Double moral hazard and the energy efficiency gap

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Abstract *(23 words)*

Moral hazard issues can deter profitable investments in energy efficiency. Energy-savings insurance and quality standards can mitigate the problem – yet not eliminate it.

Article *(1719 words)*

Are we missing opportunities for profitable investments in energy efficiency? As Adam Jaffe and Robert Stavins made clear in an influential paper in 1994, the answer could very well be 'yes,' provided that one can prove such investments are subject to market failures. Since then, economic analysis has sought to identify and quantify market failures that induce an 'energy efficiency gap,' i.e., a suboptimal level of energy efficiency investment.

In an ongoing project, we contribute to this line of research by examining information asymmetries, a classic market failure that has received little attention in the energy efficiency literature. This article summarizes early results, focusing on moral hazard issues and policy solutions to address them. It takes a broad perspective in which interactions between moral hazard and other market failures, such as environmental externalities, as well as other market barriers to energy efficiency (e.g., consumer heterogeneity) are taken into account.

How moral hazard can affect energy efficiency decisions

Moral hazard problems arise when one or several contracting parties take actions that are not fully observable to the others, but impact the final outcomes of the transaction. Such a situation is common in the context of energy retrofits for buildings. Our first result shows that when the actions of the contractors (i.e., installers of energy-saving technologies) are not fully observable, contractors will underprovide quality, and opportunities for further energy savings will be left untapped.

Consider a homeowner willing to insulate the walls in her house. She might be motivated by reducing her heating bill and, perhaps, by ancillary attributes unrelated to energy, such as cosmetic makeover or acoustic absorption. Suppose that the homeowner cannot perfectly observe the energy saving performance of the job completed by the contractor. That is, she does not have the technical skills to judge whether the insulation panels have been properly connected, although she is aware that any such defect will deter the thermal performance of the installation. Anticipating that the contractor is aware of her limitations, she will expect him to save on installation costs and perform the job poorly.

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Any claim that he will provide the highest quality, enabling her to maximize energy savings, will be considered ‘cheap talk’ by the homeowner. We show that the contractor will not deviate from these expectations and indeed complete the lowest possible quality job. Absent policy intervention, quality will not be contractible and thus underprovided. This conclusion holds irrespective of the structure of the market, from a competitive industry with free entry, which is the most likely case (Zabin et al., 2011), to a monopolistic industry.

Were energy performance perfectly observable, the homeowner would demand the level of installation quality that reduces her marginal energy expenditure up to the marginal benefit she derives from space heating. Outside this condition, the contractor does not internalize the benefits his actions provide to the homeowner and a wedge arises between social and private surplus. The wedge gets larger if, in addition to the moral hazard, one considers the environmental externalities associated with energy consumption.

Such quality problems might be substantial and affect any energy end-use technology for which installation is a significant input, such as HVAC systems or window replacements. As of 2008, only 15% of central air conditioning installations in existing dwellings met satisfactory quality specifications in California (Messenger, 2008). In the commercial sector, where retrofit projects are deployed over a large scale, the gap can be sizeable. Overall, the energy savings that would thereby remain untapped could be around two quadrillion end-use BTUs. This is a lower bound of the contribution of building shell and HVAC system improvement in existing buildings to the technical potential for energy efficiency in the U.S. by 2020, as assessed by McKinsey&Co. (2009).

Government intervention: Conditions, instruments and efficiency

A natural conclusion to the demonstration that the moral hazard induces an energy efficiency gap is that some government intervention is justified. We show, contrary to normal intuition, that addressing a moral hazard might not always be warranted in a world with large environmental externalities.

Internalizing environmental externalities is always desirable, regardless of whether or not the contracting parties overcome the moral hazard. Social welfare cannot be maximized as long as the parties do not account for the broader externalities produced by their actions. However, the reciprocal is not necessarily true: If environmental externalities are not (or cannot be) internalized, then it might be desirable to maintain, rather than undo, the moral hazard. Though unlikely, this can actually occur if the ‘rebound effect’ (i.e. the elasticity of the demand for energy service with respect to energy efficiency) is beyond a certain level, which can be derived analytically. In this case, if solving the moral hazard leads to noticeable improvements in energy efficiency, then energy consumption could actually increase. As a result, environmental externalities would be larger.

Notwithstanding this extreme and rare ‘backfire’ situation, we can consider that environmental externalities are internalized through energy price, so that we only need to worry about the moral hazard. Now, what policy instrument can fix it?

A social planner would like to get the contractor to provide the optimal level of quality and the homeowner to consume the optimal quantity of energy service. This could be achieved by a quality standard forcing the contractor to offer the level of quality that is optimal to a representative consumer. Yet such an instrument suffers from the classic criticism that it abstracts from heterogeneity in consumer valuation of energy service. Take, for instance, an owner who visits her vacation home infrequently, thus consuming little heat there. The price of a high quality retrofit to save energy would be in excess of what is optimal to her. Now if the stringency of the standard is below what would be optimal to the consumer, as long as performance remains unobservable to her, the contractor will not offer more than the standard.

Besides regulatory instruments, one might think of incentive-based mechanisms. Energy-savings insurance, whereby the contractor bears a share of the consumer's energy bill (perhaps above a certain threshold), is one example. Such a contract, however, is subject to a second moral hazard: Lowering the marginal energy expenditure to the consumer decreases her marginal benefit. She may increase her consumption of energy service by setting her thermostat to a higher temperature, knowing that the contractor will have to pay some of the cost. The contractor would provide optimal quality if he fully insured the savings to minimize insurance payouts, but energy service would be consumed optimally by the consumer were she not insured. As a result, the only insurance that can be sustained in equilibrium features incomplete coverage and only brings about a second-best outcome.

In the end, in such context where both parties can take hidden actions, the only way to bring about the first-best outcome is to involve a perfectly informed third-party (perhaps with the help of a smart meter). This is very unlikely to be implemented, however, as it would incur prohibitive transaction costs.

The instruments described are already available in the marketplace. Various types of quality certifications exist, most notably those provided by the Building Performance Institute (BPI) and the Residential Energy Services Network (RESNET). Likewise, energy-savings insurance has been present in the commercial sector for about twenty years (Mills, 2003), and has started to appear in the residential sector (see for instance Green Homes America). As normative analysis just showed, these instruments cannot fully establish economic efficiency. This does not mean, however, that they cannot improve welfare.

Assigning numbers: Size of the gap and policy effectiveness

To get a sense of the magnitude of the problems studied, we have developed an analytical model of insulation sales that is calibrated to the U.S. market. Numerical assumptions are detailed in Box 1.

BOX 1

We find that social welfare (measured as the sum of consumer's utility and firm's profit) derived from space heating consumption could be doubled, were both moral hazard and energy externalities fixed. Simply undoing the moral hazard closes about two-thirds of the gap. The results are displayed in Figure 1 in a Jaffe & Stavins-like 'energy efficiency gap diagram' (welfare vs. energy efficiency), as well as in an 'energy gap diagram' (welfare vs. energy consumption).

FIGURE 1

When it comes to policy instruments, quality standards of different stringencies (each based on what would be optimal for one specific representative consumer) will yield different welfare improvements. Yet one level could bring society remarkably close to the first-best outcome. Comparatively, energy-savings insurance achieves lower welfare gains on average. Still, those can be non-negligible in absolute value, amounting to 15% of the welfare enjoyed in the *laissez-faire* situation. This is achieved through optimal insurance coverage as low as 13% on average. These results are displayed in Figure 2.

FIGURE 2

Conclusions

Our analysis suggests that moral hazard can induce a significant energy efficiency gap. This insight is relatively new. Most of the literature has concluded that it was hard to find market failure explanations for the abnormally high implicit discount rates observed in energy efficiency decisions, which can be seen as a manifestation of the energy efficiency gap (Gillingham et al., 2009; Allcott and Greenstone, 2012). While these studies have focused on the role of possible undervaluation of energy efficiency by consumers, ours underlines that the behavior of the firms should not be excluded from the analysis.

In terms of policies to address moral hazard, we show that the first-best outcome can only be attained to the extent that energy performance can be made perfectly observable. Since no technology can meet that goal, government intervention will only generate a second-best outcome, even though it can get very close to the first-best. Our numerical simulations suggest that the various types of quality certifications already implemented may be worthwhile, although more empirical support is needed to determine whether they are set at satisfactory stringency levels and what administrative costs they incur. Energy-savings insurance may not perform as well as quality standards. Still, even with modest coverage insurance products could deliver welfare gains that should not be disregarded. This is perhaps itself a paradox that firms in constant search of new marketing strategies have not relied more heavily on such schemes.

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BOX 1

A homeowner of median income is assumed to live in a house of average size. She consumes natural gas for space heating with a price-elasticity of -0.8 and responds to energy efficiency improvements with a 20% rebound effect (which is below the 'problematic' range mentioned in the text). When considering an insulation project, she discounts future energy expenditures over ten years (which is close to the duration of either average house occupancy or energy-savings insurance contracts), at a 7% discount rate and using a constant natural gas price of $12 per thousand cubic feet. She contracts with an insulation contractor who allocates three installers a day. Job completion takes at least one full day. At this input level, job is sold $2,400 and expected energy savings are 5%. Performance increases as installers work longer and mobilize higher skills, up to 25% for three-day operation. Workers are paid $5 an hour at the end of the first day and wages escalate to $30 at the end of the third day. From a social perspective, it is assumed that energy consumption produces, over 30 years (which is the physical lifetime of energy efficiency investments), CO_2 emissions that cause damages worth $30/t$CO_2$ in constant annual present value.

FIGURE 1

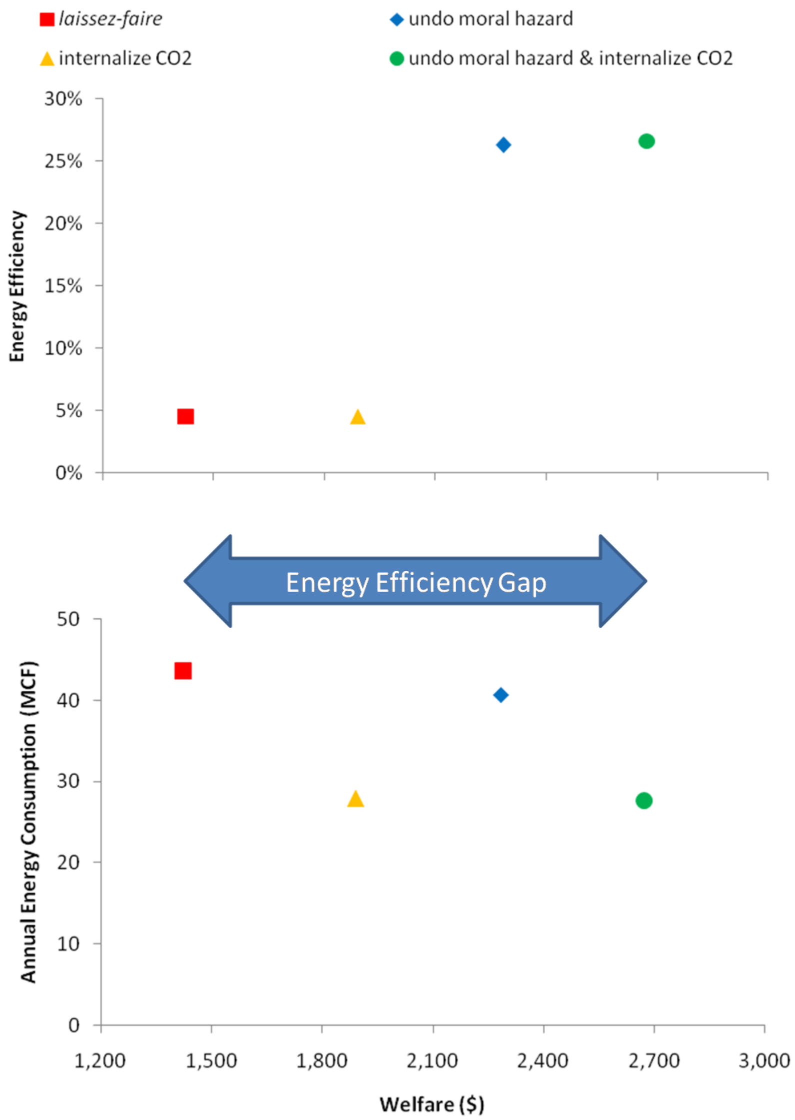
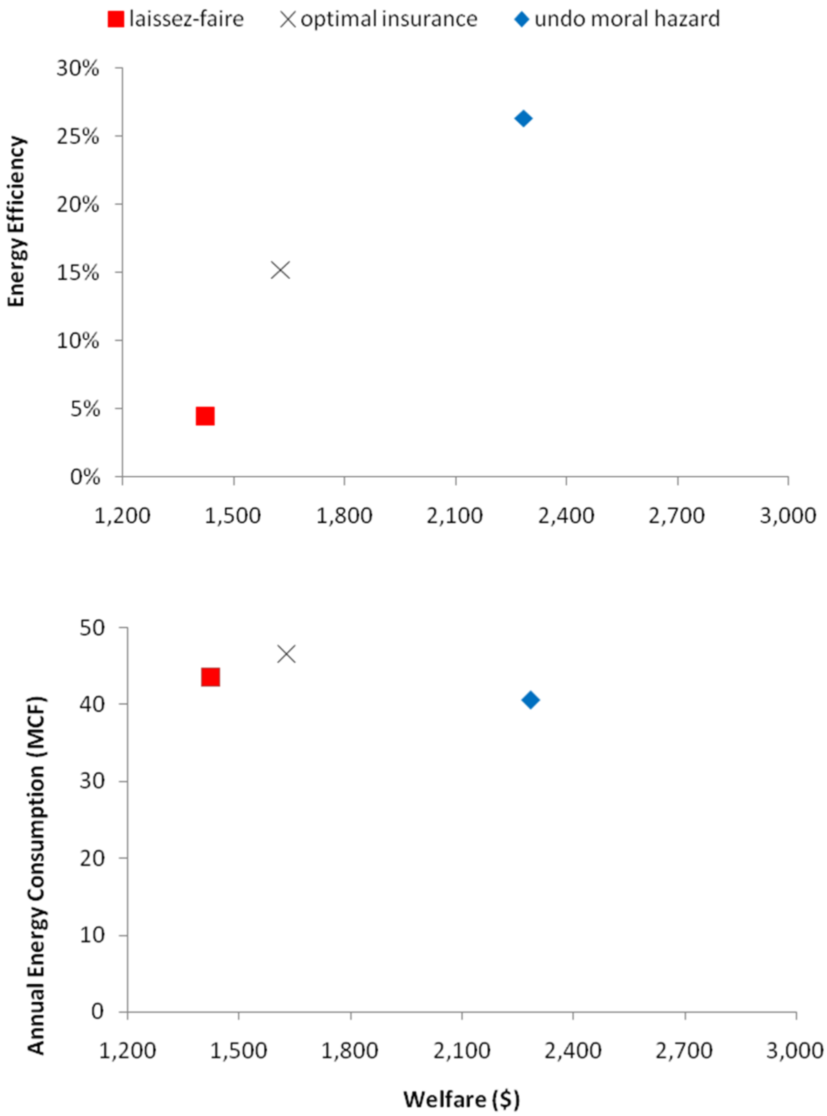


FIGURE 2



laissez-faire
optimal insurance
undo moral hazard
Energy Efficiency
30%
25%
20%
15%
10%
5%
0%
1,200
1,500
1,800
2,100
2,400
2,700
3,000
Annual Energy Consumption (MCF)
50
40
30
20
10
0
Welfare ($)