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Market buoyancy, information transparency and pricing strategy in the Scottish housing market

Nan Liu
University of Aberdeen Business School, UK

Abstract
In housing markets there is a trade-off between selling time and selling price, with pricing strategy being the balancing act between the two. Motivated by the Home Report scheme in Scotland, this paper investigates the role of information symmetry played in such a trade-off. Empirically, this study tests if sellers' pricing strategy changes when more information becomes available and whether this, in turn, affects the trade-off between the selling price and selling time. Using housing transaction data of North-East Scotland between 1998Q2 and 2018Q2, the findings show that asking price has converged to the predicted price of the property since the introduction of the Home Report. While information transparency reduces the effect of 'overpricing' on selling time, there is little evidence to show that it reduces the impact of pricing strategy on the final selling price in the sealed-bid context.

Keywords
built environment, economic processes, housing, information transparency, local government, pricing strategy, real estate

摘要
在房地产市场上，销售时间和销售价格之间存在权衡，定价策略是两者之间的平衡行为。受苏格兰《住房报告》计划的启发，本文研究了信息对称在这种权衡中的作用。这项研究实证测试了当更多的信息可用时，卖家的定价策略是否会发生变化，以及这是否会反过来影响售价和销售时间之间的权衡。利用苏格兰东北部1998年第二季度至2018年第二季度的房屋交易数据，我们的调查结果显示，自推出《住房报告》以来，要价已收敛至房屋的预测价格。虽然信息透明度降低了“定价过高”对销售时间的影响，但几乎没有证据表明它降低了密封投标环境下定价策略对最终销售价格的影响。

关键词
建筑环境、经济过程、住房、信息透明度、地方政府、定价策略、房地产

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Introduction

Sellers in housing markets face a trade-off between selling time and selling price, and pricing setting plays a crucial role in the selling process (Anglin et al., 2003; Arnold, 1999; Knight, 2002). A high asking price may signal a high reservation price, thereby generating higher bids; it may also discourage participation by potential buyers and result in a longer time-on-market (Anglin et al., 2003; Arnold, 1999; Yavas and Yang, 1995). A low asking price may attract more potential buyers, but it also reduces the probability of achieving high selling prices (Anglin et al., 2003; Arnold, 1999; Deng et al., 2012; Horowitz, 1992; Knight et al., 1994; Yavas and Yang, 1995).

Housing markets are also characterised by information asymmetry between sellers and buyers (Clapp et al., 1995; Knight et al., 1994; Levitt and Syverson, 2008). However, housing markets have become increasingly transparent regarding the information provided because of the development of technologies as well as institutional efforts (Chau and Choy, 2011; Eerola and Lyytikäinen, 2015; Pope, 2008). In the UK, schemes such as the Home Information Pack (HIP) in England and the Home Report in Scotland were introduced in the late 2000s to improve information transparency in housing transactions. These movements indicate a transformation from 'caveat emptor' (let the buyer beware, sellers have no duty of information disclosure) to 'caveat venditor' (let the seller beware, sellers are liable for non-disclosure) rules (Chau and Choy, 2011). This paper aims to empirically investigate how pricing strategies and the trade-off between selling price and selling time are affected by such institutional changes in Scotland.

The rest of the paper is organised as follows. The next section discusses the background of the Scottish housing markets. Literature on pricing strategy in the sealed-bid context is reviewed in the following section, and the case study area and data are described in the fourth section. Section 'Empirical models' discusses the empirical strategies in the paper, and empirical results are subsequently presented in the penultimate section. The final section concludes the paper.

The sealed-bid system and the Home Report in Scotland

In Scotland, most properties for sale are listed in a sealed-bid system, where the 'offers over' asking price is usually set below the seller's reservation price (Pryce, 2011). The system appears to be advantageous to sellers as it seeks to maximise the economic rent[1] (Gibb, 1992); consequently, the sealed-bid system is the dominant selling mechanism, particularly in market upswings. Other selling mechanisms such as 'fixed price' or 'price around' are used when sellers are under pressure to sell and/or properties are of lower quality.

In the market peak of the mid-2000s, setting artificially low asking prices to create competition amongst buyers was a common practice in Scotland. Such practice was criticised for leading people who could not afford the properties to pay for surveys, contributing to house price instability (Smith et al., 2006), while others argued that the low-asking-prices practice would not

Corresponding author:
Nan Liu, Centre of Real Estate Research, University of Aberdeen Business School, Edward Wright Building, Dunbar Street, Aberdeen AB24 3QY, UK.
Email: nan.liu@abdn.ac.uk

determine the pace or direction of the market (Levin and Pryce, 2007). With the objectives of improving information transparency and market efficiency, and to address the problems associated with artificially low asking prices, the Scottish government introduced the Home Report scheme in 2008 (Black et al., 2015). Since 1 December 2008, the scheme requires home sellers[2] to provide a Single Survey,[3] an energy report and a questionnaire[4] when listing dwellings on the market. Sellers are responsible for the costs of the Home Report, and potential buyers can access the report free of charge.

Pryce and Gibb (2006) suggest that the scheme is unlikely to alter sellers' benefits, but the authors are unclear about potential changes in sellers' behaviours. Based on survey and public consultation data, the Scottish government's review finds that the scheme met the objectives, particularly in addressing the issue of artificially low asking price, but, as the authors point out, 'poor market conditions have also played a role' (Black et al., 2015: 6). On the contrary, other research commissioned by the Scottish government suggests little change in price-setting practices since the introduction of the Home Report (Robertson and Blair, 2014). Recently, the emphasis on comprehensive information has been extended to the private rental sector in Scotland with proposals to include the Home Report in tenement regulations (Sottish Government, The, 2019).

Conceptualising pricing strategy in the sealed-bid context

The rationale of setting a low asking price in the sealed-bid system has been explained in several studies. Low asking prices maximise uncertainty by contributing to a larger variance in the asking–selling price differences in a submarket (Pryce, 2011; Smith et al., 2006), which, in turn, may be perceived as an indication of strong growth in selling prices. Estate agents are incentivised to reinforce the perception of a buoyant market by advising on low asking prices (Pryce, 2011). Such a strategy is less effective during market downturns as sellers are more likely to accept the first bid that meets or exceeds their reservation price, and a low asking price could signal a lower bargaining position (Thanos and White, 2014).

It is also important to distinguish between the private and common values in the auction context. Sellers determine pricing strategy according to their private values based on the acquisition prices, housing attributes and selling prices of properties nearby. The 'common value' element refers to market professionals' information on the submarket, on which they base their advice to sellers on pricing strategies (Thanos and White, 2014). Pryce (2011) measures the 'common value' element by calculating the dispersion of asking–selling price spread in a submarket. A larger dispersion indicates a weaker 'common value' element or a weaker 'locational convention'. Empirical studies find that with a weaker common value element, time-on-the-market (TOM) is more sensitive to pricing strategies (Pryce, 2011), and both optimal list price and selling price are higher (Deng et al., 2012).

Imperfect information in the housing market results in some elasticity in the demand curve for the individual dwelling (Maclennan et al., 1987). In a rapidly inflating environment, increasing prices contribute to information asymmetry by 'fracturing the flow of information which is so critical to the operation and clearing of markets' (Smith et al., 2006: 90). Levitt and Syverson (2008) argue that information asymmetry has resulted in greater pricing distortions and find that estate agents with superior information tend to sell their own properties at higher prices. Rutherford et al. (2007) show similar conclusions. Auction literature also shows that standard auctions are only revenue-maximising when buyers are symmetric and have independent private valuations, but when buyers have interdependent valuations, auctions lose this advantage (Campbell and Levin, 2006; Wang, 1993). Before the Home Report was introduced, asking prices acted as signals to potential buyers that facilitated the narrowing of their search (Anglin et al., 2003). With the Home Report, valuations are more likely to act as reference prices for buyers (Black et al., 2015). As suggested by Ariely and Simonson (2003), when salient reference prices are available, the influence of starting price on the final selling price in an auction diminishes. In the Scottish context, a Home Report valuation also indicates the collateral value for mortgage purposes, thereby reducing the level of financing uncertainty for the buyers. Hence with the Home Report, there seems to be little incentive for the sellers to set an asking price that differs hugely from the valuation. The first empirical objective of this paper is to examine whether the introduction of the Home Report has had a significant impact on sellers' pricing strategy.

If the Home Report has changed sellers' pricing behaviours, would it also have an impact on the trade-off between selling price and selling time? Nanda and Ross (2012) show that sellers who disclose more information tend to achieve higher selling prices. In Pope (2008), the disclosure of negative information (such as airport noise) reduces selling prices. Similarly, Chau and Choy (2011) find that properties affected by highway noise are sold for less under the 'caveat venditor' rules. The empirical evidence on TOM is mixed. Findings in Wong et al. (2012) imply that information symmetry reduces TOM. Supported by empirical results, Levitt and Syverson (2008) show that sellers with superior information stay on the market for longer at a higher selling price. Rutherford et al. (2007) find that information asymmetry has little impact on TOM. The second empirical objective of this paper, therefore, is to investigate the impact of information transparency on the trade-off between selling price and TOM.

Case study area and data

The study uses residential property transaction data from the Aberdeen Solicitors Property Centre (ASPC). The ASPC primarily serves as a central marketing place for residential properties in North-East Scotland and captures approximately 90% of total transactions in the region. The data set covers the housing market in Aberdeen city, Aberdeenshire and a small part of Angus adjacent to Aberdeenshire from 1984Q2 to 2018Q2.[5] Table 1 shows the description of all variables in the data set. Owing to the availability of the variables *postcode* and *geocodes*, the analysis focuses on the period between 1998Q2 and 2018Q2 with just over 145,000 observations.[6] The descriptive statistics of these variables are presented in Table 2.

In addition to the geocodes and postcodes, the data set includes 80 geographical areas, which are neighbourhoods and towns defined by the ASPC. Potential buyers can filter their search by these areas on the ASPC's website, and they are used as the predefined submarkets in this study.[7]

When the Home Report was introduced in December 2008, most UK housing markets were experiencing a dramatic downturn as a result of the global financial crisis. However, house prices in the study area were less affected by the financial crisis because the region's economy is predominantly influenced by the oil and gas sectors. As shown in Figure 1, compared with house prices at the national level, prices in the Aberdeen housing market (measured by the left-hand side vertical axis) recovered relatively quickly after the 2007 financial crisis and reached another noticeable peak in 2015.

Table 1. Descriptions for the variables in the data set.

Variable name	Description
P_i	Final transaction price of each property *i*
P_i^a	Initial asking price of each property
Pricepremium	$(P_i - P_i^a)/P_i^a$
x	Spatial coordinate (latitude) of the property
y	Spatial coordinate (longitude) of the property
Postcode	Full postcode of the property
Numpublic	Number of public rooms (0, 1, 2, 3, 4 or more than 4); including lounge, living room, drawing room, family room, kitchen, etc. Studio flat would have 0 public rooms
Numbedrooms	Number of bedrooms (0, 1, 2, 3, 4 or more than 4)
Numbathrooms	Number of bathrooms (1 or more than 1)
Heating	A binary variable to indicate whether the property has central heating
Ensuite	A binary variable to indicate whether master bedroom has an ensuite
Garage0	A binary variable to indicate whether the property has no garage
Garage1	A binary variable to indicate whether the property has one garage
Garage2	A binary variable to indicate whether the property has more than one garage
Garden	A binary variable to indicate whether the property has garden(s)
Flat	A binary variable to indicate whether the property is a flat
Non-detached	A binary variable to indicate whether the property is semi-detached or terraced
Detached	A binary variable to indicate whether the property is detached
Newbuild	A binary variable to indicate whether the property is newly constructed
TOM	Time on the market in weeks, computed as the duration between the listing date and sold date
Offersover	A binary variable to indicate whether the property is listed as 'price over', 'offers over' or 'price above'
Dec_{2008}	A binary variable to indicate whether the property is listed on or after 1 December 2008
Sold	A binary variable to indicate whether the property is successfully sold, = 0 if property was withdrawn

Subsequently, prices in the Aberdeen area started to decrease as a result of the significant fall in oil prices in late 2015, while prices in the rest of the country continued to increase. This shows the peculiar nature of the Aberdeen housing market given its independent market cycle associated with the oil industry. The case study area allows pricing strategy to be compared before and after the introduction of the Home Report without the concern of the potential simultaneous effect of a market slump. The data set also covers a relatively long period with more than one property cycle, which is useful for investigating the effect of market buoyancy on pricing strategy.

Figure 1 also shows the average *Price premiums* for 'offers over' and 'fixed price' transactions (measured by the right-hand y axis). Price premiums for both selling mechanisms were relatively small in the late 1990s and early 2000s but they started to increase substantially during the market boom leading to 2007, followed by a fall during the global financial crisis (2007Q2). But it was not until 2009Q1 (just after the introduction of the Home Report) that the premiums shrank significantly. Since then, the average 'offers over' premium has fluctuated but remained small (less than 8%), and the 'fixed price' premiums have shown much less variation.

Table 2. Descriptive statistics of the variables in the ASPC data set, 1998Q2–2018Q2.

Variable	N	Mean/%	Std dev.	Min	Max
P_i	128,380	164,951.1	116,300.2	6000	3,070,000
P_i^a	147,452	162,405.9	122,010.6	8000	3,500,000
Pricepremium	128,236	0.08	0.14	−1	3
x	146,706	0.00	1.00	−4	4
y	146,706	0.00	1.00	−7	2
Numpublic	147,339	1.59	0.87	0	14
Numbedrooms	147,339	2.60	1.20	0	18
Numbathrooms	147,339	1.06	0.51	0	10
Heating	147,339	0.85	0.36	0	1
Ensuite	147,339	0.22	0.42	0	1
*Garage*0	147,339	0.46	0.50	0	1
*Garage*1	147,339	0.22	0.41	0	1
*Garage*2	147,339	0.32	0.47	0	1
Garden	147,339	0.71	0.45	0	1
Flat	147,339	0.40	0.49	0	1
Non-detached	147,339	0.31	0.46	0	1
Detached	147,339	0.29	0.45	0	1
Newbuild	147,339	0.01	0.10	0	1
TOM	147,339	17.92	27.26	0	745.71
Offersover	147,339	0.62	0.49	0	1
Dec_{2008}	147,339	0.45	0.50	0	1
Sold	147,339	0.87	0.34	0	1

Empirical models

As highlighted in section ‘Conceptualising pricing strategy in the sealed-bid context’, this paper has the following empirical objectives:

I. to test if the introduction of the Home Report has a significant impact on sellers’ pricing strategy; and
II. to examine the influence of the Home Report on the trade-off between the selling price and selling time.

Estimating the price of a property

Pryce (2011) suggests that ‘perhaps buyer/seller beliefs about a property’s value are based on simple rules of thumb that are best approximated by a fairly rudimentary hedonic model … valuers’ “professional judgement” may in fact boil down to a fairly simple set of intuitive rules’ (p. 775). The paper starts with a baseline log-linear hedonic specification presented in Model (1):

$$\ln P_i = \alpha_i + \beta X_i + \gamma Geocode_i + \epsilon_i \qquad (1)$$

where $\ln P_i$ is the natural logarithm of the transaction price for property i, and X_i includes all the physical attributes and quarterly dummy variables that represent the time of transaction. To smooth the geographical differences in properties, $Geocode_i$, consisting of the standardised[8] spatial coordinates and their cross products, is included (Bracke, 2015; Bracke et al., 2017; Jackson, 1979).[9] The random error is ϵ_i, which is the stochastic disturbance term from a normal distribution of $N(0, \sigma^2)$.

The use of geocodes does not necessarily fully capture the locational effects concerning neighbourhood qualities. Some house price studies conceptualise the location of a

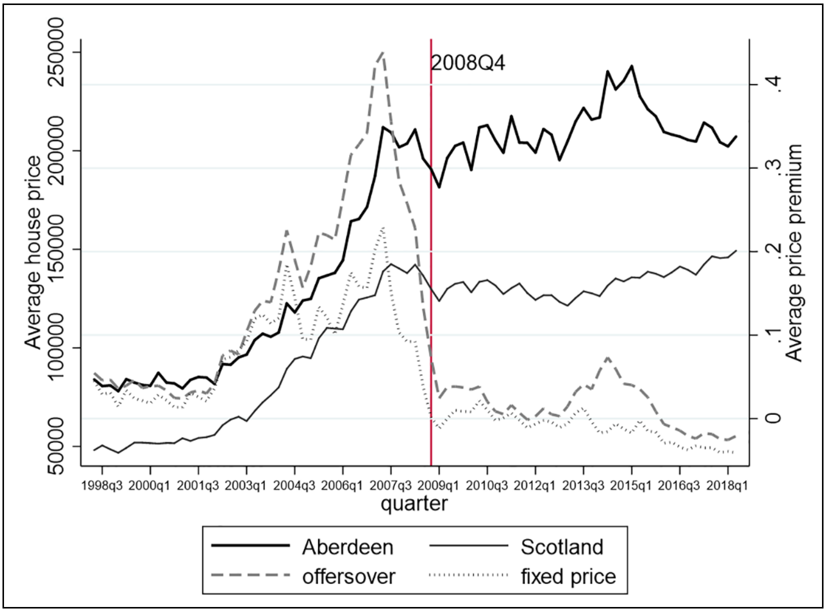

Figure 1. Asking–selling price premiums and average real house price in Aberdeen housing market and Scotland 1998Q2–2018Q2.

property using fixed locational attributes (Orford, 2002). For example, Bracke et al. (2017) include fixed effects at the street level in their hedonic model. In this paper, Model (2) captures the fixed locational effect at submarket level:

$$\ln P_i = \alpha_k + \beta X_i + \gamma Geocode_i + \epsilon_i \quad (2)$$

where α_k captures the neighbourhood fixed effect.

Many also argue that housing market dynamics operate at different spatial levels and hedonic models should allow for the differences in prices caused by such locational externalities (Gelfand et al., 2007; Goodman and Thibodeau, 1998; Jones and Bullen, 1993; Leishman, 2009; Leishman et al., 2013; Liu and Roberts, 2012; Liu et al., 2018; Orford, 2000). These studies propose multilevel models, in which house prices are modelled using property-level attributes and higher spatial-level attributes to allow for the potential differences in the intercept term and housing attributes at different spatial scales. Using neighbourhood as an example, the multilevel model assumes that neighbourhoods in the data set are a random sample of larger population neighbourhoods, and the coefficients for the neighbourhood effects vary randomly around an overall mean (hence referred to as the 'random effect').

Model (3) illustrates such hierarchical specification for the ASPC data: at the individual property level (level 1), price is assumed to be determined by physical attributes and location (measured by *geocodes*). Notably, the ASPC data set does not have dwelling age. Full postcodes may capture some of the age effect, as properties with the same postcodes tend to be constructed around the same time.[10] The use of postcodes also captures fine-grained spatial units of geography (Leishman et al., 2013). Dwellings with the same postcodes are grouped at level 2, and at level 3 postcodes are nested within submarkets as in Model (3).

$$\ln P_{ijk} = \alpha_{ijk} + \sum \beta_{jk} X_{ijk} + \epsilon_{ijk} \quad (3)$$

where $i = 1, 2, \ldots, n$ individual properties at level 1; $j = 1, 2, \ldots, n$ postcodes at level 2; and $k = 1, 2, \ldots, n$ spatial submarkets at level 3. For simplicity, X_{ijk} denotes all the attributes and quarterly dummy variables at property level.

At level 2, the random intercepts and slopes are expressed as:

$$\alpha_{ijk} = \alpha_j + \mu_{\alpha j},$$

and

$$\beta_{ijk} = \beta_j + \mu_{\beta j},$$

where α_{ijk} is the group mean α_j at postcode level j, plus a varying difference $\mu_{\alpha,j}$ for each postcode. Similarly, each coefficient β_{ijk} is considered as an average slope at postcode level β_j plus a variation from postcode to postcode $\mu_{\beta,j}$.

By the same token, the random intercepts and slopes at level 3 are:

$$\alpha_j = \alpha_{jk} + \mu_{\alpha jk},$$

and

$$\beta_j = \beta_{jk} + \mu_{\beta jk},$$

where α_{jk} is the group mean across all groups (postcodes nested in submarkets), plus a varying difference $\mu_{\alpha jk}$ for each nested group. Slope β_{jk} is the group mean across all nested groups plus a variation amongst the tested groups $\mu_{\beta jk}$. The structure assumes that not only could house prices vary amongst postcodes within a submarket but, also, the value placed on a detached house or a semi-detached house, for example, may vary between postcodes and submarkets.

This first stage of selling prices modelling is important because misspecifications could result in misleading estimates of the pricing strategy variable in the next stage (Pryce, 2011). The multilevel model recognises the potential locational structure of the data; thus it has the capacity to improve predictive power, reduce spatial dependence, capture heteroscedasticity and allow explicit modelling of the influence of submarkets (Leishman, 2009; Leishman et al., 2013; Orford, 2000, 2002). However, the model does not account for sellers' heterogeneity, which could cause unexplained residual in the hedonic specifications (Glower et al., 1996). Furthermore, the group-level effects may simply reflect the misspecification of or unaccounted for individual-level predictors (Diez-Roux, 2000; Gelman, 2006), and this limitation is particularly relevant to this study, as omitted variable bias can be present at the property level. Indeed, many have argued that multilevel models are unable to fully capture all spatial processes in house price data (Chaix et al., 2005; Chasco and Le Gallo, 2012; Hu et al., 2019). Another potential issue with multilevel models is that the interrelationships between variables at different levels are not fully examined; for instance, it is possible that property-level attributes may influence group characteristics; and vice versa (Dedrick et al., 2009; Diez-Roux, 2000).

Pricing strategy

In the following equation, the asking price is compared with the estimated prices from the hedonic models to indicate pricing strategy or the degree of overpricing (DOP):[11]

$$Dev_i = \frac{\ln P_i^a}{\ln P_i^e}$$

where $\ln P_i^a$ is the natural logarithm of asking price, and $\ln P_i^e$ is the log of the estimated price of the property.

Section 'Conceptualising pricing strategy in the sealed-bid context' highlights that the sellers' pricing strategy is influenced by market conditions, the locational convention of a submarket and selling mechanisms. First, to control market conditions, variable *AvgTOM* is calculated as the average TOM of sold properties within the last 13 weeks in submarket k.[12] The longer that recently transacted properties took to sell, the less the asking price is expected to deviate from the estimated price of the property. Variable *Sold%* is calculated as the proportion of sold properties within the last 13 weeks in a submarket. The larger this proportion, the more buoyant the market. Second, to quantify the locational convention, σ_{ik} is calculated as the standard deviation of the selling–asking price premium of recently sold properties in the same submarket within the last 13 weeks:

$$\sigma_{ik} = SD(pricepremium_{i,k}).$$

A small σ_{ik} indicates a stronger 'locational convention', and a large σ_{ik} implies 'noise' in price premiums in recent transactions. The 'noisier' the recent transactions, the higher the level of uncertainty and the more likely an asking price would deviate from the estimated price of the property. Finally, a dummy variable *Offersover* is used to differentiate the two pricing strategies. Model (4) is used to investigate the relationship between Dev_i and the above variables using an ordinary least square (OLS) specification, and Model (5) allows further control for the potential quarterly/seasonal fixed effect.

$$Dev_i = c_i + \omega\sigma_{ik} + \theta AvgTOM_{ik} + \varphi \text{Sold\%}_{ik} + \tau Offersover_i + \varepsilon, \quad (4)$$

and

$$Dev_i = c_t + \omega\sigma_{ik} + \theta AvgTOM_{ik} + \varphi \text{Sold\%}_{ik} + \tau Offersover_i + \varepsilon \quad (5)$$

where c_i is the constant for Model (4), and c_t captures the fixed effect in each quarter in Model (5).

It is unlikely that equations (4) and (5) can fully model the determinants of sellers' pricing strategy. As pointed out by previous studies, sellers' motivation and behaviours also play a critical role in housing market dynamics (Anglin et al., 2003; Genesove and Mayer, 2001; Yavas and Yang, 1995). Studies have shown that factors such as the expectation of capital gain (Ong and Koh, 2000), sellers' characteristics (Springer, 1996), sellers' motivation (Glower et al., 1996) and sellers' original purchase price (Genesove and Mayer, 2001) can all have an impact on pricing strategy. As the ASPC data have no further information on the sellers, it is impossible to include such measures in Models (4) and (5). Such limitations are further discussed in conjunction with the empirical results in section 'Empirical results'.

Testing the effect of the Home Report

To indicate the introduction of the Home Report, a dummy variable Dec_{2008} is generated. Dec_{2008} takes the value of 1 if the property was listed with a Home Report on or after 1 December 2008, and 0 otherwise. Dec_{2008} is then interacted with *AvgTOM*, *Sold%*, *Offersover* and σ_{ik}. If the seller's pricing strategy has indeed changed, the coefficients of the interactive terms are expected to have the opposite signs to the coefficients yielded in Models (4) and (5). Model (6) includes all these interactive variables using an OLS specification and Model (7) includes the quarterly fixed effects:

$$Dev_i = c_i + \omega\sigma_{ik} + \theta AvgTOM_{ik} + \varphi \text{Sold\%}_{ik} + \gamma Offersover_i + \omega'\sigma_{ik}\times Dec_{2008} + \theta' AvgTOM_{ik}\times Dec_{2008} + \varphi'\text{Sold\%}_{ik}\times Dec_{2008} + \tau' Offersover_i \times Dec_{2008} + \varepsilon \quad (6)$$

$$Dev_i = c_t + \omega\sigma_{ik} + \theta AvgTOM_{ik} + \varphi \text{Sold\%}_{ik} + \gamma Offersover_i + \omega'\sigma_{ik}\times Dec_{2008} + \theta' AvgTOM_{ik}\times Dec_{2008} + \varphi'\text{Sold\%}_{ik}\times Dec_{2008} + \tau' Offersover_{i\times} Dec_{2008} + \varepsilon \quad (7)$$

The trade-off between selling price and selling time

The second empirical objective of this paper is to examine the influence of the Home Report on the trade-off between the selling price and selling time. In the selling price Models (8)–(10), Dev_i and $Dev_i \times Dec_{2008}$ are included as regressors. As discussed in section 'Conceptualising pricing strategy in the sealed-bid context', Dev_i is expected to have a positive coefficient; however, the introduction of the Home Report in theory should reduce the magnitude of such effect because of improved information symmetry.

$$\ln P_i = \alpha_i + \beta X_i + \gamma Geocode_i + \mu Dev_i + \kappa Dev_i \times Dec_{2008} + \epsilon_i, \quad (8)$$

$$\ln P_i = \alpha_k + \beta X_i + \gamma Geocode_i + \mu Dev_i + \kappa Dev_i \times Dec_{2008} + \epsilon_i, \quad (9)$$

$$\ln P_{ijk} = \alpha_{ijk} + \sum \beta_{jk} X_{ijk} + \mu Dev_i + \kappa Dev_i \times Dec_{2008} + \epsilon_{ijk}. \quad (10)$$

The final stage is to examine Dev_i and the Home Report's effect on selling time. A parametric log-normal survival model (Model 11) is used based on the assumption that the probability of selling is higher when a property is initially listed; the probability to sell decreases as the property continues to stay on the market (Pryce, 2011; Pryce and Gibb, 2006). The survival model is specified as:

$$lnt = \beta_0 + \beta^T X + e\sigma \quad (11)$$

where $e \sim N(0,1)$, and t is the surviving time or TOM. All explanatory variables are denoted by X, including physical attributes, locational attributes, measures on market buoyancy ($\sigma_{ik}, AvgTOM_{ik}, \text{Sold\%}_{ik}$) and pricing strategies (Dev_i, $Offersover_i$), as well as their interactive terms with Dec_{2008}. The parameters β_0 *and* β^T from a sample of n_U uncensored observations and $n - n_U$ censored observations are estimated by maximising the log-likelihood function (Royston, 2001) as follows:

$$lnL = \sum_{i=1}^{n_U} lnf(t_i;\beta_0;\beta) + \sum_{i=n_U+1}^{n} lnS(t_i;\beta_0;\beta).$$

Overpriced properties are expected to have a longer TOM. However, the more buoyant the market, the shorter TOM is expected to be. If the Home Report has changed the liquidity of residential properties, the magnitude of Dev_i on TOM is expected to be reduced as a result of the scheme.

Empirical results

Results for estimating property prices

The performances of Models (1)–(3) are presented in Table 3. The adjusted R^2 for Models (1) and (2) ranges from over 82% to

Table 3. Regression results of Models (1–3) during period between 1998Q2 and 2018Q2.

	Model 1		Model 2		Model 3	
	Offers over	Fixed price	Offers over	Fixed price	Offers over	Fixed price
Numpublic	0.1424*** (79.5)	0.1237*** (77.53)	0.1006*** (66.31)	0.1001*** (71.99)	0.0719*** (59.34)	0.0764*** (68.37)
Numbedrooms	0.1964*** (151.85)	0.1846*** (118.48)	0.2069*** (189.71)	0.1683*** (124.33)	0.1835*** (201.14)	0.1413*** (124.45)
Numbathrooms	0.0418*** (16.91)	0.0738*** (21.49)	0.0310*** (15.03)	0.0637*** (21.51)	0.0222*** (14.09)	0.0374*** (15.83)
Detached	0.1268*** (38.94)	0.1310*** (35.58)	0.1191*** (43.00)	0.1521*** (46.75)	0.1233*** (48.87)	0.1490*** (49.70)
Flat	−0.0446*** (−15.82)	−0.1355*** (−24.69)	−0.1301*** (−50.42)	−0.2128*** (−42.55)	−0.1473*** (−55.44)	−0.2091*** (−44.22)
Ensuite	0.1779*** (48.39)	0.0572*** (18.03)	0.1467*** (47.65)	0.0574*** (20.71)	0.0734*** (27.33)	0.0554*** (22.85)
Garage0	−0.1463*** (−49.21)	−0.0758*** (−20.40)	−0.0992*** (−39.44)	−0.0424*** (−13.04)	−0.0586*** (−28.51)	−0.0379*** (−13.90)
Garage2	0.0623*** (6.08)	0.0793*** (19.78)	0.0649*** (7.61)	0.0904*** (25.97)	0.0556*** (8.42)	0.0831*** (28.22)
Garden	0.0417*** (15.95)	0.0358*** (6.45)	0.0586*** (25.94)	0.0471*** (9.58)	0.0459*** (23.52)	0.0479*** (11.04)
Heating	0.1336*** (54.99)	0.1311*** (30.07)	0.1177*** (57.71)	0.1151*** (30.49)	0.0972*** (61.33)	0.0909*** (29.91)
Newbuild	0.1854*** (8.82)	0.2309*** (24.42)	0.1935*** (11.05)	0.2090*** (25.56)	0.1643*** (11.39)	0.1602*** (23.47)
TOM	−0.0024*** (−44.59)	−0.0016*** (−30.44)	−0.0019*** (−42.50)	−0.0013*** (−27.83)	−0.0016*** (−48.28)	−0.0011*** (−29.62)
Constant	10.3114*** (476.22)	10.3177*** (332.12)	10.4033*** (525.66)	10.5030*** (373.88)	10.4580*** (367.88)	10.6347*** (317.49)
Year/quarter	√	√	√	√	√	√
Geo codes	√	√	√	√	√	√
Fixed effect at submarket			√	√		
Multilevel		°	°	°	√°	√°
N	80,737	45,922	80,737	45,922	80,737	45,922
Adj R^2	0.8361	0.8241	0.8869	0.8702		
Submarket F			458.969***	206.75***		
Random effect parameters						
Level 1 property					0.1448***	0.1658***
Level 2 postcode					0.1697***	0.1914***
Level 3 spatial submarket					0.1172***	0.1904***
Log likelihood					70201.71	30847.32

Notes: *t*-Statistics for Models 1 and 2, *z*-statistics for Model 3 in parentheses.
$^{*}p < 0.05$, $^{**}p < 0.01$, $^{***}p < 0.001$.
°R^2 is not available for multilevel models with three or more levels.

87%,[13] which is relatively high compared with the results of similar models in other recent studies.[14] Most housing attributes have the expected significant coefficients in all three models; for instance, one extra bedroom yields a 15%–23% higher selling price. TOM has significant but negative coefficients, suggesting that for one extra week on the market, the selling price decreases by 0.1%–0.2%. Geocodes and their cross products have significant coefficients at 0.1% significance level.[15] The random effect parameters in Model (3) are all significant, indicating significant differences in the intercepts and coefficients at the postcode and neighbourhood levels. Also, Model (3) yields smaller coefficients for many housing attributes compared with the OLS specifications. In line with Orford (2002), this implies that the coefficients in the OLS may be overestimated if the hierarchical structure of the data is ignored. Hence, predicted selling prices generated by Model (3) are used in the next few stages.[16]

The Home Report and pricing strategy

Table 4 displays the results of Models (4)–(7) and shows that market conditions, locational convention and selling mechanisms are significantly correlated to Dev_i. This supports the discussion in the existing literature finding that sellers tend to set lower asking prices with the sealed-bid system when the market is buoyant and/or when there is a high level of uncertainty. As shown in columns 3 and 4, the introduction of the Home Report appears to reduce the effects of the four variables. For example, the positive coefficient of *AvgTOM* is almost offset by the negative coefficients of $AvgTOM \times Dec_{2008}$. The interactive terms with σ_{ik}, *offersover* and *Sold*% all yield positive and significant coefficients. These results support the view that sellers' pricing strategies appear to have changed since the

Table 4. Regression results of Models (4–7) during period between 1998Q2 and 2018Q2.

	Model 4	Model 5	Model 6	Model 7
Avg TOM	0.0001*** (22.13)	0.0000*** (7.4800)	0.0002*** (37.18)	0.0001*** (7.96)
σ_{ik}	−0.0833*** (−118.33)	−0.0142*** (−14.2300)	−0.0662*** (−70.98)	−0.0156*** (−13.07)
Offersover	−0.0040*** (−53.94)	−0.0044*** (−59.3200)	−0.0059*** (−61.64)	−0.0059*** (−62.54)
Sold%	−0.0221*** (−51.10)	−0.0005 (−0.7400)	−0.0218*** (−47.27)	−0.0104*** (−11.27)
$AvgTOM \times Dec_{2008}$			−0.0002*** (−34.23)	−0.00002** (−2.68)
$\sigma_{ik} \times Dec_{2008}$			0.0470*** (23.35)	0.0081*** (3.76)
$Offersover \times Dec_{2008}$			0.0036*** (24.37)	0.0038*** (25.54)
$Sold\% \times Dec_{2008}$			0.0037*** (15.28)	0.0143*** (13.42)
Constant	1.0221*** (2544.66)	0.9987*** (1748.19)	1.0183*** (2490.54)	1.0017*** (1655.78)
N	143,192	143,193	143,194	143,195
Adjusted R^2	0.1744	0.2355	0.2012	0.2405
F at quarterly level	142.426***			92.534***

Notes: *t*-Statistics in parentheses.
$^{*}p < 0.05$, $^{**}p < 0.01$, $^{***}p < 0.001$.

introduction of the Home Report, setting asking prices that converge to the perceived prices. Notably, the R^2s for the models are relatively low, implying that the issues associated with omitted behavioural factors can be present. Hence, the paper cannot conclude that the Home Report is effective in addressing the problem of setting artificially low asking prices.

The trade-off between selling price and selling time

Consistent with previous studies such as Anglin et al. (2003), Arnold (1999) and Springer (1996), results of the price Models (8)–(10) in Table 5 show positive and significant coefficients of Dev_i. However, the interactive term ($Dev_i \times Dec_{2008}$) only yields significant coefficients in the 'fixed price' sample, suggesting that only 'fixed price' selling prices are less sensitive to pricing strategy as a result of the Home Report. These are somewhat contradictory results to those discussed in section 'Conceptualising pricing strategy in the sealed-bid context', finding that the influence of asking price on the final selling price is likely to diminish if salient reference prices are available.

There are four possible explanations for such 'puzzling' results. First, this paper implicitly assumes that agents are rational and that they use current market price as the reference point; but it does not consider behavioural biases that can affect exchange behaviour (Gallimore and Wolverton, 1997; Paraschiv and Chenavaz, 2011). An example of a behavioural factor is illustrated in Genesove and Mayer (2001) and Einiö et al. (2008), when a seller's reluctance to realise a housing loss can help explain their choice of an asking price. In addition, factors such as Loan-to-Value (LTV) put 'an institutional constraint on sellers' behavior', and 'its effect does not diminish with learning or exposure to market conditions' (Genesove and Mayer, 2001: 1252), it is also possible that such institutional constraint has not changed with the Home Report. Second, publicly available information may not be adequately considered by buyers (Pope, 2008) and improvement of such information symmetry may not affect the final selling price. Third, the Home Report does not disclose all the information (for example, there is no information on the neighbours or nuisance) and information asymmetry can still exist. Finally, as mentioned before, there might be misspecifications of the hedonic models that misrepresent sellers' bargaining power (Anglin et al., 2003).

Results in Table 6 confirm the anticipated positive correlation between overpricing and TOM, which is in line with previous studies (Pryce, 2011; Yavas and Yang, 1995). Also as expected, properties are more liquid in a buoyant market and 'offers over' properties sell faster than 'fixed price' properties. The highly significant coefficients of the interactive terms $Dev_i \times Dec_{2008}$ and $\sigma_{ik} \times Dec_{2008}$ confirm the proposition that the impacts of pricing strategy and uncertainty on liquidity were mitigated by the introduction of the Home Report. The Home Report also seems to accelerate selling time in buoyant market conditions in the sealed-bid context. Although there might be other factors that influence selling time (for example, the ASPC data do not observe changes in listing prices), results in Tables 5 and 6 show some evidence that improved information transparency increases the liquidity of houses in the sealed-bid context. Unlike the suggestion by Pryce and Gibb (2006), these findings imply that sellers could benefit from the Home Report.

Table 5. Hedonic regression on selling price with inclusion of pricing strategy variables.

	Model 8	Model 9	Model 10			
	Offers over	Fixed price	Offers over	Fixed price	Offers over	Fixed price
Dev_i	10.8223*** (159.82)	10.9266*** (121.86)	11.2823*** (221.31)	11.4327*** (161.47)	10.7256*** (473.24)	11.0361*** (359.13)
$Dev_i \times Dec_{2008}$	0.0093 (0.78)	−0.0397*** (−4.22)	−0.0011 (−0.12)	−0.0218** (−2.94)	0.0038 (0.92)	0.0018 (0.53)
Numpublic	0.1466*** (93.95)	0.1293*** (93.32)	0.1034*** (86.50)	0.1050*** (94.82)	0.0744*** (121.64)	0.0807*** (148.85)
Numbedrooms	0.1893*** (167.90)	0.1838*** (135.92)	0.1996*** (232.06)	0.1666*** (154.57)	0.1769*** (385.46)	0.1384*** (249.32)
Numbathrooms	0.0440*** (20.43)	0.0755*** (25.34)	0.0329*** (20.26)	0.0650*** (27.54)	0.0229*** (29.07)	0.0389*** (33.85)
Detached	0.1307*** (46.09)	0.1190*** (37.26)	0.1220*** (55.89)	0.1402*** (54.11)	0.1241*** (95.19)	0.1401*** (94.60)
Flat	−0.0416*** (−16.96)	−0.1641*** (−34.44)	−0.1320*** (−64.90)	−0.2461*** (−61.71)	−0.1485*** (−109.02)	−0.2385*** (−100.19)
Ensuite	0.1704*** (53.21)	0.0513*** (18.62)	0.1384*** (57.04)	0.0514*** (23.32)	0.0729*** (53.41)	0.0522*** (44.12)
*Garage*0	−0.1484*** (−57.30)	−0.0903*** (−27.99)	−0.1011*** (−51.00)	−0.0566*** (−21.88)	−0.0623*** (−60.50)	−0.0495*** (−37.23)
*Garage*2	0.0638*** (7.15)	0.0726*** (20.88)	0.0659*** (9.81)	0.0833*** (30.05)	0.0531*** (15.96)	0.0784*** (54.82)
Garden	0.0486*** (21.30)	0.0506*** (10.51)	0.0676*** (37.99)	0.0625*** (15.95)	0.0497*** (51.04)	0.0589*** (27.45)
Heating	0.1357*** (64.11)	0.1343*** (35.48)	0.1190*** (74.04)	0.1180*** (39.26)	0.1003*** (127.38)	0.0920*** (62.38)
Newbuild	0.1436*** (7.84)	0.2156*** (26.26)	0.1511*** (10.95)	0.1916*** (29.41)	0.1148*** (15.38)	0.1376*** (41.09)
TOM	−0.0033*** (−69.53)	−0.0022*** (−45.88)	−0.0029*** (−79.40)	−0.0019*** (−48.58)	−0.0026*** (−147.24)	−0.0016*** (−86.08)
Constant	−0.4559*** (−6.52)	−0.5689*** (−6.10)	−0.8133*** (−15.34)	−0.8863*** (−11.98)	−0.1949*** (−5.70)	−0.3508*** (−8.40)
Year/quarter	√	√	√	√	√	√
Geo codes	√	√	√	√	√	√
Fixed effect at pcode			√	√		
Multilevel					√	√
N	80,737	45,922	80,737	45,922	80,737	45,922
Adj R^2	0.8757	0.8674	0.9298	0.9176		
Submarket *F*			786.6***	353.584***		
Random effect parameters						
Level 1 property					0.0712***	0.1967***
Level 2 postcode					0.1655***	0.1928***
Level 3 spatial submarket					0.1833***	0.1967***
Log likelihood					83,359.743	37,836.159

Notes: *t*-Statistics for Models 8 and 9, *z*-statistics for Model 10 in parentheses.
$^{*}p < 0.05$, $^{**}p < 0.01$, $^{***}p < 0.001$.

Table 6. Survival analysis results (Model 11).

_t	Coef.	Std err.	z	P > z
Dev_i	11.75766	0.191556	61.38	0
σ_{ik}	−0.9594	0.083099	−11.55	0
Offersover	−0.31543	0.0076	−41.51	0
Sold%	−0.14908	0.067351	−2.21	0.027
$AvgTOM_{ik}$	0.012892	0.000453	28.49	0
$Dev_i \times Dec_{2008}$	−1.27077	0.074913	−16.96	0
$\sigma_{ik} \times Dec_{2008}$	1.174868	0.148909	7.89	0
$Offersover \times Dec_{2008}$	−0.23107	0.010613	−21.77	0
$Sold\% \times Dec_{2008}$	−0.91397	0.084383	−10.83	0
$AvgTOM_{ik} \times Dec_{2008}$	−0.00408	0.000585	−6.97	0
Numpublic	0.008662	0.003735	2.32	0.02
Numbedrooms	0.05247	0.0032	16.4	0
Numbathrooms	0.045238	0.006131	7.38	0
Detached	0.138626	0.007753	17.88	0
Flat	0.1439	0.0082	17.55	0
Ensuite	−0.04741	0.007456	−6.36	0
*Garage*0	0.186301	0.007386	25.22	0
*Garage*2	−0.02838	0.010997	−2.58	0.01
Garden	−0.09737	0.007726	−12.6	0
Heating	−0.12782	0.006936	−18.43	0
Newbuild	0.543863	0.025329	21.47	0
Constant	−9.80089	0.208085	−47.1	0
$ln\sum$	−0.13128	0.002019	−65.02	0
N	143,139			
Log likelihood	−175,929			
LR x^2	52,240.82			
Prob > x^2	0			

Conclusion

There has been a global trend in improving information transparency in housing markets at an institutional level and this paper set out to investigate the impact of such institutional changes on the trade-off between selling price and selling time in the sealed-bid context. The empirical results support the view in the existing literature: improvements in information symmetry appeared to influence sellers' pricing strategy. However, while the results suggest that the Home Report reduces the effect of pricing strategy on selling time, this study did not find conclusive evidence to support the view that the scheme could reduce the influence of overpricing on the final selling price. This finding implies that although sellers bear the costs of the Home Report, potentially they could benefit from increased liquidity.

The paper has a wider implication for policymakers globally. It highlights that institutional factors do influence the behaviours of market participants. Both sellers and buyers can benefit from a higher level of information symmetry. Policymakers should compare the monetary and social cost of improving information transparency with the benefits of such schemes and further assess the usefulness of such schemes in bringing market stability.

Inevitably, the study has some shortcomings. First, there might be specification issues surrounding the computation of predicted selling price, which in turn could misestimate the pricing strategy variable. The study attempted to address the problem using a multilevel model in order to consider the unobservable neighbourhood effects. Despite the limitations of the OLS and multilevel model, the models yielded reasonable goodness to fit and the results appear to be robust. Nevertheless, the limitations of the models should not be ignored. Second, the pricing strategy is modelled using a simple OLS regression with limited control over sellers' characteristics, so the prediction level of the model was relatively low. This is an area where further research is needed. There is also more work to be done in the trade-off between selling price and selling time. Particularly, the study can be extended to examine the behavioural factors of both sellers and buyers. Third, there is a need to further understand the role of TOM as a determinant of equilibrium price in a 'caveat emptor' context (Pryce, 2011). The process of shifting from one selling mechanism to another and the role played by TOM was not explicitly examined in this paper. From an institutional perspective, future research should consider the implications for the total information costs under the two distinct legal regimes (caveat emptor and caveat venditor).

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ORCID iD

Nan Liu https://orcid.org/0000-0003-1490-840X

Supplemental material

Supplemental material for this article is available online.

Notes

1. The difference between selling price and valuation (Gibb, 1992).
2. This includes all private properties listed in the market, excluding 'right to buy' properties, and some of the new developments.
3. The Single Survey is a valuation equivalent survey that shows the condition of the property, the insurance rebuild cost and the estimated market value, which is widely accepted by lenders for mortgage purposes.
4. Questionnaires are completed by the sellers regarding other information about the property, such as the length of ownership, council tax band, utility providers, whether there have been alterations or extensions and whether the property has been flooded.
5. Map of the housing market is available upon request.
6. Unrealistic values are treated as data errors and are excluded from the regression models. Transactions outside the Aberdeen rural housing market boundary are also excluded.
7. A list of these areas is available upon request.
8. The deviation from its mean, divided by its standard deviation: $\frac{x-\mu_y}{\sigma_x}, \frac{y-\mu_x}{\sigma_y}$.
9. Pryce (2011) further develops this polynomial estimation by interacting time, location and attribute variables. His model yields a R^2 of 0.70. In this study, Model 2's R^2 is over 0.80; the results are further discussed in section 'Empirical results'.
10. When houses are constructed, developers need to apply for new postcodes. The postcodes hence tend to represent a street or part of a street.
11. This follows the concept of DOP in Pryce (2011) and Yavas and Yang (1995). Seller's pricing strategy is presented by comparing asking price with the expected market price in a given period.
12. Pryce (2011) uses a 3 km radius circle when the standard deviation is calculated. This paper argues that this circle does not correspond to a submarket, particularly if the

property is located on the edge of a neighbourhood. Submarkets used in this study consider community boundaries and are more intuitive.
13. R^2 is not available with Model (3).
14. For example, the adjusted R^2s are 44% and 70% in the OLS model and multiple fractional polynomial models, respectively, in Pryce (2011).
15. Results are not listed in the table but are available upon request.
16. Results from Models (1)–(3) subsequently yield very similar results in Models (4)–(9),

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