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How effective are energy-efficiency incentive programs? Evidence from Italian homeowners☆

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ABSTRACT

We evaluate incentives for residential energy upgrades in Italy using data from an original survey of Italian homeowners. In this paper, attention is restricted to heating system replacements, and to the effect of monetary and non-monetary incentives on the propensity to replace the heating equipment with a more efficient one. To get around adverse selection and free riding issues, we ask stated preference questions to those who weren't planning energy efficiency upgrades any time soon. We argue that these persons are not affected by these behaviors. We use their responses to fit an energy-efficiency renovations curve that predicts the share of the population that will undertake these improvements for any given incentive level. This curve is used to estimate the CO_2 emissions saved and their cost-effectiveness. Respondents are more likely to agree to a replacement when the savings on the energy bills are larger and experienced over a longer horizon, and when rebates are offered to them. Reminding the respondents about possible CO_2 emissions reductions (our non-monetary incentive) had little effect. Even under optimistic assumptions, monetary incentives similar to those in the Italian tax credit program are generally not cost-effective.

1. Introduction and motivation

In recent years, many countries have implemented policies that offer incentives to encourage residential energy-efficiency upgrades. These typically include certain home renovations (such as insulation and new windows) and equipment (such as high-efficiency heating and cooling systems, and selected appliances). A major goal of these policies is to reduce the emissions of greenhouse gases associated with electricity generation and energy use in the home. Additional benefits include diminished reliance on fuel imports and reduced pressure on highly congested grids. Support for these policies is motivated by their large potential, as buildings account for some 30%–40% of all energy use, and by their alleged low or even negative cost (Choi Granade et al., 2009; Levine et al., 2007).

Despite the extensive reliance on these systems, little is known about their effectiveness at reducing energy use and the associated greenhouse gas emissions. Assessing incentive programs is inherently difficult because of adverse selection issues (people replace equipment at the end of its life; Sandler, 2012), free riding (people may install thermal integrity measures, but would have anyway, even in the absence of the incentives) and because these programs are likely to attract persons who are more productive at reducing energy use (Joskow and Marron, 1992). Unless these factors are appropriately accounted for, evaluations will typically overstate the effectiveness of the programs (Boomhower and Davis, 2013; Joskow and Marron, 1992).

Evaluating incentive programs requires answering three key, and related, questions. The first is how responsive households are to the incentive amount: In other words, by how much must the incentive be raised to result in the desired number of energy efficiency adoptions? Second, what is the reduction in energy use (and associated carbon emissions) that can be correctly ascribed to the program? Third, what is the cost (to households, taxpayers, and other parties) per unit of energy or carbon emissions avoided, and how does that compare with that of alternate policies?

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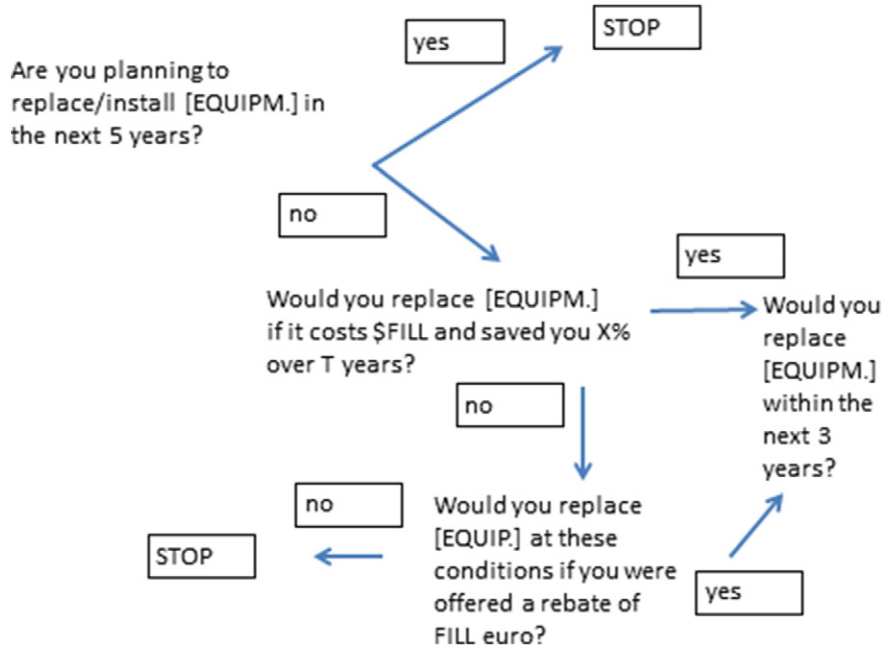

Fig. 1. Structure of the hypothetical questions.

Despite the extensive reliance on residential energy-efficiency incentives, the evidence about the first question is mixed and inconclusive (Boomhower and Davis, 2013; Hassett and Metcalf, 1995; Walsh, 1989). Identifying the energy use reductions that can be correctly attributed to incentive programs—the second key question above—is even more challenging. An important concern is free riding, which occurs when the economic agents targeted by the policy take the incentives, but would have done the home renovations or appliance replacements anyway. Blumstein (2010) and Vine et al. (2001) discuss the difficulty of recognizing free riders, and other studies have used a variety of approaches to estimate the shares of free riders in incentive-based programs (Boomhower and Davis, 2013; Grösche and Vance, 2009; Joskow and Marron, 1992; Malm, 1996). In practice, some studies simply assume free ridership away, others assume that the impact of free riders cancels out with other behavioral responses (Haberl et al., 1998), and others yet assume that a specific percentage of the program participants are free riders (e.g., Allaire and Brown, 2012).

Ignoring free riders overstates the cost-effectiveness of an incentive program—the third key question above—sometimes to a staggering extent (Joskow and Marron, 1992). Hartman (1988) establishes that the average conservation truly attributable to an audit program is only 39% of the savings calculated based on a naïve comparison between participants and non-participants. Waldman and Ozog (1996) study a specific "demand side management" (DSM) program and estimate that it only accounts for 71% of total energy conservation; the rest would have happened regardless. In Loughran and Kulik (2004), DSM expenditures are found to have reduced electricity usage at a cost per kWh that exceeds the price charged to the consumer.

In contrast, Gillingham and Palmer (2013) and Blumstein (2010) discuss free drivers, namely, persons who do not avail themselves of the incentives offered by a program, but choose to make energy-efficiency purchases because their awareness has been raised by the existence of the program. Alberini et al. (2013) report that climate change concerns and CO_2 emissions are important drivers of Swiss homeowners' decisions to undertake energy efficiency upgrades, at least as reported in a stated preference survey, and Ramseier (2013) finds that energy consultants exert an important influence in the nature and extent of actual energy efficiency home renovations in five cantons in Switzerland.

In this paper, we report the results of a study in which we gathered both revealed and stated-preference data from a sample of Italian homeowners. The survey was conducted in May–June 2013 through computer-assisted web interviews. Tax credits to help defray the cost of energy-efficiency home renovations have been available to Italian homeowners since the beginning of 2007. Until recently, specified energy-efficiency upgrades on existing homes and buildings, including heating system replacements, insulation, and new windows, qualified for 55% tax credits on the purchase and installation costs. From June 6, 2013 to December 31, 2013 (June 30, 2014 for renovations in communal parts of apartment blocks), the tax credits were temporarily increased to 65% of the purchase and installation costs.

The Italian Renewable Energy Agency (ENEA) reports that hundreds of thousands of tax credit claims have been filed every year since the inception of the program. Unfortunately, the Agency does not make the individual claim data available (Alberini et al., 2014; ENEA, 2009, 2010, 2011), which prevents us from studying the reasons for the energy-efficiency renovations and the responsiveness to the size of the incentives themselves. We circumvent this problem by developing a survey questionnaire to gather information about upgrades covered by the tax credits, their costs and characteristics. The questionnaire was administered online to a sample of Italian homeowners.

Since adverse selection and free riding are likely to be pervasive in the presence of energy-efficiency upgrades funded through incentives;

Table 1
Heating system replacements and monetary incentives in the sample.

Description	Frequency	Percent
Has replaced their heating system in 2007–2013	841	27.89
and received rebates or tax credits	244	29.01
Types of rebates or tax credits received		
36% Tax credits	9	3.69
55% Tax credits	158	64.75
Government rebate	40	16.39
Manufacturer, retailer, or installer rebate or discount	33	13.52
Other	4	1.64
Will change the heating system in the next 5 years	520	
Will not change the heating system in the next 5 years or doesn't know	1654	