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What is important when modeling the economic impact of energy efficiency standards?

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ABSTRACT

Energy efficiency standards are often cited as a potential economic driver for states that implement them. We identify the major factors that need to be included when determining the economic impact of energy efficiency standards and discuss how these determinants may be incorrectly estimated or ignored within the economic impact literature. Finally, we find that there is a tendency to over-estimate the economic impact of energy efficiency standards and that any jobs created may come at the cost of reduced employment in relatively well-paid sectors.

1. Introduction

Improvements in energy efficiency, with a focus on electricity usage, occur when the total amount of electricity required to produce a *given* amount of a good/service or to achieve a particular outcome decreases. In effect, energy efficiency reduces the electricity-intensive nature of the particular production process in question. For instance, the installation of a new, more efficient,[2] air-conditioning (AC) unit would require less electricity to cool a home to a particular temperature than an older and less efficient system.

Many energy efficiency advocates argue that increased levels of energy efficiency generated via the introduction of an energy efficiency standard provides a "win–win–win" situation. That is, that energy efficiency is cost effective, clean and creates numerous jobs.

Leaving questions to one side about the first two "win situations" and why regulation is needed in the first place to encourage improved energy efficiency adoption if it is reportedly such a "good idea",[3] the purpose of this paper is to examine in more detail the claims of the final point.

To examine how energy efficiency may lead to improved economic outcomes such as creating jobs, identification of the major determinants or "drivers" of job creation via the adoption of energy efficiency standards is required. Once this identification process is completed we will then be able to highlight how an over/under estimation of the true economic impact associated with energy efficiency standards may occur.[4]

This type of analysis is important if credible results are going to be estimated. Croucher et al. (2010) examined numerous different reports that looked at the economic impact of introducing various different technologies, including increased adoption of energy efficiency measures, to reduce carbon emissions. They show that studies that estimate improved environmental outcomes as well as positive impacts on economic activity rely on dubious assumptions surrounding renewable energy costs and/or over-estimation of the overall economic benefits from energy efficiency.

Section 2 lays out a more complete method for estimating the economic impact of energy efficiency and discusses how the identified determinants may be incorrectly estimated or ignored within the literature. Section 3 examines the performance of an often-cited study that estimates the economic impact of energy efficiency in the Southwestern States of America. Section 4 provides some conclusions.

2. Modeling the economic impact of energy efficiency

Improvements in energy efficiency are often put forward as a potential driver of increased economic activity within a state. To

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[1] The views expressed herein are those of the author and do not necessarily reflect the views of Arizona State University.

[2] The efficiency of an air-conditioning unit can be described by its Seasonal Energy Efficiency Ratio (SEER) rating. The higher the SEER value the more efficient the unit. See the Department of Energy (DOE) for more details.

[3] See Croucher (2010c) for some discussion on these questions.

[4] Or may already have occurred.

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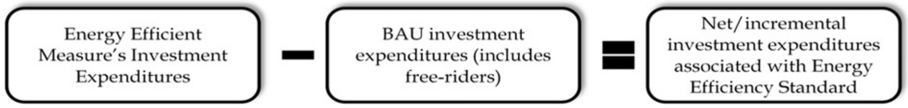

Fig. 1. Estimation process for calculating investment expenditures.

get a more detailed and complete picture of how the adoption of energy efficiency measures may impact an economy generally requires using an economic impact model such as IMPLAN or REMI.

Economic impact models such as IMPLAN and REMI are relatively sophisticated input–output (IO) models.[5] These mathematical models attempt to characterize, at varying degrees of disaggregation, the overall economy.

Importantly, these models have linkages between sectors of the economy embedded in them and thus are able to generate estimates with regards to how a change that occurs in a particular sector will impact – typical impacts measured are changes in gross state product, real disposable income and the overall number of jobs created – all other sectors in the economy. Thus, use of these IO models allows researchers to estimate more than just the direct economic impact associated with a particular change in the economy.

For example, a new mechanic that is hired at a newly built hypothetical garage would represent a direct job (direct impact). The income that this mechanic receives and thus spends in the local economy will in turn create revenues/income for a gamut of different businesses – which in turn will generate other jobs throughout the economy (these are known as indirect or induced jobs).[6]

Therefore to accurately model the total economic impact of a public policy decision such as introducing energy efficiency standards it is paramount that any initial direct impacts are modeled correctly as these are the foundation for all other indirect/induced impacts that may occur.

At a high level, modeling the economic impact of energy efficiency standards initially appears relatively easy. At its simplest level the adoption of energy efficiency measures impacts the economy in two sequential stages. The first stage relates to the initial up-front expenditure/investment associated with purchasing and installing the energy efficiency measure. The second stage relates to the post installation time period where the individual or business potentially receives energy savings from installing a measure that uses less electricity per good/outcome.

Below is a more detailed discussion of each stage and what elements require estimation.

2.1. Initial investment/installation period

The vast majority of energy efficiency opportunities are realized through investing and installing a variety of new devices, for example, a more efficient AC unit. When estimating the cost effectiveness of installing energy efficiency devices it is often assumed that the individual or business making the decision is at the *replacement* stage. That is, their current standard measure or device is non-existent, either because it is not functioning (needs replacing) or was not installed in the first place.

When evaluating the investment spending that is *directly* caused by the introduction of an energy efficiency standard (relative to a business-as-usual (BAU) baseline) it is important to focus on how the energy efficiency standard changes *net* investment rather than merely estimating *gross* investment – this is especially true if the researcher wants to remain logically consistent in terms of arguing that energy efficiency measures represent cost effective opportunities.

Thus, rather than incorporating into the analysis the total investment that occurs from installing a more efficient AC unit instead of a "standard" unit only the *additional* investment expenditures should be included.

This is because *without* the energy efficiency standard, which tends to lead to more generous rebate programs by utilities to encourage the adoption of energy efficiency measures, the marketplace would naturally already be spending "investment dollars" via installing standard units.[7] Thus, inclusion of *total* investment expenditures associated with the more efficient AC unit would represent an *over-estimation* of investment expenditures caused by an energy efficiency standard. Instead, *net* investment should be included as this more accurately reflects potential increases in (direct) economic activity.

Of course, it is possible that the energy efficiency standard encourages a total level of investment expenditure that would otherwise not have occurred. For example, investment expenditures associated with AC duct repair-work. In these cases gross investment would be equal to net investment as there are no naturally occurring BAU investment dollars to "subtract".

Fig. 1 depicts the correct estimation process for estimating the increased investment expenditure associated with a particular energy efficient measure.

Once net investment expenditures have been calculated the next step is to determine *who* is responsible for financing these net expenditures. For energy efficiency measures there are generally three participants who assist with "paying" for a given measures. These are:

- The government (local, state and federal);
- The customer's electricity utility company;
- and the consumer/business who installs the energy efficient measure.[8]

Ultimately the purpose of the first two groups, the government (in its numerous forms) and the customer's electricity utility company, is to assist financially with reducing the up-front costs that the final consumer/business have to bear themselves. This is generally done, to further promote the financial attractiveness of adopting energy efficiency measures.

[5] There are many other models available that can be used to model the economic impacts of energy efficiency (for example RIMS II). However, IMPLAN and REMI tend to be the most widely used.

[6] Sometimes a distinction is made between induced and indirect jobs. Induced jobs are the jobs created by the expenditure of the newly created income (due to the new mechanic being hired) being spent elsewhere in the economy, for instance, the new waitress at a restaurant who is employed because the mechanic eats there often. Whilst indirect jobs can be defined as those jobs that are created because the direct job (mechanic) needs inputs to complete his/her job, for instance, the auto parts salesman who sells parts to the newly hired mechanic.

[7] It is possible that some consumers may have purchased more efficient AC units even if the standard (and/or rebates) were not in place/offered. These "free-riders" need to be excluded from the analysis also. When utilities determine the electricity savings from the adoption of energy efficiency measures these free-riders are accounted for by adjustments in net to gross (NTG) ratios.

[8] We are ignoring any principal/agent problems here. For example we are focusing on owner-occupied buildings rather than say rental properties. See Croucher (2010c) for more details on principal/agent problems.