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EVIDENCE ON THE EFFECTIVENESS OF USING TAX CREDITS TO PROMOTE ENERGY CONSERVATION

Kathryn A. S. Lancaster
Michael R. Kinney
Jack Robison*

The country seems to have quickly embarked on a new energy crisis. "From Manhattan to Montana, worries are mounting that skyrocketing power prices and rolling blackouts will soon spread from their epicenter in California. . . . Concern about the power picture extends to the top levels of the Bush Administration as it attempts to hammer out a new energy policy."[1] As politicians search for possible solutions to the current crisis, incentives for energy conservation are often mentioned as a possible remedy. A recent Congressional Research Service Issue Brief describes several potential bills. Two create a refundable tax credit for up to 50% of increased residential energy costs, a third establishes a 15% residential tax credit for homeowners who purchase photovoltaics and solar thermal equipment.[2] Because tax incentives have been used in past crises, a logical step should be to examine the policies used to determine if they were effective and should be utilized in the future. This paper reports the results of a study of the Energy Tax Act of 1978's provisions relating to residential energy credits.

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* Professor Lancaster is Associate Professor at Cal Poly State University; Professor Kinney is Associate Professor at Texas A&M University; Jack Robison is Professor at Cal Poly State University.

[1] Smith, R., and J. R. Emshwiller. 2001. Why California Isn't The Only Place Bracing For Electrical Shocks. The Wall Street Journal, April 26, 2001: A1.

[2] F. Sissine. 2001. IB10041: Renewable Energy: Tax Credit, Budget, and Electricity Restructuring Issues, Resources, Science, and Industry Division, March 9, 2001 <www.cnie.org/nle/eng-54.html> May 14, 2001.

The Energy Tax Act provided for tax credits on installation of renewable energy equipment, insulation, and energy-conserving components in personal residences. With these credits, Congress hoped to foster energy conservation. This paper evaluates the efficacy of including the conservation subsidy component in the Act and its amendments by using an empirical model to examine the attributes of taxpayers claiming the credit. This information will be utilized in determining whether Congress' goals were met and whether similar policies could be effectively utilized to deal with the current energy crisis.

The remainder of this paper is organized as follows. Section Two describes some of the political tools that have been implemented in the United States since 1974 in an effort to modify energy consumption behavior, and summarizes relevant portions of the Energy Tax Act of 1978 that were designed to modify consumption patterns. Section Three reviews previous literature and Section Four develops the theory and models. Section Five describes the database, sample selection, descriptive statistics, and the methodology used in the analyses. Results of both a probit model and maximum likelihood estimation model for all years are presented in Section Six. Section Seven discusses the limitations of the study and suggestions for further research. Finally, Section Eight presents conclusions.

Rationale for and Provisions of the 1978 Energy Tax Credits

Development of a formal energy policy began in the late 1970s in reaction to the oil shortage and the overthrow of the Shah of Iran, which created a political crisis in the Persian Gulf region. A package of legislative tools was introduced to ease transition into the next energy source. These tools can be divided into four categories—regulations, taxes, subsidies, and loans or grants. This paper addresses the third category (tax subsidies).

Subsidies can be designed to promote production or reduce consumption. One form of consumption subsidy encourages conservation and investment in alternative energy sources by providing a tax credit for investments in energy-saving devices or alternative energy sources. Examples of this type are credits for expenses incurred for insulation, storm windows, or installation of solar panels. A disadvantage of nonrefundable tax credits is that the method of reimbursement is a tax-offset that reduces

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the taxpayers' tax liability—this requires that the taxpayer have positive tax liability against which to offset the credit. This may effectively eliminate the capability of lower income people to take advantage of the credit since their tax burden may be insufficient. The result is described as a regressive credit policy.

Beginning in 1974, a number of energy acts were passed in response to the crises, with amendments occurring yearly into the mid 1980s. The 1978 Energy Tax Act was selected for examination in this study because most of the relevant tax implications were formalized by its enactment. The first section of the Act's energy tax provisions addressed residential energy credits, which were available for improvements made from April 20, 1977 through December 31, 1985. The available credits were separated into two categories: insulation and energy conserving components, and solar and wind energy equipment. Different tax structures were imposed on each of them and the insulation credit was available only on residences in existence before April 20, 1977, whereas, the solar credit was available on both existing and new homes. Otherwise the structures were similar. Homeowners and renters were eligible for both credits and both were available for principal residences only. The insulation and energy conservation credit applied to expenditures associated with insulation, exterior storm or thermal doors and windows, exterior caulking or weather-stripping of doors and windows and some types of replacement or upgrades of heating devices. The provisions allowed for the carry forward of any unused credits for up to two years to insure that lower income taxpayers were more likely to receive a benefit from the credit. The laws' provisions, including amendments, are outlined in Table 1.

Table 1: Summary of Residential Energy Tax Credit from 1977 through 1985

Item	Energy Conservation Credit	Renewable Energy Source Equipment
Time period in which qualified expenditures could be incurred	Expenditures made on or after April 20, 1977 and before January 1, 1986 (The credit for 1977 expenditures was allowable on 1978 returns)	Same
Credit Amount for expenditures incurred between 4/20/77 and 12/31/79	15% of qualified expenditures up to $2,000	30% of the first $2,000 plus 20% of the next $8,000.
Credit Amount for expenditures incurred from 1/1/80 until 12/31/84	Unchanged	40% of the first $10,000
Homes on which expenditures were allowable	Home must have been substantially completed before 4/20/77	Any home
Type of Expenditures covered	Insulation and other energy conserving component expenditures made to a principal residence	Solar, wind and geothermal equipment expenditures on the principal residence of the taxpayer

Source: I.R.C. Sec. 44C as enacted by the Energy Tax Act of 1978 and amended by the Windfall Profits Act of 1980.

Prior Studies

A few researchers have attempted to analyze the impact of the Energy Tax Acts both in terms of monetary cost to the Federal Government and in terms of the amount of behavioral change brought about by the energy policy. The results of the two most pertinent studies are somewhat conflicting. Pitts and Wittenbach[3] conducted a phone survey in the spring of 1979, which was approximately 24 months after the tax credit became effective. They contacted households that had made insulation and other energy conservation purchases. Their results suggest that the majority of households taking advantage of the credit were higher income households that would have made the

[3] Pitts, R. E., and J. L. Wittenbach. 1981. Tax credits as a means of influencing consumer behavior. Journal of Consumer Research 8 (December): 335-338.

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same expenditures regardless of the tax credit. They also found that only 61 percent of the respondents knew about the tax credit before making qualified purchases. Based on their survey responses, Pitts and Wittenbach concluded that higher income taxpayers were more likely to utilize the tax credit and that the provisions did not successfully alter consumer behavior.

Long[4] examined the same issue using the 1981 Individual Tax Model File, which is a random sample of personal tax returns filed. Extrapolating from the sample, Long estimated 3,741,935 taxpayers reported energy conservation expenditures in 1981 and spent over $2.9 billion on them. He also determined that 224,758 tax returns reported expenditures for renewable energy sources in 1981, which amounted to an estimated aggregate expenditure of $718 million. Six multiple regression models were estimated to examine the effects of different types of expenditures. The dependent variables were total energy conservation, four specific categories of energy conservation expenditures, and renewable energy sources. His findings were:

1) as income and energy costs increased households spent significantly more on both energy conservation and on renewable energy sources;
2) elderly taxpayers spent significantly more for energy conservation, which may indicate that an elderly person's home is older and in greater need of energy conservation measures;[5] and
3) both state subsidies and family size[6] had a positive impact on expenditures for renewable energy sources.

A limitation of Long's study is that a household reporting energy conservation expenditures would have self-selected into the sample, yielding a biased, nonrandom sample.

Theory and Model Development

One of the basic tenets of economic theory is that individuals (and therefore households) are utility maximizers and, as rational consumers, will select the best bundle of goods they can

[4] Long, J. E. 1993. An econometric analysis of residential expenditures on energy conservation and renewable energy sources. Energy Economics 15, No. 4 (October): 232-238.

[5] Their homes are more likely to be eligible for the insulation credit, which was available only on residences that were in existence before April 20, 1977.

[6] Measured by number of persons in household.

afford. For a normal good, when price increases, households have an incentive to alter their consumption bundle. However, Suranovic[7] demonstrated that oil has an inelastic demand curve in the short run, which becomes more elastic in the long run. As such, households may have more tendency to take energy reducing measures once they conclude the price change is permanent. As a consequence, Long's results may be year specific and not valid in the later years of the energy tax credit. In addition, there may be greater incentive in later years to report energy conservation expenditures before the credit expires.

This study extends previous research by examining seven of the years the tax credit was in effect individually to determine whether Long's findings are consistent throughout the entire period. Additional variables are included in the models to determine whether household characteristics other than those identified by Long are significant. Of particular interest is whether the use of a professional preparer affected the likelihood of a household reporting an energy conservation expenditure. Collins *et al.*[8] conclude that the reasons taxpayers rely on professional preparers differ. For some, the objective is a correct return, while others cited tax minimization as their primary objective. Characteristics of the first objective group are associated with the personality trait of value orthodoxy, low tax knowledge, and complex tax returns. Those striving to minimize their tax liability are characterized as having high income, low social responsibility, low tax knowledge, and increased age. The common characteristic is low tax knowledge. Because tax laws are complex, many people turn to a professional preparer. Consequently, professional preparers may be a valuable resource for disseminating information when implementing new tax policies.

Three models are estimated for each year. The dependent variable for the first, which is a multivariate probit model, is a dichotomous variable indicating whether or not the household reported energy expenditures. The next two models are estimated using continuous dependent variables comparable to

[7] Suranovic S. M. 1994. Import policy effects on the optimal price. *Energy Journal* 15, No. 3 (July): 123-144.

[8] Collins, J. H., V. C. Milliron, and D. R. Toy. 1990. Factors associated with household demand for tax preparers. *Journal of the American Taxation Association* 12, No. 1, (Fall): 9-25.

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Long: 1) Energy conservation expenditures (ECE) is the total current year expenditures on insulation, storm (or thermal) windows or doors, caulking, and other costs to weatherize the home; and 2) a total energy expenditure (SUM), which in addition to the preceding expenditures, includes renewable energy conservation (the current year cost of renewable energy source items, such as solar, geothermal, or wind generators).

The independent variables are categorized as either providing economic incentive to incur energy conservation expenditures or as measuring a source of tax credit information. The economic factors hypothesized to impact a household's expenditures on energy conservation are discussed first. Marginal tax rate (MTR) is included in the model to test the hypothesis that the greater the marginal tax, the more incentive the household will have to engage in tax-reducing expenditures.[9] A number of studies (e.g. Mackie-Mason;[10] Kinney and Trezevant;[11] and Manzon[12]) found that when faced with greater marginal tax rates, managers of corporations were more likely to take income-reducing steps to reduce the firm's tax burden. The same should hold true for individual households. As such, we expect this variable to be positively correlated with all three dependent variables.

Congressional intent was to establish a credit that did not favor high income taxpayers[13] and we therefore predict that Adjusted Gross Income (AGI) will be negatively correlated with filing Form 5695. However in the later models where the dependent variable incorporates the amount of credit claimed, we predict that AGI will be positively correlated with the dependent variable. This is consistent with the findings of Long

[9] MTR, AGI, MORT, and SUM were scaled to approximate one.

[10] Mackie-Mason, J. 1990. Do taxes affect corporate financing decisions? *The Journal of Finance* XLV, No. 5 (December): 1471-1493.

[11] Kinney, M. and R. Trezevant. 1993. Taxes and the timing of corporate capital expenditures. *Journal of American Taxation Association.* 40-62.

[12] Manzon Jr., G. B. 1994. The role of taxes in early debt retirement. *Journal of American Taxation Association* 16, No. 1 (Spring): 87-100.

[13] This intent was more evident in the Senate's version of the bill, which provided for a refundable credit, much like the current Earned Income Credit. But even the final version of the Act provided that unused credits could be carried forward for two years so that lower income individuals would not lose the benefit of the credit simply because they had no income in the year the expenditures were incurred (Conference Committee Report, P.L. 95-618, pg. 44).

and the fact that higher income taxpayers have more discretionary income to spend on their homes. Number of exemptions (EXMPT)[14] is included to determine if larger families were more likely to take the tax credit. For two reasons we expect this variable to be positively correlated with the dependent variables. First, the number of exemptions may be a proxy for size of house and energy costs may be greater for larger houses. Secondly, larger families may have less discretionary income, which would provide greater incentive to reduce energy expenditures.

Marital status (MS) is included in the model to examine Long's conflicting results. His study found marital status was negatively correlated with energy conservation and positively correlated with solar energy expenditures, although neither was significant.

A dummy variable AGE is included in the model, which identifies households who checked the age exemption box. It is expected that older taxpayers would have held their homes longer and therefore be more likely to need energy saving updates.

It is hypothesized that homeowners have more economic incentive to invest in capital improvements to a home. An additional continuous variable, MORT, is included, which is the amount of home mortgage interest deducted on Schedule A—Itemized Deductions.[15] MORT may proxy for size of home—the larger the mortgage, the larger the home—and is hypothesized to have a positive correlation with the dependent variables. The previous variable may not pick up some homeowners, since taxpayers who did not itemize, but own homes, will not be identified.

Taxpayers were able to take the credit for more than one principal residence. If they had taken the maximum on one residence and then moved, they were able to take the maximum credit amount on the new home as well. Moving expenses, gain on sale of home, and inclusion of Form 2119, which is used

[14] Number of exemptions includes dependents and the extra exemptions claimed for age and blindness.

[15] Since both homeowners and renters were eligible for the energy tax credits, an indicator variable indicating homeownership was included in lieu of the mortgage variable. There was no significant difference in either the explanatory power of the model or in the other variables.

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to report a sale or exchange of principal residence were combined into one dummy variable as a proxy to identify a taxpayer that moved to another residence (MOVE). There may be taxpayers who moved that are not picked up by this variable because they did not file a Form 2119 because, for example, the household realized a loss or did not meet the mileage requirement of the moving provisions.

A number of control variables included in Long's model are also included in our model. Long included the number of heating degree-days (HEAT) to characterize climate conditions.[16] The normal seasonal heating and cooling degree-days based on a standard 30-year period (from 1951 through 1980) was used.[17] HEAT was divided by the state's population in thousands and is hypothesized to be positively correlated with both energy tax credits, since they are expected to be associated with energy consumption.

Long incorporated a dummy variable to identify states that allowed tax credits or deductions for conservation improvements. This study also incorporates a dummy variable to identify taxpayers who filed from states with their own subsidy programs (STSUB). These states were Arizona, California, Colorado, Montana, and Oregon, which allowed tax credits; and Arkansas, Idaho, and Indiana, which permitted tax deductions for energy conservation expenditures. We expect this variable to be positively correlated with the dependent variables.

The next economic variable is Energy price changes (PRCHG). Price changes are approximated by using the annual

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[16] Cooling degree days (COOL) was examined as well, however the results are similar to HEAT and are not presented.

[17] This is measured by the average annual number of heating degree days in the taxpayer's state of residence. Degree days is a relative measurement of outdoor temperature. Heating degree days is the sum of the deviation of mean daily temperatures below 65 degrees Fahrenheit. For example, if the mean daily temperature at a weather station was 43 degrees, the station would report 22 heating degree days. Cooling degree days (COOL) works in the reverse manner and is a measure of the deviation above 65 degrees. Heating degree days is a measure of the need to heat a home, and cooling degree days measures the need to cool a home. U. S. Department of Energy (1979. *State Energy Overview.* Washington, D.C.: GPO (October)) and Statistical Abstract of the United States (U. S. Department of Commerce. 1995. *Statistical Abstract of the United States.* Bureau of the Census, Washington, D.C.: GPO, pp. 217-218).

percentage increase over the period 1978-81 in average residential electricity rates (per 1,000 KWH) in the taxpayer's state of residence. These rates are computed from data reported in the US Department of Energy, Energy Information Administration's "Typical Electric Bills" for specific years.[18] An attempt is made to duplicate Long's efforts by using the yearly percentage change in state average monthly bills for residences. The bills are based on an average of 500-kilowatt hour usage. This variable is also hypothesized to be positively correlated to energy tax credit expenditures since households should have more incentive to install energy saving devices when energy prices are increasing.

Professional taxpayer assistance (PREP) is included in the model, for the three years the information is available (1982 through 1984). Information about the tax credit would have been available from a number of sources—one of which is a professional preparer. PREP and AGI are positively correlated at 0.147, which indicates that PREP is not merely a proxy for wealthier taxpayers.

The basic models are as follows (a summary of variables is presented in Table 2):

E_{it} = f(AGI, MTR, EXMPT, AGE, MS, MOVE, MORT, PREP, STSUB, HEAT, PRCHG,) (1)

where

i = 1-3 models and t = 1-7 years

and

E = Model 1) Dichotomous variable (one if taxpayer filed Form 5695)

Model 2) Energy Conservation Expenditure divided by 1,000 (ECE)

Model 3) Sum of credits taken divided by 1,000 (SUM)

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[18] U. S. Department of Energy. 1979-1986. *Typical Electric Bills.* Energy Information Administration, Washington, D. C.: GPO (Various months).

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Table 2. Summary of Variable Used in Regression Models (All variables are hypothesized to have positive coefficients with the exception of AGI in Model 1.)

Variable	Description
Dependent Variables	
FORM	Model 1) Dichotomous variable (one if taxpayer filed Form 5695)
ECE	Model 2) Energy Conservation Expenditure divided by 1,000
SUM	Model 2) Sum of credits taken divided by 1,000 (SUM)
Explanatory Variables	
AGI	Adjusted Gross Income divided by 10,000
MTR	Marginal tax rate divided by 100
EXMPT	Number of exemptions (includes dependents and taxpayers taking additional exemptions for age or blindness)
AGE	Dummy variable set to one if taxpayer marked the age exemption box.
MS	Dummy variable set to one if taxpayer is married, 0 if single
MOVE	Dummy variable set to one if moving expenses or gain from sale of residence
MORT	Amount of mortgage interest spent on home divided by 1,000
PREP	Dummy variable set to one if taxpayer paid a professional to prepare tax return
STSUB	Dummy variable to indicate state allowing energy tax credits
HEAT	Number of heating days - 30 year average heat index
PRCHG	Energy price change from previous year

Database, Sample Selection, Descriptive Statistics, and Methodology

Our household data are extracted from the Internal Revenue Service Individual Tax Panel File for tax years 1979 through 1985. For 1979, of the 92,694,302 individual filers, 45,051 are included in the available SOI data set. The Panel File was randomly drawn from the Model File, which is a stratified random sample of unaudited individual tax returns. For example, 1979 was stratified to include a minimum of 1,800 returns per state. It was also stratified to include a representative sample of various income levels, so high income taxpayers (adjusted gross income (AGI) of $200,000 or more) are over-represented. Although both stratifications may skew the results, the sample size used for this study should alleviate any serious problems. Amended returns filed in sample years are not included in the data set. Returns for the other years included in the data set are selected in a comparable manner.

The dependent variable for the probit model identifies those taxpayers who filed a Form 5695, which was used to report energy expenditures. The dependent variables for the two regression models—total energy conservation expenditures (ECE) and total credits taken (SUM), which includes total renewable energy expenditures—are collected from the SOI data set and were extracted from Form 5695. Adjusted gross income (AGI), marginal tax rate (MTR), number of exemptions (EXMPT), marital status (MS), AGE, mortgage (MORT), and declared (MOVE) are also part of the SOI data set.

Prior to running empirical tests, the taxpayers were separated into two groups based on whether they filed Form 5695 "Residential Energy Credit." The results are summarized in Table 3. As might be expected, the percentage of taxpayers reporting the tax credit declines over the years going from 5.3 percent to a low of 2.6 percent in 1983, with a small increase during the last two years.

Table 3. Comparison of Full Sample versus those Filing Form 5695 (Energy Tax Credit)

Year	**Cumulative Frequency**		**Percent Frequency**
	Full Sample	5695 Sample	5695 Sample
1979	45,051	2,397	5.3
1980	45,897	2,393	5.2
1981	46,084	1,974	4.3
1982	9,112	332	3.6
1983	18,862	492	2.6
1984	9,629	259	2.7
1985	19,917	602	3.0

Univariate tests were employed to determine whether the means of the sub sample of individual taxpayers reporting energy expenditures were significantly different from the means of the full year model file, which is assumed to be a representative sample of all individual taxpayers.[19] T-statistics comparing the entire SOI database and the sub sample for each year for selected SOI variables used in analysis are presented in Table 4.[20] Most of the Form 5695 samples are negative and

[19] Two-tailed t-tests were computed using the "Separate-Variance t-test" explained by Ott (1993. *An Introduction to Statistical Methods and Data Analysis, 4th Edition.* Belmont, California: Duxbury Press, p. 270).

[20] *Ibid.*

statistically different at the .005 level[21] from the full sample for the variables presented. The results provide initial evidence that taxpayers reporting energy tax credits have larger families (or are older and claim additional deductions), have more income, and have larger or newer homes. On average, taxpayers who reported an energy expenditure also had higher marginal tax rates.

Table 4 Comparable Means (and Standard Deviations) of Selected Parameters from Full Sample and the Subsample of Taxpayers Reporting Energy Tax Credits

Variable	1979			1980		
	Full	Reduced	T-stat	Full	Reduced	T-stat
TOTAL EXEMPTIONS	2.430 (1.529)	3.279 (1.458)	-27.67	2.422 (1.514)	3.358 (1.432)	-31.04
ENERGY CONSERV	35.83 (242.96)	641.75 (791.43)	-37.38	35.28 (238.04)	660.19 (752.22)	--40.53
SOLAR ENERGY	1.668 (83.52)	5.463 (83.57)	-2.16	4.66 (160.48)	64.332 (579.33)	-5.03
ADJ GROSS INC.	15776 (21049)	26109 (14160)	-33.69	17116 (23011)	30510 (21553)	--29.50
MTR	18.90 (12.14)	26.91 (9.345)	-40.10	19.91 (12.71)	28.394 (10.926)	-36.65
HOME MORT INT.	524.21 (1308)	1345.4 (1698.2)	-23.29	628.76 (1600)		

Variable	1981			1982		
	Full	Reduced	T-stat	Full	Reduced	T-stat
TOTAL EXEMPTIONS	2.424 (1.499)	3.195 (1.341)	-24.00	2.44 (1.482)	3.253 (1.329)	-11.21
ENERGY CONSERV	31.85 (277.80)	733.34 (1018.6)	-30.48	26.21 (219.78)	729.08 (912.98)	-14.43
SOLAR ENERGY	7.35 (255.44)	202.6 (1200.0)	-7.21	9.69 (240.12)	269.7 (1240.2)	-3.93
ADJ GROSS INC	18686 (26150)	30361 (18042)	-26.00	20842 (49666)	34364 (22735)	-10.23
MTR	21.13 (13.08)	29.09 (10.63)	-30.88	19.66 (11.95)	27.214 (10.86)	-12.75
HOME MORT INT.	721.32 (1992)		-19.96	827.83 (2098)	2284.1 (2752.4)	-9.81
PREP	NA	NA		.47 (.611)	.6355 (.568)	-5.35

Variable	1983			1984			1985		
	Full	Reduced	T-stat	Full	Reduced	T-stat	Full	Reduced	T-stat
TOTAL EXEMPT.	2.43 (1.48)	3.199 (1.396)	-12.04	2.422 (1.45)	311.58 (1.32)	-8.31	2.397 (1.44)	3.027 (1.290)	-11.76
ENERGY CONSERV	22.41 (232.94)	867.1 (1172.9)	-15.97	24.99 (254.94)	879.86 (1082.4)	-12.70	33.38 (316.05)	1114.2 (1462.4)	-18.12
SOLAR ENERGY	7.03 (218.55)	273.13 (1336.8)	-4.41	9.35 (214.64)	347.77 (1272.5)	-4.28	11.54 (278.96)	387.1 (1571.7)	-5.86
ADJ GROSS INC	21981 (154330)	33573 (20129)	-7.61	22173 (47935)	34546 (24943)	-7.61	23624 (58705)	37730 (25792)	-12.46
MTR	17.97 (11.07)	25.085 (8.962)	-17.27	17.77 (10.70)	23.514 (9.72)	-9.36	17.76 (10.73)	24.628 (9.3)	-17.76
HOME MORT INT.	927.99 (2484)	2419.6 (3564.6)	-9.22	1021.09 (2510)	2472.7 (3324.4)	-6.97	1146.67 (3073)	2874.3 (297.3)	-9.79
PREP	.484 (.608)	.659 (.475)	-8.00	.485 (.605)	.71815 (.57204)	-6.46	NA	NA	

The first part of the empirical analysis was to randomly select a sub sample of 8,000 taxpayers from each year's model file.[22]

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[21] Solar energy expenditures in 1979 and 1980 are statistically significant at the.01 level. This is probably an artifact of the limited observations; for example, only eight taxpayers reported solar energy expenditures in 1979.

[22] The first year's database was developed using five groups of randomly

Prior to selecting the sub sample, two filters were applied, which deleted a few observations from the full model files: First, households with income greater than $200,000 were removed since the state identifying code had been deleted. Second, observations with state codes from the District of Columbia, APO/FPO, Puerto Rico, and CP:IO were deleted due to missing data.[23] Univariate t-statistics are estimated to determine whether the sub sample is representative of the full sample. The results of these tests are presented in Table 5. Differences between all variables are insignificant except for adjusted gross income in all years, professional assistance in years where the information is available (1982 through 1984), and marginal tax rate and home mortgage interest in 1985. All these differences are significant at a p-value of less than .01. The lower income, marginal tax rate, and mortgage interest expense are probably caused by the elimination of taxpayers with adjusted income greater than $200,000. All the above-mentioned differences have lower means in the sub sample than in the full sample, which if anything, biases against finding significant results in the regression analyses.

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selected last four digits of the taxpayer's social security number. The same five groups were used to pull the samples for 1980 and 1981. 1982 and 1984 are based on one of the five social security number groups used in previous sample selection and 1983 and 1985 incorporate two of the five groups.

23 This reduced the model year files from 45,051 to 44,631 for 1979, 46,214 to 45,897 for 1980, 46,668 to 46,084 for 1981, 9,239 to 9,112 for 1982, 19,120 to 18,862 for 1983, 9,762 to 9,629 for 1984, and 20,202 to 19,917 for 1985, for an average loss of about 2%.

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Table 5 Comparable Means (and Standard Deviations) of Selected Parameters from Full Sample and the Randomly Selected Subsample used in the Probit and Regression Models.

Variable	1979			1980		
	Full	Reduced	T-stat	Full	Reduced	T-stat
TOTAL EXEMPTIONS	2.430 (1.529)	2.415 (1.5478)	.79	2.422 (1.514)	2.43 (1.52)	-.45
ENERGY CONSERV	35.83 (242.96)	36.881 (239.42)	-.35	35.28 (238 04)	33.163 (212.93)	.80
SOLAR ENERGY	1.668 (83.52)	3.139 (146.54)	-.87	4.66 (160.48)	2.51 (76.50)	1.90
ADJ GROSS INC.	15776 (21049)	15083 (14355)	3.67	17116 (23011)	16611 (15708)	2.46
MTR	18.90 (12.14)	18.633 (11.922)	1.85	19.91 (12.71)	19.812 (12.437)	.62
HOME MORT INT.	524.21 (1308)	513.78 1250.6	.68	628.76 (1600)	630.14 (1621.6)	-.07

Variable	1981			1982		
	Full	Reduced	T-stat	Full	Reduced	T-stat
TOTAL EXEMPTIONS	2.424 (1.499)	2.424 (1.475)	-.017	2.44 (1.482)	2.46 (1.495)	-.69
ENERGY CONSERV	31.85 (277.80)	31.787 (233.77)	.02	26.21 (219.78)	24.75 (213.28)	.44
SOLAR ENERGY	7.35 (255.44)	NA	NA	9.69 (240.12)	8.45 (211.64)	.36
ADJ GROSS INC	18686 (26150)	18023 (17553)	2.88	20842 (49666)	18989 (18142)	3.39
MTR	21.13 (13.08)	20.94 (12.99)	1.22	19.66 (11.95)	19.41 (11.76)	1.33
HOME MORT INT.	721.32 (1992)	722.9 (1884.9)	-.07	827.83 (2098)	800.05 (2018.3)	.87
PREP	NA	NA	NA	.47 (.611)	.44 (.496)	3.86

Variable	1983			1984			1985		
	Full	Reduced	T-stat	Full	Reduced	T-stat	Full	Reduced	T-stat
TOTAL EXEMPTIONS	2.43 (1.48)	2.42 (1.47)	.57	2.422 (1.45)	2.40 (1.43)	1.00	2.397 (1.44)	2.38 (1.45)	1.16
ENERGY CONSERV	22.41 (232.94)	19.10 (193.2)	1.21	24.99 (254.94)	23.39 (233.41)	.44	33.38 (316.05)	30.28 (271.1)	.82
SOLAR ENERGY	7.03 (218.55)	3.46 (111.5)	1.77	9.35 (214.64)	7.37 (179.77)	.67	11.54 (278.96)	11.36 (253.83)	.05
ADJ GROSS INC	21981 (154330)	19633 (18898)	2.06	22173 (47935)	20726 (22984)	2.64	23624 (58705)	21100 (20557)	5.34
MTR	17.97 (11.07)	17.95 (10.88)	.18	17.77 (10.70)	17.77 (10.51)	-.04	17.76 (10.73)	17.41 (10.6)	2.51
HOME MORT INT.	927.99 (2484)	883.47 (2436)	1.36	1021.09 (2510)	1046.3 (2590)	-.65	1146.67 (3073)	1070.4 (262.5)	2.09
PREP	.484 (.608)	.451 (.497)	4.62	.485 (.605)	.460 (.498)	2.97	NA	NA	

Table 6 reports the correlations among the dependent and explanatory variables for the sub sample for 1979. The results for that year are representative of the correlations for the other six years. With the exception of the high correlation among the dependent variables, which are not used at the same time in any of the models, the highest correlations are marital status and number of exemptions (0.68), marginal tax rate and adjusted gross income (0.83), mortgage and home (0.76), and moving expense and move (0.66). All the other correlations are less than 0.50. The last two combinations represent dummy variables generated from the first of each pair and are not used at the same time in the models. The main concern is marginal tax rate and adjusted gross income,[24] which is in the gray area

[24] The same holds true for all years in the study with the correlation between adjusted gross income and marginal tax rate at about 0.83.

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nd T. Lee. 1988. *Introduc-*
econd Edition. New York:

Table 6 Correlations between the explanatory variables used in Probit and Regression Analysis for the subsample from the 1979 year model file

	FORM	REC	ECE	REE	SUM	AGI	MTR	EXPT	AGE	MS	MORT	HOME	MVEX	MOVE	HEAT	COOL	STSB	PRCH
FORM	1.0																	
REC	.653	1.0																
ECE	.624	.80	1.0															
REE	.101	.424	.001	1.0														
SUM	.631	.874	.974	.225	1.0													
AGI	.174	.134	.121	.020	.122	1.0												
MTR	.144	.115	.096	.014	.097	**.830**	1.0											
EXPT	.146	.107	.102	.022	.105	.377	.193	1.0										
AGE	-.016	- .021	-.012	-.008	-.014	-.027	-.057	.110	1.0									
MS	.182	.125	.120	.024	.122	.460	.316	**.680**	.054	1.0								
MORT	.158	.127	.090	.093	.108	.457	.314	.266	-.103	.295	1.0							
HOME	.231	.168	.150	.046	.157	.476	.375	.337	-.116	.380	**.756**	1.0						
MVEX	-.008	- .010	-.010	-.002	-.010	.063	.045	.049	-.024	.041	.129	.089	1.0					
MOVE	-.010	- .015	-.014	-.003	-.015	.041	.045	.044	-.037	.035	.087	.066	**.655**	1.0				
HEAT	.021	.010	.004	.013	.007	-.012	-.009	-.008	.001	.008	-.019	-.023	-.016	-.007	1.0			
COOL	-.012	.015	-.028	.086	-.008	-.026	-.041	.023	.001	.036	.012	.004	.031	.023	.208	1.0		
STSB	-.040	- .027	-.030	.002	-.029	.027	.028	-.011	-.014	-.013	.124	.073	.014	.005	-.094	-.066	1.0	
PRCH	.014	.021	.017	.002	.017	.033	.034	.010	-.011	.012	-.045	-.007	-.017	-.013	.014	-.020	-.194	1.0

Separate regressions are run for each year and the results are examined to identify trends. To further analyze the data we recognize that the decision to report energy tax credits is made independently of the amount expended. Our analysis incorporates Heckman's two-step estimation procedure.[26] The first step models the decision to report energy expenditures using a dichotomous dependent variable where one represents households that filed Form 5695. This directly addresses the aforementioned limitation of Long's study by including all taxpayers in the random sample. Equation (1) is modified to capture the probability of a taxpayer reporting energy expenditures by filing Form 5695. The probit analysis takes the following general form:

$$E[y_{it} | F5695 = 1] = a_0 + b_1 AGI_{it} + b_2 MTR_{it} + b_3 EXMPT_{it} + b_4 AGE_{it} +_{it} + b_5 MS_{it} + b_6 MOVE_{it} + b_7 MORT_{it} + b_8 PREP_{it} + b_9 STSUB_{it} + b_{10} HEAT_{it} + b_{11} PRCHG_{it} \quad (i = 1 - 8000 \text{ and } t = 1 - 7) \tag{2}$$

The objective of the Heckman two step procedure is to determine whether or not the amount of energy expenditures reported is explained by specific household characteristics. A maximum likelihood model is estimated using the full subsample of taxpayers. In addition to the independent regressors used in the first stage, the estimated inverse Mills Ratio (IMR) is included for both sets of households. The IMR is defined as:

$$I\vec{M}R_{it} = \begin{cases} \dfrac{\phi(X_i \vec{\beta}_t)}{\Phi(X_i \vec{\beta}_t)} \text{ for } Y_{it} = 1 \\ \dfrac{\phi(X_i \vec{\beta}_t)}{1 - \Phi(X_i \vec{\beta}_t)} \text{ for } Y_{it} = 0 \end{cases} \tag{3}$$

Where X_i is a vector of regressors for a household, $\vec{\beta}$ is the coefficient vector estimated from the probit model, ϕ is the probability density function, Φ is the cumulative distribution function and Y_{it} is the dependent variable from the probit model.

The IMR is a measure of the probability that the taxpayer filed Form 5695 and estimates the mean and variance for a truncated distribution. This type of correction has been used in the

[26] Greene, W. 1993. *Econometric Analysis, 2nd Edition.* New York: MacMillan Publishing Company pp. 711-713.

analysis of household good expenditures as a function of income and other variables where the number of nonpurchasers results in distortion of the data.[27] The second step was initially estimated using OLS; however, diagnostic tests indicated heteroskedasticity. To improve the precision of the estimates, a maximum likelihood estimation procedure was implemented, which corrected for multiplicative heteroskedasticity, and is linked to the probit model through the inclusion of the Inverse Mills Ratio as estimated using equation (3). Two maximum likelihood models were developed—one to estimate characteristics of households reporting energy conservation measures, the other to examine all energy credits. The maximum likelihood model takes the following general form where the independent variables are the same as those used in the probit analysis:

$$\begin{aligned} -0.5*((Y_{it} - (b_0 + b_1AGI_{it} + b_2MTR_{it} + b_3EXMPT_{it} + b_4AGE_{it} + b_5SEX_{it} + b_6MS_{it} \\ + b_7MOVE_{it} + b_8MORT_{it} + b_9PREP_{it} + b_{10}STSUB_{it} + b_{10}HEAT_{it} \\ + b_{11}PRCHG_{it} + b_{12}IMR_{it})^2/\exp(a_1SAGI_{it}) + (a_1SAGI_{it})) \\ (i = 1 - 8000 \text{ and } t = 1 - 7) \end{aligned} \quad (4)$$

The form is a log likelihood function where Y_{it} is either energy conservation expenditures or total energy related expenditures; IMR_{it} captures the probability of the taxpayer filing Form 5695; and the last term, $SAGI_{it}$, is included to correct for multiplicative heteroskedasticity in the error term.[28]

RESULTS

Model of Who Filed Form 5695. Parameter estimates for the probit model are presented in Table 7. They show the impact on the probability of filing a Form 5695 for the various parameters for each year. Several trends are apparent in the data. The coefficient for adjusted gross income is negative in six of the seven years as predicted, and significant in two of those years. This result is counter to previous findings that income is positively associated with the energy tax credit and is consistent

[27] See Saha, A, O. Capps, Jr., P. Byrne. 1995. Calculating marginal effects in models for zero expenditures in household budgets using a Heckman-type correction. Working Paper. Texas A&M University, College Station, Texas for examples.

[28] SAGI is AGI scaled by an additional 100 to prevent the exponential portion of the equation from exploding.

with Congress' goal of encouraging lower income households to make energy expenditures. Marginal tax rate is positive and significant in all years as was hypothesized. This result suggests that as the marginal tax rate increases, a taxpayer is more likely to engage in tax reducing activities to reduce the tax burden in the same manner that firms do. The concept of AGI being negatively associated with the credit and marginal tax rate being positively associated with the credit seems at first glance to be counterintuitive, but an explanation of this result is provided when the relationship is examined on an elasticity basis as discussed below.

Table 7 Results from Probit Model (Dependent variable is FORM—a dichotomous variable indicating taxpayer filed Form 5695 - Energy Credits)

Yearly coefficients and asymptotic t-ratios (in parentheses).

Variables	1979	1980	1981	1982	1983	1984	1985
AGI	-.139 (-4.06)*	-.096 (-2.97)*	.011 (.367)	-.031 (-1.05)	-.084 (-2.24)	-.006 (-.36)	-.061 (-2.01)
MTR	3.750 (7.57)*	3.75 (7.67)*	1.989 (4.41)*	2.201 (4.26)*	3.509 (4.84)*	1.286 (2.78)*	3.199 (4.96)*
EXMPT	*.047* (2.29)*	*.076* (3.58)*	*.011* (.467)	*.025* (1.01)	*.081* (2.97)*	-*.006* (-.19)	.064 (2.48)*
AGE	.147 (1.71)	.287 (3.58)*	.158 (1.75)	.153 (1.72)	.101 (.98)	.296 (3.29)*	.083 (.90)
MS	.616 (8.45)*	.556 (7.51)*	.542 (6.64)*	.585 (6.71)*	.495 (4.93)*	.473 (5.07)*	.394 (4.56)*
MORT	.119 (6.72)*	.067 (4.97)*	.066 (5.45)*	.070 (6.26)*	.033 (2.97)*	-.038 (4.10)	.045 (4.38)*
MOVE	-.165 (-.90)	-.417 (-1.87)	-.388 (-1.96)	.056 (.34)	.419 (2.86)*	-.082 (-.45)	-.157 (-.92)
PREP	NA	NA	NA	.149 (2.55)	.385 (5.42)*	.381 (5.54)*	NA
STSUB	-.384 (-4.76)	.001 (.012)	-.181 (-2.32)	-.168 (-1.99)	-.24 (-2.55)	-.085 (-.98)	-.116 (-1.38)
HEAT	.009 (.86)	.044 (3.97)*	.028 (2.26)	-.073 (-.51)	-.005 (-.27)	.006 (.37)	.003 (.17)
PRCHG	.879 (2.00)	1.166 (4.22)*	.041 (.13)	-.012 (-.035)	-.014 (-.03)	-.478 (-.66)	-.495 (-.69)
CONSTANT	-2.79 (-26.86)*	-3.22 (-25.92)*	-2.749 (-23.35)*	-2.861 (-22.81)*	-3.381 (-21.73)*	-2.778 (-22.775)*	-2.84 (-23.71)*

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tic t-ratios (in parentheses).

1983	1984	1985
-.084 (-2.24)	-.006 (-.36)	-.061 (-2.01)
3.509 (4.84)*	1.286 (2.78)*	3.199 (4.96)*
.081 (2.97)*	-.006 (-.19)	.064 (2.48)*
.101 (.98)	.296 (3.29)*	.083 (.90)
.495 (4.93)*	.473 (5.07)*	.394 (4.56)*
.033 (2.97)*	-.038 (4.10)	.045 (4.38)*
.419 (2.86)*	-.082 (-.45)	-.157 (-.92)
.385 (5.42)*	.381 (5.54)*	NA
-.24 (-2.55)	-.085 (-.98)	-.116 (-1.38)
-.005 (-.27)	.006 (.37)	.003 (.17)
-.014 (-.03)	-.478 (-.66)	-.495 (-.69)
-3.381 (-21.73)*	-2.778 (-22.775)*	-2.84 (-23.71)*

Yearly coefficients and asymptotic t-ratios (in parentheses).

Variables	1979	1980	1981	1982 -	1983	1984	1985
N	8000	8000	8000	8000	8000	8000	8000
Craig-Uhler R-square	.182	.169	.146	.141	.145	.105	.106
%Correct Predictions	94.4	94.5	95.7	96.4	97.6	97.5	97.1

Note: * denotes asymptotic t-ratios significant at a.005 p-value

Married taxpayers were more likely to take the credit than single taxpayers as evidenced by the significance of the MS variable in all years. Mortgage is positive (as hypothesized) and significant in six years, which indicates home owners are more inclined to make improvements to reduce energy costs than renters. The number of exemptions is also positive and significant in four years. The results for age are inconsistent in only two of the seven years; taxpayers greater than sixty-five years of age were more likely to report expenditures. As previously mentioned this variable may serve as a proxy for older homes, which are more in need of being upgraded to conserve energy.

For two of the three years information was available, there is statistically significant evidence that the use of a professional preparer increased the probability of reporting energy expenditures. This lends support to the hypothesis that households use professional preparers as a source of information, which could be capitalized on to support future legislative goals. There is evidence in one year early in the period that the credit was available that energy prices did have a significantly positive effect on the probability to make energy conservation expenditures. However, this result does not hold in the later years. Finally the results for state subsidies, heating days, and price change are for the most part inconsistent and insignificant, all of which conflict with Long's results.

To evaluate the performance of our model over time, we compute the Craig-Uhler R-square using one of the methods suggested by Maddala[29] and developed by J.G. Craig and R.

[29] Maddala, G. S. 1988. *Introduction to Econometrics*. New York: Macmillan Publishing Company, pp. 278-279.

Uhler as appropriate for measures based on likelihood ratios. It measures the difference between an unrestricted (all parameters included) and a restricted (that all coefficients are equal to zero) log likelihood function. The pseudo R^2 equation is

$$\frac{L_{UR}^{2/n} - L_{R}^{2/n}}{1 - L_{R}^{2/n}} \qquad (5)$$

where L is the log-likelihood ratio. The results suggest that the models decline over time in their ability to predict form filers. One possible reason for this decline is the reduced number of filers through time as shown in Table 4. Another indicator of the explanatory power is the percentage of correct predictions. The model correctly predicted approximately 95% of the 8,000 observations. However, further analysis indicates that although the prediction rate is impressive, the disproportionate number of Form 5695 non-filers (zeros) (at least 95% in all years) drives these results.

Determining the Strength of the Independent Variables in the Form 5695 Model. Since there are only two possibilities for the dependent variable, the coefficients cannot be interpreted in the same manner as they could for a continuous dependent variable. The marginal effects are computed for the continuous independent variables by computing the probability density function of the estimated probit coefficients computed at the means of the independent variables. However, as Saha, et al.[30] observed, the marginal effect magnitudes are conditional on measurement units. To allow comparison of the relative importance of various parameters, the marginal effect estimates are converted into elasticities. The probability elasticity of a given regressor (x) is computed using the following equation:

[30] *Op. Cit.*

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$$\frac{\partial \text{prob}(Y^t = 1)}{\partial x_j} \cdot \frac{\bar{x}_j}{\text{prob}(Y^t = 1)} = \bar{\beta}^t_j \cdot \frac{\phi\left(\bar{X}^t \bar{\beta}^t_j\right) \cdot \bar{x}_j}{\Phi\left(\bar{X}^t \bar{\beta}^t_j\right)} \qquad (6)$$

where

j denotes a specific parameter,

$\bar{x}$ denotes the mean for the specific parameter,

t denotes a given year model,

$\bar{X}$ denotes sample means for all parameters in the model,

$\bar{\beta}$ is the estimated coefficients,

ϕ is the probability density function, and

Φ is the cumulative density function

Equation (6) is appropriate for estimating the elasticities of continuous variables, and standard errors may be computed using the delta method. However, dummy variables may not be estimated in this manner. Estimates of the elasticities for each of the dummy variables were computed by estimating two cumulative distribution functions (CDF). In both, all other variables are estimated at their means, whereas the dummy variable of interest is set at one in the first and at zero in the second. The difference between the two CDFs computed at one and zero approximates an elasticity measure for the dummy variable.

The elasticities are presented in Table 8. The only parameter other than the intercept term that is consistently significant is marginal tax rate. This suggests that although both AGI and marginal tax rate are significantly correlated with who files Form 5695 (as shown in Table 7), it is marginal tax rate that is relatively more important. Price change is also significant for the first two years, which is when energy prices increased dramatically and reached their highest average prices. This suggests that the main motivation behind a taxpayer's decision to invest in energy conservation expenditures is their level of taxable income (as evidenced by their marginal tax rate) and their economic desire to reduce energy consumption expenditures.

Table 8 Probability Elasticity Results from Probit Model
(Dependent variable is FORM—a dichotomous variable indicating taxpayer filed Form 5695 - Energy Credits)

Yearly probability elasticity results and asymptotic t-ratios (in parentheses)*

Variables	1979	1980	1981	1982	1983	1984	1985
AGI	-.476 (-.52)	-.362 (.31)	.045 (.05)	-.142 (-.14)	-.431 (-.24)	-.033 (-.04)	-.314 (-.23)
MTR	1.567 (13.39)*	1.689 (13.97)*	.984 (6.37)*	1.033 (6.05)*	1.643 (7.74)*	.569 (3.47)*	1.354 (7.44)*
EXMPT	.254 (.19)	.418 (.27)	.063 (.06)	.145 (.13)	.514 (.26)	-.034 (-.041)	.374 (.28)
AGE	.012	.025	.011	.009	.003	.016	.004
MS	.048	.040	.033	.030	.016	.010	.019
MOVE	-.011	-.020	-.016	.003	.020	-.003	-.006
MORT	.133 (.50)	.096 (.40)	.112 (.37)	.-.030 (.35)	.075 (.10)	-.100 (.26)	.117 (.19)
PREP	NA	NA	NA	.007	.013	.016	NA
STSUB	-.023	.0000	-.010	-.007	-.006	-.003	-.005
HEAT	.024 (.04)	.106 (.70)	.068 (.15)	-.002 (-.04)	.013 (-.02)	-.016 (-.04)	.007 (.01)
PRCHG	.086 (1.83)*	.450 (3.67)*	.016 (.13)	-.021 (-.03)	-.018 (-.03)	-.059 (.675)	-.056 (-.67)
CONSTANT	-6.179 (-8.21)*	-7.294 (-7.96)*	-6.399 (-9.31)*	-1.03 (-8.94)*	-8.71 (-7.22)*	-6.920 (-10.41)*	-6.913 (-8.06)*

*Note: t-ratios are presented only for the continuous variables, since standard errors of elasticity cannot be computed for the dummy variables.

* denotes asymptotic t-ratios significant at a.005 p-value

Model Describing the Amount of the Energy Conservation Expenditure. The second stage model presented in equation (4) is estimated using the full sample and includes the estimated IMRs for each observation. This portion extends Long's study, by including the IMR and by estimating the coefficients using all observations in the sample, not only those who reported an energy expenditure. The second-stage model is estimated for both energy conservation expenditures separately, and for the

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ratios (in parentheses)*			
	1983	1984	1985
	-.431 (-.24)	-.033 (-.04)	-.314 (-.23)
	1.643 (7.74)*	.569 (3.47)*	1.354 (7.44)*
	.514 (.26)	-.034 (-.041)	.374 (.28)
	.003	.016	.004
	.016	.010	.019
	.020	-.003	-.006
	.075 (.10)	-.100 (.26)	.117 (.19)
	.013	.016	NA
	-.006	-.003	-.005
	.013 (-.02)	-.016 (-.04)	.007 (.01)
	-.018 (-.03)	-.059 (.675)	-.056 (-.67)
*	-8.71 (-7.22)*	-6.920 (-10.41)*	-6.913 (-8.06)*

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resented in equation (4) includes the estimated n extends Long's study, ıg the coefficients using ı those who reported an model is estimated for separately, and for the

total amount of energy conservation expenditures and renewable energy expenditures. However, since the results are comparable for both models, only the summed results are presented in Table 9 and discussed in the text.

The coefficient to correct for heteroskedasticity is significant at $p < .005$, which confirms the decision to estimate the coefficients using the maximum likelihood method. The main explanatory variable in the second step is the IMR, which is significantly positive and significant at $p < .005$ for all years. This result emphasizes the appropriateness of developing the model using the Heckman two-step method. If the IMR had been insignificant, the first step would have been unnecessary. Adjusted gross income is positively significant for four of the seven years as we hypothesized. This result suggests there is a positive relationship between the amount spent and income. In many years the sign is not as hypothesized for marginal tax rates, marital status, mortgage, heat, price change, and professional preparer. These results, while unanticipated, may be evidence that the correlation is already picked up in the first step and is included in the IMR.

Table 9 Results from Maximum Likelihood Estimation Procedure (Dependent variable is SUM—total sum of energy conservation and renewable resource expenditures made by taxpayers)

	Yearly coefficients and t-ratios (in parentheses)*						
Variables	1979	1980	1981	1982	1983	1984	1985
AGI	.016 (4.27)*	.019 (8.99)*	-.004 (-1.61)	.003 (2.49)*	.003 (4.65)*	-.002 (.62)	.006 (1.90)
MTR	-.31 (-3.20)	-.472 (-6.78)	-.107 (-1.45)	-.156 (-2.41)	-.111 (-2.69)	-.098 (-.90)	-.315 (-2.71)
EXMPT	-.005 (-.85)	.093 (32.21)*	-.026 (-5.06)	-.001 (-.44)	-.008 (-3.44)	.002 (.34)	-.002 (-.311)
AGE	-.025 (-1.03)	-.060 (-3.01)	.115 (.58)	-.014 (-1.27)	-.015 (-2.76)	-.024 (-1.03)	-.014 (-.58)
MS	-.077 (-3.44)	-.25 (-15.51)	-.005 (-.30)	-.045 (-3.85)	-.009 (-1.25)	-.05 (-2.71)	-.034 (-1.51)
MOVE	-.032 (-.93)	.082 (1.49)	-.007 (-.31)	.011 (.477)	-.074 (-6.14)	.211 (5.02)*	-.014 (-.34)
MORT	.021 (6.27)*	-.022 (-13.93)	.017 (9.68)	-.016 (-13.11)	-.005 (-29.06)	.003 (1.58)	-.006 (-3.56)
PREP	NA	NA	NA	-.026 (-2.75)	-.010 (-1.65)	-.023 (-1.41)	NA
STSUB	.104 (4.60)*	-.024 (-1.44)	-.052 (-3.30)	.010 (.72)	.047 (8.78)*	.006 (.30)	.025 (1.17)
HEAT	-.003 (-.84)	-.013 (-3.54)	-.007 (-1.97)	.002 (.55)	.0003 (1.54)	.004 (-.85)	-.001 (-12)
PRCHG	-.477 (-3.47)	-.116 (-1.77)	-.030 (.42)	.060 (.91)	.156 (4.74)*	-.220 (-1.28)	.063 (.37)
IMR	.552 (27.13)*	.588 (40.55)*	.424 (27.85)*	.614 (49.17)*	.490 (47.24)	.572 (29.59)*	.794 (38.26)*
CONSTANT	.004 (.17)	-.071 (-2.83)*	.055 (2.34)	.017 (.81)	.003 (.246)	.031 (1.18)	.010 (.39)
Adj R^2	.262	.157	.308	.272	.378	.402	.377

*Note: * denotes asymptotic t-ratios significant at a.005 p-value

Limitations and Possible Extensions of the Study

There are several limitations to this study. Some of the variables may not be adequate proxies for the hypothesized characteristics. For example, price change may not have picked up the true economic effects of the dramatic increase in energy costs. There were also limitations associated with the database. The need to drop the upper income households may have caused a truncation bias. Another limitation is caused by the exclusion of a potentially important variable. Households that used the full amount of the credit in the first year were necessarily excluded from using the credit in future years, unless they moved. A variable, which was not included in the model, would have helped identify these households was the previous year's expenditure. Finally, cross-sectional samples such as this one are always subject to heteroskedasticity and comparison of cross-sectional models relies on the assumption that the variances are common across years.

One obvious extension to this study would be to develop a cross-sectional panel model to examine the characteristics and spending habits of households taking the credit across the entire time span the credit was available. This would identify whether the same household used the credit for more than one home and whether the household used the entire credit in one year or spread out the credits. An interesting byproduct of examining the issue from this standpoint may be the ability to investigate whether individual taxpayers use tax credits as a tax management tool in the same way firms do. Another extension would be to attempt to investigate interactions among the variables that might proxy for education level to determine whether higher educated households have different objectives than less educated. This would provide additional guidance to policymakers and better enable them to achieve their goals.

Another possible method for analyzing the data would be to develop matched pairs by matching those households that reported the energy credit with a household that did not. This method would provide a more evenly dispersed sample than the one used in this study and may reduce variance and provide better evidence of the differences between those households that did make energy conservation expenditures and those that did not.

Conclusions

This paper discusses the economic rationale behind governmental intervention in energy conservation issues, summarizes policies implemented for individuals during the last energy crisis, and finally, empirically tests a two-step model to determine whether the goals of the policies were met. The results of the first stage of the modeling, the probit analysis, suggest there are significant characteristics and economic consequences that increase the probability of a taxpayer reporting energy conservation expenditures. The characteristics that describe the household more likely to have reported are: 1) larger households; 2) married or widowed taxpayers as opposed to single taxpayers; 3) higher income; and 4) the use of a paid preparer in two of the three years information was available. This last characteristic is of particular importance since it provides evidence that professional preparers are one source for tax-related information or are sought out when taxpayers encounter new or complex situations. This suggests that legislators increase the likelihood of distributing information to taxpayers by providing the information to professional taxpayers, and that future tax regulators could use this to their advantage.

The economic variables that increased the probability of filing Form 5695 were:

1) marginal tax rate (the greater the rate, the more likely the household took the credit) for all seven years, and

2) the energy price change from the previous year (for the first two years the credit was available).

The results from the second step suggest that the most significant regressor to explain the amount of expenditure is the IMR, which measures the probability of filing Form 5695. Adjusted gross income was also significantly positive for four of the seven years. Another major contribution this study makes is the application of the Heckman two-step estimation procedure. Since many subsamples of commonly used databases in accounting research potentially have a self-selection bias, use of this procedure may help adjust for the bias. As the results of the second-step in this study indicate, previously significant results may have been overstated by not correcting for self-selection. For example, accounting method choice studies often examine the information content of selecting a particular accounting method; however, firms using that method self-selected into the sample.

Is the use of an energy credit a good policy choice in helping to encourage energy conservation? Although the modeling reveals that lower income taxpayers were significant users of

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the tax incentive (filed From 5695), when the analysis shifts to the amount of credit claimed, higher income taxpayers (higher AGI) were the major recipients of the credit. Thus, the majority of the tax subsidy went to higher income taxpayers, contrary to the goal of the 1978 Energy Act. When this information is combined with the results of the Pitts and Wittenbach study, which found that most higher income taxpayers were not aware of the credit at the time they decided to incur the conservation expenditures, and the fact that taxpayers in cooler areas were no more likely than others to claim the credit, one must conclude that the tax credit was probably not the most effective tool for energy policy implementation. We can therefore not recommend that a similar credit be utilized as a partial solution to the current energy crisis. But the results do confirm the importance of utilizing tax preparers as a source of information about any new/complex tax law.