Home Energy Efficiency and Mortgage Risks: An Extended Abstract

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In recent years, home energy efficiency (EE) has progressed from the margins to the mainstream. However, many households are deterred by large upfront costs and longer payback periods, so are missing significant opportunities to implement cost effective energy savings measures in their homes. Financing would help overcome these obstacles. However, the use of loans for energy efficiency upgrades has been low. In particular, as de T'Sercales (2007) points out, lenders have not promoted loans for energy efficiency upgrades because of lack of information about the relationship between energy efficiency and risks. We provide initial evidence of the associative relationship between home energy efficiency and mortgage risks. Using a national sample, compared to non-ENERGY STAR houses, we find that the odds of default for households in ENERGY STAR houses are 32 precent lower and odds of prepayment are 28 precent lower. Furthermore, the greater the efficiency within the ENERGY STAR residences, the lower the risk of default. These results are reported in Cityscape by Kaza, Quercia and Tian (2014) and this paper summarizes them.

In 2012, the market share of the ENERGY STAR label in new single family construction had reached close to 40 precent in some states in the US (Environmental Protection Agency 2013). On a square foot basis, all types of houses have become more energy efficient in the last few decades. Yet, the United States is the fifth largest consumer of primary energy per capita among the OECD countries and its residential sector accounts for 20 percent of the total energy consumed in the United States. Households in the U.S. spend around 230 billion dollars annually on residential energy (Energy Information Administration 2012). According to the Consumer Expenditure Survey, an average household spends about a fifth of its housing costs in utility expenditures, with rural households spending up to a quarter of their housing costs (Bureau of Labor Statistics 2013).

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While there is little in the literature on the price premium for new energy efficient homes, there is evidence to suggest that green labels such as ENERGY STAR and Leadership in Energy and Environmental Design (LEED) command a 8 percent premium on resale (Kok and Kahn 2012). Nevin and Watson (1998) find that, *ceteris paribus*, a dollar decrease in utility costs is associated with about a $20 increase in home values. Preliminary analysis using the 2011 American Housing Survey data and the framework of Nevin and Watson replicates these results ($17, with 7.6 standard error).

Despite these trends, energy consumption in the residential sector continues to rise. This is partly due to countervailing trends such as reduction in household size, increase in house size and increasing number of appliances (Kaza 2010). While promoting conservation behavior is important to reduce energy consumption, energy efficiency still has a large role to play. Longer payback periods and higher upfront costs are likely to prevent many moderate and low-income households from purchasing energy efficient houses and making efficiency upgrades, and these households are precisely those that are most likely to benefit from them. While the households in the top income quintile pay more than three times as much as the bottom quintile in shelter costs, they only pay 75 percent more in utility costs, suggesting that the energy consumption is relatively income-inelastic and energy inefficiency places a greater burden on the low income households (Bureau of Labor Statistics 2013). A recent survey by the National Association of Home Builders finds that an overwhelming majority of homebuyers (over 80 percent) prefer energy efficient features, including appliances, windows and an ENERGY STAR rating for the house, and are willing to pay a 3 percent premium over an inefficient house (National Association of Home Builders 2013). An important way to improve access and to satisfy this potential demand is for mortgage pricing and underwriting to reflect the savings that come as a result of energy efficiency. Until now, lenders and investors have been reluctant to do so, in part because they lack reliable loan performance data on which to base underwriting decisions.

Financing Energy Efficiency

In many cases, financing residential energy efficiency is treated as financing energy retrofits in homes. Most energy improvements for existing homes can be financed through consumer loans, a home equity loan secured by property, or a traditional or specialized mortgage. Such financing usually requires that consumers have substantial equity in their existing homes, the financial reserves to pay any added costs out-of-pocket, or larger down payments for a home purchase. The U.S. housing stock is valued at about $18.5 trillion, according to the Federal Reserve System. Even if 2 percent were devoted per year to energy efficiency improvements, this would mean capital outlays of nearly $370 billion and $3.7 trillion over a decade. A variety of funding mechanisms exist today, such as state and local energy efficiency loan funds, on-bill repayment, and Property Assessed Clean Energy (PACE) bonds. But their scale is vastly lower than what is required and is estimated at less than $6 billion annually.

Contrast this to a recent estimate that an increase in residential energy efficiency has the potential to save up to $41 billion annually (Granade et al. 2009).

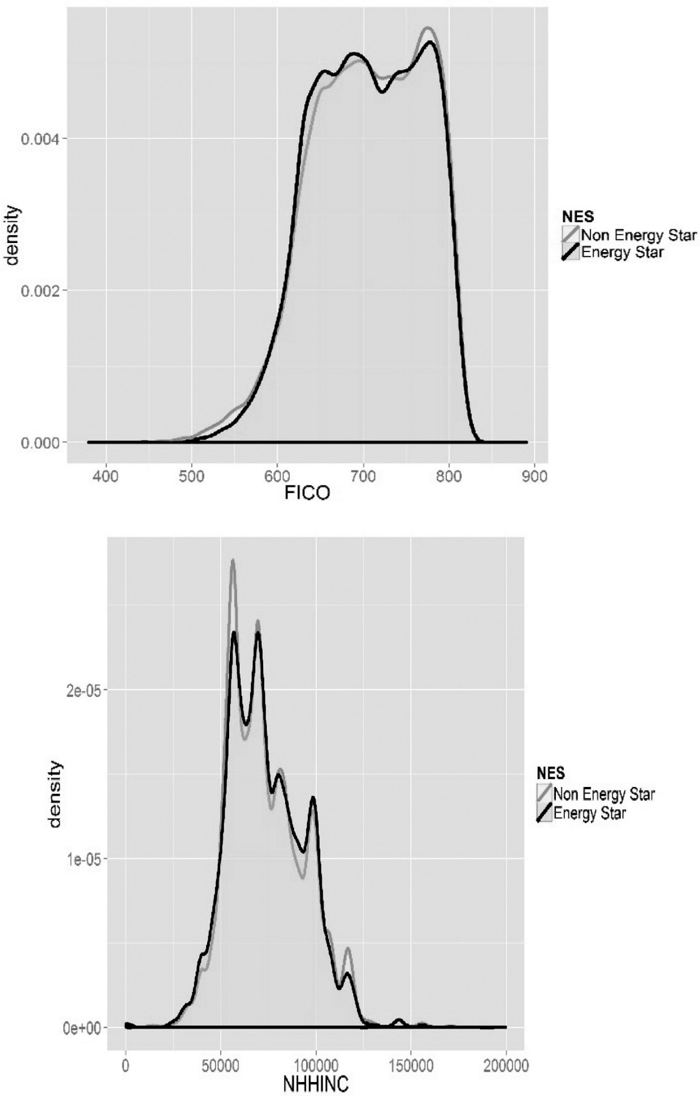
For many first-time homebuyers and moderate-income borrowers who do not have these financial resources, energy-efficient mortgages (EEM) could offer a solution. EEMs allow some flexibility in underwriting considerations so that borrowers can qualify for larger loans to implement energy-saving improvements and/or purchase homes that already meet certain performance criteria. However, EEMs that are backed by the Federal Housing Administration and the Department of Veterans Affairs have not caught on, because of the transactional complexity, poorly developed lender guidance, limited benefits for lenders, and lack of consumer information. Transaction costs and information asymmetries prevent rapid and widespread adoption of these products. In a wide ranging study, de T'Sercales (2007) showed that a more important barrier that prevents large scale adoption of energy efficiency is the financiers' belief of higher risk exposure than the availability of funding. Thus, it is useful to quantify the risks associated with energy efficiency investments.

Current underwriting standards do not recognize the potential lower risks associated with energy efficient housing. *Ceteris paribus*, lower and less volatile utility costs might provide a household with some cushion in case of crisis events to pay its mortgage. Furthermore, valuing energy efficiency might be a marker of financial savvy for the household. If, indeed, mortgages held by homeowners in energy-efficient homes have lower risks than those in less efficient homes, then good credit policy would merit more flexible underwriting standards or even consideration in loan-level price adjustments. Traditional residential mortgages offer the potential to create the scale necessary for energy efficiency investment because they rely on the mainstream financial system. In addition, with more accurate information on risks, lenders may be able to develop and tailor mortgage products that better meet the needs of both consumers and investors

Data & Methodology

This study examines actual loan performance data obtained from CoreLogic, the lending industry's leading source of such data. A carefully constructed sample was developed of both ENERGY STAR (obtained from RESNET and other Home Energy Rating providers) and non-ENERGY STAR-rated single-family homes (other non-rated homes in the same Zip code), so that the distributions of loan, household, house and neighborhood characteristics of the two groups were similar (see Figure 1). These databases are merged with data from the American Community Survey for neighborhood characteristics, climate data from the National Climatic Data Center, and electricity prices from Open Energy Info accounting for privacy restrictions. We restricted the analysis to 30 year fixed rate mortgages, the first five years after origination and Loan-to-Value ratios between 50 percent and 150 percent. This resulted in a national sample of 71,062 loans, of which 35 percent were for ENERGY STAR homes.

Figure 1. Examples of distributional similarities in the covariates (FICO scores & Neighborhood Income) for ENERGY STAR and non-ENERGY STAR homes



There are two frameworks in the literature that explain the twin (prepayment and default) mortgage termination risks; financial benefit of options and trigger event considerations. Our study, like many others, uses a combination of these frameworks that accounts for local unemployment rates, loan-to-value ratio, borrower credit and wealth. To account for the possibility that borrowers might still default after the study period, hazard analysis techniques are used. To operationalize this, the econometric model takes the form of a multinomial logit model with a set of dummy variables representing the age of loan in months. In our models, we also account for state fixed effects.

The savings resulting from energy efficiency can be viewed as a cushion to unanticipated crisis or adverse events that could make mortgage repayment more difficult. It is also likely that homeowners in the market for efficient homes weigh the long-term savings derived from energy efficiency against the short-term higher costs, thus reflecting a higher degree of financial savvy. On the basis of the mortgage termination literature, we hypothesize mortgages on energy-efficient homes to have a lower probability of default than those on less efficient ones.

Results

We find that the odds of default for households in ENERGY STAR houses decrease by 32 percent and odds of prepayment decrease by 28 percent compared to non-ENERGY STAR houses. Furthermore, the greater the efficiency, the lower the risk of default. Controlling for other factors within the ENERGY STAR subsample, more efficiency, measured by a point decrease in the Home Energy Rating System (HERS) score, is associated with a decrease in the risk of default by 4 percent and in that of prepayment by 2 percent. This suggests that mortgages on more efficient homes exhibit even lower mortgage risks than those on their less-efficient but still ENERGY STAR-rated counterparts. For more details and complete results refer to Kaza et.al (2014).

Table 1. Selected Results from the model estimations with the inclusion of County Type variable. For full set of results, refer to Kaza et. al (2014).

	Base model				HERS model			
	prepay		default		prepay		default	
	estimate	odds ratio	default	odds ratio	estimate	odds ratio	estimate	odds ratio
ENERGY STAR Certification	-0.311*** (0.00001)	0.73	-0.380*** (0.00)	0.68				
HERS Index					0.021*** (0.001)	1.02	0.038*** (0.0001)	1.04
Mixed Rural	-0.191*** (0.00)	0.83	0.094*** (0.00)	1.10	-0.263*** (0.00001)	0.77	0.355*** (0.00)	1.43
Mixed Urban	-0.276*** (0.000)	0.76	0.002*** (0.00)	1.00	-0.359*** (0.00001)	0.70	0.207*** (0.000)	1.23
Urban	-0.409*** (0.00)	0.67	0.163*** (0.00)	1.18	-0.529*** (0.000)	0.59	0.379*** (0.000)	1.46

Note: *p<0.1; **p<0.05; ***p<0.01

To test the robustness of the results and the differences in the implications for different markets, we included a county type variable (Isserman 2005) in the models specified by Kaza et.al (2014). The coefficients in both the base model (with ENERGY STAR certification dummy variable) and HERS model (with HERS Index variable within the ENERGY STAR subsample) remain as previously reported (see Table 1). However, urban households are less likely to prepay and more likely to default than their rural counterparts. In the base model, the default risks for the mixed urban and mixed rural households are only marginally greater than those of rural households though substantially higher within the HERS model (ENERGY STAR subsample). Although the results suggest that mortgage risks are geographically uneven and are correlated with the development trajectory of the place, the effect of energy efficiency on mortgage risks is remarkably consistent.

Caveats

Future work needs to address a number of issues associated with this research. It is important to recognize that the energy savings of energy efficient homes may not cause the reduction in risk. What we have demonstrated in this work is the association between reduction in risk and energy efficiency, which could very well be reflective of the underlying borrower characteristics. Panel data that tracks the borrower's income and market conditions and that will allow us to tease these effects is not available. Many borrower characteristics such as income and employment status are not available in the dataset. We included a number of Zip code level variables as proxy for individual variables. Cognizant of ecological fallacy risks, we do not derive implications from the inclusion of these variables.

Future research also needs to examine additional measures of energy efficiency. While HERS can predict average energy costs in general, individual ratings, especially for older houses, are largely uncorrelated with the energy costs (Stein and Meier 2000). Therefore, better measures of energy savings could be considered in future studies to capture more fully its impact on mortgage risks. Future research should use a broader sample to study the effect on risk. Furthermore, other rating systems such as LEED and the National Green Building Standard which promote more comprehensive green building strategies could also be examined for their effect on mortgage risk. However, overall, we believe the findings in this paper are robust and consistent enough across different model specifications to warrant further examination.

Policy Implications

Because the findings are consistent across different model specifications and types of subsamples, we can derive a number of implications for policy and lending practices.

First, lenders may want to require information about energy costs and encourage an energy audit or energy rating during the process of mortgage underwriting. In the same manner that appraisals calculate the value of the home, an energy-rating determination could inform other important characteristics of the loan, including the debt-to-income ratio. Utilizing energy audits as part of the mortgage underwriting process would help homeowners make informed decisions about energy efficiency investments and likely promote long-term efficiency of the house.

Second, lenders and secondary market investors should take into account the energy efficiency of the home used as collateral for the loan in an underwriting decision. For instance, they may allow for a higher debt-to-income ratio and changes to appraisal guidelines to offset the modest increase in cost of energy improvements. This and similar approaches would allow borrowers to obtain the underwriting flexibility needed to cover the modest additional cost of the improvements. This step would increase affordability for many moderate- and middle-income borrowers. Moreover, when possible, lenders should consider an energy rating that accounts for degrees of energy efficiency.

In summary, the findings demonstrate that energy efficiency and the degree of energy efficiency matter. The lower risks associated with energy efficiency should be taken into consideration when underwriting mortgage risks. Major market stakeholders, such as FHA, Freddie Mac, and Fannie Mae, could encourage underwriting flexibility for mortgages on energy-efficient homes as well as promote energy efficiency to consumers in concert with their lending partners. Finally, Congress should consider the findings in its deliberations of the Sensible Accounting to Value Energy (SAVE) Act, the bill proposed to improve the accuracy of mortgage underwriting used by federal mortgage agencies, by ensuring that estimated energy cost savings are considered in the underwriting process.

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