Strategic Vendor Due Diligence in real estate transactions

12 June 2021

Abstract

Purpose - In light of the ever-growing complexity of real estate transactions, the need for vendors and buyers to better understand the role of vendor due diligence (VDD) is imperative. The purpose of this paper is twofold: firstly, it provides a detailed literature review regarding the role of VDD from both the vendor's and buyers' perspectives. Secondly, it analyses the value of VDD over and above the buyer's due diligence in real estate transactions by proposing a theoretical model involving two-stage auctions.

Design/methodology/approach - Real-world examples from the industry are used as a motivation behind listing a set of practical questions. A theoretical construct is built to approximate the real estate environment under study. The construct is then studied from a game-theoretic perspective to obtain theoretical answers to the questions. These answers are then used to shape recommendations for the relevant industry and beyond.

Findings - The model suggested accommodates the feature that even though the VDD is broadly increasing informational efficiency in the market, its value is limited and sometimes harmful when the vendors have a sound prior understanding of their assets and the buyers' pre-transaction information about the asset is already high.

Originality - Though the real estate market is considered here, the theoretical model we propose is applicable to any other complex asset transaction decision that supports endogenous information disclosure considerations using VDD.

Keywords Complex assets, private information, two-stage auctions, due diligence.

Paper type Research paper

1 Introduction

Vendor due diligence (VDD) is frequently recommended by transaction advisors as an addition to buyer's due diligence (henceforth BDD) in transactions of high-value non-homogeneous complex assets such as real estate.[1] Such transactions require substantial time and costs to make informed sale-purchase decisions. These processes may include the vendor's investigations of the asset with the aim to strategically release some information about the asset to inform the potential buyers via VDD. VDD is a relatively new phenomenon that originated in the UK in the late 1990s (Howson, 2017; Dickens, 2015) in response to the vendors' frustrations around inefficiencies in transactions.

What is the value of VDD over BDD and why is it that sometimes VDD is exercised, while on other occasions it is not? The real estate literature has not paid enough attention to this question. In this regard, our paper lists the various issues regarding BDD and VDD in the real estate market and proposes a theoretical construct involving two-stage auctions to analyse the usefulness of VDD over and above BDD. To the best of our knowledge, this paper is the first to systematically investigate VDD's applications in the real estate sector within the framework of the two-stage auction model with strategic dissemination of information.

Section two reviews the literature on VDD within the real estate sector. Section three presents a theoretical model of a two-stage auction with VDD. Section four discusses the equilibrium usage of VDD and its impact on the transaction and the welfare of the vendor and the bidders. This is followed by a review of the literature on auctions with two-stage bidding that is closely related to VDD. Section five provides concluding remarks and practical implications for vendors and buyers.

2 Due Diligence in real estate transactions

2.1. Features of BDD

In the real estate market longer transaction periods and costs are typically associated with more complex real estate assets like shopping centres, portfolio transactions, assets without freehold ownership, or atypical assets and share deals (Bond *et al.*, 2004; Haurin *et al.*, 2010; Devaney and Scofield, 2015; Ishaak *et al.*, 2021). This implies that an investigation of the potential buyers and sellers by the other sides would be inevitable, and this forms the cornerstone of interactive decision-making in large real estate transactions. For instance, the potential buyers value information about the credibility of self-claimed ownership of the sellers including the seller's financial conditions. In particular, a sudden declaration of bankruptcy can derail long procedures of transactions where the buyers have already incurred some initial costs.

These complexities result in large real estate transactions being commonly conducted via two-stage auctions (Foley, 2003; Lu and Ye, 2018). In the first stage, the bidders submit their indicative bids based on prior information about the asset. An "indicative bid" is a term generally used to mean any activity at an early stage that is undertaken by the buyer that signals credibly to the vendor the commitment and willingness on the buyers' part to buy the asset. The indicative bids are made based on information acquired about the asset (publicly available data and information memorandum confidentially disclosed by the vendor). Following this, the vendor selects the final bidders, who are then confidentially granted access to substantial information, which then leads to the final bids made in the second stage.

A substantial volume of BDD is conducted for a complex real estate asset for which the publicly available information is often biased. BDD is well discussed in the two-stage auction literature, where the information acquisition is treated as a costly entry into the transaction process (Bergemann and Valimaki, 2006). Lu and Ye (2018) note that the optimal mechanism design is challenging in such cases, as the parties to the transaction "must balance information acquisition at the entry stage and information elicitation in the final stage, which are interdependent."

2.2. Features of VDD and existing literature

Due to the complexities and potential mutual mistrust highlighted above it is not unnatural to envisage that the sellers, especially those who are genuine, will have large incentives to credibly signal their fundamentals to the buyers at an early stage of large and complex real estate transactions.

Although the Information Memorandum (IM) is the most popular marketing document used by the sellers, VDD is the only observed industry-accepted practice of a seller credibly promoting its asset to the prospective buyers. This is because the IM would always come with a disclaimer, while VDD (at least in Europe) would be subject to reliance letters, which are legally binding. [2]

In view of the confidential nature of complex real estate transactions, it is impossible to generate hard stylised facts about the popularity of VDD. However, VDD is clearly observed to be promoted by transaction advisors such as Deloitte (McDonald and Lam, 2014), EY (Scott *et al.*, 2014) or Grant Thornton (Cohen *et al.*, 2010), suggesting that these consultancies provide such services as a useful tool to improve transaction efficiency in view of the BDD processes requiring expert knowledge and coordination of multiple external parties (commercial, legal, financial, tax, technical and environmental advisors) to interpret the asset data and inform the bid price. Moreover, the BDD data is typically provided on a disclaimer basis wherein the vendor and their advisors do not effectively hold the duty of care to the potential bidders and their advisors. VDD forms an essential part of the preparation of the

vendor for sale, where specific non-standard data on complex real estate assets are assembled, analysed, and interpreted by third-party specialist experts.

While the informational value of BDD is well established, there is little research to formally justify VDD in rea.l estate transactions. This paper bridges this gap by evaluating the strategic value of VDD in the informationally complex asset real estate transactions on the basis of practical industry observations and through the usage of a theoretical decision and information transfer model.

We also introduce the real estate audience to the literature on selling mechanisms and auctions with sequential information flow. In our proposed theoretical setup, the vendor may strategically decide the precise design of the VDD disclosure policy through a public announcement [3]. This would depend on a host of parameters such as the cost of acquiring private information for the bidders, the signal precisions with which the vendor and the buyers may acquire information regarding the value of the asset, and the cost of the vendor to engage in VDD. If there indeed exist separating equilibria where credible information regarding underlying asset quality is generated from the VDD policy the vendor cannot commit to adhere to, it must be that the no-mimicking incentive compatibility constraints are satisfied. These would ensure that the vendors do not have any incentive to misreport by unilaterally deviating from the publicly announced VDD disclosure policy. These aspects of the equilibria and their repercussions on the aggregate information generated via the VDD and the private information of the buyers are discussed in detail in Section 4.3.

The existing literature suggests that the purpose of a VDD report is to provide disclosure of material issues to potential buyers. Hence, the scope of the VDD report needs to give assurance to the prospective buyers so that they can be reasonably satisfied that there is no need to undertake additional BDD (Potter 2011 Kruse and Toor, 2016). On the other hand, as the scope of the VDD report is based on instructions from the vendor and / or their transaction advisors, *"it may not necessarily deal with each prospective buyers' primary concerns"* (Kruse and Toor, 2016). Matters subject to VDD in real estate transactions typically relate to non-standard parameters of the asset or the transaction and may include specific technical, environmental, legal, commercial, tax of financial matters.

Confidence of the prospective buyer over the independence of the expert VDD report is critical (Rankine *et al.*, 2003; Narwe and Nagel, 2005; Kruse and Toor, 2016; Howson, 2017; Swan, 2017) and so is the reliability based on the reputation of the expert (Caruso, 2012; Rankine *et al.*, 2003; Potter, 2011). Hence, one cannot assume that a bidder will fully follow the VDD report and not seek to hire their own advisers to undertake a BDD (Kruse and Toor, 2016).

The advantages of VDD to the vendor may include increased transaction transparency (Schenker, 2010; Caruso, 2012; Scott *et al.*, 2014; Howson, 2017;

Johnston and Leshinsky, 2018), enhanced transaction value (Martin *et al.*, 2007; Potter, 2011; Caruso, 2012; Howson, 2017; Israel, 2017; Orton, 2018), improved control over negotiations (Potter, 2011; Brady, 2011; Cohen *et al.*, 2015; Israel, 2017), and accelerated transaction process (Martin *et al.*, 2007; Schenker, 2010; Potter, 2011; McDonald and Lam, 2014; Scott *et al.*, 2014; Israel, 2017; Swan, 2017). Potential disadvantages of VDD for the vendor include increased transaction preparation time (Bromberg *et al.*, 2014; Dickens, 2015; Kruse and Toor, 2016; Swan, 2017) and increased upfront costs (Potter, 2011; Bromberg *et al.*, 2014; Dickens, 2015; Kruse and Toor, 2016), the impact of matters subject to VDD on the sale price (Dickens, 2015), risk of disclosing private information to uninterested parties, of not being able to reduce number and complexity of bidders' queries (Schenker, 2010; Dickens, 2015; Kruse and Toor, 2016) and of the risk of not achieving tangible benefits of VDD in terms of improved sale terms (Dickens, 2015). From the buyers' perspective, the key advantages of VDD may include an early go / no-go decision (Dickens, 2015), greater confidence in the transaction process (Schenker, 2010; Dickens, 2015; Israel, 2017; Orton, 2018), lower BDD costs (Potter, 2011; Scott *et al.*, 2014; Bromberg *et al.*, 2014; Dickens, 2015), accelerated transaction process (Schenker, 2010; Potter, 2011; Bromberg *et al.*, 2014; Dickens, 2015), and greater control over the bid pricing (Dickens, 2015). The key disadvantages of VDD for the buyers may include the perception of limited buyers' control over the transaction process (Howson, 2017), lack of recommendations on contentious issues (Potter, 2011), and stronger competition for the asset (Schenker, 2010; Kruse and Toor, 2016).

The above discussion provides evidence for VDD to be widely supported by the industry. Despite having certain disadvantages for both the vendors and the prospective buyers, VDD is promoted by transaction lead consultants. As shown above, the existing academic literature is scarce and most of the publications rest within the corporate domain. While the corporate publications provide clear insights into the matter, they lack academic rigour to justify the suggested benefits. As VDD is not an all-encompassing solution to increase the market efficiency even though it may have specific advantages of its own, it does not fully replace BDD. Hence, the following section seeks to provide a formal representation of a two-stage auction using VDD to establish equilibrium usage of VDD and its impact on the transactions.

3 Theoretical model

The asset: A vendor owns an asset that she wishes to sell to a set of buyers $N = \{1, \ldots, n\}$. The value θ of the asset is uncertain to all parties, and can take two values θ_l (low value) and θ_h (high value) with prior probabilities p and $1 - p$. The asset is informationally complex and so the prior probability p is close to ½.

Vendor due diligence and the information package: The vendor receives a private signal $\sigma \in \{l,h\}$ about the value θ that comes with precision $\sigma \in \{1/2,1\}$. This means that

$$\Pr[s=l|\theta_l] = \Pr[s=h|\theta_h] = \sigma$$

This information about the asset is based on the vendor's internal operational studies and assessments.

After observing s, the vendor has an option to hire an expert to obtain a second signal r with precision $\rho \geq \sigma$. Again,

$$\Pr[r=l|\theta_l] = \Pr[r=h|\theta_h] = \rho$$

In line with observations by Narwe and Nagel (2005), Howson (2017), Rankine *et al.* (2003) and Kruse and Toor (2016), the expert is of repute in the consultancy business. She charges an amount $C(\rho)$ to the vendor for her services. The realisation of the signal r received by the experts (and shared with the vendor) is what we call the VDD.[1]

Once the VDD is delivered, the vendor prepares a disclosure policy. A disclosure policy is a correspondence δ: $(s,r) \rightarrow \{\emptyset\} \cup \{s\} \cup \{r\} \cup \{s,r\}$ that defines whether the vendor, after receiving the information package (r,s), discloses none of it, part of it or all of it to the buyer in the final stages of the bidding process.

Buyers' private valuation: Each buyer has a private valuation of the asset given by $v_i + \theta$. In this formulation, v_i is private information and drawn iid through a distribution function F from the interval $[0,1]$ and θ is the unobserved state of the asset in an intrinsic sense that is common to all buyers. All the above is common knowledge between all parties involved.

The selling process: The selling process involves multiple stages of costly VDD reports, costly private signals of buyers, buyer elimination, and late-stage disclosure and further private information acquisition. We describe the timeline of this process below.

- *VDD decisions*: Nature determines the true value of the asset that remains uncertain to all players. The vendor receives the private signal s and then decides whether or not to exercise the option of a VDD along with a disclosure policy δ to be used in the second stage and an integer $k = 1,...,n$. We assume that the pair (k,δ) is announced publicly to all buyers.

[1] The expert may have incentives to misrepresent the signal r, but we assume such strategic behaviour is too risky for her business. Hence, the VDD is always truthful to the best ability of the expert and the amount C spent by the vendor on the services of the expert.

- *Early-stage information acquisition by buyers*: Each buyer i can spend c_1 to acquire private information that comes as an iid signal $\alpha_i \in \{l, h\}$ with precision $\pi = \Pr[\alpha_i = l|\theta_l] = \Pr[\alpha_i = h|\theta_h]$.
- *Signalling willingness to participate through indicative bids*: All n buyers announce their willingness to participate in the auction by signalling their commitment independently and simultaneously, based on the prior information and their acquired costly first stage private information if any. We denote the willingness-bids of buyer i as $b_i \geq 0$ and assume that bidding at this stage involves a fixed cost of c. The idea is that b_i can be thought of as the number of personnel hired and the paperwork executed at this early stage in order to prepare for the forthcoming stages of the auction. Clearly, these willingness-bids (or indicative bids) have no consequences on the final prices directly but impact bidder selection as follows:
- *Selection of buyers*: For the first stage bidding profile $b = (b_1,...,b_n)$, denote by $b(k)$ the *k-th* highest bid. Let $N_k(b) = \{i \in N | b_i \geq b(k)\}$. Each bidder $i \in N_k(b)$ proceeds to the second stage while all bidders $i \notin N_k(b)$ quit the game.
- *VDD revelation*: At the beginning of the second stage, the vendor releases the disclosure publicly to all bidders in $N_k(b)$. Thus, the VDD is now revealed to the final set of bidders.
- *Late stage information acquisition by buyers*: Each bidder $i \in N_k(b)$ analyses the VDD and then decides whether to obtain a second stage of costly private information at cost c_2 that is again a binary signal $\beta_i \in \{l,h\}$ with precision

$$\varepsilon = \Pr[\beta_i = l|\theta_l] = \Pr[\beta_i = h|\theta_h].$$

- *Bidding*: With all the available information in hand, the bidders then announce their final bids denoted by $\phi I_i \geq 0$. At the final bidding profile $\phi = (\phi_i)_{i \in N_k(b)}$, the highest bidder obtains the asset and pays a price that depends on the auction format. For example, in the first price format the highest bidder pays his bid. In the second price format, he pays the second highest bid.

The above sequence of activities yields a highly complex dynamic Bayesian game wherein the instruments in the hands of the vendor are the auction format, the option of using a VDD, the number k and the disclosure policy δ. The basic setup and the selling mechanism with VDD are summarised in Figure 1 below. In what follows we will provide an intuitive summary of some obtainable results that help us understand the role of VDD in buyers' equilibrium payoffs and when it is likely for the vendor to use it.

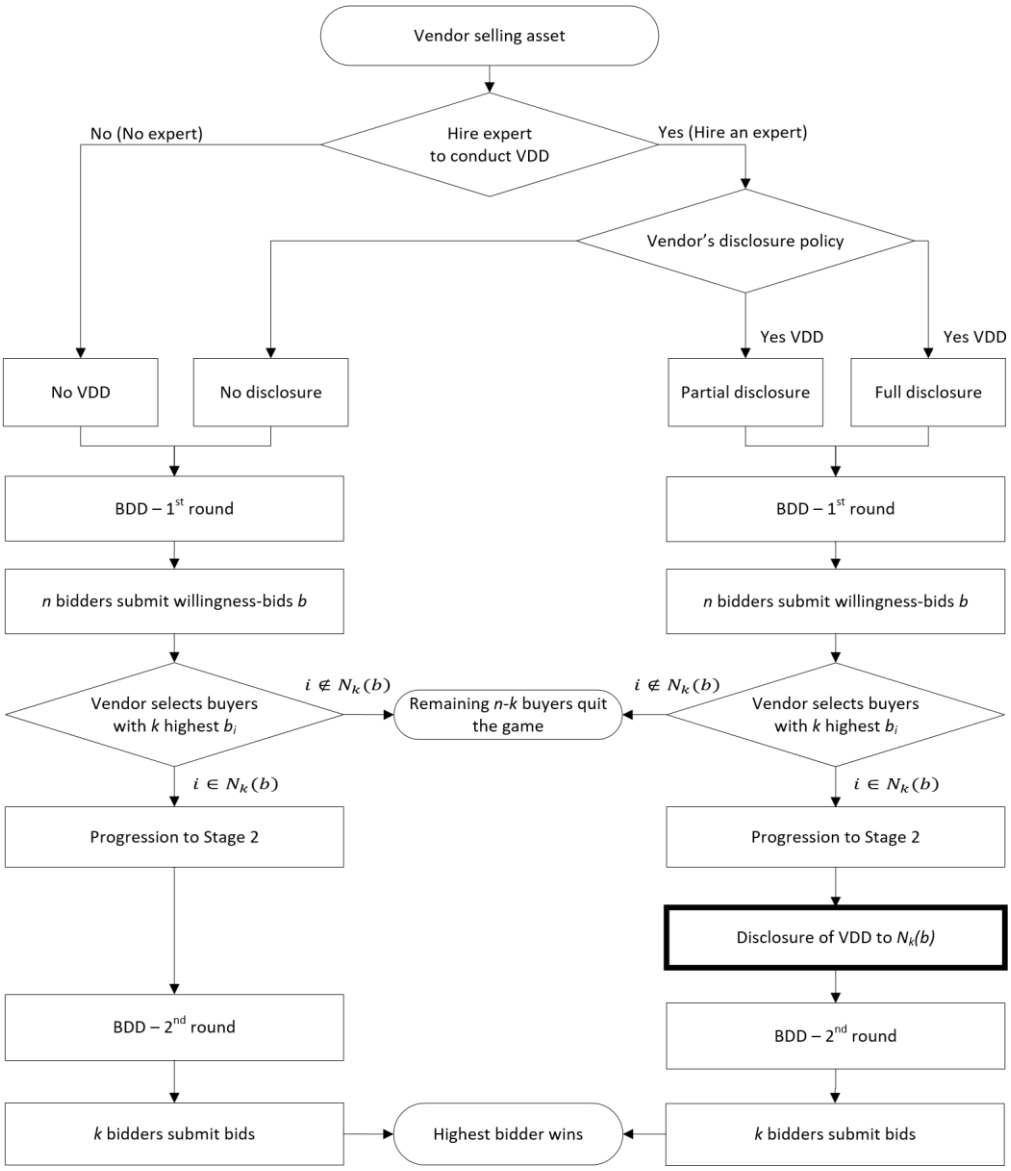

Figure 1: Selling mechanism with VDD

4. Analysis of equilibrium usage of VDD and its impact

4.1. Important parameters of the selling mechanism

Central to our analytical discussion will be the role of VDD. The key features of the theoretical model that will play a role in determining the usefulness of VDD can be listed as follows:

- The prior information about the quality of the asset, summarised by the probability p
- Vendor's prior and private information through the signal s with precision σ
- VDD signal r with precision ρ that can be purchased by the vendor at price $C(\rho)$ by hiring an expert
- The late-stage disclosure policy δ
- The integer k that identifies the first stage indicative bidders who move to the second stage
- Buyer i's first costly private signal α_i with precision π and cost c_1
- Fixed cost c of first-stage bidding
- Buyer i's second costly private signal β_i with precision ε and cost c_2

4.2. Different theoretical possibilities and their impacts

Indistinguishable but partly informative: An early commitment on part of the vendor to provide a VDD report to late-stage buyers can act as a signal that the vendor's private information about the asset is favourable (that is, the vendor's original private signal s about the value of the asset is h). If transmitted credibly, such a message might incentivise more buyers to invest and signal aggressively in the first stage through indicative bidding as they can afford to do so without having to spend on c_1 for additional information that may thwart many from participating, or to save c_2 and yet bid aggressively in the second stage. This can also enhance higher bidding in the final stages. But this conclusion is confounded on two grounds.

First, as s is private information and cannot be credibly disclosed, particularly if it comes in the form of soft information, a vendor with a low signal l might mimic the above behaviour of a vendor with a high signal h. This will reduce the power of a VDD to attract buyers at an early stage. But despite this possibility (called pooling in the language of Bayesian games), we can safely say the following:

Primary Impact 1: Even if the decision to have a VDD does not reveal fully the vendor's private information as both types of vendors opt for a VDD, an early-stage commitment to a VDD sends additional information to the buyer that increases buyer participation. The information content of this decision is higher the higher is the cost C(ρ) of hiring an expert, particularly if that cost is observable.

Second, there might be a reverse signalling mechanism working in the background whereby announcing the absence of a VDD, the vendor sends the message that his information is too strong (this can happen only when r is high enough) and he is confident that buyers will also learn the same if and when they indulge in costly

information acquisition on their part. But again, to hide one's type, a vendor with a low signal might end up mimicking his high-type counterpart. But this cannot be an equilibrium behaviour as in such a case, it is in the best interest of the confident vendor to announce a VDD. As a result, we can obtain a situation where both vendor types play mixed strategies on the VDD decision but with probabilities that keep the posterior beliefs of the buyer favourable to the asset whenever they observe the decision of a VDD. Overall, it is generally true that equilibria are typically pooling in nature (where both vendor types undertake the same VDD strategy with positive probabilities). This implies that the use of VDD is expected to be robust. This brings us to the first case of secondary impact:

Secondary Impact 1: Under certain circumstances, the decisions of having or not having a VDD is possible from both vendor types with positive probabilities. Nevertheless, whenever a VDD is observed, it pushes the buyers towards believing that the asset is more favourable than their prior beliefs.

Perfectly informative: How about a separating equilibrium where a commitment to a VDD strategy fully reveals the vendor's private signal? For this to be the case, the following needs to be true. If the high-type vendor is the only one with a VDD, then the precision of early private signal of the vendor *r* must be sufficiently high so that it is not profitable for a vendor who receives a low signal to mimic the action of his high-type counterpart, and instead pass the buck to the buyers when it comes to more information. Of course, in this case, a VDD is expected to enhance buyer participation and bids even beyond the case of a pooling equilibrium with a VDD.

The impact on buyer welfare is however ambiguous in such an equilibrium. This is because while a strong signal of high quality due to the use of VDD in a separating equilibrium can save the buyer's cost in the entire bidding protocol, it can attract more buyers into the second stage. As a result, the average bids can be higher and then the net surplus to the winning bidder could be lower. This brings us to the second primary impact:

Primary Impact 2: If the vendor's initial information is highly precise, then there can be situations where only those vendors with a high signal opt for a VDD. The vendor's early-stage commitment to a VDD in this case fully reveals the asset quality and increases buyer participation to the fullest. The buyers' welfare remains ambiguous.

On the other hand, could it be that a low-type vendor spends money to signal his type when by not using a VDD, he can hide as a high type as a high-type decides not to use the VDD? It could only be in the hope that it reduces the buyer's cost of participation and information acquisition so that in the end they have a bigger budget to bid with. Hence, while this equilibrium is least likely, it is not impossible. In other words, it is not universally true that VDDs are only conducted for assets with high valuation.

Secondary Impact 2: There is a perverse equilibrium where only low-type vendors opt for a VDD. It exists only if the prior information of the vendor is not too precise. Upon observing the decision, buyers know it is more likely that the asset is of low quality, thereby saving information costs and bidding with a higher budget. Absence of VDD has the same impact except that the bids can be higher.

Despite these nuances, VDDs typically increase informational efficiency in the market. In addition, we can also say the following:

Additional impacts and overall summary: *The value of VDD to both the buyer and the vendor is higher as the prior probability p is closer to ½, where pre-market information is very weak so that the asset is deemed informationally complex. A similar set of arguments can be put forward for the actual disclosure policy δ. In particular, higher amount of disclosure should raise higher participation at the early stage and stronger bids in the later stage.*

The above arguments should hold true for each value of k even though in the model, k is chosen strategically by the vendor. The equilibrium value of k is a very complex matter in this scenario because its choice can also transmit signal about the vendor's private information. For example, a high value of k might signal that the vendor's initial information is moderate and that he is enhancing competition in the hope to include more competitive bids. One would typically expect that the more likely is the VDD and more open is the disclosure policy, the smaller is k. The value of a VDD both to the buyer and the vendor is typically higher the higher are the costs c_1 and c_2 of acquiring private information or the participation cost c. How about the value of VDDs in relation to the strength of private signals?

Comparative benefits: *The vendor's side involves two signals with precisions s and r and the value of a VDD should typically be higher as these precisions are higher as a vendor with a VDD and with high values of s will typically be spending on r and buyers should expect the value of q to be higher. This will enhance participation, bids and save costs of information acquisition. On the buyer's side, there are two signal precisions, p and ε, and the marginal value of a VDD decreases with these precisions simply because private information of the buyers is always dominant.*

4.3. The Role of Indicative Bidding

The theoretical model that we propose with respect to BDD and VDD involves a two-stage bidding process. In general, in the first stage, bidders make nonbinding *"indicative bids"* that are used to separate serious candidates. Then, after an information gathering stage, serious bids are made. This setting has not received as much attention in terms of theoretical modelling as some other auction designs have. Ye (2007) was to the best of our knowledge the first paper to theoretically model indicative bidding theory.

Two important points to address in this regard are the following. Firstly, the prospects of potential buyers making infinite or at least very large bids in the indicative stage need to be considered. According to Quint and Hendricks (2018), buyers want to avoid being selected if they are unlikely to win since there is always a cost of continuation in a long bidding process. As a result, low-value buyers will try to separate themselves from high value buyers by submitting lower indicative bids. Thus, the equilibrium helps the vendor select high value buyers with greater likelihood. Hence, even though the indicative bids are non-binding, they turn out to contain information about buyer's valuation and serve as a tool to control the number of entrants in the final stage of the auction.

This gives rise to the second question, which is to ask why a vendor would want to deliberately curtail the number of participants in the auction through this two-stage indicative bidding process in the first place. It is postulated here that the vendor may find it difficult to attract a large number of bidders without the indicative stage, because bidders do not want to spend substantial capital on participating in an auction against a large number of competitors. In this context, merely ensuring the right number of final participants alone is not enough. For the sale to be optimal, not only is the number of participants in the second stage important, but also it should be that they are the most qualified ones. In other words, the entry process must be *"efficient"*. Naturally, all these concerns are not automatically satisfied and need to be verified in the context of the model that is considered.

In an early contribution, Kagel *et al.* (2008) have conducted experiments to compare the relative performances of a uniform-price, two-stage bid process with indicative bidding. Their experiment shows that indicative bidding performs as well as the alternative bid process in terms of efficiency. Further, indicative bidding does better on other dimensions. Most importantly, indicative bidding yields higher average profits than the alternative two-stage process in the initial auction periods. Ye (2007) considers first price, second price, and all-pay auctions with different bidder valuation distributions in a theoretical setting and concludes that in general, efficient entry is may not, in general, be guaranteed under indicative bidding. However, when auctions with entry rights and binding first-stage bids are considered, efficient entry may be induced.

With respect to the relative performance of the two-stage indicative bidding framework, Quint and Hendricks (2018) compare it to the unrestricted entry setting. In the latter, buyers decide based on their private information whether or not to enter the auction, pay the entry cost, update their values, and submit binding bids. Their main theoretical result is that indicative bidding yields greater revenue and greater total surplus than the unrestricted auction when the number of potential buyers is large. They also establish that two-stage auctions with indicative bids help the vendor select

high value bidders with higher likelihood, although the highest value bidders are not always selected.

4.4. Auctions with costly information acquisition and entry

In the model we propose, the bidders invest as a part of BDD to acquire information about the quality of the asset. This therefore connects our framework to the literature on auctions where the participants must incur a cost to acquire information. This includes Persico (2000), Bergemann and Valimaki (2002), Compte and Jehiel (2007), Bergemann *et al.* (2009), Shi (2012) and Cremer *et al.* (2009). Bergemann and Valimaki (2002) consider a one-period general mechanism design problem in which agents can acquire costly information of varying qualities. However, the decision regarding the acquisition of information is made simultaneously by all agents before they participate. Cremer *et al.* (2009) characterize optimal selling mechanisms in auction environments with learning costs for the bidders. They define *"search procedures"*, which provide instructions on which buyers should acquire information at each period, when to end the process, and which buyer should eventually get the good. They show that the vendor can obtain the same profit as if he had full control over the bidders' acquisition of information and could have directly observed their valuations once they are informed. This holds whether or not the buyers' types are independent, and can be extended to cases where the acquisition of information proceeds through several stages.

Lu (2010) and Moreno and Wooders (2011) consider endogenous entry, in which potential bidders decide whether to enter the auction (and incur information acquisition costs) independently and simultaneously. They characterize threshold entry equilibria in which each bidder enters the auction if and only if her entry cost is lower than some endogenously determined entry threshold. Lu and Ye (2017) study optimal two-stage mechanisms in an auction environment where bidders are endowed with original estimates (*"types"*) about their private values and can further learn their true values of the object for sale by incurring an entry cost. They derive conditions as required by incentive compatibility in these two-stage mechanisms, based on which the optimality of the generalized Myerson allocation rule is demonstrated in this environment of costly information acquisition.

Lu and Ye (2013) consider two-stage mechanisms with the first stage being the entry right allocation mechanism and the second stage being the (standard) private good provision mechanism. They find that both efficiency and revenue optimality require that the second stage selling mechanism be ex-post efficient. They also show that in all-pay auctions, efficient entry can be truthfully implemented in dominant strategies. However, they are not implementable in uniform-price or discriminatory price auctions.

In our model, we have the vendor publicly declaring VDD disclosure policy to the prospective buyers strategically. This embeds our framework in the literature of strategic information dissemination in auctions. Szech (2011) considers a second-price auction with entry fees and characterises the optimal structure through which a vendor should optimally disseminate costly information among the bidders. It is found that marginal gross revenues do not generally behave monotonically in total information release. Even the bidder who gets less information is willing to pay a higher entry fee for asymmetric information allocations than for the symmetric one.

In this line of research, there are papers that deviate from these assumptions partially. Bergemann and Pesendorfer (2007) consider the case of no entry fees and no information costs. Eso and Szentes (2007) allow for entry fees but rule out information costs. Ganuza and Penalva (2010) rule out entry fees but allow for information costs. However, the issue of strategic dissemination of information in a two-stage auction with indicative bidding has not been addressed yet.

The analysis we have undertaken in this paper assumes away speculation. For example, a buyer may not be the end-user but simply a middle person. In the case of shopping malls, the buyer might also restructure or remodel the asset before re-selling it. The middle person may also re-sell the asset under a different market condition. For instance, see Leung and Tse (2017) or Bayer *et al.* (2020) for evidence of these phenomena in the residential market. While the possibility of speculation can change the incentives of both the buyer and the seller to invest in BDD and VDD respectively that makes the selling mechanism under study more complex. Nevertheless, one can modify our model to incorporate potentially different use-value of the asset for the buyer by adding new stochastic components for θ_l and θ_h about which the seller can give no information, but the respective buyer can fill the vacuum through appropriate additions in BDDs or other forms of information acquisition. As long as there is some correlation between θ_l and θ_h and the newly defined values for the buyer, our analytical insights hold.

The other dimension of trading which we do not consider is the dynamic nature of values of real estate assets, whether residential or commercial. For instance, see Kwong and Leung (2000), Kan *et al.* (2004); Ghen and Owyang (2010), Arsenault *et al.* (2013) and Leung (2014). These papers demonstrate that prices of real estate assets can correlate (cyclically or anti-cyclically) with market or economy-wide fundamentals. Based on the typical stochastic nature of these fundamentals, informed buyers can make their own judgements not only about the price dynamics of the asset at each point in time in the future, but also generate present discounted values of these assets after incorporating the estimated dynamics. In the model proposed by us, this is then a re-evaluation of the two possible asset values θ_l and θ_h. Of course, while price fluctuations are typically not too significant during the period of negotiations and

auctions, such short-term fluctuations can affect the dynamic incentives so that auctions may start looking more like dynamic mechanisms where future VDD promises could be made dependent on the realizations of such fluctuations. Such models are very complex to analyse and remain beyond the scope of the present paper.

5. Conclusion

The analysis of the theoretical model suggests that VDD can be of value for transactions of complex assets, such as real estate, irrespective of the value of the asset. VDDs typically increase informational efficiency in the market with the value of VDD to both the buyer and the vendor increasing with the extent of informational complexity of the asset, which in turn is signified through the weakness of the public signal. Similarly, a higher degree of VDD disclosure announced at an early stage should increase participation at the early stage and result in stronger bids in the later stage. The value of a VDD both to the buyer and the vendor is typically higher when the cost of acquiring private information in both stages of the bidding process is more, or the participation cost in the bidding process is higher.

From the vendor's perspective, the value of a VDD should typically be higher when the precision of information about the asset is higher at both stages. From the buyer's perspective, the usefulness of VDD decreases with increasing precision of their information.

The main body of the industry literature is produced by institutions typically acting as lead transaction advisors and VDD experts. Hence, it is only natural that this literature focuses on promoting benefits of VDD rather than its limitations. Thus, vendors making their divestment decisions should carefully consider if indeed the VDD is likely to help them obtain a better price for their assets.

The paper provides a strong foundation platform for further perhaps case study-based empirical research. Firstly, observable parameters described in the model are worth exploring. Secondly, enrichment of the analysed mechanism and detailed analysis of the industrial practice – especially considering differences between the US and European markets – should shed more light on the value of VDD subject to specific conditions. We reserve these issues for future research.

Notes

[1] VDD, in the corporate world, is also frequently referred to as sell-side due diligence (McDonald and Lam, 2014; Israel, 2017; Newman, 2013; Bromberg *et al.*, 2014) or seller due diligence (McDonald and Lam, 2014), or less frequently as advance due diligence (Olson and Bergamini, 2004), or defensive due diligence (Cohen *et al.*, 2010). More confusingly, the term reverse due diligence is also used at times to refer to VDD (Caruso, 2012).

[2] In Europe, the VDD report is typically issued subject to reliance letters, based on which the expert has a duty of care to the potential buyer (Schenker, 2010; Bromberg *et al.*, 2014). On the contrary, in the US and Canada, the VDD report is issued to the prospective buyer on a *non-reliance* or *hold harmless* basis, where the third-party expert disclaims at least some liability to prospective buyers for decisions made based on the VDD report (Bromberg *et al.*, 2014; Potter, 2011; Kruse and Toor, 2016). Either way, the bidders effectively become recipients and ultimate users of the VDD report.

[3] If the vendor can commit to adhering to the disclosure policy, this would be in the realm of games of persuasion (Milgrom, 1981; Grossman, 1981; Shin, 1994). An alternative setup would be one wherein *"cheap talk"* messages (Crawford and Sobel, 1982) in the form of public disclosure policies are announced which the vendor is not obligated to adhere to. In a mechanism design framework, we may then proceed to investigate under which kind of disclosure policy and subsequent auction design can the expected revenue of the vendor be maximised.

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