EVALUATING THE ECONOMIC EFFECTS OF THE LOW-INCOME WEATHERIZATION PROGRAM: A CONCEPTUAL AND METHODOLOGICAL FRAMEWORK*

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ABSTRACT

This paper provides a conceptual framework and discusses methodological issues surrounding the estimation of micro- and macroeconomic impacts of the Low-Income Weatherization Program. Important microeconomic impacts include (1) expenditure of program funds on materials and support services and (2) an effective income gain realized by program participants through induced energy savings. These impacts stimulate economic activity in industries affected by changes in demand for weatherization products and increased purchases of goods and services by participating households. Together, these impacts affect employment and output levels in a wide range of industries. Because of complex industrial interrelationships, the effects are not limited to the sectors, or even the regions, where the program expenditures or consumption changes take place.

Methodological and data quality issues involved in deriving estimates of these impacts are presented from two broad perspectives: (1) the consumption effects of the program, including (a) materials and support and (b) induced demands of program participants and (2) the output and employment effects. Sources of primary and secondary data and the application of regional input-output models are discussed, along with limitations and caveats in their use.

The paper concludes with a discussion of the implications for conducting economic evaluations of the Low-Income Weatherization Program along the conceptual lines presented. They include considerations in cost-benefit analysis, application in principle to other energy conservation practices and the utilization of energy conservation evaluation research results.

* Research funded in part by Vermont Agricultural Experiment Station (Hatch Project #370).

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INTRODUCTION AND OVERVIEW

Increasing the energy efficiency of low-income residences is the legislative objective underlying the federal Low-Income Weatherization Assistance Program (LIWAP). An ancillary purpose is to reduce energy expenditures of program participants, while at the same time improving thermal comfort and healthful living conditions.

Since its inception, the program has been formally and informally evaluated in terms of process and impact. Process has been evaluated for appropriate program administration and degree of effectiveness within constraints of program regulations (Sherman, 1985). Hirst and Armstrong (1980) assessed efficiency of state energy offices' management of energy conservation programs, using Minnesota as a case-in-point.

Impact has been evaluated at the state administration level (e.g., Kushler and Witt, 1985; Nadel and Sherman, 1985; and Hewitt, et.al., 1985) as well as nationally (Peabody, 1984). Rodberg (1983) examined broader impacts, estimating state-by-state employment effects of an anticipated expenditure by states of Exxon overcharge funds exclusively on low-income weatherization.

This paper departs from other evaluation studies in that it presents a conceptual framework and discusses methodological issues surrounding the estimation of micro- and microeconomic impacts of the program.

The broad framework within which these impacts take place is set forth in Figure 1. The program draws from the economy by amounts specified in annual appropriations for its implemention. However, it also stimulates economic activity at two levels: (1) directly, through expenditure of program funds, shown by a solid line and (2) indirectly through induced energy savings of participating households, shown by a broken line. In conceptualizing this framework, it is important to recognize that alternative uses of the appropriated funds would also generate economic activity of some kind. Therefore, any net energy analysis of the program would require an accounting of those effects.

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By means of the budgetary process, funds are earmarked specifically for labor, weatherization materials and related support services in accordance with program regulations. Allowable expenditures for materials and related program support activities spur demand in a wide range of industries including insulation products, transportation, storage and liability insurance, among others.

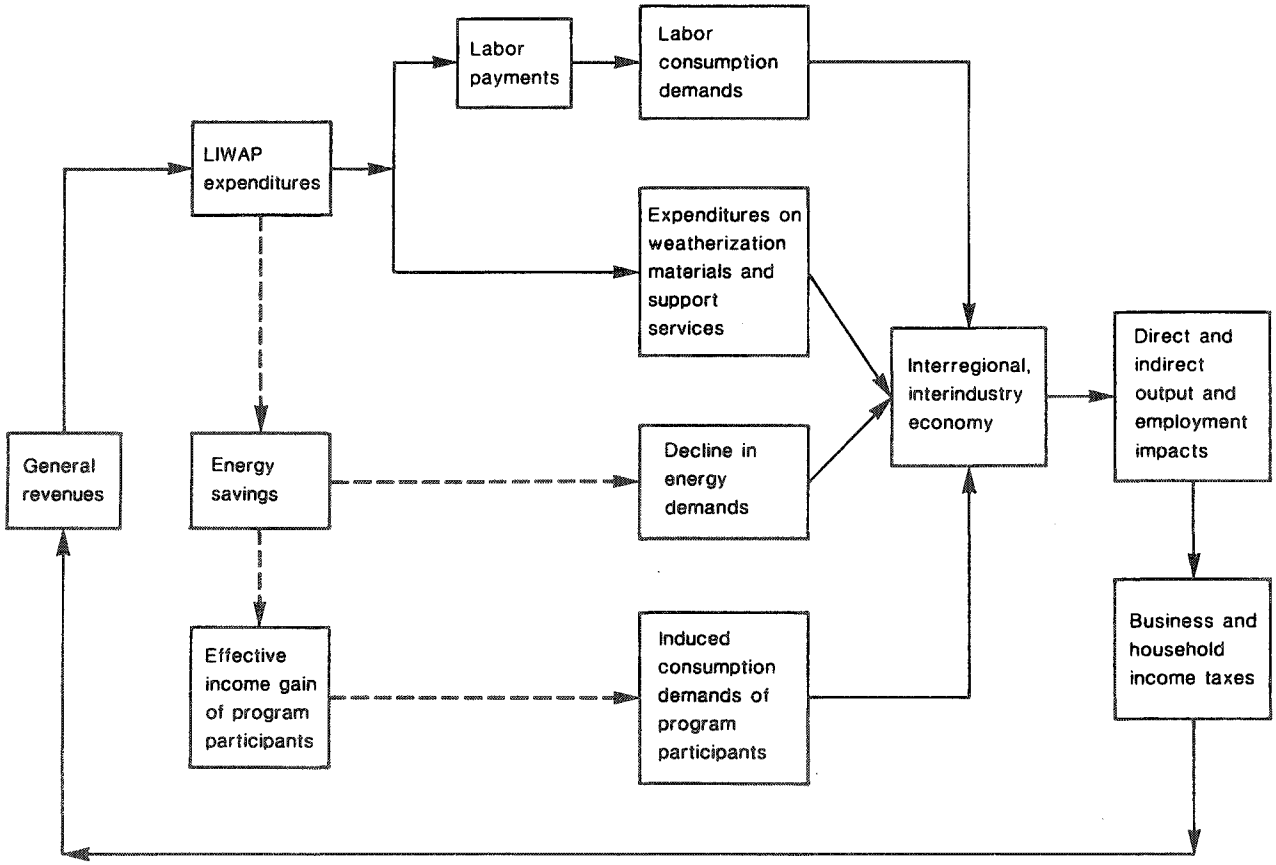

Figure 1. Economic impacts of the low-income weatherization program

The economic impacts of program expenditures for labor are less clear. Wages which serve as income to households will have positive economic effects only if they would not be available in the same amount to those households in the absence of the program. Although the

program's regulations encourage state program administrators to employ workers under the Job Training and Partnership Act (JTPA) and to engage contractors which are nonprofit or disadvantaged,[1] the net income gain attributable exclusively to the program is assumed to be minimal.

Households participating in the program realize an effective reduction in expenditure on energy for home heating purposes. As in-kind income it is not subject to tax and it is axiomatic that it is not likely to be saved due to the general low level of discretionary income among low-income households. Therefore, it is reasonable to assume that it will be allocated across a "market basket" of goods and services in some manner. As a result of households' adjustments in expenditure, it is expected that industries in the residential energy supply chain will experience a decrease in demand, whereas industries in other goods and service categories will experience increases in demand.

Thus, there are four major types of demand changes that may result from the program:

1. Program payments to labor may induce additional household consumption on the part of weatherization workers.

2. Program expenditures on weatherization materials and support services directly increase demand in associated sectors.

3. As a result of program induced energy savings, the demand for energy services will decline.

4. The effective incomes of program participants will be increased, thereby increasing household consumption demands.

Of course, the impacts of the program extend far beyond these demand changes. Shifts in regional industrial demands will, in turn, generate direct and indirect output and employment impacts. As a consequence, household incomes and business profits will be affected. Finally, through taxes on household incomes and business profits, a portion of the program expenditures for weatherization will be returned to general revenues. Again, alternative uses of funds expended for the program must be considered in assessing the effect on general revenues in the same manner as they would be accounted for in generating other economic impacts.

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[1] Sect. 440.19, Federal Register, January 27, 1985, p. 3634.

METHODOLOGICAL AND DATA QUALITY ISSUES

While the above presentation is useful as a conceptual base, the real concern for program evaluation purposes lies in the ability to derive valid estimates of these economic impacts. We have identified two levels of economic activity stimulated by the program: (1) materials and related support and (2) participating households.

Estimating Consumption Impacts

Materials and Related Support. Under LIWAP regulations,[2] states are generally allowed an expenditure of up to $1,000 per unit for materials and related support. States submit reports to Department of Energy (DOE) Support Offices in some detail, providing data on amounts expended exclusively on materials, related support (such as maintenance and transportation of tools and materials, and carrying out low cost/no cost weatherization measures), liability insurance, and training and technical assistance.

Where expenditures from aggregated data sources are not traceable to specific industries (under the broad classification of "weatherization materials"), it would be necessary to derive estimates of expenditures for various kinds of materials by examining the Building Weatherization Reports of state program administrators and/or their subgrantees.[3] It would not be necessary to amass these data in precise detail; a reasonable estimate of how program funds are allocated among various industries would be sufficient for tracing the subsequent economic impacts of the program.

Participating Households. The estimation of induced consumption changes on the part of program participants is much more complicated. An examination of secondary data sources is necessary to derive estimates of households' (1) energy savings following program participation and (2) marginal propensities to consume specific categories of goods and services in response to the income gain realized from the reduced expenditure for home heating.

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[2] Sect. 440.18, Federal Register, January 27, 1985, pp. 3633 & 3634.

[3] Information obtained from DOE Boston Support Office, telephone conversation, May 23, 1986.

The two major sources for these respective purposes are the LIWAP evaluation study conducted in 1980-81 by DOE's Energy Information Administration (Peabody, 1984) and the Bureau of Labor Statistics' Consumer Expenditure Interview Survey (CEIS) (U.S. Department of Labor, 1985).

The DOE evaluation not only uses the same time period as the CEIS, but also, its total sample of 1,727 homes is compatible in two other respects. First, it is statistically representative of all the single family homes receiving LIWAP services. Second, the profile closely approximates all families falling below the 125% poverty level with regard to income (U.S. Department of Commerce, 1982), and therefore provides a means for estimating the average effectiveness of the program. The DOE weatherization evaluation sample is also representative of the low-income population with respect to the number of persons in the household, square feet of heated space, and race (Peabody, 1984).

The DOE evaluation findings calculated a 13.1% to 13.7% range for average savings of the main heating fuel used specifically for home heating. In using these results for estimating the savings from weatherization efforts, the following cautions should be noted:

- The geographic distribution of the sample used for the DOE evaluation is more heavily weighted to colder climates because more homes in those areas were weatherized in 1981.

- Weatherized homes tend to be older than all homes of the low-income population.

- There are more householders over age 60 among LIWAP participants than in the general population.

- Occupants of weatherized households are more likely to receive Social Security, food stamps, and other government benefits than income from wages and salaries. (Peabody, 1985).

Other caveats in interpreting results of the DOE study pertain in any residential energy conservation program evaluation. They include lack of identical household and housing circumstances before and after the evaluation and variations in characteristics of the weatherized housing units, types and quality of materials, and installation work (Peabody, 1985).

Energy savings created by the program will have two types of effects. First, these savings will reduce the demand for energy services. Second, energy savings will increase the effective incomes of program participants. These two types of effects will not cancel each other out because the output and employment multipliers associated with reductions in energy demand will not be the same as multipliers associated with household changes in the demand for goods and services induced by the income gains of program participants.

Estimation of the decline in the demand for energy services is trivial since it is equal to the energy savings generated by the program. However, estimating changes in household consumption demand induced by energy savings is more difficult.

The CEIS provides a means of identifying the expenditure categories where households would be expected to spend income obtained in the form of energy savings. It covers family income and expenditures classified by family characteristics and is the most detailed source of this information available. The Interview Survey reports on a wide range of expenditure categories collected from a sampling of 5,000 households at three-month intervals. Although the Interview Survey relies on respondents' recall, unlike the Diary Survey which records fewer expenditures more frequently, its use is preferred for our purposes because of its broader coverage of consumer expenditure items.

Characteristics of LIWAP participants can be matched with the CEIS to obtain a baseline of household expenditures in selected categories. Then, the marginal propensities of these households to consume these categories of expenditures given the income gain from energy savings, can be determined by regression analysis, again using CEIS data.[4]

In using the CEIS data, it should be recognized that variables other than income may alter households' marginal propensities to consume. Using the CEIS, Musgrove (1982) examined all income groups and found that household expenditures were more closely related to household composition, than to age or income per se. However, because elderly are targeted for priority attention in the program, it would also be important to identify how their expenditures--especially energy--may

[4] This method is adapted from Golladay and Haveman, 1977.

differ from other low-income households. The major studies of consumption patterns have demonstrated significant age effects on the composition but not the level of demand (e.g., Parks and Barten, 1973). However, little attention has yet been given to age-specific differences in household energy demand.[5]

Further precautions revolve around general limitations of the CEIS. Some statistical pitfalls may be inherent in attempts to derive detailed data. As Wagner (1985) has noted, the sample size was decreased for the 1980-81 survey, resulting in small cell sizes. This could be problematic in attempts to analyze narrowly defined consumer expenditure categories of low-income elderly, for example.

Estimating Output and Employment Impacts[6]

Because of the complex interrelationships among industries, weatherization-induced employment and output impacts need not be confined to the sectors, or even the regions, where the household and energy-sector consumption changes or program expenditures take place. In this section, we discuss how an input-output model may be used to estimate the employment and output impacts of the weatherization program.

There are many regional models that may be used to translate consumption changes into employment and output impacts. Regional input-output models, however, are particularly appropriate for estimating the direct and indirect impacts of consumption changes.[7]

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[5] See Stern, ed. (1984) and Holub (1985) for critiques of previous attempts to model residential energy consumption, particularly their failure to take account of a number of variables that affect consumption potential.

[6] As discussed above, the program-induced consumption effects resulting from payments to weatherization laborers are probably negligible. Therefore, estimation of those effects will not be discussed in the remainder of this paper. If these effects were estimated, the approach would follow closely the methodology used to estimate the household demand changes stimulated by energy savings on the part of program participation.

[7] See Miller and Blair (1985) and Hannon et.al. (1984) for a discussion of some of the issues surrounding the use of input output models for energy analyses.

Several available regional input-output models could be used to estimate the employment and output impacts of the weatherization program (e.g., Cartwright, et. al., 1981; Goettle, et. al. 1977; and Jack Faucett Associates, 1983). These models may be classified into two major types: those with detailed interregional trade information and those with import and export information only. Although the latter type of model is more common, a model with a completely specified set of interregional, inter-industry relations[8] would be more appropriate for calculating the output impacts generated by the estimated consumption changes.

Once the output impacts have been estimated it is a straight-forward matter to translate them into employment impacts. For most regional input-output models, employment statistics are available for the same regional industrial categories as the output data. Employment-to-output ratios can therefore be calculated for the base-year data underlying the model. If one assumes that these ratios remain stable for other output levels, the employment impacts of output changes can be estimated by multiplying the base-year employment-to-output ratios by the estimated output changes. For relatively small output changes, this is probably a reasonable assumption.

Like all quantitative techniques, several assumptions underlie the use of input-output models. These include constant returns to scale, homogeneous products, and fixed technology and trade coefficients. The assumption that creates the most concern among regional analysts is that of constant regional production technologies. The validity of this assumption is largely determined by the level of regional and industrial aggregation, as well as the extent of backward and forward linkages in the regions included in the model. A less developed region which has few industrial linkages is likely to undergo much greater technological change than a more developed region. Nevertheless, studies conducted at both the national and regional levels have indicated "a high degree of coefficient stability over time, with large variations being both exceptional and predictable." (Richardson, 1972, p. 172).

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[8] The most comprehensive model of this type is the 1977 Multiregional Input-Output (MRIO) model constructed by Jack Faucett Associates (1983). This is a more detailed (and restructured) version of the 1963 MRIO model developed by Polenske (1980).

DISCUSSION

The broad perspective undertaken in this paper to assess the economic impacts of the LIWAP has ramifications in at least three areas.

First, our conceptual framework has implications for conducting cost-benefit analysis of the program in terms of identifying revenue flows that go beyond energy to other industrial sectors. Moreover, if cost benefit analysis takes into account these gross benefits, economies of scale and efficiency in overall program administration may be encouraged.

The analytical approach described in this paper, however, would be only a first step in conducting a cost-benefit analysis of the program. Program participants will continue to enjoy energy savings in successive years once their homes have been weatherized. This implies that the induced consumption effects of the program will continue for several years after the initial weatherization. Thus, in any year, the consumption effects of the program will not only be those for that year alone, but also a complicated function of consumption changes induced by weatherization in previous years. This implies that cost-benefit studies that do not take account of the recurring energy savings of weatherization understate program benefits relative to costs.

Second, the approach we propose in this paper has conceptual application to energy conservation practices for buildings in general, irrespective of their legislative mandate. Limiting the scope of our focus to the LIWAP enables a discussion of empirical considerations around specified program conditions: (1) a fixed population subgroup (low-income households), (2) defined expenditures on materials and labor (program funds to states) and (3) identifiable types of materials (as set forth in program regulations).

Finally, the use of program impact evaluation data, as an integral part of the proposed methodology, underscores the need for continued improved quality in evaluation research in energy conservation program planning and implementation.

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