Journal of Urban Economics 73 (2013) 43–56

Contents lists available at SciVerse ScienceDirect

Journal of Urban Economics

www.elsevier.com/locate/jue

Repairs under imperfect information ☆

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ARTICLE INFO

Article history:
Revised 4 July 2012
Available online 20 July 2012

JEL classification:
D8
R2

Keywords:
House prices
Imperfect information
Repairs

ABSTRACT

We propose a theory of how repairs affect prices under imperfect information. Our model reveals that repairs may lower prices because, if repairs are not always successful, they may reveal negative information about product quality. We also show that the price effect of repairs is increasing in the share of defective products in the population. Under perfect information a repair cannot lower the price and the price effect does not depend on the defective unit share. Data on condominium transactions during Vancouver's leaky condominium crisis provide support for the model predictions.

1. Introduction

In the late 1990s, hundreds of stories appeared in the Vancouver BC news media about water leaks leading to rot and mold in condominiums. Over one third of the wood-frame condos built in the 1990s underwent building envelope repairs. The cost of repairs to individual unit owners averaged in excess of $50,000.[1] Condo buyers during this period faced the difficult choice of whether to buy a repaired or unrepaired condo. Since not all condo building repairs are completely successful, a repaired condo is "damaged goods" and of uncertain quality. However, an unrepaired condo was also of uncertain quality as it might have defects that had yet to be corrected.

In this paper, we model the price effect of a repair under perfect and imperfect information and test the theories using data on prices and sales of Vancouver condominiums. In the imperfect information model, buyers do not know the true quality of a unit but know whether it has been repaired. We establish that a repair lowers the price if the share of defective units in the population is low and raises the price when the share is high. This result contrasts with the effect of a repair under perfect information that we show cannot reduce a condo's price and is independent of the share of defective units.

The housing transaction data from the leaky condo crisis provide useful variation for testing the theories. First, variation in the length of time between a transaction and a subsequent repair helps distinguish between cases of perfect and imperfect information. For units that transact shortly before the repair, buyers are likely aware of the leak problem because the damage may be visible and they have access to strata council meeting minutes where the leak may be discussed. For transactions occurring well before the repair, it is more likely that buyers are not aware of the problem.

In addition, the data contain cross-sectional and temporal variation in the share of defective condo units. We establish that changes in building codes led to higher defect rates for units of a particular type and vintage. Over time the surge in media accounts of the problem led to increased buyer recognition of the leakage problem and a growing public perception of the high defect rate in the condo population. Therefore, as buyers learned of the problem through media accounts, they updated their priors about the likelihood that an unrepaired unit will be defective. These features of the data provide a unique setting to test the models.

Relying primarily on repeat sales estimation methods, we find that for units repaired soon after their initial purchase, repairs are associated with higher prices. We interpret this finding as indicating that the buyer knew the condo was defective at time of purchase. However, when repairs occurred more than a year

☆ We appreciate the financial support provided by the Social Sciences and Humanities Research Council of Canada. We thank two anonymous referees and the co-editor for helpful comments and Sun Hua and Joelle Wendt for valuable research assistance. We gratefully acknowledge Landcor (www.landcor.com) and British Columbia's Homeowner Protection Office (HPO) for providing data and Tova Kornfeld for helping get the cooperation of the HPO.

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[1] The repair incidence figure is based on our data and calculations (see Table 1). Boei (2008) reports that per-unit repair loans issued by the Homeowner Protection Office averaged $62,000 for wood-frame apartments and $72,000 for concrete buildings.

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http://dx.doi.org/10.1016/j.jue.2012.07.003

subsequent to the initial purchase, we find both positive and negative effects of repairs. For unrepaired units purchased prior to widespread media reporting of the leaky condo crises, subsequent repairs are associated with lower prices when the units are resold. However, once the problems became well known, we find evidence that buyers discounted the prices of unrepaired condos of the type subject to the most defects—wood-frame condos built between 1989 and 1999—and subsequent repair of these units resulted in higher prices.

A feature of many second-hand markets is that the buyer often has information on whether the product has undergone a repair. While obtaining this information is useful, there often remains uncertainty about whether the repair is successful. We contribute to the literature on imperfect information by incorporating the repair decision into a model of equilibrium pricing with imperfect information. To our knowledge, this is the first paper to consider how information on repairs influences pricing.

Our analysis is closely related to the asymmetric information literature because buyers do not observe the true quality of goods. This literature predicts, in the extreme case, that bad units completely drive out good units from the resale market (Akerlof, 1970). In this case, all units trade for the same price equal to the quality of bad units and our price results would not obtain. We show that under plausible assumptions both good and bad units will be offered for resale even when sellers know the true quality of their units and strategically choose whether to repair defective units and offer them for sale. Thus, we contribute a general depiction of pricing of repaired and unprepared goods under imperfect information that extends to the case of asymmetric information.

The empirical literature on imperfect information in property markets has focussed on identifying information asymmetries. Levitt and Syverson (2008) find that real estate agents appear to take advantage of information asymmetries by persuading clients to accept offers more quickly and at lower prices than they are willing to accept for their own homes. Rutherford et al. (2007) demonstrate that these results also extend to the condominium market. Garmaise and Moskowitz (2004) investigate how differences in the quality of property tax assessments influence commercial real estate activity. They show that informationally disadvantaged agents limit their participation in real estate markets characterized by asymmetric information. Nanda and Ross (2009) find that state adoption of seller disclosure laws mitigate the lemons problem associated with asymmetric information in property markets and result in higher prices. We extend this literature by investigating the price effects of a common feature of housing markets—information available to buyers that a unit has undergone repair.

In the next section, we present our theory of the price effects of repairs under perfect and imperfect information and identify testable predictions. We explain how repeat sales information on condominium transactions can be used to test the theory. Section 3 contains the empirical analysis. It includes a description of the data, the econometric specification, and presentation and discussion of the results. In Section 4, we explain why the model predictions are robust to features of the leaky condo setting not explicitly captured in our general model of pricing of repaired goods. Section 5 summarizes our results.

2. Theory

This section presents theory that generates the key predictions we test in our empirical analysis. We derive the price impact of a repair under two hypotheses: perfect information and imperfect information. Unique implications that distinguish imperfect information from perfect information are that repairs can *lower* housing prices under imperfect information and that the price change due to a repair increases with the share of defective units in the population. In order to focus on the key ideas, this model assumes that repairs and sales occur randomly with exogenously given probabilities. We provide a full model which endogenize these decisions in Appendix A.

2.1. Description

There is one unit measure of condo units. Units differ in their quality $q \in \{G,D\}$ where G and D indicate the quality of good units and defective units respectively ($G > D$). A key parameter in the model is β that measures the share of the defective units in the population.

We assume an infinite number of risk neutral buyers with the following preferences

$$x + q \cdot I_O, \tag{1}$$

where x is the numeraire good, $q \in \{G,D\}$ is unit quality, and I_O is an indicator variable taking 1 if an individual owns a unit and 0 otherwise.

In stage 0, the nature randomly assigns each unit to either perfect information or imperfect information. Under perfect information, buyers can observe unit quality. Under imperfect information, buyers cannot observe quality. The probability of a unit being assigned to imperfect information is α.

In stage 1, randomly chosen $\phi \in (0,1)$ share of defective units get repaired. A repair has a stochastic outcome: a repaired defective unit becomes a good unit with probability $\rho \in (0,1)$ and remains a defective unit with probability $1-\rho$. Repair outcomes are realized at the end of stage 1.

In stage 2, units are offered for sale. There are four types of condo units at the beginning of stage 2: RG (repaired good), RD (repaired defective), UG (unrepaired good), and UD (unrepaired defective). Different types can have different selling probabilities: type iq gets randomly sold with probability σ_q^i ($i = R, U$ and $q = G, D$).

We are interested in how the price effect of a repair differs under perfect information and imperfect information. To make the distinction clear, we characterize the equilibrium separately for a sub-game representing each case. We will present the combined effect in Section 2.5.1 where we map our model to data.

2.2. Equilibrium under perfect information

Suppose that buyers can directly observe unit quality. Buyers' utility function given in (1) implies that each buyer is willing to pay G and D for a good unit and a defective unit, respectively. Since there are an infinite number of buyers, housing prices are determined as

$$\begin{cases} P_G = G \\ P_D = D. \end{cases}$$

Now we characterize how a repair affects the unit price. If a repair succeeds, housing price changes from D to G. If a repair does not succeed, the price remains at D. Thus, average price gain due to a repair is $\rho(G-D)$. A repair cannot lower price and the average price gain does not depend on the defective unit share β.

Proposition 1. *Suppose that buyers can observe the true quality of housing units.*

(a) *A repair either raises a unit's price or leaves it unchanged. On average, repairs have positive effects on prices.*
(b) *The average price change associated with repairs does not depend on the defective unit share β.*