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The capitalization of green labels in the California housing market ☆

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ABSTRACT

The residential sector accounts for 33% of electricity consumption in the U.S., with a total expenditure of $166 billion in 2010. Increasing the energy efficiency of the durable housing stock can thus provide significant cost savings for consumers. One promising trend is the rise of homes labeled by a third party as "green" or energy efficient. This paper documents evidence on the effects of providing information about the energy efficiency and "sustainability" of structures in affecting consumer choice. We conduct a hedonic pricing analysis of all single-family home sales in California over the time period 2007 to 2012, and find that homes labeled with a green label transact at a small premium relative to otherwise comparable, non-labeled homes. We show evidence of spatial variation in this capitalization such that both environmental ideology and local climatic conditions play a role in explaining the variation in the green premium across geographies.

1. Introduction

Increased awareness of energy efficiency and the importance of the built environment therein, have turned public attention to more efficient, "green" building. The inventory of certified green *commercial* space in the U.S. has increased dramatically since the introduction of rating schemes (Kok et al., 2011). Importantly, tenants and investors seem to value the "green" features in such buildings. There is empirical evidence that "green" labels affect the financial performance of commercial office space: Eichholtz et al. (2010) study commercial office buildings certified under the LEED program of the U.S. Green Building Council and the Energy Star program of the EPA, documenting that these labels positively affect rents, vacancy rates and transaction prices.

Of course, private homeowners may be different from tenants and investors in commercial buildings, especially in the absence of standardized, publicly available information on the energy efficiency of homes. But in recent years, there has been an increase in the number of homes certified as energy efficient, based on national standards such as Energy Star and LEED, and local standards such as GreenPoint Rated in California. It is claimed that these "green" labeled homes have lower operational costs than conventional homes, with rating requirements going beyond standard efficiency levels prescribed by building codes. In addition, it is claimed that owners of such homes enjoy ancillary benefits beyond energy savings, such as greater comfort levels and better indoor environmental quality. If consumers observe and value these features, hedonic methods can be used to measure the price premium for such attributes, representing the valuation of the marginal buyer (Bajari and Benkard, 2005; Rosen, 1974).

In the European Union, the introduction of energy labels, following the 2003 European Performance of Buildings Directive (EPBD), has provided single-family homebuyers with information about how observationally identical homes differ with respect to thermal efficiency. Presumably, heterogeneity in thermal efficiency affects electricity and gas consumption. The EU energy label seems to be quite effective in resolving the information asymmetry in understanding the energy efficiency of dwellings: Brounen and Kok (2011) estimate hedonic pricing gradients for recently sold homes in the Netherlands and document that homes receiving an "A" grade in terms of energy efficiency sell for a 10% price premium. Conversely, dwellings that are labeled as inefficient transact for substantial discounts relative to otherwise comparable, standard homes. In Singapore, Yongheng Deng et al. (2012) document that homes labeled under the government-designed Green Mark scheme sell for a 4–6% price premium.

In the United States, few if any large sample studies have investigated the financial performance of "green homes." There is some information on the capitalization of solar panels in home prices — one study based in California documents that homes with solar panels sell for roughly 3.5% more than comparable homes without solar

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panels (Dastrup et al., 2012). But unlike findings in previous research on the commercial real estate sector, there is a dearth of systematic evidence on the capitalization of energy-efficiency and other sustainability-related amenities in asset prices of the residential building stock, leading to uncertainty among private investors and residential developers to invest in the construction and redevelopment of more efficient homes.[1]

This paper systematically addresses the impact of labels attesting to energy efficiency and other "green" features of single-family dwellings, on the value of these homes as observed in the marketplace, providing evidence on the private returns to the investments in energy-efficient single-family dwellings, an increasingly important topic for the U.S. housing market.

Using a large sample of transactions in California, consisting of some 4231 buildings certified by the USGBC, EPA, and a statewide rating agency, Build It Green, and a control sample of some 1.6 million non-certified homes, we relate transaction prices of these dwellings to their hedonic characteristics, controlling for geographic location and the time of the sale.

The results indicate the importance of a label attesting to the sustainability of a property in affecting the transaction price of recently constructed homes as observed in the marketplace, suggesting that an otherwise identical dwelling with a "green" certification will transact for about 2–4% more. The results are robust to the inclusion of a large set of control variables, such as dwelling vintage, size and the presence of amenities, to stratification of the sample by geography and vintage, and to the application of propensity-score matching.

In addition to estimating the average effect, we test whether the price premium is higher for homes located in hotter climates and in electric utility districts featuring higher average residential electricity prices. Presumably, more efficient homes are more valuable in regions where climatic conditions demand more cooling, and where energy prices are higher. In line with evidence on the capitalization of energy efficiency in commercial buildings (Eichholtz et al., 2013) our results suggest that a label appears to add more value in hotter climates, where cooling expenses are likely to be a larger part of total housing expenses. This provides some evidence on the rationality consumers in appropriately capitalizing the benefits of more efficient homes.

We also test whether the price of certified homes is affected by consumer ideology, as measured by the percentage of hybrid registrations in the neighborhood. A desire to appear environmentally conscious may increase the value of "green" homes, because it is a tangible signal of environmental virtue (Sexton and Sexton, 2011). The results show that the green premium is positively related to the environmental ideology of the neighborhood — green homes located in areas with a higher fraction of hybrid registrations sell for higher prices. Some homeowners seem to attribute non-financial utility to a green label (and its underlying features), which is in line with previous evidence on the private value of green product attributes (Kahn, 2007).

This paper contributes to an emerging literature on the economic value of labels in encouraging behavior that mitigates environmental externalities. Jin and Leslie (2003, 2009) document the role of labels indicating restaurant public health quality. They find that these labels induce supply and demand side behavioral change, so that public health improves. Shimshack and Ward (2010) study the role that mercury warnings on fish play in altering consumption patterns. Informed consumers are more likely to substitute to lower risk products. Graff Zivin and Neidel (2009) document that the population responds by avoiding smoggy inland areas when a given polluted day is labeled to be a "Smog Alert" day. Each of these examples highlights the role that trusted labels play in differentiating consumer products.

The remainder of this paper is organized as follows: Section 2 describes the empirical framework and the econometric models. Section 3 discusses the data, which represent a unique combination of dwelling-level transaction data with detailed information on "green" labels that have been assigned to a subsample of the data. Section 4 provides the main results of the analysis. Section 5 provides a discussion and policy implications of the findings.

2. Method and empirical framework

2.1. The definition of green homes

In the U.S., there are multiple programs that encourage the development of energy efficient and sustainable dwellings through systems of ratings to designate and publicize exemplary buildings. These labels are asset ratings: snapshots in time that quantify the thermal and other sustainability characteristics of the building, predicting its energy performance through energy models. The labels do not measure actual performance, and thus do not take occupant behavior into account. The Energy Star program, jointly sponsored by the U.S. Environmental Protection Agency and the U.S. Department of Energy, is intended to identify and promote energy-efficient products, appliances, and buildings. The Energy Star label was first offered for residential buildings in 1995.[2]

The Energy Star label is an asset rating touted as a vehicle for reducing operational costs in heating, cooling, and water-delivering in homes, with conservation claims in the range of 20–30%, or $200–$400 in annual savings for a typical home. In addition, it is claimed that the label improves comfort by sealing leaks, reducing indoor humidity and creating a quieter environment. But the Energy Star label is also marketed as a commitment to conservation and environmental stewardship, reducing air pollution.

In a parallel effort, the U.S. Green Building Council, a private nonprofit organization, has developed the LEED green building rating system to encourage the "adoption of sustainable green building and development practices." Since adoption in 1999, separate standards have been applied to new buildings and to existing structures.

The LEED label requires sustainability performance in areas beyond energy use, and the requirements for certification of LEED buildings are substantially more complex than those for the award of an Energy Star rating. The certification process for homes measures six distinct components of sustainability: sustainable sites, water efficiency, materials and resources, indoor environmental quality, innovation, as well as energy performance. Additional points can be

[1] There are some industry-initiated case studies on the financial performance of "green" homes. An example is a study by the Earth Advantage Institute, which documents for a sample of existing homes in Oregon that those with a sustainable certification sell for 30% more than homes without such a designation, based on sales data provided by the Portland Regional Multiple Listing Service. However, the sources of the economic premiums are diverse, not quantified, and not based on rigorous econometric estimations.

[2] Under the initial rating system, which lasted until 2006, buildings could receive an Energy Star certification if improvements were made in several key areas of the home, including high-performance windows, tight constructions and ducts, and efficient heating and cooling equipment. An independent third-party verification by a certified Home Energy Rater was required. Homes qualified under Energy Star Version 1 had to meet a predefined energy efficiency score ("HERS") of 86, equating more than 30% energy savings as compared to a home built to the 1992 building code. From January 2006 until the end of 2011, homes were qualified under Energy Star Version 2. This version was developed in response to increased mandatory requirements in the national building codes and local regulations, as well as technological progress in construction practices. The updated guidelines included a visual inspection of the insulation installation, a requirement for appropriately sized HVAC systems, and a stronger promotion of incorporating efficient lighting and appliances into qualified homes. An additional "thermal bypass checklist" (TBC) became mandatory in 2007. As of 2012, Energy Star Version 3 has been in place, including further requirements for energy efficiency measures and strict enforcement of checklist completion.

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