,p}$). π_t stands for bidding cycle fixed effects and λ_p stands for bidder pair fixed effect. We examine three outcome variables related to the bidding decisions, (1) whether the pair of bidders both bid after the golf sessions ($Both\_bid_{t,p}$); (2) whether the pair of bidders bid in the same auction after the golf sessions ($Bid\_Same\_Auc_{t,p}$); (3) whether the pair bid in the same auction as separate bidders after the golf sessions ($Compete_{t,p}$). $Bid\_Same\_Auc_{t,p}$ equals to 1 when two bidders in a pair *p* appear in the same auction either as two separate bidders or as a joint venture. Thus, the case represented by $Compete_{t,p}$=1 is included in the case represented by $Bid\_Same\_Auc_{t,p}$=1. The regression results are in Columns 2-4 in Table 3. After a pair of bidders in pair *p* play golf together, the likelihood of them to both bid drop by 4.5% (Column 2), and the likelihood of them to bid in the same auction drops by 2.3% (Column 3), bidding separately in the same auction by 2.6% (Column 4).

The results imply that the golf games between the two bidders decrease the likelihood of the two golf players to bid for the same land parcel as separate bidders. We cannot conclude collusion from these results: one bidder could choose to drop out because he realizes his bid cannot match his golf partners'. We move on to examine the bidding outcomes. We hypothesize that on average, members of an effective cartel should not be less likely to win the land auctions; otherwise, no bidder would join the cartel. Therefore, if we observe a lower likelihood of both winning for a pair of golfers, the collusion hypothesis is rejected.

The regression is shown in equation (3). The outcome variable is a dummy variable indicating if in one bidding cycle, both of the golfers in pair *p* win at least one auction after the golf sessions between them ($Both\_win_{t,p}$). Taking into consideration the possibility that collusive bidders may take turns to win during two bidding cycles (around a year) rather than over one cycle (around half a year), we extend the outcome variable to include cycle *t+1* so that the outcome variable identifies whether they both win during cycle *t* and *t+1* after the golf sessions between them at cycle *t* ($Both\_Win_{t\ or\ t+1,p}$). The regression results are in Table 4.

[Insert Table 4 here]

After a pair of bidders *p* play golf together, the likelihood of at least one of the bidders winning during cycle *t* decreases by 1.7% (Column 1). Taking the winning probabilities during cycle *t* and cycle *t+1* together, the likelihood of the two bidders winning still decreases by 2.6% (Column 2).

The results in Table 4 reject the collusion explanation: the negative coefficients indicate that playing golf together decrease the chance that both win in at least one land auction. If the cartel is effective, it should ensure none of the members lose. Therefore, we conclude that the two bidders compete head-on with separate bids[4].

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[4] Side payments are possible, but established developers are unlikely to use such practices that could have adverse impact on their bottom-lines.

Why do the golf partners avoid each other in the land auctions if they are competing? This could be due to the fact that the bidder with a lower valuation chooses not to bid. Specifically, a pair of golfers may exchange two types of information, (1) whether they are going to bid in a certain auction and (2) the approximate valuations of the land parcel. Only when their valuations match, will both of them bid. When their valuations do not match, the bidder with lower valuation may drop out from the upcoming auctions[5].

4.3 Third Stage: The Land Bidding Outcomes

Given the results in the previous two sections, we conclude that (1) golf patterns change after land auction schedule announcements: the developers join in more golf sessions with one another; (2) the bidding decisions are endogenous to the golf sessions: the bidder in a pair of golfers with lower valuation drops out. Only when the two golfers agree with each other's valuation, will both bid; (3) the golfers are not colluding, given that the golf partners are not more likely to both win.

In this section, we define two types of bidders based on their golf patterns. The definition is visualized in the flow chart shown in Figure 4.

[Insert Figure 4 here]

If a bid is submitted by a bidder who golfs with another developer after the land supply schedule announcement and before the land auction opening, the bidder has information exchanges on the golf courses with other bidders. For these bids, the variable *Golf with Developer*$_{i,j}$ equal to 1. For simplicity, we refer to these bidders as "golfing bidders". If a bid is submitted by a bidder who never golfs, golfs alone or golfs with someone not working for real estate developers as directors, the bidders has no information exchanges on the golf courses with other bidders. For these bids, the variable *Golf with Developer*$_{i,j}$ equal to 0. We acknowledge the fact that golf is not the only way of social interaction. We could be classifying some bidders that interacted not on the golf course as non-informed. Besides, the golfing bidders could have interacted with his golf partners through other channels before the golf sessions. In this case, our identification of the golfing bidders as more informed is noisy, thus inflating the standard error of the coefficients.

[Insert Table 6 here]

In the third stage, we show how the bidders exploit the information acquired from other bidders through golfing. We first test the likelihood of winning of the golfing bidders. The regression specification is defined in equation (4) which has the dependent variable $Win_{i,j}$ indicating whether a bid *j* received in a land auction *i* is a winning bid. *Golf with Developer*$_{i,j}$ is a dummy identifying whether the bidders golf with other developers after land supply schedule announcement and before auction opening. $X_{i,j}$ stands for control variables for each bid. π_t stands for year fixed effects, λ_j stands for developer fixed effects and μ_p stands for planning area fixed effects. The regression coefficients are in Column 1, Table 6. The coefficient of the dummy is represented in the first bar in Figure 5. The results show that the informed bidders' chance of winning is not significantly higher than other bidders'.

$$Win_{i,j} = \beta\ Golf\_with\_Developer_{i,j} + X_{i,j} + \pi_t + \lambda_j + \mu_i + \epsilon_{i,j} \quad (4)$$

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[5] We acknowledge the possibility that the golfers may not exchange their true valuation. However, they are unlikely to cheat in a repeat game.

We then compare the land bids submitted by the two types of bidders. To address the problem of bidders' self-selection in bidding for land parcels with certain unobservable characteristics, we include the losing bids submitted by the four types of bidders as a reference. For example, if the golfing bidders self-select to bid for low-quality land parcels, both the losing bid and the winning bid of the bidders should be lower than the bids submitted by other types of bidders. Thus, by including the losing bids, we can control for the unobservable developer bidding preference. The regression specification is in equation (5), where the dependent variable is the bid *j* received in each land auction i. *Golf with Developer*$_{i,j}$ is a dummy identifying whether the bidders golf with other developers before auction opening. The dummy is interacted with the *Win* dummy to test for information effects on the winning bids. $X_{i,j}$ stands for control variables for each land parcel *i* and for each bid *j*. λ_j stands for developer fixed effects, π_t stands for year fixed effects and μ_i stands for planning area fixed effects. We expect that the winning bids by golfing bidders to be lower than other winning bids, while their losing bids are not significantly different from other losing bids. Therefore, we expect γ to be negative while β is not significantly different from zero. The coefficients are shown in Columns 2 and 3, Table 6. In Column 2, the interaction terms between $Golf\_with\_Developer_{i,j}$ and *Win*$_{i,j}$ are excluded.

$$\ln\left(Bid_{i,j}\right) = \beta\ Golf\_with\_Developer_{i,j} + \gamma\ Golf\_with\_Developer_{i,j} * Win_{i,j} + \sigma Win_{i,j} + X_{i,j} + \lambda_j + \pi_t + \mu_i + \epsilon_{i,j} \tag{5}$$

γ is shown in the second bar of Figure 5 and β is shown in the third bar of Figure 5. As shown in Figure 5, on average the bids submitted by the golfing bidders are not significantly different from the bids by the non-golfing bidders. However, the top right panel of Figure 5, the winning bids submitted by golfing bidders are 6% lower than the winning bids by non-golfing bidders. Thus, the results are consistent with our expectation that the golfing bidders who have information exchange on the golf courses avoid overbid and acquire land parcels at lower prices. All else being equal, we expect a lower bid to be correlated with a lower chance of winning. However, as previously shown, the chance of golfing bidders winning is not statistically different from the chance of winning by non-golfing bidders, which reflects the information advantage of the golfing bidders.

Lastly, we examine the degree of winners' curse. One important feature of information efficiency in FPSBA is that information helps reduce winners' curse. The intuition is that the uninformed winners may over-bid, while the informed bidders with more accurate valuation can shade the bid enough to reduce winners' curse (Krishna 2009). We expect the winners' curse, which is measured by the difference between the winning bid and the second highest-losing bid divided by the second highest-losing bid, to be smaller for more informed bidders. The regression specification is in equation (6) with the dependent variable capturing the difference between the highest bid and the second-highest bid in a land auction *i*, then divided by the second-highest bid. *Golf with Developer*$_{i,j}$ is a dummy identifying the golfing bidders. X_i stands for control variables for each land parcel. π_t stands for year fixed effects and μ_i stands for planning area fixed effects. We expect the golfing bidders to suffer less from winners' curse, so μ_4 should be significantly negative.

$$Winners'\ curse_i = \beta\ Golf\_with\_Developer_{i,j}\ + X_i + \pi_t + \mu_i + \epsilon_i \tag{6}$$

The coefficient β is in the bottom right panel of Figure 5. The regression coefficients are in Column 4, Table 5. The winners' curse for golfing bidders is 5% lower than the winners' curse for *Type 1* bidders. This result resolves the concerns on the omitted variable bias where the parcels acquired by the golfing bidders may have unobservable defects that negatively affect the land value. If the omitted variable bias is driving the result, we should observe a lower bid from all bidders. Besides, the unobserved defects can be differenced out with the winners' curse measurement. Detailed information on the regressions is shown in Column 4 of Table 6.

[Insert Figure 5 and Table 6 here]

To mitigate the concerns that golf may change the bidding behaviors through channels other than information exchange, we conduct two heterogeneous tests on the bidding outcomes to further validate our identification strategy, by instrumenting the degree of information asymmetry with two variables, (1) the days from the auction schedule announcements to the auction opening date and (2) the duration of the auctions (Ooi & Sirmans 2004).

The first variable, the days from the auction schedule announcements to the auction opening, is the time period during which the potential bidders prepare for the auction. If the auction is scheduled close to the announcements, the bidders have a limited time to prepare the bid and may overbid. Figure 6 illustrates the point. The degree of winners' curse is negatively related to the period between the announcements and the openings. The golfing bidders who wins participate in more auctions that are scheduled later, possibly due to the time taken to find available golf courses and to find a time slot convenient for the directors. Motivated by this evidence, we divide the sample into two based on the period between the announcements and the auction opening date. We expect that the golfing bidders to perform better in the subsample of auctions that are scheduled later. We re-run the regression in equation (5) on the two subsamples. The results are reported in Columns 1 and 2 in Table 7. As expected, the golfing bidders acquire parcels at a lower cost in auctions that are scheduled later. For the auctions that are scheduled later, the winning bids are 8.5% lower than that submitted by non-golfing bidders. For the auctions that are scheduled earlier, the golfing bidders' winning bids are not lower, with the coefficient statistically insignificant.

[Insert Figure 6 here]

The second variable, the duration of the land auctions, is closely related to the degree of information asymmetry of the land parcel. Intuitively, when the land parcel is hard to evaluate, the government tends to schedule the tender with a longer duration, so that the developers have enough time to decide the bid and to prepare the tender documents. Thus, the bidders should benefit more from the information if they bid in auctions with longer durations. We divide the sample into two based on the duration of the land auctions and then re-run the regression in equation (5). The results are in Columns 3 and 4 in Table 6. As expected, the golfing bidders' winning bids are lower than the winning bids submitted by other bidders. For the tenders with the top 50% longest duration, the winning bid submitted by the golfing bidders are 11.2% lower than other winning bids.

[Insert Table 6 here]

We also conduct another heterogeneous test by examining the relationship between the bids and the proportion of one's golf partners who also compete with him in the same land auction. We expect that when a golfing bidder have more golf partners who decide to bid in the same auction as he does, they should agree with one another on the valuation, thus their valuation should be closer to the fair market value. To save space, the results are in Table A.4 in the Appendix.

4.4 Fourth Stage: Subsequent New Projects

This section tests how informed bidders could benefit through subsequent sales of their new projects in the property market. As shown earlier, the information acquired on the golf courses helps the winners acquire parcels at a lower price. We expect that the new projects built on the cheaper land to be sold at a lower price. We test the hypothesis using the regression specified in equation (7). The dependent variable is the new sale price per square meter of unit *u* in the project built on land parcel *i*. $X_{i,u}$ stands for control variables for each unit *u* in each project *i*. λ_i stands for developer fixed effects, π_t stands for year fixed effects and μ_i stands for planning area fixed effects. We expect that the new sale price of units in the golfing bidders' projects to be lower than units in comparable projects and η to be negative.

$$\ln\left(\frac{Price}{sqm}\right)_{i,u} = \eta\ Golf\_with\_Developer_{i,j} + X_{i,u} + \lambda_i + \pi_t + \mu_i + \epsilon_{i,u} \quad (7)$$

Table 8 shows the influence on subsequent property price. The first column is a baseline regression where the bidder type dummy variables are not included. An advantage of our data is that we can observe the construction quality of each project. We include *Construction Quality*$_i$ and *Quality Assessed or Not*$_i$ to control for the construction quality of the projects. *Construction Quality*$_i$ is the CONQUAS Score for the project quality evaluated by the government. The assessment process is a voluntary scheme, but the score for each assessment is published mandatorily online. We use a dummy *Quality Assessed or Not*$_i$ to identify whether a developer requests the government to evaluate the quality of the project and publish the CONQUAS Score online. We expect higher CONQUAS Score to correspond with higher selling price while the relation between price and assessment or not is theoretically unclear. On the one hand, developers of higher quality projects may prefer to reveal the quality information of the project to the market. On the other hand, previous literature also finds that the producer of high-quality products may use nondisclosure as a countersignal and choose not to reveal the quality information (Bederson *et al.* 2018). The positive coefficient of $Construction\ quality_i$ implies that conditional on being assessed, a higher score yields a higher selling price. The negative coefficient of *Quality Assessed or Not*$_i$ implies that the quality score could be a counter signal for the high-quality projects, and the developers of these projects may choose not to reveal information through this channel.

[Insert Table 8 here]

The projects by the golfing bidders sell for 3% less than the new projects by non-golfing bidders, while the coefficient is statistically insignificant. Given that the land price is 6% lower, the golfing bidders only partially transfer the land cost savings to the home buyers while still reaping 3% more in profits on these projects (=6%-3%) than other developers do on their projects.

4.5 Fifth Stage: Externalities of Informed Land Transactions

The results in section 4.3 and section 4.4 reveal that the golfing bidders benefit from the information by saving on land costs; while arguably, the buyers also benefit by paying lower prices for units in these projects. However, informed trading may not benefit everyone. Developers and individual homeowners of existing housing units could experience negative externalities from the golfing bidders' low winning bids. On the one hand, the market participants may take the lower winning bids as a negative signal and adjust their expectations accordingly. On the other hand, facing potential competition from newer and cheaper projects, other sellers are compelled to lower their selling prices. Therefore, we expect that after the golfing bidders' winning bids are announced, the neighboring housing market may experience a significant price drop.

Using the land auction results announcement dates as exogenous shocks, we compare changes in the property transaction prices in the vicinity of the land parcels acquired by golfing bidders and in the vicinity of the land parcels acquired by non-golfing bidders. To determine the range of distance affected by the announcement of new land auction results, we implement a local weighted polynomial regression (LWR) method. The details of the method and the results can be found in Figure A.3.

The regression specification is a triple differences method where the 500 meters cutoff from the LWR result is employed to define the treated and control groups. Based on the linear distance, the treated group includes properties located within 500 meters from the land parcels acquired by golfing bidders. Control group 1 includes the units located between 500 meters and 5,000 meters from the land parcels acquired by the golfing bidders. Control group 2 includes units located within 5,000 meters from other land parcels acquired by the non-golfing bidders. The first difference is defined by the distance from the transacted units to the newly sold sites. The second difference is whether the properties are neighboring the land parcels acquired by the golfing bidders or the non-golfing bidders. We employ the second control group to address the alternative explanation that the auction results announcement may decrease the neighboring property prices. Specifically, prices of residential units that are closer to the newly sold parcels may drop in expectation of noise and other externalities associated with construction works at new sites. For the identification strategy to be valid, we must observe that prior to the announcement of the auction results, for the new parcels acquired by golfing bidders and non-golfing bidders, the price differences between the residential units located within 500 meters from the new parcels and the units located from 500 meters to 5000 meters from the new parcels have parallel trend. The results show no violation of the parallel trend assumption.

The regression equation is shown in equation (8). The subscript *u* denotes the unit *u*, *t* denotes the time of transaction of unit *u*, and *i* denotes the land parcel *i* (or project *i*) which is within 5 km from the unit *u*. $Near_{u,i}$ equals to one if unit *u* and parcel *i* are within 500 meters from each other and otherwise equals to zero. $Golf\_with\_Developer_{u,i}$ is a dummy which equals to one if the winner of land auction *i* is a golfing bidder and otherwise equals to zero. $After_{u,i,t}$ equals to one if unit *u* is transacted after the auction result of parcel *i* is released to the market and otherwise equals to zero. The interaction of these three dummies represents the spillover effect of informed land transaction *i* on the price of unit *u*. We expect φ_1 to be significantly negative if the negative spillovers are generated after the new auction results are announced. $X_{u,i,t}$ stands for control variables for each unit *u* in each project *i* transacted at time *t*. π_t stands for year fixed effects and μ_i stands for planning area fixed effects. The pre-treatment period is 360 days.

$$\ln\left(\frac{Price}{sqm}\right)_{u,i,t} = \varphi_1\, Near_{u,i} * Golf\_with\_Developer_{u,i} * After_{u,i,t} + \varphi_2 Near_{u,i} + \varphi_3 After_{u,i,t} + \varphi_4\, Golf\_with\_Developer_{u,i} + \varphi_5\, Near_{u,i} * After_{u,i,t} + \varphi_6\, Near_{u,i} * Golf\_with\_Developer_{u,i} + \varphi_7\, Golf\_with\_Developer_{u,i} * After_{u,i,t} + X_{u,i,t} + \pi_t + \mu_i + \epsilon_{u,i,t} \quad (8)$$

We plot φ_1 for different post-treatment window sizes in Figure 7. The treatment effect on the projects located within 500 meters from the parcels acquired by informed bidders is -4.7% in the

90 days after the bidding results announcement. If the parallel trend assumption is not violated, the result implies that within 90 days after the announcements, residential units closer to the land parcels acquired by informed bidders are sold 4.7% cheaper than those located farther away from these land parcels. The effect diminishes gradually and approaches zero after 90 days. The short-run nature of the spillover effect suggests possible overreactions by homeowners and developers. The fact that the price differences revert to zero after 90 days suggests that our estimation is not driven by omitted variable bias: if there is a regional unobservable factor which negatively affects the price within 500 meters from the new parcel, we should observe a long-run effect. In the Appendix, we also examine the effect on transaction volume and on the days to sell. We find no effect on these two outcome variables.

[Insert Figure 7 here]

4.6 Welfare Analysis

In this section, we perform a brief welfare analysis based on the results shown in the previous five sections. There are three parts of welfare transferred, the government's losses in land revenue, the losses in land tax, and the changes in the property price due to the negative externality effects.

First, we calculate the government's loss due to the decrease in the land price. From November 2010 to May 2014, the average winning bid of a non-golfing bidder is SGD $5,565 per sqm per plot ratio. The average buildable area (site area times plot ratio) of the parcels acquired by non-golfing bidders is 48,891 sqm per parcel. Golfing bidders acquired 30 parcels, and the land revenue losses on these sales are estimated at SGD $497.20 million (=6.1%*5,565*48,891*30), or SGD $138.75 million per year (=497.20/3.58 years, USD $100 million), corresponding to 0.2% of government revenue and 0.8% of annual land sale proceedings, on average. Losses in land revenues, which could otherwise be invested in infrastructure improvements, translate into more welfare losses for the whole city, but we are not able to estimate this part of losses.

Then we estimate the losses in property tax on land. In Singapore, the government levy property tax on sold state land at a tax rate of 10% before the completion of construction. The tax base is 5% of the land value. Thus, assuming the tax is collected for one year, the losses in land tax are estimated at SGD $2.49 million (=10%*5%*497.20, USD $1.83 million).

5 Discussions and Conclusions

Social networks and social interactions are critical to the individual outcomes (Barnea & Guedj 2006; Bailey *et al.* 2018a; Bailey *et al.* 2018b) and the corporate performances (Cohen *et al.* 2008; Khwaja *et al.* 2008, 2011). More importantly, social networks may generate social multiplier effect where the effect of a policy may be amplified (Glaeser *et al.* 2003). Besides, social networks are shown to be important to economic development (Guiso *et al.* 2000). Therefore, understanding various types of social networks and interactions is important. Using golf games to identify social interactions, this paper examines the relationships between social interactions and developers' land acquisition behaviors.

Company directors consciously collect information through social networks to improve the companies' investment performance. Their golf pattern changes significantly after the land auctions are announced. We find that the winning bid of the golfing bidders is 6% lower, but the likelihood of winning is not negatively affected by the lower bid. Informed bidders are more likely to face a lower winners' curse in their winning bids, despite the stiff competition in the land market. This result shows that informal interactions improve information dissemination that benefits companies in the decision-making process. The lower land price results in losses in the land sale revenues of SGD $138.75 million (around USD $100 million) per year between November 2010 and May 2014. Our results reject the collusion hypothesis. We acknowledge that golf is not the only way of social interactions among the top managers. The non-golfing bidders could have interacted with developer directors before the auctions through other ways. Besides, it is also possible that some golfing bidders did not interact on the golf course. Therefore, our identification strategy is noisy and could inflate the standard errors.

Our paper is related to the extensive literature on social networks among company executives (Fracassi & Tate 2012; Bruynseels & Cardinaels 2014). There are few discussions on social interactions in the literature due to data limitations and lack of identification (Shue 2013). We fill in the gap in the literature around social interactions by establishing a clear causal relationship between information exchanges and social interactions.

The patterns of social interactions change after the government announces a land sale, and the social interactions significantly influence the company behaviors in land biddings. The behavioral changes of individuals and/or companies create social multiplier effects to other nodes in the network (Glaeser *et al.* 2003; Shue 2013; Provan *et al.* 2016). Thus, the social networks of the connected directors of land bidders amplify aggregate effects of the land sale schedule announcements. The multiplier effect discovered in this study may also be generalized to other policies and other industries.

The existing literature finds that the connections among the top executives may either add value to the companies (Tian *et al.* 2011; Engelberg *et al.* 2012; Schmidt 2015) or destroy value (Fracassi & Tate 2012; Nguyen 2012; Ishii & Xuan 2014; Gompers *et al.* 2016). This paper adds new evidence supporting the former. To corporate management, the result implies that employing directors with well-connected information networks with other companies' directors will add value to companies through the information channel.

In a competitive land auction market, firms need to outbid rival firms to win the auctions; the winning motives, however, do not stop the firms from colluding and cooperating with each other. One way to collude or cooperate is for directors of the bidders to play golf with directors of rival bidders before the opening of land bidding, and to exchange information related to the bid on the golf courses. Information sharing, which is not prohibited by law, causes significant losses to the government's land sale revenues and creates significant negative spillover effects on other neighboring residential projects. Land sale revenues make up a large proportion of the government's fiscal revenue in many countries; it is thus important to understand the developers' information-sharing behavior on golf courses.

The paper shows clear evidence that informal inter-organizational interactions are value-adding when rival companies are involved; however, it provides limited insights into the intra-organization connections (Adams & Ferreira 2007) and other types of inter-organizational connections (Westphal *et al.* 2006; Kuhnen 2009; Dyck *et al.* 2010; Bruynseels & Cardinaels 2014; Dyck *et al.* 2017; Brogaard *et al.* 2018), which can be directions of future research. It would also be interesting to extend the research to nonprofit organizations such as the government (Chau *et al.* 2016).

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Appendix

Institutional Background

We first provide a brief introduction to the Singapore land market. In this paper, we use the land market as a context to study information efficiency. In Singapore, more than 80% of the land parcels are controlled and supplied by the government. Two agencies oversee the land supply, the Housing Development Board (HDB), and the Urban Redevelopment Authority (URA). The land parcels are sold through First Price Seal Bid Auctions (FPSBA), namely tenders, by the two authorities. These two authorities make land auction schedules every half a year. The schedules include the detailed information of each parcel, including the location, area, development restrictions and other necessary information for the developers to make bidding decisions, as well as the approximate tender opening dates (usually the month). We believe the land market is a good context for two reasons. Firstly, the land market is highly sensitive to the government land supply. When the government releases the schedule, there will be intensive media report analyzing the profitability of each parcel and the market sentiments. Secondly, the developers' profits are closely hinged on land cost. During our sample period, the land cost takes more than half of the total development costs[6]. We believe that the developers should spend effort to save land cost and to boost profits.

First Stage

In the main text, we conduct the dynamic DID and the event study with the dummy variable, $Golf\_with\_Developer_{i,n,j}$, as the outcome variable. In Figure A.1 in the Appendix, we repeat the dynamic DID regressions shown in equation (2) by employing a continuous variable, the proportion of golf games played with other developers by a player i in week n before or after the announcement j ($Prop\_Golf\_Dev_{i,n,j}$), as the outcome variable. $Prop\_Golf\_Dev_{i,n,j}$ and $Golf\_with\_Developer_{i,n,j}$ are equal for most of the observations because most players play golf at most once a week.

[Insert Figure A.1 here]

$Week_{n,j}$ is a dummy that identifies the n-th event week after (or before, for negative n) the announcement j. The control variables include the number of tournament games in the week, the number of days of public holidays in the week. The horizontal axis shows the event weeks, where "*Week 0*" is the first seven days after the land auction schedule announcements. Before the announcements, the golf patterns show no differences across the treatment group (the developer directors) and the control groups (the non-developer directors and the non-directors), while after the announcements, the differences in the golf pattern appears.

[6] https://sg.news.yahoo.com/land-cost-takes-over-property-prices-income-growth-044914310--sector.html

Third Stage

We conduct a falsification test by randomly define the bidder types. Specifically, we randomly select 288 bids among the 895 bids and define them as submitted by the golfing bidders, and 607 bids defined as submitted by the non-golfing bidders. Then we repeat the regression shown in equation (5) for one hundred times. The coefficient of the dummy variable, *Golf with Developer*$_{i,j}$, and of the interaction term, *Golf with Developer*$_{i,j}$ * *Win*, are plotted in Panel A and Panel B of Figure A.2, respectively, with the *p*-value indicated by the color of the markers. The horizontal axis indicates the ID number of the regression. Only one of the one hundred regressions have a statistically significant coefficient for *Golf with Developer*$_{i,j}$, and only three of them have a statistically significant interaction term. Among the three significant interaction terms, two are significantly negative, with the magnitude larger than 0.061 (the true coefficient in Table 5). We conclude that it is unlikely that the results in Figure 5 and Table 6 are unrelated correlations.

[Insert Figure A.2 here]

The result in the second stage (Section 4.2) suggest that the golfers who realize that his bid is lower than his partners' bid would drop out from the auction. Therefore, as the number of one's golf partners who bid in the same auction as one does increase, his valuation should be closer to the fair market value. Specifically, when a higher proportion of one's golf partners choose to stay and bid, the more likely that his valuation is low for the following reasons: the fact that one's golf partners also bid in the same auction as he does possibly indicate that his golf partners agree with his valuation, or have higher valuations. If the former is true, he and his golf partners evaluate the land parcel similarly and they may all bid in the auction. The fact that they all agree on the same valuation makes it very likely that their valuations are close to the true value of the land (usually the potential property selling price minus the cost of construction and of management). If the latter is true and one's golf partners have higher valuations than he does, he would not bid because he would never win, so this case could not happen.

[Insert Table A.4 here]

Table A.4 shows the relation between the bid and the degree of information advantage measured with the proportion of one's golf partners who also bid in the same auction. For example, if after the land auction schedule announcement and before the opening of an auction, a developer director golfs with ten different bidders, three of them bid in the same auction as the developer does, the variable *Golf_Partner_Bid* equals to 30%. The corresponding regression equation is shown in equation (A1). The dependent variable is the value of bid j in auction i. $X_{i,j}$ stands for control variables for each land parcel and for each bid. λ_j stands for developer fixed effects, π_t stands for year fixed effects and μ_i stands for planning area fixed effects. The sample used for the regressions only include bids submitted by bidders who golf after the auction schedule is released and before the auction, because we cannot define the variable *Golf_Partner_Bid*$_{i,j}$ for bidders who never golf during this period. We expect that the coefficient of *Golf_Partner_Bid*$_{i,j}$ and the coefficient of the interaction between *Golf_Partner_Bid*$_{i,j}$ and *Win*$_{i,j}$ to be negative. In the first column, the coefficient of this variable is negative, which means that for all the bidders who golf after the auction schedule announcement and before the auction opening, if he has more golf partners competing with him in land auctions, his bid is lower, so $Golf\_Partner\_Bid_{i,j}$ is correlated with information advantage. In Column 2, the interaction of $Golf\_Partner\_Bid_{i,j}$ and $Win_{i,j}$ has a negative significant coefficient which means that when a winner has more golf partners competing in the same auction, his bid is significantly lower than other winners who have fewer golf partners competing with him in the auctions. When the winning bidder has 1% more golf partners competing with him than other land winners do, his bid is 2% lower. In Column 2, *Golf_Partner_Bid* is not significant, which is consistent with the result in Column 3 of Table 5 that the losing bid submitted by the golfing bidders are not significantly lower than the losing bid by other bidders.

$$\ln\left(Bid_{i,j}\right) = \beta_1 Golf\_Partner\_Bid_{i,j} + \beta_2 Golf\_Partner\_Bid_{i,j} * Win_{i,j} + \beta_3 Win_{i,j} + X_{i,j} + \lambda_j + \pi_t + \mu_i + \epsilon_{i,j} \quad (A1)$$

Fifth Stage

To determine the range of distance affected by the announcement of new land auction results, we implement a local weighted polynomial regression (LWR) method, following Linden and Rockoff (2008). In this method, the only independent variable is the distance from the property transaction to the new auction, and the dependent variable is the unit price of the property transaction. Before the announcement, we expect that the transaction price to increase with the distance because around the unsold parcels, the amenities are often worse than the developed areas. After the announcement, the price of properties close to the newly sold parcel should further decrease because the market participants expect that the environment to worse off due to the noise and dust that come with the new construction project (Dye & McMillen 2007). The prices decline more for properties that are closer to the parcels acquired by the golfing bidders because the market may take the lower bid as a negative signal indicating worse market condition.

Figure A.3 shows the property price gradient with the distance to the newly sold land estimated with LWR. The two grey lines in the lower part are the locally weighted average price of units neighboring the parcels acquired by the less informed bidders (non-golfing bidders), before and after the auction results release date. The two blue lines on the upper part are the locally weighted average price of units neighboring the parcels acquired by the informed bidders *(*golfing bidders), before and after the auction results are released. As we expected, after the announcements of the auction result, the price of housing transactions decreases in the vicinity of the newly sold parcel. The prices decrease more if the parcel is acquired by an informed bidder (golfing bidders). The prices of units neighboring the newly auctioned parcels decrease sharply within around 500 meters distance from the new parcels after the announcements, compared to before the announcements. This result gives rise to the triple differences specification shown in Figure 7in the main text. (Linden & Rockoff 2008).

[Insert Figure A.3 here]

In the main text, we look at the negative spillover effect of new auction results announcements on the property transaction prices in the vicinity. In this section, we further examine the heterogeneous effect on different types of sale. In Singapore, new properties are directly purchased from the developers before the projects' completion, sub-sales are the transactions of new properties from individual homeowners before the projects' completion and resales are the transactions of old properties from individual homeowners after the projects' completion. Table A.7 tests the effect on new sales. The magnitude of the effect on new sales is larger than the effects found in Figure 7 in the main text. Within 90 days from auction results announcements, the price of new properties neighboring the informed land acquisition decreased by 3%, although the coefficient is statistically not significant. Similar to the results found in Figure 8, the effect diminishes to approximately zero after 90 days.

[Insert Table A.7 here]

Although in Figure 7 and Table A.7, the price decreases, it is possibly driven by the increase in supply rather than driven by the decrease in demand. To rule out this alternative explanation, we examine the changes in transaction volume. If the transaction volume increases, the decrease in price is possibly driven by the increase in supply. If the transaction volume does not increase with the decreasing selling price, a necessary condition is that the demand for units neighboring the informed transactions decreases. As shown in equation (A2), the dependent variable is the proportion of units sold at distance *d* to the new auction *i* at time *t*. It is the number of units sold during time *t* divided by the total number of residential units in the area. π_t stands for year fixed effects and μ_i stands for planning area fixed effects. Other variables are defined the same as in equation (9).

$$Proportion\ of\ Units\ Sold_{i,t,d} = \gamma_1 Near_d * Informed_i * After_t + \gamma_2 Near_d + \gamma_3 After_t + \gamma_4 Informed_i + \gamma_5 Near_d * Informed_i * + \gamma_6 Near_d * After_t + \gamma_7 After_t * Informed_i + \pi_t + \mu_i + \epsilon_{i,t,d} \qquad (A2)$$

We also examine the days between two sales of a unit to further show that the demand change causes the price decrease. If the demand does not decrease, the days to sell should be shorter with lower prices. If the demand decreases, the days to sell should be unchanged or even increase. In equation (A3), the dependent variable is the days between the two transactions of unit *u* in project *i*, conditional on the unit has been sold for more than once. The year fixed effect represented by π_t is the year of the second transaction. The results are shown in the last column of Table A.8. The coefficients of the triple interaction term for both regressions are not statistically significant. We conclude that the price decrease is not due to the supply increase.

$$Days\ to\ Sell_{u,i,t} = \varphi_1 Near_{u,i} * Informed_{\ u,i} * After_{u,i,t} + \varphi_2 Near_{u,i} + \varphi_3 After_{u,i,t} + \varphi_4\ Informed_{\ u,i} + \varphi_5\ Near_{u,i} * After_{u,i,t} + \varphi_6\ Near_{u,i} * Informed_{\ u,i} + \varphi_7\ Informed_{\ u,i} * After_{u,i,t} + X_{u,i,t} + \pi_t + \mu_i + \epsilon_{u,i,t} \qquad (A3)$$

[Insert Table A.8 here]

References for the Appendix

Dye, R.F., McMillen, D.P., 2007. Teardowns and land values in the chicago metropolitan area. Journal of Urban Economics 61, 45-63

Linden, L., Rockoff, J.E., 2008. Estimates of the impact of crime risk on property values from Megan's Laws. American Economic Review 98, 1103-1127

Figures and Tables

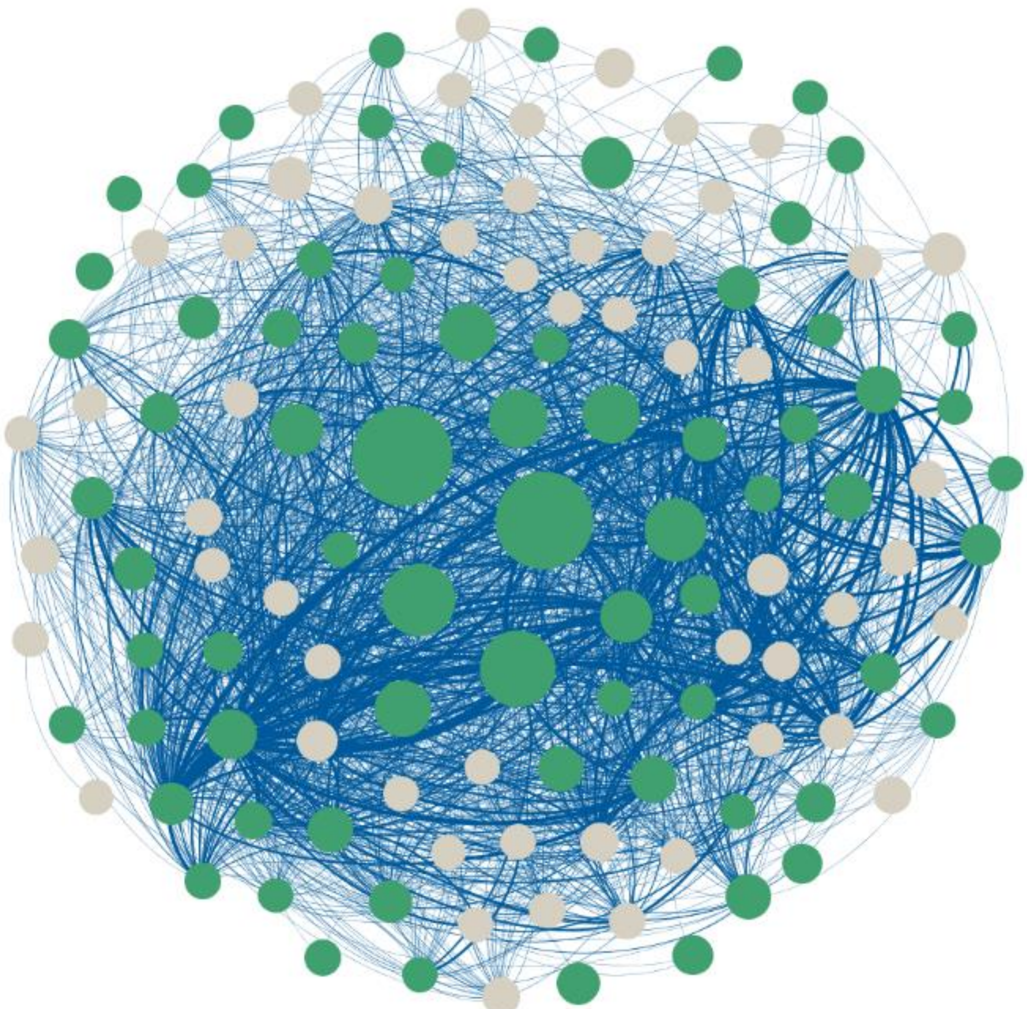
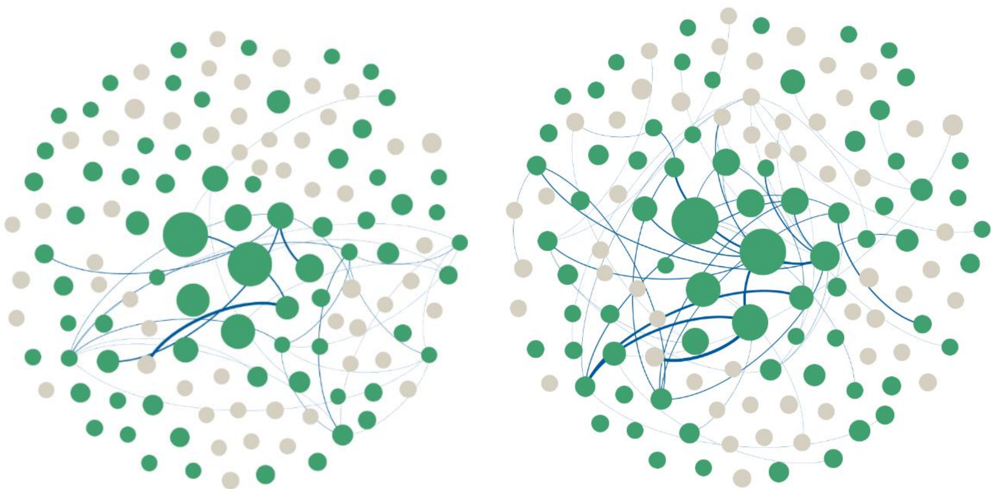


Figure 1 Golf Relationships Among All Bidders

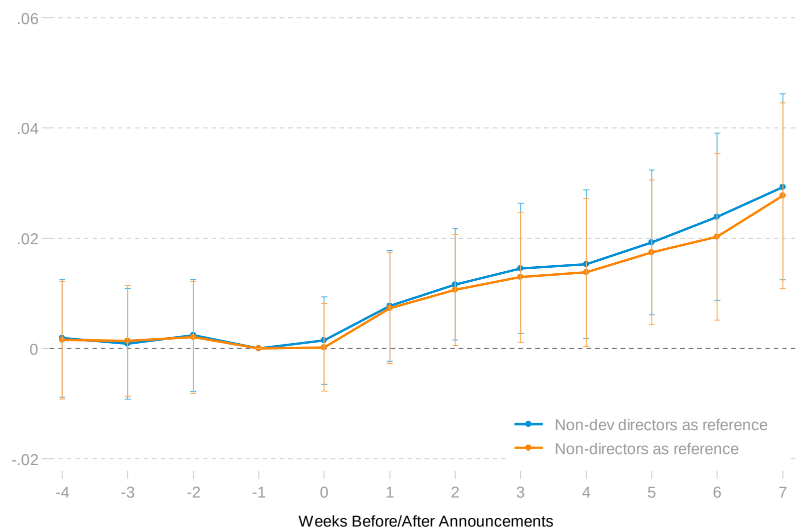
Notes: The nodes in the figure represent all the land bidders who bid from November 2010 to May 2014. The green nodes are regular bidders who bid for more than eight times during the sample period. The grey nodes are non-regular bidders who bid less than eight times during the sample period. The size of the node is larger when the developers bid more during the sample period. The edges connecting each node are the golf relationships. If they have golfed together, they are connected with a line. And if they golf more, the color of the line is darker, and the thickness increases.



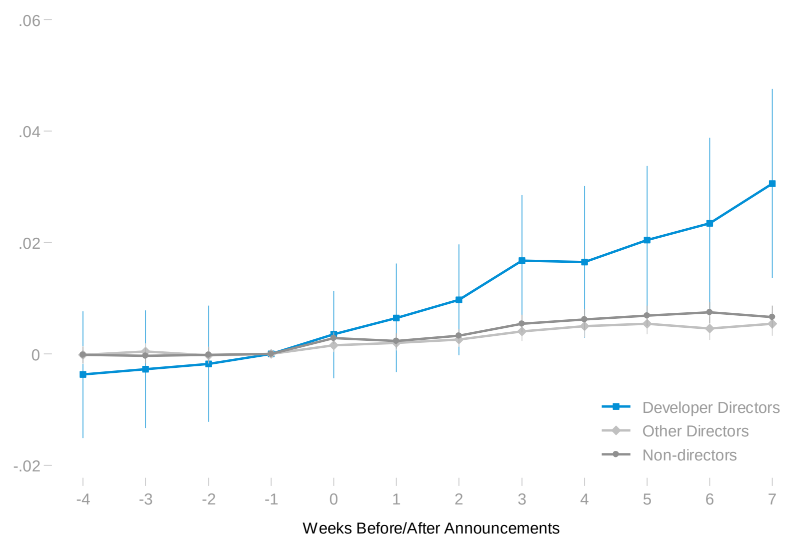
(a) **(b)**

Figure 2 Golf Before and After the Announcement of the Auction Schedules

Notes: The figure shows the golf games played before (a) and after (b) the land sale schedule announcement. The nodes in the figure represent all the land bidders who bid from November 2010 to May 2014. The positions of the nodes are consistent with those in Figure 1. The green nodes are regular bidders who bid for more than eight times during the sample period. The grey nodes are non-regular bidders who bid less than eight times during the sample period. The size of the node is larger when the developers bid more during the sample period. The edge connecting each node is the golf relationship. If they ever golf together before (a) or after (b) the land auctions schedule announcements, they are connected with a line. And if they golf more, the color of the line is darker, and the thickness increases.



Panel A Dynamic DID Regressions



Panel B Event Study Regressions

Figure 3 Changes in Golf Patterns After Auction Announcements

Note: The figures visualize the coefficients of the dynamic DID regressions and the event study regressions showing the changes in golf patterns before and after the land auction announcements. Each of the two lines in Panel A represents the set of coefficients for one DID regression, with the control group indicated in the figure legend. Each of the three lines in Panel B represents the set of coefficients of the event study for one group of golfers, with the identity of the golfer indicated in the figure legend. The dependent variable for all regressions in the two figures is a dummy variable identifying whether the golf games are played with developer directors ($Golf\_with\_Developer_{i,n,j}$). The regression results are shown in Table A.1 (DID) and Table A.2 (Event study) in the Appendix. Note that the weeks are event weeks. *Week (-) i* is the *i*-th seven days (before) after the announcements of land sale schedules. The announcement date is the first day of Week 0. Week -1 is the reference group omitted from the regressions. 95% confidence intervals are shown with vertical lines.

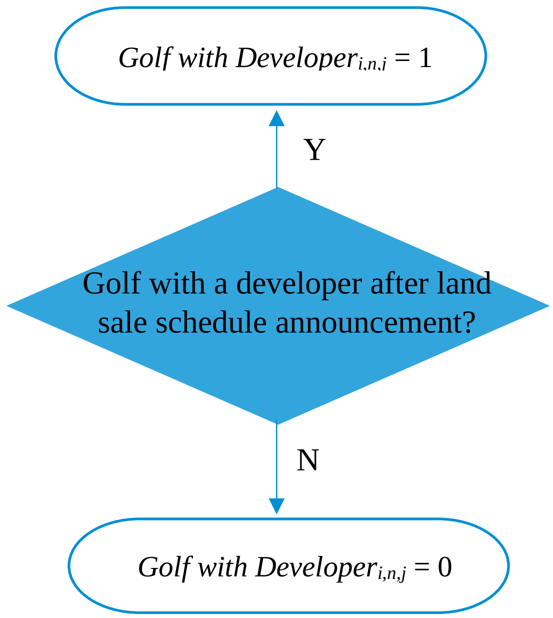


Figure 4 Definition of Four Types of Bidders

Notes: The flow chart shows the definition of the two types of bidders defined in Section 4.3. If a bid is submitted by a bidder who golfs with another developer after the auction is announced and before the auction opens, variable *Golf with Developer*$_{i,n,j}$ = 1. If a bid is submitted by a bidder who golfs alone or with non-developer after the auction is announced and before the auction opens, variable *Golf with Developer*$_{i,n,j}$ = 0.

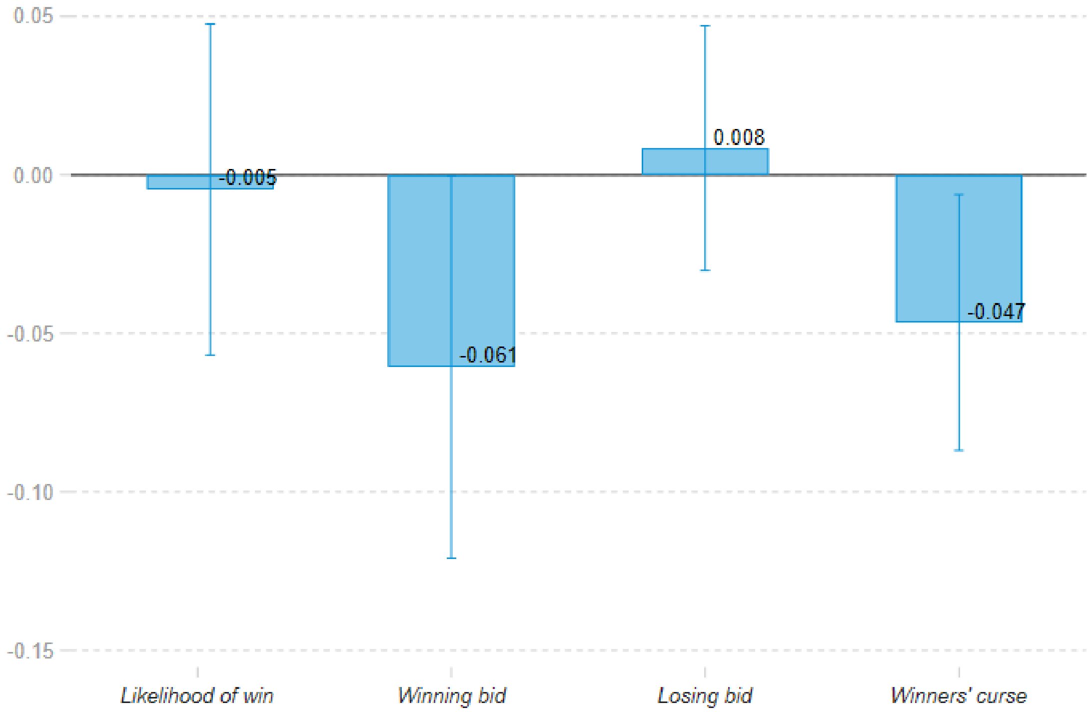


Figure 5 Bidding Outcomes and Information Advantage

Note: The figure shows the bidding outcomes of the golfing bidders as defined in Figure 4. The regression coefficients are shown in Columns 1, 3 and 4 of Table 5. The bars are the regression coefficients of the dummy variable *Golf with* $Developer_{i,j}$. The first bar corresponds to Column 1 where the outcome is the likelihood of winning (*Win=1*). The second and the third bar corresponds to Column 3 where the outcome variable is the bid price (ln(*Bid*)). The second bar is the coefficient of the interaction term of golfing bidder dummy and *Win* dummy (*Golf with* $Developer_{i,j}$ * *Win*) which captures the differences in winning bid of the golfing bidders relative to those of the reference group (non-golfing bidders). The third bar is the coefficient of *Golf with* $Developer_{i,j}$ which in this specification capture the difference in the losing bids of the golfing bidders relative to those of the reference group (non-golfing bidders). The fourth bar corresponds to Column 4 where the outcome variable is the winners' curse measured by the differences between the winning bids and the highest losing bids. 95% confidence intervals are shown with vertical lines. The coefficients are labeled on the bars. The regression specifications are in equations (4)-(6). And the regression coefficients are in Table 6.

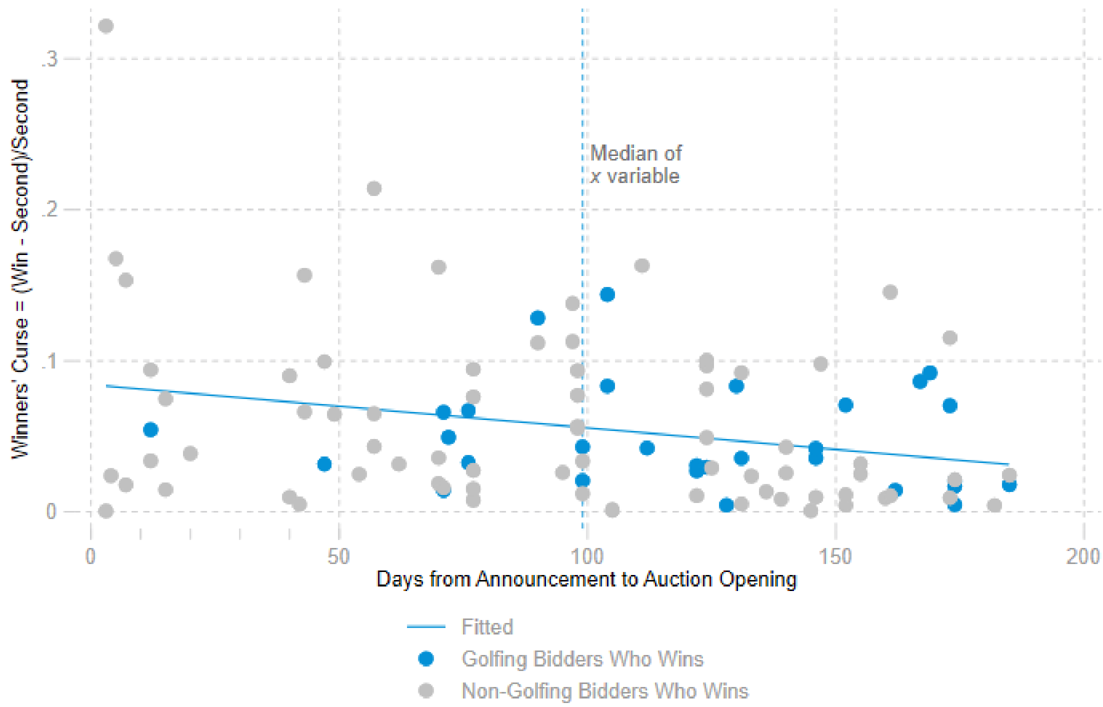


Figure 6 Winners' Curse and Days from Auction Schedule Announcements

Note: The figure shows the relation between the magnitude of the winners' curse and the days from land sale schedule announcements to the auction opening date. The blue dots are the golfing bidders who win. The grey dots are the remaining winners (non-golfing bidders who win). The blue dashed line indicates the median of the x variable, the days from announcements to auction opening. The winners' curse is measured by the difference between winning bid and the second-highest bid then divided by the second highest bid.

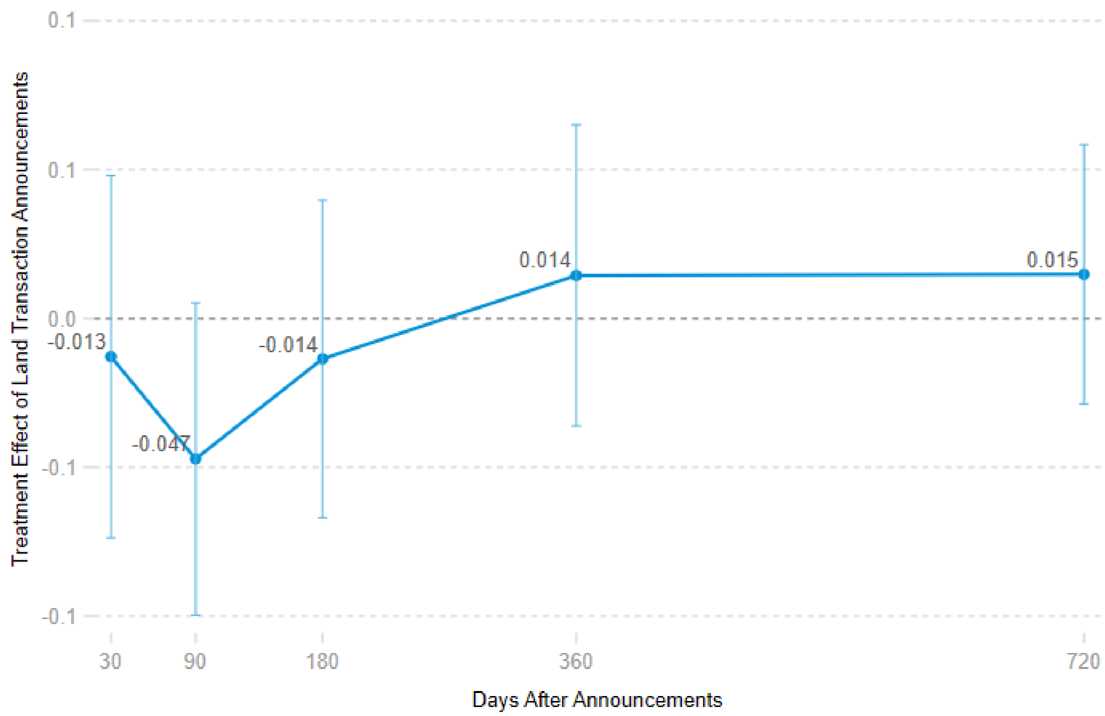


Figure 7 Spillover of Informed Land Transactions

Note: The figure plots the regression coefficients of the triple interaction terms in Table A.6. The coefficients represent the treatment effect of the results announcements of the golfing bidders' land transactions on the neighboring property transaction price in the short-run (within 30 days), in the mid-run (within 90 days and within 180 days) and in the long-run (within 360 days and within 720 days). 95% confidence intervals are shown with vertical lines. The coefficients are labeled beside the markers.

Table 1 Descriptive Statistics of Land Auction Data

Variables	(1) N	(2) Mean	(3) Std. Div
Summary of each land parcel			
Winning Bids (million $)	103	278.341	184.822
Distance to MRT (km)	103	0.715	0.532
Distance to CBD (km)	103	11.758	4.325
Site Area (sqm)	103	49,461.13	19,710.12
GPR	103	2.756	0.871
Number of Bids	103	8.689	4.18
Executive Condominium	103	0.282	0.452
Landed	103	0.029	0.169
Nonlanded	103	0.689	0.465
Mixed Use	103	0.068	0.253
Summary of each bid			
Bids (million $)	895	219.634	138.263
Golf with Developer=1	895	0.322	0.467
Win = 1	895	0.115	0.319
Joint bids	895	0.241	0.428

Notes: The table summarizes the land auction data. There are 103 land auctions, with 895 bids included. *Winning Bids* is the highest bid in each auction. *Distance to MRT* is the distance in kilometers to the nearest rail transit station. *Distance to CBD* is the distance in kilometers to the city center. *Site Area* is the floor area that can be constructed on each parcel. *GPR* is the gross plot ratio which measures the construction density of each parcel. *Number of Bids* is the number of bids received in each auction. *Executive Condominium* is a dummy indicating whether the land parcels are sold for the construction of Executive Condominiums. *Landed*, *Nonlanded* and *Mixed Use* are dummies identifying whether the land parcels are sold for landed properties, nonlanded properties or mixed use other than Executive Condominiums, respectively. *Bids* is all the bids received in each auction. *Golf with Developer* identifies the bids submitted by the bidders who golf after auction announcements and before auction opens. *Win* is a dummy identifies the winning bids. *Joint Bids* is a dummy indicating whether the bidder is a joint venture comprised of more than one companies.

Table 2 Descriptive Statistics of Golf Data

Variables	(1) N	(2) Mean	(3) Std. Div.
Number of Golf Sessions			
Developer Directors	59,808	0.062	0.267
Non-Developer Directors	1,005,144	0.064	0.275
Other Golfers	1,395,492	0.062	0.275
Golf with developer directors in a week=1			
Developer Directors	59,808	0.056	0.230
Non-Developer Directors	1,005,144	0.016	0.127
Other Golfers	1,395,492	0.020	0.139

Notes: The table summarizes the golf record by the three groups of golfers, including developer directors, other directors, non-directors. The sample period is from 2010 to 2014. The golf data is structured as a golfer by event week panel, where an event week is the seven days before or after the announcement of land supply schedules. For example, event week 0 is the first seven days after the announcement of land supply schedules. Two variables are summarized, the number of golf sessions conducted in an event week, and a dummy indicating whether a golfer golfs with a developer director in an event week.

Table 3 Golf and Bidding Participation

	(1)	(2)	(3)	(4)
	Bidder Level		Bidder Pair Level	
Variables	$Bid_{t,i}$	$Both\_bid_{t,p}$	$Bid\_same\_auc_{t,p}$	$Compete_{t,p}$
$Golf\_with\_Developer_{t,i}$	-0.000			
	(0.000)			
$Golf\_together_{t,p}$		-0.045***	-0.024*	-0.026*
		(0.013)	(0.013)	(0.013)
Observations	882	55,125	55,125	55,125
R-squared	0.361	0.275	0.303	0.303
Bidding Cycle FE	Yes	Yes	Yes	Yes
Bidder FE	Yes	No	No	No
Bidder Pair FE	No	Yes	Yes	Yes
SE Cluster	Bidder Level	Two-way Cluster on Bidder Level		
Mean of D.V.		0.154	0.061	0.058

Note: The table shows the relation between the golf participation and the bidding participation on bidder level (Column 1) and on bidder pair level (Columns 2-4). In Column 1, we include the bidders who bid during the sample period and restructure the data into a bidding cycle by bidder panel. We examine the relation between bidding participation and golf participation. Bidder fixed effects and bidding cycle fixed effects are included. In the last three columns, the data is a bidder pair by bidding cycle panel, with each observation reflects the bidding behavior and golf behavior of a pair of bidders *p* during bidding cycle *t*. The independent variable is a dummy indicating whether the pair of bidders *p* have golfed together in the cycle *t* ($Golf\ Together_{t,p}$). Column 2 examines the likelihood of a pair of developers to both bid (not necessarily in the same auction) after they golf together during cycle *t* ($Both\_bid_{t,p}=1$). Column 3 examines the likelihood of a pair of developers to bid in the same auction after they golf together during cycle *t* ($Bid\_Same\_Auc_{t,p}=1$). Column 4 examines the likelihood of a pair of developers to bid in the same auction as separate bidders after they golf together during cycle *t* ($Compete_{t,p}=1$). Bidder pair fixed effects and bidding cycle fixed effects are included. Robust standard errors clustered by bidder are reported in parentheses. ***, **, * indicate significance at 1%, 5%, and 10% levels, respectively.

Table 4 Information Sharing or Collusion

Variables	(1) *Both win*$_{t,p}$	(2) *Both win*$_{t\ or\ t+1,p}$
Golf_together$_{t,p}$	-0.017***	-0.026***
	(0.005)	(0.007)
Observations	55,125	55,125
R-squared	0.230	0.365
Bidding Cycle year FE	Yes	Yes
Pair FE	Yes	Yes
SE Cluster	Two-way Cluster on Bidder Level	
Mean of D.V.	0.013	0.022

Note: The table shows the relationship between the bidding outcome and golf behavior. The dependent variables are dummy variables listed in the first row, so the regression coefficients capture the occurrence likelihood of the cases represented by the outcome variables. The data is a bidder pair by bidding cycle panel. Each observation represents the bidding behavior and golf behavior of a pair of developers *p* during bidding cycle *t*. The independent variable is a dummy indicating whether the pair of developers *p* have golfed together in the bidding cycle *t* (*Golf_together*$_{t,p}$). The first column examines the likelihood of a pair of developers to both win after they golf together during time *t* (*Both win*$_{t,p}$ *=1)*. The second column examines the likelihood of a pair of developers *p* to both win during time *t* or *t+1* after they golf together during cycle *t* (*Both win*$_{t\ or\ t+1,p}$ *=1)*. The regression specification is shown in equation (3). Robust standard errors two-way clustered by bidder are reported in the parentheses. ***, **, * indicate significance at 1%, 5%, and 10% levels, respectively.

Table 5 Summary of Bids by Bidder Type (Million SGD)

Variables		N	Mean	Std. Dev.
Win = 1	$Golf\_with\_Developer_{i,j}$=1	30	300.416	127.007
Win = 1	$Golf\_with\_Developer_{i,j}$=0	73	269.269	203.981
Win = 0	$Golf\_with\_Developer_{i,j}$=1	258	232.909	116.040
Win = 0	$Golf\_with\_Developer_{i,j}$=0	534	201.897	134.046

Notes: The table summarizes the bids submitted in different auctions by golfing or not and by winning or not. There are 103 land auctions, with 895 bids. $Golf\_with\_Developer_{i,j}$ is a dummy identifying the golfing bidders as defined in Figure 4.

Table 6 Information Advantage and Bidding Outcomes

Variables	(1) *Win = 1*	(2) *ln (Bid)*	(3)	(4) *Winners' curse*
Golf_with_Developer$_{i,j}$ * Win			-0.061**	
			(0.030)	
Golf_with_Developer$_{i,j}$	-0.006	0.002	0.008	-0.047**
	(0.027)	(0.019)	(0.019)	(0.020)
Win = 1		0.165***	0.185***	
		(0.016)	(0.021)	
Observations	895	895	895	103
R-squared	0.226	0.868	0.868	0.526
Control Variables	Yes	Yes	Yes	Yes
Developer FE	Yes	Yes	Yes	No
Planning Area FE	Yes	Yes	Yes	Yes
Year of Land Sale FE	Yes	Yes	Yes	Yes
SE Cluster		Land Level		Not Clustered

Notes: The table reports the relation between information advantage and land bids. *Golf_with_developer*$_{i,j}$ is a dummy identifying the golfing bidders. *Win = 1* identifies winning bids. Control variables are omitted, including *ln(Site Area)* (natural log of the floor area), *GPR* (the plot ratio of the parcel), *Distance to MRT* (the distance in kilometers from the transacted land parcel to the nearest rail transit station), *Distance to CBD* (the distance in kilometers from the transacted land parcel to the city center), *Number of Bids* (the number of bidders bidding for the land) and *Joint Bids* (whether the bid is a joint bid submitted by more than one bidder). The types of land, including Executive Condominium use, mixed use, landed use and nonlanded use, are also controlled. Planning area fixed effects and the year of sale fixed effects are also included. Developer fixed effects are included in the first three columns. Robust standard errors are reported in the parentheses and are clustered by land auction for the first three columns. ***, **, * indicate significance at 1%, 5%, and 10% levels, respectively.

Table 7 Heterogenous Test: Tenders with Different Duration and Tenders Hold with Different Time Intervals From Announcement

	(1)	(2)	(3)	(4)
Cutoffs based on:	Period Between Announcement and Auction		Duration of Auctions	
Cutoffs	0-50%	50%-100%	0-50%	50%-100%
Variables	*ln (Bid)*			
$Golf\_with\_Developer_{i,j}$ * Win	-0.065	-0.085*	0.002	-0.112*
	(0.047)	(0.046)	(0.048)	(0.058)
$Golf\_with\_Developer_{i,j}$	-0.025	0.022	0.007	0.025
	(0.034)	(0.020)	(0.022)	(0.031)
Win = 1	0.206***	0.181***	0.151***	0.249***
	(0.031)	(0.038)	(0.024)	(0.043)
Observations	433	462	419	476
R-squared	0.901	0.897	0.934	0.881
Control Variables	Yes	Yes	Yes	Yes
Developer FE	Yes	Yes	Yes	Yes
Planning Area FE	Yes	Yes	Yes	Yes
Year of Land Sale FE	Yes	Yes	Yes	Yes
SE Cluster	Land Level			

Notes: The table is a heterogeneous test based on equation (5). The sample is divided into sections based on the length of the auction duration and based on the time period between the auction schedule announcements and the auction openings, listed on the second row of the table. The cutoffs are represented as percentiles on the third row of the table. $Golf\_with\_Developer_{i,j}$ is a dummy identifying the golfing bidders. *Win = 1* identifies winning bids. Control variables are omitted, including *ln(Site Area)* (natural log of the floor area), *GPR* (the plot ratio of the parcel), *Distance to MRT* (the distance in kilometers from the transacted unit to the nearest rail transit station), *Distance to CBD* (the distance in kilometers from the transacted unit to the city center), *Number of Bids* (the number of bidders bidding for the land) and *Joint Bids* (whether the bid is a joint bid submitted by more than one bidder). The types of land, including Executive Condominium use, mixed use, landed use and nonlanded use, is also controlled. Planning area fixed effects and the year of sale fixed effects are also included. Developer fixed effects, planning area fixed effects and the year of sale fixed effects are also included. Robust standard errors clustered by land auction are reported in parentheses. ***, **, * indicate significance at 1%, 5%, and 10% levels, respectively.

Table 8 Informed Land Acquisition and New Project Selling Price

Variables	(1)	(2)
	Ln (Property Price per sqm)	
$Golf\_with\_Developer_{i,j}$		-0.030
		(0.018)
Construction Quality	0.019***	0.022***
	(0.004)	(0.004)
Quality Assessed or Not	-1.764***	-1.998***
	(0.349)	(0.387)
Observations	50,516	50,516
R-squared	0.937	0.937
Control Variables	Yes	Yes
Property Type FE	Yes	Yes
Developer FE	Yes	Yes
Planning Area FE	Yes	Yes
Year of Transaction FE	Yes	Yes
SE Cluster	Land Level	

Notes: Column 1 shows the baseline specification, where we only include control variables. Column 2 includes both the control variables and the dummy, $Golf\_with\_Developer_{i,j}$ identifying the golfing bidders. *Construction quality* is measured using the CONQUAS score of project quality assessed by the Singapore government, per application by the developers. A higher score means better quality. If the developer did not apply for a quality assessment, the score is replaced with zero. *Quality Assessed or Not* is a dummy identifies whether the developer of a project applies to the government to assess the quality of the project. Other control variables are omitted, including the *ln(Property Area)* (natural log of property area), total number of units in the project, number of units transacted in one transaction, *Upgrader* (a dummy variable indicating whether the buyer is an upgrader), *Distance to MRT* (the distance in kilometers from the transacted unit to the nearest rail transit station), and *Distance to CBD* (the distance in kilometers from the transacted unit to the city center). The types of the properties, including Executive Condominium, mixed use, other nonlanded and landed are included in the fixed effects. Developer fixed effects, planning area fixed effects and the year of sale fixed effects are also included. Robust standard errors clustered by player are reported in parentheses. ***, **, * indicate significance at 1%, 5%, and 10% levels, respectively.

Appendix Figures and Tables

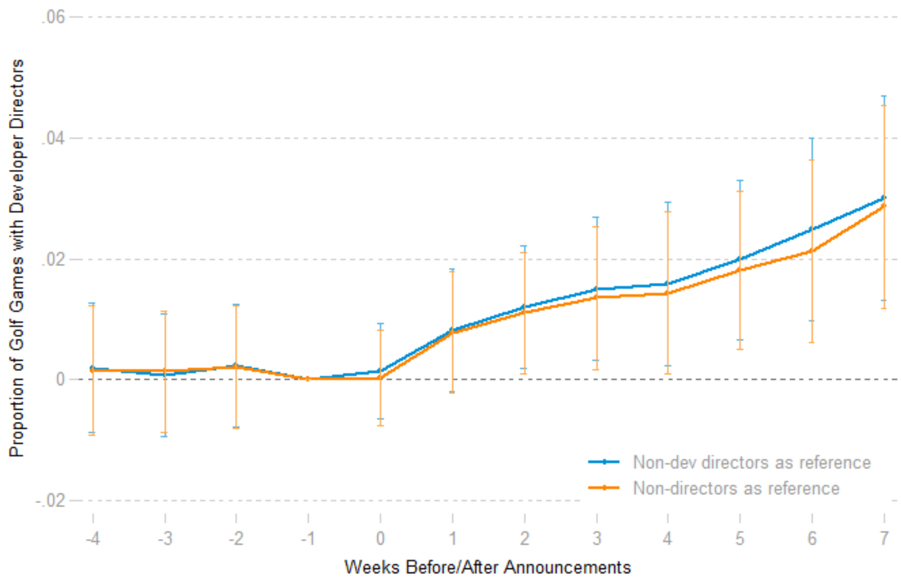
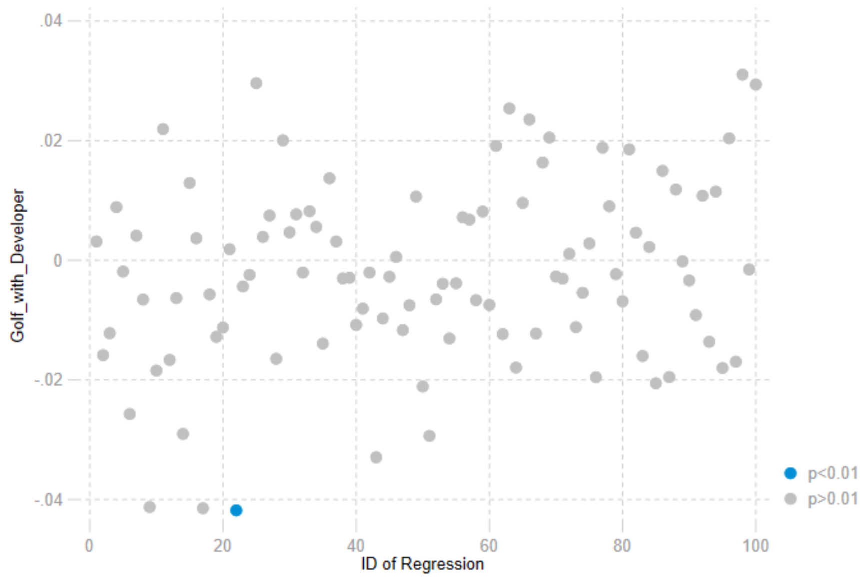
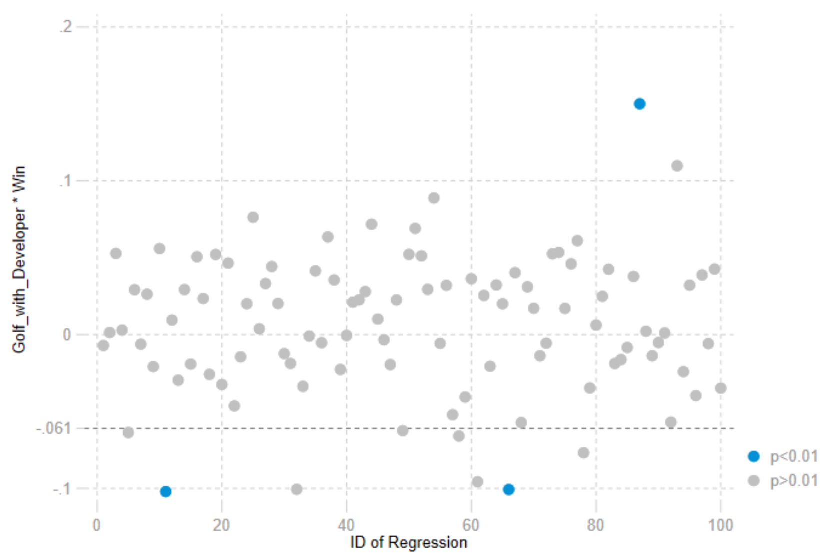


Figure A.1 DID: The Proportion of Golf Games with Developer Directors

Note: The figure visualizes the coefficients of the dynamic DID regressions showing the changes in golf patterns before and after the land sale schedule announcements, defined in equation (2). The dependent variable is the proportion of golf games played with developer directors in the week. The regression results are shown in Table A.1. Note that the weeks are event weeks. *Week (-) i* is the *i*-th seven days (before) after the announcements of land sale schedules. The announcement date is the first day of Week 0. Week -1 is the reference group omitted from the regressions. 95% confidence intervals are shown with vertical lines.



Panel A Coefficients of *Golf_with_Developer* Dummy



Panel B Coefficients of the Interaction Term: *Golf_with_Developer * Win*

Figure A.2 Placebo Test: Randomly Defining Bidder Types

Note: The two figures visualize the coefficients of the two variables *Golf_with_Developer* and *Golf_with_Developer * Win* in the placebo tests. We replicate the regression shown in equation (5) for 100 times with the variable *Golf_with_Developer* defined as one for 288 randomly selected observations and zero for the remaining 507 observations. The vertical axis is the point estimate of the two coefficients, and the horizontal axis is the ID (No.1-No.100) of the regressions. The coefficients that are statistically significant at 1% level are in blue, while the coefficients that are not significant are in grey.

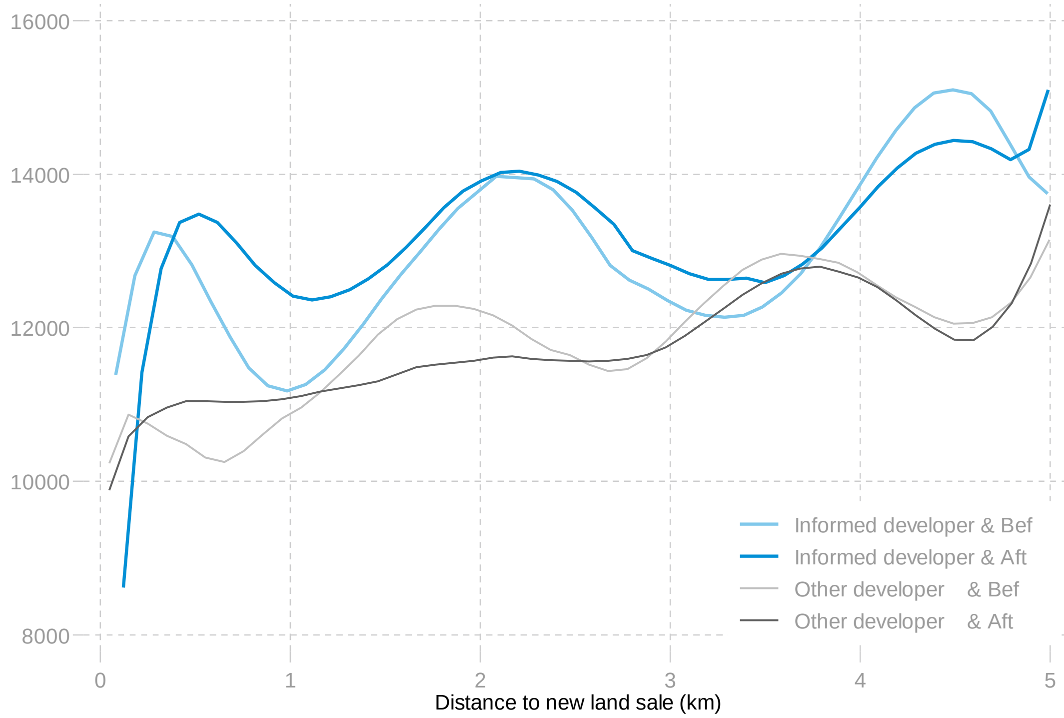


Figure A.3 Negative Spillover of Informed Land Transactions

Notes: The figure shows the locally weighted regression of property price neighboring the land parcels acquired by the golfing bidders and by the non-golfing bidders. We use this method to determine the range of effects of the auction result announcements. The horizontal axis is the distance from the residential units to the new land auctions in kilometers. The vertical axis is the unit price of the transaction. The two blue lines are the price gradient from the newly sold land parcels acquired by the golfing bidders (the informed bidders). The light blue line is the price gradient before the announcements of the auction result, while the dark blue line is the price gradient after the announcement. The two grey lines are the price gradient from the newly sold land parcels acquired by the non-golfing bidders. The light grey line is the price before the announcements of the auction results, while the dark grey line is the price after the announcements.

Table A.1 DID: Bidding Announcement Effect on Golf Patterns

	(1)	(2)	(3)	(4)
Control Group	Non-developer Directors		Other Golfers	
Variables	*Golf with Developer = 1*			
Developer * After	0.009***		0.008***	
	(0.002)		(0.002)	
Week = -4		0.002		0.002
		(0.005)		(0.005)
Week = -3		0.001		0.001
		(0.005)		(0.005)
Week = -2		0.002		0.002
		(0.005)		(0.005)
Week = 0		0.001		0.000
		(0.004)		(0.004)
Week = 1		0.008		0.007
		(0.005)		(0.005)
Week = 2		0.012**		0.011**
		(0.005)		(0.005)
Week = 3		0.015**		0.013**
		(0.006)		(0.006)
Week = 4		0.015**		0.014**
		(0.007)		(0.007)
Week = 5		0.019***		0.017***
		(0.007)		(0.007)
Week = 6		0.024***		0.020***
		(0.008)		(0.008)
Week = 7		0.029***		0.028***
		(0.009)		(0.009)
Observations	1,064,952	1,064,952	1,455,300	1,455,300
R-squared	0.022	0.023	0.024	0.025
Number of PlayerID	12,678	12,678	17,325	17,325
Controls	Yes	Yes	Yes	Yes
Year * Month FE	Yes	Yes	Yes	Yes
Player FE	Yes	Yes	Yes	Yes
Event Week FE	Yes	Yes	Yes	Yes
SE Cluster	Player Level			

Notes: The table shows the changes in the golf pattern after the government releases the land supply schedule for the upcoming six months. The outcome variable is a dummy variable indicating whether the player played golf with a developer director or not. Columns 1 and 3 are typical DID regressions. Column 2 and 4 are DID regressions with dynamic time dummies. The developer directors are the treated group. Two groups of golfers are included as control groups, non-real estate company directors (*Non-developer Directors*) and non-directors (*Other Golfers*). *Developer* is a dummy variable equal to one for golf players working for developers as directors and zero otherwise. 4 weeks before and 8 weeks after the announcements are included in the dynamic DID regression. Note that the weeks are event weeks. The number of observations for the first two columns and the last two columns can be calculated respectively as follow: 1,064,952=12,678*(4+8)*7 and 1,455,300=17,325*(4+8)*7, where 7 represents the seven land auction announcements and 12,678 and 17,325 represent the number of golf players included in the two regressions. To save space, only the interaction terms are shown in the table. Control variables are omitted, including the number of tournament games in the week and the number of days of public holidays in the week. Robust standard errors clustered by player are reported in parentheses. ***, **, * indicate significance at 1%, 5%, and 10% levels, respectively.

Table A.2 Event Study: Bidding Announcement Effect on Golf Patterns

	(1)	(2)	(3)
Variables		*Golf_with_Developers = 1*	
Week = -4	-0.004	-0.000	0.000
	(0.006)	(0.001)	(0.001)
Week = -3	-0.003	0.001	-0.000
	(0.005)	(0.001)	(0.001)
Week = -2	-0.002	0.000	0.000
	(0.005)	(0.001)	(0.001)
Week = 0	0.003	0.001***	0.003***
	(0.004)	(0.001)	(0.001)
Week = 1	0.006	0.002**	0.002***
	(0.005)	(0.001)	(0.001)
Week = 2	0.010*	0.002***	0.003***
	(0.005)	(0.001)	(0.001)
Week = 3	0.017***	0.004***	0.005***
	(0.006)	(0.001)	(0.001)
Week = 4	0.017**	0.005***	0.006***
	(0.007)	(0.001)	(0.001)
Week = 5	0.020***	0.005***	0.006***
	(0.007)	(0.001)	(0.001)
Week = 6	0.023***	0.004***	0.007***
	(0.008)	(0.001)	(0.001)
Week = 7	0.031***	0.005***	0.006***
	(0.009)	(0.001)	(0.001)
Observations	59,808	1,005,144	1,395,492
R-squared	0.030	0.021	0.023
Number of Player ID	712	11,966	16,613
Control Variables	Yes	Yes	Yes
Year * Month FE	Yes	Yes	Yes
Player FE	Yes	Yes	Yes
SE Cluster	Player Level	Player Level	Player Level

Note: The table shows the changes in the golf pattern after the government release the land supply schedule for the upcoming six months. The outcome variable is a dummy variable indicating whether the player played golf with a developer director or not. 4 weeks before and 8 weeks after the announcements are included in the regression. Note that the weeks are event weeks. Control variables are omitted, including the number of tournament games in the week and the number of days of public holidays in the week. Robust standard errors clustered by player are reported in parentheses. ***, **, * indicate significance at 1%, 5%, and 10% levels, respectively.

Table A.3 Descriptive Statistics of Property Transactions

Variables	(1) N	(2) Mean	(3) Std. Div.
Property Price ($/sqm)	50,516	11,966.115	3,550.788
Property Area (sqm)	50,516	90.250	34.463
Total Units	50,516	642.041	221.212
Number Units Sold	50,516	1.000	0.012
Distance to MRT (km)	50,516	0.871	0.696
Distance to CBD (km)	50,516	12.100	4.133
Quality Assessed or not	50,516	0.626	0.484
Construction quality	50,516	57.791	44.762
Construction quality if Quality Assessed	29,873	92.419	3.007
Land Use Type			
Landed	50,516	0.004	0.065
Nonlanded	50,516	0.922	0.268
Mixed Use	50,516	0.074	0.261
Executive Condominium	50,516	0.300	0.458

Note: The table summarizes the property transaction data used in the Fourth Stage. *Property price* is the transaction price divided by the area of each unit. *Property Area* is the area of the property in square meters. *Total Units* is the total number of units in the project. *Number Units Sold* is the number of units transacted in one transaction. *Distance to MRT* is the distance in kilometer to the nearest rail transit station. *Distance to CBD* (the distance in kilometers from the transacted unit to the city center). *Upgrader* is a dummy variable equal to 1 for the upgrader buyers who moves from public housing to private housing. *Construction quality* is measured using the CONQUAS score of project quality assessed by the Singapore government. If the project is not assessed, the score is replaced with zero. *Construction quality if Quality Assessed* summarizes the score if the project has been assessed. A higher score means better quality. *Quality Assessed or not* is a dummy indicating whether the developer of a project applies to the government to assess the quality of the project. *Land use type* is the type of use according to the government zoning policies, including landed residential use, mixed use, non-landed residential use and Executive Condominium use.

Table A.4 Land Bids with the Proportion of Golf Partners' Bidding Behaviors

	(1)	(2)
Variables	*ln (Bid)*	
Golf_Partner_Bid	-0.126	0.301
	(0.621)	(0.660)
Golf_Partner_Bid * Win		-2.289**
		(1.096)
Win = 1	0.171***	0.194***
	(0.035)	(0.042)
Observations	288	288
R-squared	0.882	0.883
Controls	Yes	Yes
Developer FE	Yes	Yes
Planning area FE	Yes	Yes
Year of land sale FE	Yes	Yes
SE Cluster	Land Level	

Note: The table reports the relationship between the land bids and the proportion of one's golf partners who also bid in the same land auction as one does. Only the bids submitted by the developers whose directors golf before auctions are included in the sample. *Golf_Partner_Bid* is the percentage of one's golf partners who also bid in the same land auction as one does after the golf games between them. Control variables are omitted, including *ln(Site Area)* (natural log of the floor area), *GPR* (the plot ratio of the parcel), *Distance to MRT* is the distance in kilometer to the nearest rail transit station, *Distance to CBD* (the distance in kilometers to the city center), *Number of bids* (the number of bidders bidding for the land) and *Joint Bids* (whether the bid is a joint bid submitted by more than one bidder). The type of land, including Executive Condominium use, mixed use, landed use and nonlanded use is also controlled. Developer fixed effects, planning area fixed effects and the year of sale fixed effects are included. Robust standard errors clustered by land auction are reported in the parentheses. ***, **, * indicate significance at 1%, 5%, and 10% levels, respectively.

Table A.6 Externality of Informed Land Acquisition to Other Projects: Price

	(1)	(2)	(3)	(4)	(5)
Window Size:	30 days	90 days	180 days	360 days	720 days
Variables			*Ln (Property Price per sqm)*		
Near* Golf_with_Developer * After	-0.013	-0.047*	-0.014	0.014	0.015
	(0.031)	(0.027)	(0.027)	(0.026)	(0.022)
Near	0.015	0.015	0.005	0.003	0.001
	(0.017)	(0.016)	(0.012)	(0.011)	(0.011)
After	-0.003	-0.002	0.000	0.001	0.003
	(0.005)	(0.005)	(0.004)	(0.003)	(0.004)
Golf_with_Developer	0.009**	0.009**	0.009**	0.010**	0.009**
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
Near * After	0.041**	0.066***	0.054***	0.029**	0.020
	(0.018)	(0.022)	(0.020)	(0.015)	(0.014)
Near * Golf_with_Developer	-0.052**	-0.051**	-0.040**	-0.036*	-0.023
	(0.025)	(0.024)	(0.020)	(0.019)	(0.018)
After * Golf_with_Developer	0.005	0.003	0.001	0.002	-0.001
	(0.008)	(0.007)	(0.006)	(0.005)	(0.006)
Observations	613,578	709,287	842,182	1,083,220	1,480,123
R-squared	0.753	0.753	0.767	0.765	0.764
Controls	Yes	Yes	Yes	Yes	Yes
Land Type FE	Yes	Yes	Yes	Yes	Yes
Year of transaction FE	Yes	Yes	Yes	Yes	Yes
Planning area FE	Yes	Yes	Yes	Yes	Yes
SE Cluster			Project Level		

Notes: The table reports the negative spillover effect of the informed land transactions on the neighboring property price. *Near* is a dummy variable equal to one if the property unit is located within 500 meters from a new land auction, and equal to zero otherwise. *After* is a dummy identifies whether the property is transacted after the new auction results are released. *Golf_with_Developer* identifies the golfing bidders who win the land auction. Control variables are omitted, including property area in square meters in log term, type of sale (including resale, new sale and subsale), *FH* (a dummy variable identifying whether the unit is freehold), age of the building, *Distance to MRT* (the distance in kilometers from the transacted unit to the nearest rail transit station), *Distance to CBD* (the distance in kilometers from the transacted unit to the city center, number of units sold in one transaction, and the types of properties (Landed, Non-landed, Mixed Use and Executive Condominium). Planning area fixed effects and the year of sale fixed effects are included. Robust standard errors clustered by project are reported in parentheses. ***, **, * indicate significance at 1%, 5%, and 10% levels, respectively.

Table A.7 Externality of Informed Land Acquisition to Other Projects: New Sale Price

	(1)	(2)	(3)	(4)	(5)
Window size:	30 days	90 days	180 days	360 days	720 days
Variables	*Ln (Property price per sqm)*				
Near* Golf_with_Developer * After	-0.021	-0.032	-0.011	0.008	0.006
	(0.030)	(0.037)	(0.033)	(0.028)	(0.024)
Near	-0.001	-0.000	-0.000	-0.000	-0.001
	(0.013)	(0.013)	(0.013)	(0.013)	(0.013)
After	-0.009	-0.009	-0.006	-0.005	-0.003
	(0.007)	(0.007)	(0.005)	(0.004)	(0.005)
Golf_with_Developer	0.004	0.004	0.004	0.004	0.002
	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)
Near * After	0.033*	0.068**	0.055**	0.030*	0.019
	(0.018)	(0.031)	(0.026)	(0.018)	(0.016)
Near * Golf_with_Developer	-0.037	-0.037	-0.034	-0.032	-0.016
	(0.025)	(0.024)	(0.023)	(0.022)	(0.022)
After * Golf_with_Developer	0.008	0.014	0.015*	0.014*	0.010
	(0.012)	(0.012)	(0.009)	(0.007)	(0.008)
Observations	366,092	428,107	515,370	677,708	952,718
R-squared	0.830	0.829	0.829	0.828	0.827
Controls	Yes	Yes	Yes	Yes	Yes
Land Type FE	Yes	Yes	Yes	Yes	Yes
Year of transaction FE	Yes	Yes	Yes	Yes	Yes
Planning area FE	Yes	Yes	Yes	Yes	Yes
SE Cluster	Project Level				

Notes: The table reports the negative spillover effect of the informed land transactions on the neighboring new property price. *Near* is a dummy variable equal to one if the property unit is located within 500 meters from a new land auction, and equal to zero otherwise. *After* is a dummy identifies whether the property is transacted after the new auction results are released. *Golf_with_Developer* identifies the golfing bidders who win the land auction. Control variables are omitted, including property area in square meters, *FH* (a dummy variable identifying whether the unit is freehold), age of the building, *Distance to MRT* (the distance in kilometers from the transacted unit to the nearest rail transit station), *Distance to CBD* (the distance in kilometers from the transacted unit to the city center, *Upgrader* (a dummy variable indicating whether the buyer is an upgrader) and the types of properties. Planning area fixed effects and the year of sale fixed effects are included. Robust standard errors clustered by project are reported in parentheses. ***, **, * indicate significance at 1%, 5%, and 10% levels, respectively.

Table A.8 Externality of Informed Land Acquisition to Other Projects: Transaction Volume and Days to Sell

Variables	(1) Number of Units Sold	(2) Days to Sell
Near* Golf_with_Developer * After	1.070	-66.191
	(0.660)	(124.055)
Near	-8.865***	-170.864**
	(0.662)	(73.231)
After	0.309	5.914
	(0.252)	(11.416)
Golf_with_Developer	0.605	7.361
	(0.676)	(12.702)
Near * Golf_with_Developer	-0.389	216.233*
	(1.167)	(127.480)
After * Golf_with_Developer	-0.684	15.519
	(0.663)	(19.759)
Near * After	-0.109	-41.920
	(0.242)	(50.117)
Observations	81,526	232,254
R-squared	0.419	0.169
Controls	No	Yes
Year FE	Yes	Yes
Planning Area FE	Yes	Yes
SE Cluster	Land Level	

Notes: The table tests the negative spillover effect of the informed land transactions on the neighboring property transaction volume and the days between the two transactions of one unit. The post-treatment window size is 90 days after the announcement of auction results. The dependent variables include the number of units sold in the area *(Number of Units Sold)* and the days between the two transactions of one unit *(Days to Sell)*. *Near* is a dummy variable equal to one if the property unit is located within 500 meters from a new land auction, and equal to zero otherwise. *After* is a dummy identifies whether the property is transacted after the new auction results are released. *Golf_with_Developer* identifies the golfing bidders who win the land auction. Planning area fixed effects and the year of sale fixed effects are also included. For the second column, the attributes of the units transacted are controlled, including property area in square meters, type of sale (including resale and subsale), *FH* (a dummy variable identifying whether the unit is freehold), age of the building, *Distance to MRT* (the distance in kilometers from the transacted unit to the nearest rail transit station), *Distance to CBD* (the distance in kilometers from the transacted unit to the city center, *Upgrader* (a dummy variable indicating whether the buyer is an upgrader) and the type of the properties. Robust standard errors clustered by project are reported in parentheses. ***, **, * indicate significance at 1%, 5%, and 10% levels, respectively.

Table A.9 Dates of Land Sale Schedule Announcement

2010 November 25
2011 June 09
2011 December 07
2012 June 13
2012 December 14
2013 June 25
2013 December 18