Energy Economics 60 (2016) 197–205

Contents lists available at ScienceDirect

Energy Economics

journal homepage: www.elsevier.com/locate/eneeco

Doing good but not that well? A dilemma for energy conserving homeowners

Marie H. Wahlström

Department of Urban Planning and Environment, School of Architecture and the Built Environment, KTH - Royal Institute of Technology, Stockholm, Sweden

ARTICLE INFO

Article history:
Received 18 August 2015
Received in revised form 22 September 2016
Accepted 24 September 2016
Available online 11 October 2016

JEL Codes:
D1
D10
D11
D12
D19

Keywords:
Price premium
Energy efficient housing
Single-family houses
Energy saving potential
Building attributes
Energy performance certificate

ABSTRACT

In this paper the issue of market capitalization of energy efficient buildings is addressed by considering single-family housing in Sweden and through analyzing as to what extent the market price for a house is influenced by its energy performance. Are Swedish homeowners doing well by doing good?
We make use of information provided by the Swedish energy performance certificates for single-family homes matched with data on the corresponding transaction prices, household characteristics and attributes of the neighborhood. The resulting database, covering about 77,000 individual observations, is used to analyze the relationship between the price of a house and its energy performance by means of a hedonic model. Unlike most other studies the energy performance is decomposed into energy consumption and several other variables characterizing the energy system. The main question addressed is if there is a price premium for energy efficient housing in Sweden.
Our results differ from earlier studies and indicate no price premium related to the energy consumption but substantial premiums for housing attributes that improve the energy efficiency. A likely explanation is that prospective buyers of new homes base their expectations about future energy consumption on those attributes rather than on the energy consumption of the previous owner.

1. Introduction

In the seminal paper "Doing good by doing well. Green office buildings." Eichholtz et al. (2010) present systematic evidence on the economic value of certification of green buildings. According to the results, otherwise identical buildings with an Energy Star certification will have a price premium of 16%. This paper addresses the issue of market capitalization of energy efficient buildings by considering single family housing in Sweden and investigates as to what extent the market price for a single family home is influenced by its energy performance. Are Swedish homeowners doing well by doing good?

The Swedish energy performance certificates (EPC) for single-family housing include detailed information about the energy consumption and the energy system, and additionally about a few housing attributes.[1] They also include expert estimates of the energy conservation potentials resulting from implementing cost-efficient energy saving measures. By matching the certificates issued in 2009 and 2010 with data sources of their own, the Swedish Central Bureau of Statistics helped to add information about the selling price, the residents, the neighborhood (including the local climate) and several additional housing attributes. The resulting database contains about 77,000 individual observations, each comprising about 200 variables. I will analyze the relationship between the selling price of a house, its energy performance, and various characteristics of the building and neighborhood. The energy performance will be characterized by several energy system attributes rather than by an index, like energy consumption per square meter. Specifically, hedonic regressions will be used to address the following questions: Is the market price for single-family homes higher the lower the anticipated energy consumption? Is the price also influenced by other attributes characterizing the energy system of the house and by the expert assessments of their conservation potentials?

The paper adds to earlier price impact studies in several ways. First and foremost, it distinguishes between the impact caused by energy consumption and by different components characterizing the energy system, such as heat pumps, rather than relating the price impact to a green label or an energy performance rating. This decomposition is also important since the buyer of a home might expect to consume more as well as less energy than the seller without making any changes of its energy system — implying that the transaction price might be related to the expected rather than the observed energy consumption. In another Swedish study, Högberg (2013) notes that the energy conservation measures suggested by the assessors might influence the price and include a categorization

[1] The EPCs were introduced in 2009 in line with the Directive 2002/91/EC of the European parliament.

http://dx.doi.org/10.1016/j.eneco.2016.09.025
0140-9883/

of the measures when estimating the hedonic price function. Since all suggested measures are cost-effective any rational buyer is likely to implement them. As a consequence, the expected energy consumption might rather be related to the difference between the observed energy consumption and the conservation potential. A test of this hypothesis is a third contribution of this paper.

Our results differ from Högberg (2013) and also from e.g. Hyland et al. (2013), Feurst et al. (2015, 2016) and Brounen and Kok (2011). Keeping the energy system components constant, the relationship between the selling price and the energy consumption turns out to be positive rather than negative. A possible explanation for this anomaly is that buyers of new homes form their expectations about energy consumption on the energy system of the house and on non-observable factors rather than on the energy consumption of the previous owner. In line with this idea, the characteristics of the energy system are shown to play a significant role for the selling price. By way of example, in comparison with a house relying on electricity only, a ground-sourced heat pump generates a price premium of 18%.

The large database created by using the energy performance certificates as a corner stone can also be considered as contribution. It provides a far richer description of the energy system and other attributes characterizing a house than earlier studies and offers great opportunities to analyze the relationship between sales price and energy consumption for subsets of homes having common specific characteristics. Considering Sweden's relatively long tradition of an ambitious environmental policy one would also expect a fairly high degree of environmental awareness among Swedish consumers, see e.g. Nair et al. (2010) and Hårsman and Wijkmark (2013). It might hence be especially interesting to use Sweden as a benchmark when analyzing energy performance data from other European countries.

The paper is organized as follows. The next section provides an overview of previous research and Section 3 describes the data. Section 4 presents the conceptual framework and hypotheses. The regression model and results are presented in Section 5. Finally, Section 6 provides a short summary and some conclusions for policy and future research.

2. Literature review

Since the introduction of energy performance certificates in the EU and green labeling of buildings in other countries, research on the relationship between real estate prices and energy consumption has been growing rapidly. Several papers have addressed the question of a price premium on “green buildings”. Focusing on residential buildings, these studies can be divided into two categories; the ones that relate house prices to a “green” label or energy performance index and those that explicitly consider the energy system including the energy consumption.

In a study of Dutch households based on the data from 177,000 dwellings (houses and apartments), Brounen and Kok (2011) estimate that homes labeled as “green” sell for 2–4% more than other homes, ceteris paribus.[2] Using a differentiation between green rating categories, it is also shown that homes with the “strongest” label sell for approximately 10% more, which according to the authors seem to reflect more than the corresponding energy savings.

A Californian study by Kahn and Kok (2013) covers 1.6 million houses, of which 4200 are labeled as “green”[3] concludes that the green-labeled houses sell for approximately 5% more than non-labeled homes. However, they acknowledge several important interdependencies when estimating the price premium. For example that the premium is positively correlated to the environmental ideology of the area as measured by the rate of hybrid vehicles — some homeowners seem to attribute non-financial utility to a green label and its underlying features, explaining part of the premium paid for green homes. Their results further indicate an interaction effect between energy efficiency and climate: more energy efficient homes located in hotter climates are more valuable as compared to labeled homes constructed in more moderate climates.

Based on Irish data, Hyland et al. (2013) find that high energy efficiency ratings have a strong positive effect on price; approximately 2–9% depending on the rating. Their results, when comparing the estimated cost saving with the price premiums of homes with different energy ratings imply that actual energy savings are not yet fully incorporated into price premiums and that engineering-based estimates overstate the actual savings.

Feurst et al. (2015, 2016) report evidence from the UK and Wales, respectively, indicating a positive relationship between the energy efficiency rating of a dwelling and the transaction price. In the UK, the size of the premium is approximately 5–13% depending on the rating. However, in certain market segments there is no significant or a significant negative effect (e.g. detached sparse). Interestingly, the study for Wales indicates that there are no significant discounts for rental dwellings having below average energy performance.

Another study that analyzes the price premium for energy efficient housing in five European countries states that the results “overwhelmingly points to energy efficiency being rewarded by the market”, see page 12 in Bio Intelligence Service et al. (2013). The premium related to energy efficiency was found to be clear and positive in all countries and regions but Oxford (UK). In for example the Flanders, Belgium the sales price will increase with 4% if the energy efficiency is increased one level on the seven-level scale.

The Swedish studies by Högberg (2013) and Cerin et al. (2014) both analyze the energy performance in terms of consumed kWh/square meters opposed to a green label.[4] Högberg (2013) uses data from single-family homes in Stockholm, the capital of Sweden and estimates a price premium of 0.04% per percent energy conservation. The findings of Cerin et al. (2014), which are based on similar data covering all cities (with a certain density) in Sweden, suggest that it is premature to conclude that energy performance is fully capitalized in the residential property market. Their results show a significant but small price discount on energy efficiency for the full sample, but for different segments of the data the result is quite inconclusive.

Mandell and Wilhelmsson (2011) combine transaction data and data from a postal survey answered by 618 households in Stockholm. Instead of focusing on the energy consumption, they study the relationship between different environmentally related housing attributes and the house price. These attributes are different energy saving features such as extra insulation, water-reduced WC, heat pump and three-glass windows. In order to handle potential problems with multicollinearity the attributes are transformed into a smaller number of factors using principal component analysis. They conclude that there is a positive, if any, willingness to pay for environmental attributes. Further, their results indicate that households who label themselves as environmentally aware are willing to pay more than other households for many of the environmental attributes considered.

Summarizing, the reviewed literature suggests, that households are willing to pay more for a given housing alternative if the house is labeled as green or has attributes anticipated to lower the energy consumption. But, these studies also acknowledge a number of different potential problems when analyzing the relationship between price and energy efficiency of single-family housing, such as interdependencies, multicollinearity and endogeneity.

[2] The European energy label has a common base across all member states. It is derived from the thermal quality of the dwelling taking elements such as insulation quality, heating installation, ventilation, solar systems and indoor air climate into account. It is based upon the modeled primary energy consumption under average conditions (i.e. an average household under normal climatic conditions) and thus not based on the actual energy consumption as measured by the energy bill (Brounen and Kok, 2011).

[3] The “green” houses in Kahn and Kok (2013) are either labeled by the national Energy Star, LEED or rated by the local standard GreenPoint. These labels all refer to the house's potential for saving at least 15% energy, beyond building code (minimum) requirements.

[4] In Sweden, the certificates' data on energy performance reports the amount of bought energy (kWh/year) per heated sqm, adjusted to the climate a "normal" year.