Comments on the July 2012 Revision of "Is There an Energy Efficiency Gap?"

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An ACEEE White Paper

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Abstract

“Is There an Energy Efficiency Gap?” is the title of a recent article by Hunt Allcott and Michael Greenstone (201a2) published in the *Journal of Economic Perspectives* and posted in revised form at the Social Science Research Network (Allcott and Greenstone 2012b).

In their paper, Allcott and Greenstone examine energy efficiency policies and specifically “whether there are investment inefficiencies that a policy would correct.” They conclude that “a reliance on observational studies of variable credibility and the possibility of unobserved costs and benefits of energy efficiency make it difficult to assess the magnitude of the Energy Efficiency Gap definitively. Nevertheless, the available evidence from empirical analyses of weatherization, demand-side management programs, automobile and appliance markets, the ‘landlord–tenant’ agency problem, and information elicitation suggests that while investment inefficiencies do appear in various settings, the actual magnitude of the Energy Efficiency Gap is small relative to the assessments from engineering analyses.”

In this paper, we review their evidence in each of these six areas and find that while the authors have some useful points to make, in general they interpret available data in ways that best support their points, downplaying other important findings in the various articles they cite. For example, in much of the research they cite, they emphasize results using the highest discount rates analyzed in a paper. When the data are examined more broadly, their argument that “the Energy Efficiency Gap is small” does not stand up to scrutiny.

Allcott and Greenstone end with a policy discussion raising objections to the use of incentives and standards to address externalities in otherwise perfectly functioning markets. However, perfect markets are not the environment in which energy efficiency policies are proposed, and externalities are only one of the rationales for policy intervention. As they acknowledge, energy efficiency policies such as standards can be very cost-effective when there are investment inefficiencies.

Introduction

"Is There an Energy Efficiency Gap?" is the title of a recent article by Hunt Allcott and Michael Greenstone (2012a) published in the *Journal of Economic Perspectives*. We previously critiqued this article (Nadel and Langer 2012). In response, Allcott and Greenstone (2012b) posted their paper in revised form at the Social Science Research Network. We are now revising our paper to address this new version.

In their paper, Allcott and Greenstone examine energy efficiency and specifically "whether there are investment inefficiencies that a policy would correct." They conclude that "a reliance on observational studies of variable credibility and the possibility of unobserved costs and benefits of energy efficiency make it difficult to assess the magnitude of the Energy Efficiency Gap definitively. Nevertheless, the available evidence from empirical analyses of weatherization, demand-side management programs, automobile and appliance markets, the 'landlord–tenant' agency problem, and information elicitation suggests that while investment inefficiencies do appear in various settings, the actual magnitude of the Energy Efficiency Gap is small relative to the assessments from engineering analyses."

We have reviewed this article and while, as discussed below, the authors have some useful points to make, in general they interpret available data in ways that best support their points, downplaying or ignoring other findings in the various articles they cite. For example, when a paper they cite uses several different discount rates, Allcott and Greenstone generally use only the higher discount rates reported. Allcott and Greenstone end with a policy discussion raising objections to the use of incentives and standards to address externalities in otherwise perfectly functioning markets, but perfect markets are not the environment in which energy efficiency policies are proposed and externalities are only one of the rationales for policy intervention.

This ACEEE white paper is intended as a short response to the latest version of Allcott and Greenstone's paper. We organize our response by examining their arguments in the six categories of evidence summarized in their conclusion. Following this we make a few additional comments.

Weatherization

Allcott and Greenstone examine the results of evaluations of the federal low-income Weatherization Assistance Program (WAP), citing Schweitzer (2005) who examined many WAP evaluations and found that the average weatherization job costs $2600 and reduces natural gas use by $260 per year. Allcott and Greenstone then go on to say that "if the $260 annual savings… are assumed to have a lifetime of 10 years or less, then weatherization does not pay back the $2600 cost at any positive discount rate. At lifetimes of 15 or 20 years, the discount rate that equates future discounted benefits with current costs is 5.6 or 7.8 percent respectively."

However, the ten-year life comes from Allcott and Greenstone—Schweitzer uses 20 years. Sumi and Coates (1989), which Allcott and Greenstone mention in a footnote, found a 14% cumulative degradation in savings after 6 years following weatherization. At this level of attrition, after 20 years, 59% of the savings will still be achieved, lending support for an average measure life of at least 20 years and not the 10 or 15 years Allcott and Greenstone suggest. Furthermore, Schweitzer uses a 2.9% discount rate, citing a circular from the U.S. Office of Management and Budget (OMB), significantly less than the discount rate Allcott and Greenstone support. Also, in addition to direct energy bill savings, the WAP program can make homes warmer and less drafty, making residents more comfortable. Allcott and Greenstone note these potential benefits, but do not incorporate them into the economic calculations. There is a significant literature on quantifying non-energy benefits of weatherization (Amann 2006) and including such benefits in a sensitivity case would be worthwhile.

Likewise, Allcott and Greenstone discuss a study by Metcalf and Hassett (1999) that estimates the returns on attic insulation, finding an average annual return of about 10%, but also noting that one-quarter of households have returns of 13.5% or more. Allcott and Greenstone then argue, based on a theoretical selection model, that households that have already adopted attic insulation are in the higher group and therefore that average returns for those that have not yet insulated will have returns less than 10%. We recommend leaving such arguments to empirical data and not theory.

Demand-Side Management Programs

Allcott and Greenstone look at utility demand-side management programs, referring in particular to a study "by Arimura, Li, Newell, and Palmer (2011), whose point estimates indicate that between 1992 and 2006, demand-side management conserved electricity at a program cost of 5.0 and 6.1 cents per kilowatt-hour, assuming [real] discount rates of 5 and 7 percent, respectively." They relegate to a footnote that Arimura et al. also provide analyses at discount rates of 0% and 3%, which yield average cost of energy savings of 3 and 4.1 cents per kilowatt-hour (kWh), respectively. Furthermore, Arimura et al. use an approach that includes the costs of free riders in their calculations but not the savings achieved by these free riders (free riders are program participants who would have made efficiency investments even if a program were not offered). Typically free riders are either fully included (both costs and benefits counted) or fully excluded (neither costs nor benefits counted). It is also worth noting that Arimura et al. arrive at a higher estimate of DSM costs than some other studies. For example, as noted by Allcott and Greenstone, Friedrich et al. (2009) estimate an average cost to the utility of 2.5 cents per kWh saved based on a review of program data in 14 states. Allcott and Greenstone imply that Friedrich et al. use primarily engineering estimates of savings but in fact the Friedrich et al. work is based on a mix of statistical analysis of energy bills and engineering estimates.

Most utility commissions use the weighted average utility cost of capital for the discount rate when evaluating demand-side management programs in order to use the same discount rate for both demand-side and supply-side resources (e.g., new power plants) since demand-side programs are an alternative to building new power plants. An analysis of cost of capital by Damodaran (2012) finds that for electric utilities, as of January 2012, the average cost of capital was about 4.23% nominal. In 2011, the GDP deflator was 2.1%, meaning that the average cost of utility capital is 2.1% real, far less than the 5% and 7% figures Allcott and Greenstone use. While cost of capital is particularly low at present, due to the Great Recession, it is also rare for cost of capital for financing power plants to be as high as 7% real.

Allcott and Greenstone go on to argue that these are only the utility costs of energy efficiency measures and consumer contributions to these costs should be added to the calculations. While this argument is correct if we are only considering efficiency economics from the consumer point of view (which is Allcott and Greenstone's perspective), this argument ignores the fact that demand-side management programs are offered by utilities because they are less expensive to utilities (and hence their ratepayers) than new power plants. A recent analysis by Lazard (2011) found that power from new power plants costs from 6.9–9.7 cents for natural gas combined cycle plants per kWh levelized over the life of the plant, from 7.8–15.5 cents for coal, and from 7.7–11.3 cents for nuclear, making energy efficiency programs that cost utilities 4 cents per kWh or even 6 cents per kWh a bargain.

Automobile Markets

Current federal proposals to increase fuel economy standards are based on detailed engineering analysis of the potential for cost-effective technological improvements. Allcott and Greenstone express skepticism with regard to engineering analyses of efficiency potential generally, citing two flaws that they may contain: first, that they ignore unseen and unquantified attributes (‘ξ’) of the product that could introduce a loss of utility with increased efficiency; and second that the analyses do not correspond to real-world savings. There are of course diverse factors in consumers’ assessment of vehicle utility. Given the recent transformation of Corporate Average Fuel Economy (CAFE) standards to size-based standards, however, and the fact that the agencies assess technological potential for efficiency while holding performance constant, there is no good candidate for such losses in utility under improved CAFE. The second concern is not relevant to today’s analyses of fuel economy potential, which are quite comprehensive and supported by high-grade modeling work.

Allcott and Greenstone cite four papers that “use different models to show that the current and proposed CAFE standards are much more stringent than can be justified by even worst-case estimates of investment inefficiencies.” One of these papers, Allcott and Wozny (2011), makes an empirical estimate that consumers value 72 cents of each dollar of discounted fuel savings in making vehicle purchase decisions, which strongly influences the conclusions of the paper. The authors acknowledge considerable uncertainty in this estimate, however, and surveys of consumer willingness to pay for higher fuel economy indicate far greater implicit discounting of future fuel savings (Greene et al. 2009). Moreover, the paper’s conclusions regarding justifiable fuel economy increases rely on the representation, for modeling purposes, of CAFE standards as a “behavioral feebate” in which consumers merely shift their selections among existing vehicle models. The mechanism by which standards will increase fuel economy is not by shifting market shares of existing vehicles, however, but rather by inducing manufacturers to add efficiency technologies to their products.

Two other papers cited cannot plausibly be said to demonstrate that current and proposed CAFE standards are too stringent. Fischer, Harrington, and Parry (2007) published before these standards were formulated. The paper discusses the welfare gains or losses of a 4-mile-per-gallon increase in CAFE under various assumptions about consumer valuation of fuel savings, finding positive gains in one of three scenarios, namely the “short horizon” scenario, in which consumers value only three years of fuel savings. The remaining two scenarios are: (i) the “farsighted consumer” scenario, in which the consumer fully values fuel savings; and (ii) the “high discount rate” scenario in which the consumer values 14 years of fuel savings at a private discount rate of 14 percent. The finding of positive welfare impacts for the “short horizon” scenario is robust under the sensitivity case of an 8-mile-per-gallon CAFE increase, and no further CAFÉ increases are considered in their analysis. Allcott and Greenstone apparently regard the “short horizon” scenario as beyond the “worst-case estimates of investment inefficiencies,” and Allcott’s research (Allcott 2012 and Allcott and Wozny 2011) does indeed support this view. Yet this scenario in fact would be regarded as the most plausible by many knowledgeable parties. As Fischer, Harrington, and Parry notes, this is the view often articulated by auto manufacturers and is one of the two scenarios considered in the 2002 National Academy of Sciences panel report on fuel economy (NRC 2002). Moreover, while the Fischer, Harrington, and Parry paper is generally ambivalent about fuel economy standards, it raises a critical question of whether standards lead to technological improvements that would not otherwise be developed by manufacturers, and acknowledges that the modeling done for the paper would not detect such a benefit.

The third paper (Heutel 2011) also cannot reasonably be said to find that current and proposed CAFE standards are too stringent. The point of the paper is to show that “when consumers exhibit present bias and are time-inconsistent, Pigouvian pricing is suboptimal," a point with which we certainly concur. The author ran a simulation for illustrative purposes, using an expression for vehicle cost as a function of fuel economy based on two data points. As Allcott and Greenstone explain in a footnote, Heutel calculates the increase in fuel consumption that follows from a 30 percent consumer undervaluation of fuel savings, and finds it to be very small. However, Heutel simply assumes the 30 percent figure, the value of which is not central to his argument. Given this, and absent a more sophisticated and up-to-date fuel economy/cost relationship, it is not appropriate to assign importance to the particular CAFE values generated by the simulation. Indeed, Heutel states in concluding that "the purpose of this simulation is not to pin down optimal policy point estimates, but rather to provide an idea of the magnitude of the effects of time-inconsistency on policy prescriptions."

We note that Heutel does indeed find that a fuel economy standard in isolation is, of the five policy approaches considered, the furthest from optimal, while a fuel economy standard with gasoline tax is a "first-best" option in certain circumstances. We do not doubt that a well-timed gasoline tax could be a useful complement to fuel economy standards. However, Heutel does not make the case that CAFE is worse than no policy, and the companion policies (e.g., gas tax and carbon tax) are unlikely to be adopted at this time. Furthermore, given that the projected benefits associated with the proposed CAFÉ standards are overwhelmingly from net consumer savings rather than the reduction of externalities, the gains from CAFE alone are likely to be a large fraction of the benefits that could be obtained from CAFE together with a tax.

The last paper Allcott and Greenstone cite on this point (Allcott 2012), as well as Busse, Knittel, and Zettelmeyer (2012), which they cite earlier on, provide interesting evidence that consumers do not significantly underestimate the value of fuel economy. On the other hand, a recent review of studies on this topic (Greene 2010) found: "The 28 studies reviewed are approximately equally divided between those that imply that consumers significantly undervalue future fuel savings in their car buying decisions and those that find that they either approximately fully value or significantly over-value them." So certainly there is a diversity of views on this point, a fact that any overview of the subject should acknowledge.

It is important also to mention that consumer undervaluation of fuel economy is by no means the only reason to regulate fuel economy. As Allcott notes: "[T]here may be other sources of inefficiency, such as naive present bias … or inattention to fuel economy as a product attribute" (Allcott 2012). Fuel economy standards can also help to address supply-side failures in the vehicle market. Consumers cannot purchase efficient vehicles that meet their requirements if manufacturers do not produce those vehicles. Various explanations have been offered of why manufacturers might fail to produce vehicles that customers would buy (e.g., first mover costs) or produce such technologies more slowly than the optimal rate (EPA and NHTSA 2011).

Appliance Markets

Allcott and Greenstone cite two papers from the 1970s and 1980s that estimate "implied discount rates" for consumer purchases of room air conditioners and heating systems of 15–25%. Implied discount rates seek to understand observed consumer behavior without trying to understand what causes this behavior. Such rates have been discussed for decades. However, as Geller (2005) writes in a study for the International Energy Agency, "the observation that there are high implicit discount rates in the marketplace is simply a restatement of the existence of the energy efficiency 'gap'."

The "Landlord–Tenant" Agency Problem

Allcott and Greenstone also investigate information on efficiency of rental versus owner-occupied housing. Frequently costs are split in some way between owners and tenants, decreasing the incentive for either owners or tenants to invest in efficiency. For example, owners generally purchase heating equipment and often purchase appliances. Frequently tenants pay electrical bills and often they pay heating bills as well. Allcott and Greenstone cite two studies that they purport shows that even for rental property, the efficiency gap is small.

For example, they report that Davis (2010) found that "renters are 1 to 10 percentage points less likely to report having Energy Star appliances…, [which] represent between 5.6 and 68 percent of the overall average Energy Star saturation rate." They go on to say that "because non-renters are themselves not very likely to own Energy Star appliances and because appliances make up only one-quarter of residential energy use, the differences in appliance ownership do not add up to a large difference in energy use; [we] calculate that if renters had the same energy efficient appliance ownership rates as owner-occupied homes, total energy bills in rental homes would be 0.5 percent lower." However, this small result is because they only looked at a minority of energy use and only from an energy efficiency measure with modest savings (typically around 15% savings among the roughly 35% of consumers who purchase Energy Star). Energy Star appliances are useful, but they are only a very small portion of available energy efficiency savings opportunities.

Likewise, Allcott and Greenstone cite a study by Gillingham et al. (2012) that found that owner-occupied houses in California are 12–20% more likely to have insulation than rentals. They then state: "Under the optimistic assumption that insulation reduces total energy demand by 10 percent, this implies that rental properties would use 1.2 to 2.0 percent less energy if insulated at the same level as owner-occupied properties." The 10% and 1.2–2.0% estimates are from Allcott and Greenstone, not the original paper. More importantly, the modest difference in insulation between rental and owner-occupied homes is likely a consequence of California's strong building codes that mandate insulation levels for both rental and owner-occupied homes, a factor they mention but state tentatively.

Information Elicitation

Allcott and Greenstone also discuss several studies that show that consumers are not very good at calculating the gasoline costs for different automobiles and that consumers were more responsive to energy prices in their room air conditioner and water heater purchase decisions after Energy Guide labels for these products were introduced. But they downplay these results as providing only limited information, looking instead for "large-scale randomized evaluations of energy efficiency information disclosure." We agree that such studies would be useful, but other studies should not be dismissed out of hand.

To provide several additional examples that they do not cite:

- Attari et al. (2010) find that for a sample of 15 activities, participants underestimated energy use and savings by a factor of 2.8 on average, with small overestimates for low-energy activities and large underestimates for high-energy activities.
- Thorne and Egan (2002) examine U.S. appliance efficiency labels via a set of consumer focus groups, in store interviews, a consumer survey, and a shopping experiment. They find that many U.S. consumers found the U.S. Energy Guide label difficult to understand and use, that many countries have found categorical labels (e.g., rating products as one star, five star, etc.) easier to understand and use and more effective than the U.S.-style continuous label, and that

most U.S. consumers found an optimized stars-based categorical label superior to an optimized continuous label in terms of visual appeal, attention-grabbing ability, ease of understanding and use, and motivating ability.

- The Institute for Market Transformation (2010), in a white paper, summarizes the results of six studies on the impact of Energy Star labels in U.S. commercial buildings, finding that Energy Star labeled buildings had higher occupancy rates, higher rental rates, and higher sale prices, with the Energy Star premium varying from 1.3–15.5% depending on the study and the metric.
- Kok and Kahn (2012), in a just-published economic analysis of 1.6 million homes sold in California between 2007 and 2012, found that homes labeled by Energy Star, LEED, and GreenPoint sell for 9% more (+/-4%) than comparable non-labeled homes, after controlling for other variables known to influence home prices.

Taken together, these various studies clearly show that many consumers are poorly informed about energy efficiency choices and improved information can make a difference, a conclusion we suspect Alcott and Greenstone might agree with.

Discussion

Allcott and Greenstone interpret available data in ways that best support their points, downplaying other important findings in the various articles they cite. To begin the section on the policy implications of their findings, they argue that "[w]hen no investment inefficiencies exist, energy efficiency policies such as subsidies for energy efficient durable goods and minimum energy efficiency standards would have larger welfare costs per unit of pollution abated compared to the first-best Pigouvian tax…" (taxing things we want to discourage, such as pollution). But many readers will miss the qualification about "no investment inefficiencies." Situations in which there are no investment inefficiencies are beside the point because energy efficiency policies are proposed precisely when there is reason to believe that large investment inefficiencies exist. The authors raise the example of CAFE standards, even though the benefits attributed to those standards are overwhelmingly net savings to car buyers, not the reductions in externalities that might be best addressed through a Pigouvian tax. That a gas tax would be a less expensive approach to carbon abatement than CAFE standards absent investment inefficiencies, a finding attributed to Jacobsen (2010), is irrelevant to the real-world policy context, in which fuel economy standards are designed to address those inefficiencies.

The second paper the authors cite to demonstrate the high cost of efficiency standards is an analysis by Krupnick et al. (2010) that examines the Waxman-Markey cap-and-trade bill. According to Allcott and Greenstone, this study finds that "the cap-and-trade, or an equivalent carbon tax, abates carbon dioxide at a welfare cost of $12 per ton. Under the assumption that there are no investment inefficiencies, the energy efficiency standards [in Waxman-Markey] are five times more costly, or $60 per ton." What they leave to a footnote is that Krupnick et al. look at two different discount rates to evaluate standards—20% real (the values Allcott and Greenstone cite, labeled "no market failure" by Krupnick et al.) and 5% real. At the 5% discount rate, Krupnick et al. find that appliance standards have a cost of only $7 per ton, substantially less than the cap-and-trade program. While we agree that Pigouvian taxes can be useful (see Nadel and Farley 2011), they do not solve all problems—other policies are needed as well.

Interestingly, as discussed above, one of the papers Allcott and Greenstone cite, a paper by Heutel (2011), makes a similar argument. Heutel's key conclusion, as noted in the first sentence of his abstract, is that: "When consumers exhibit present bias and are time-inconsistent, the standard solution to market failures caused by externalities—Pigouvian pricing—is suboptimal."

This is a point where ultimately Allcott and Greenstone and we agree. In a footnote to their revised paper Allcott and Greenstone state that "energy efficiency policies can increase welfare then there are investment inefficiencies." It is also worth noting that externalities and information gaps are not the only rationales for energy efficiency policies. As noted earlier in the discussion of the cost of utility energy efficiency programs, utilities offer these programs because they are less expensive than new power plants. Also, as discussed above about automobiles, energy efficiency policies help address inefficiencies that affect manufacturers, spurring manufacturers to develop higher efficiency vehicles than if there were no regulation. These give consumers more choices and economies of scale help to reduce the price to consumers of these efficiency improvements. The same applies to product standards. For example, lamp manufacturers knew how to produce more efficient incandescent lamps, but did not bring these products to market until lamp efficiency standards were enacted.[1] Likewise, clothes washer manufacturers have brought a wide-variety of highly efficient products to market in the past decade, which save energy and clean clothes better,[2] in response to increased efficiency standards, Energy Star specifications, and tax credits for "super-efficient" products.

Allcott and Greenstone also argue that consumers are heterogeneous, and that policies should be tailored to address this. For example, they argue that appliance standards for heating and cooling equipment should be different in Chicago than in Los Angeles. We tend to agree and, for example, successfully advocated that the latest standards for furnaces and central air conditioners vary between the North and South. However, customizing policies also has costs and a balance needs to be found between ease and cost of implementation and addressing heterogeneity, a point Allcott and Greenstone note in the new version of their paper. For example, with furnace and air conditioner standards, the entire country was divided into two zones (heating) and three zones (cooling) to make implementation manageable, and not the dozens of climate zones that could have been used.

Finally, Allcott and Greenstone argue that additional rigorous empirical work is needed, utilizing randomized controlled trials and quasi-experimental techniques. In fact, Allcott and Greenstone (together and separately) now have two such projects underway. We agree that further study would be useful. Randomized controlled trials can be very useful, but these can be hard to do in the "real world" as they can be expensive and hard to fit in around other programs that are serving the same customers. Thus, while we support randomized control trials where possible, we believe that they can and should be complemented with careful evaluations of consumer responses to existing programs relative to a control group of non-participants. There are hundreds of current programs that could be evaluated in this way, providing useful information to design the most effective energy efficiency programs.

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