# DO EXPENDITURES EXPLAIN INCOME?: A Study of Variables for Income Imputation

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NOTE: This paper describes the results of research undertaken by the staffs of the U.S. Bureau of Labor Statistics and the U.S. Bureau of the Census. Any opinions expressed in this paper are those of the authors and do not constitute policy of either agency. This paper has been abridged. For a copy of the complete version, contact the authors.

## I. Introduction

Most studies of household spending patterns use income as a variable in some way. For example, Moehrle (1990) compares expenditures for older workers and non-workers in different income groups. Sawtelle (1993) uses a linear demand system to estimate income elasticities for several goods and services. Many studies have also found that income is related to the probability of events as diverse as the consumption of wine (Blaylock and Blisard, 1993) to the purchase of a home (Gillingham and Hagemann, 1983; Brownstone and Englund, 1991). Yet, non-response to income questions is a common problem in household surveys, including the U.S. Consumer Expenditure Survey (CE). As a result, some authors use total expenditures as a proxy for permanent income (e.g., Nelson 1988; Branch 1993). Other authors focus on improving income data directly. For example, Eltinge and Yansaneh (1993) pursue weighting adjustment as a method to estimate mean consumer income. Paulin and Sweet (1993) experiment with model building to estimate wage and salary income for individual non-respondents. But neither of the income-adjusting studies directly uses expenditure data to impute income. Presumably, each approach has certain advantages and drawbacks. Although using expenditures as a proxy for permanent income is a simple, straightforward method with some justification in the literature (e.g., Houthakker and Taylor, 1970), total expenditures are not perfectly correlated with income, and may not be useful to studies where transitory income effects are important. Similarly, the income improvement methods fail to include a variable that may have significant explanatory power in an imputation framework. On the other hand, if expenditures are used to predict income, then results of regressions of expenditures on imputed income may be biased. How much does the use of expenditures improve estimates for income? Which expenditures (if any) should be used to predict income? These issues will be explored by comparing statistics, such as $R^2$ and mean square errors, of models using no expenditures, total expenditures, and individual expenditure categories, such as food at home, for single persons who earn primarily either wage and salary or self-employment income.

## II. Background

*The Survey.* Sponsored by the U.S. Bureau of Labor Statistics (BLS) and collected under contract by the U.S. Bureau of the Census, the CE is the only major U.S. government survey to collect detailed expenditure and demographic data from families. The information is collected in a series of five quarterly interviews. Income data are collected in the second and fifth of these interviews.

Currently, consumer units (Appendix A) are divided into two groups: "complete" and "incomplete" income reporters. However, complete income reporters do not always provide a full accounting of all types of income. As a result, these classifications do not completely correct for the problems caused by missing data. For example, many groups of complete reporters are shown on average to spend more than their reported incomes. It is hoped that imputing data to replace missing income values will improve the quality of the published CE data.

*Imputation Strategy.* Lillard, Smith, and Welch (1986) and David, Little, Samuhel, and Triest (1986) examine the hot deck procedure for imputing wage and salary incomes in the U.S. Current Population Survey (CPS). However, the CE sample size is too small to use hot-decking. Model-based imputation is an attractive alternative. It is well-grounded in statistical theory, and may have some advantages over hot decking: "The modeling approach allows a ready transfer of empirical results from research and can be updated as easily as the hot deck," and "modeling appears to have slightly lower mean absolute error than the hot deck that is based on the same information" (David et al., p. 40).

But the problem is more complicated than just selecting an approach. An assumption as to the type of non-response evident in the data is critical. Using the terminology of Little and Rubin (1987), the response mechanism may be classified as Missing-Completely-at-Random (MCAR), Missing-at-Random

(MAR), or Non-Ignorable Non-Response (NINR). If the mechanism is MCAR, the probability of non-response is identical for every respondent in the survey. If the mechanism is MAR, then the probability of non-response may be related to the demographic characteristics of the respondent, but not to the response variable (i.e., income). If the mechanism is NINR, the probability of response is directly related to income. The mechanism is assumed to be MAR in this study for several reasons:

1. Although some research (e.g., Greenlees, Reece, and Zieschang, 1982) concludes that the response mechanism is NINR, later research (Crawford 1989-90) finds evidence to the contrary.

2. MAR results provide a base-line to which NINR results can be compared.

3. NINR assumptions are more complicated, and involve greater difficulty in the implementation stages.

4. Although David et al. find evidence of NINR in CPS data (pp. 39-40), they later conclude that "there is no evidence of systematic departures of imputed values from the comparison [values]. This finding is perhaps most significant, because it throws substantial doubt on the allegation that nonignorable nonresponse is qualitatively important." (p. 40)

A second stage as described by Little and Rubin (1987) is also necessary. Multivariate analysis is needed to obtain analytical solutions to simultaneous non-linear equations and to generate random variables with replacement. The reasoning listed above (especially number 3) also holds true for this stage.

Two income sources are studied here. Wage and salary income is focused on because about two-thirds of complete reporters report wage and salary earnings. It is also assumed to be the most accurately reported type of income, since people generally have a good idea of their wage or salary level. This may not be true of other types of income. Self-employment income is studied both because it is a major source of labor income, and because it fluctuates more than wage and salary income; therefore, each source may be differenty related to expenditures.

## III. Modeling Issues

*The Sample.* Single persons are studied. There are no questions about intra-household resource sharing or other interactions among persons when incorporating expenditures into the models. Singles constitute a sufficiently important group to study (29 percent of consumer units interviewed in 1992). The sample is further restricted to persons in their second interview who said that most of their earnings during the past year had come from either self-employment or a wage and salary occupation, as opposed to pension or other supplemental income. Those who report most of their earnings are from a wage and salary job are defined as salaried singles, even if they have some self-employment or other income; similarly, those who report that most of their earnings are from self-employment are classified as self-employed singles, even if they report other income. Additionally, only "valid" reporters of income are included. Salaried singles are valid if the respondent reports positive wage and salary income. Self-employed singles are valid if the respondent reports no negative self-employment income either from business or farm, and if neither source of income (business or farm) has an invalid response (refusal or "don't know"). The salaried singles (2,207) were interviewed between 1988 and 1990. The self-employed data are from interviews taking place between 1988 through 1992 in order to achieve a large enough sample (202) to study.

*Expenditures.* The stronger the relationship to income, the more obvious the shape of the Engel curve (i.e., expenditure as a function of income) is, and the more useful the expenditure is in predicting income. Perhaps the most obvious candidate is total expenditures, since these data clearly should be related to income. However, some subcategories of expenditures may be better predictors. For example, if all consumers spend about the same share of income on a particular item, then income can be estimated by just multiplying the particular item by the inverse of its income share, whereas total expenditures may have more noise when used to predict income.

Virtually all consumer units have some value reported for total expenditures, but not all incur every type of expenditure. Therefore, it is important that specific expenditures have few non-purchasers; or, if there are a substantial number of zeros reported, they should be meaningful. That is, if almost no one under a certain income ever purchases a certain item, and almost everyone with more than the critical amount makes a purchase, then the zero expenditure may yield useful information. But if purchases of the item are naturally lumpy over time regardless of income(e.g., automobile purchases), then the lack of an expenditure is not a meaningful indicator of level of income. Three candidates are: food at home, shelter and utilities, and telephone services.

Income elasticity (i.e., the percent change in the expenditure due to a one percent increase in income) might also play a role in predicting income. For example, items with a low elasticity (i.e., less than one) may help predict wage and salary income, which is relatively stable, whereas items with a high elasticity (i.e., greater than one) may better predict the more transitory self-employment incomes, since high

elasticity items are by definition more sensitive to changes in income. However, the endogeneity issue is more complicated if individual expenditure categories are used. Some endogeneity may exist for all data users if total expenditures are used. But if food at home is used in imputation, researchers analyzing housing demand will have little concern with endogeneity whereas researchers analyzing food demand will have a greater concern. Therefore, some compromise candidates are proposed, based on Paulin (forthcoming). Basic goods and services (Appendix B) and recreation and related expenditures (Appendix B) have few zeros. The endogeneity problem is lessened with summed expenditures, and *a priori*, they should have different income elasticities (basic goods should be low and recreation should be high).

Incomes and expenditures are divided by the level of the Consumer Price Index (CPI) for all goods and services for the month in which the interview takes place to control for price changes, because multiple years of data are used in each sample, and incomes and expenditures change with prices.

*Demographic Variables.* Traditional variables are used to predict income (Appendix B). Interaction terms (age and age squared with education), which are found to be important in Paulin and Sweet (1993), also have significant explanatory power in the present models, at least for the salaried singles (Table 8). Housing tenure is used because the Interview survey routinely shows that homeowners report higher incomes than renters. Also, a dummy variable is included describing whether the homeowner has a mortgage. The interaction of this dummy variable and the level of the expenditure variable is used in each regression. Paulin (forthcoming) finds that owners with and without mortgages differ frequently in expenditure pattern, even when income and other characteristics are controlled.

*Labor-related Variables.* Dummy variables describing type of occupation, whether other forms of labor income are also earned, and other variables describing number of hours per year worked (including the dummy variables FULLTIME and OVERTIME) are included in each model.

*Survey attribute variables.* Persons with long interviews may have more expenditures or income information to report than those with short interviews. Incomes may also be better reported during the quarters of the year closest to the tax season. For the self-employed a dummy variable RECESS is included for those who are interviewed in 1991 or 1992. This variable controls for differences in income due to slow economic growth during the period, (see *Survey of Current Business* [1991]), which is not covered for the salaried sample.

*Transformations.* Many authors (Greenlees et al., 1982; David et al., 1986) use the log of income in their models to approximate normality. However, it is not clear that the log transformation is optimal. Scott and Rope (1993) in their study of CE expenditure data describe the many benefits of Box-Cox transformations. The formula is:

$(X^{\lambda} - 1)/\lambda$

where X is the variable being transformed and $\lambda$ is a parameter found through maximum likelihood estimation (Scott and Rope [1993]).

For salaried workers $\lambda$ matches the value that Paulin and Sweet (1993) find for salaried two-member consumer units. Also, for each type of worker $\lambda$ for total expenditures (0.125) and telephone expenditures (0.375) match, indicating a similar distribution of these expenditures regardless of income source. The values of $\lambda$ are shown in Table 1.

**Table 1. Optimal Values of $\lambda$ for Income and Expenditures.**

| Variable | Salaried | Self-employed |
|---|---|---|
| Income | 0.375 | 0.200 |
| Total Expenditures | 0.125 | 0.125 |
| Food at Home | 0.425 | 0.375 |
| Shelter/Utilities | 0.475 | 0.375 |
| Telephone Services | 0.375 | 0.375 |
| Basic Goods/Services | 0.350 | 0.250 |
| Recreation Related | 0.200 | 0.275 |

*Weighting.* The regressions are weighted to reflect the population and to account for sample design effect.

*Multicollinearity.* Usually, when the goal is to impute a variable, multicollinearity in the model stage is not a serious problem because it is the predicted outcome, and not any individual parameter estimate, that is of interest. However, if expenditures are perfectly explained by the other independent variables, then it is more efficient to include only expenditures in the model. On the other hand, if processing is more complicated when expenditures are used, it may be more efficient to use only demographics in the model. When expenditures are regressed on characteristics, the largest $R^2$ is 0.5204 (for total expenditures for the self-employed). Since this value is smaller than the smallest $R^2$ for income regressed on an expenditure and other characteristics (0.6167 for self-employed food at home model), Kennedy (1992, p. 181) suggests that multicollinearity is not serious. Table 2 shows results of the regressions of expenditures on demographic characteristics.

**Table 2. $R^2$ Values for Expenditures Regressed on Demographic Characteristics**

| Variable | Salaried | Self-employed |
|---|---|---|
| Total Expenditures | 0.4316 | 0.5204 |
| Food at Home | 0.1425 | 0.2237 |
| Shelter/Utilities | 0.3739 | 0.4854 |
| Telephone Services | 0.1916 | 0.3116 |
| Basic Goods/Services | 0.3818 | 0.4499 |
| Recreation Related | 0.2046 | 0.3498 |

## IV. Results

*Income Shares.* According to Banner, Baxter, and Rees (1972), Engel's original proposition of 1857 is that as incomes increase, the proportion of income spent on food diminishes (p. 140). Because shares of other goods and services may also vary with level of income, it is worthwhile to test some relationships. However, because income is endogenous, total expenditures are used as a proxy to predict the share. Thus, the dependent variable in the model becomes the untransformed level of the specific expenditure (i.e., total expenditure, food at home, etc.) divided by the untransformed income from the appropriate source (wage and salary or self-employment income), or the *income shares*. The independent variables include the demographic characteristics and transformed total expenditures.

Surprisingly, none of the shares tested is very useful in predicting income. For the salaried singles the models all have extremely low $R^2$ values--0.02 or less in each case. The models also predict *negative* shares for more than one-fourth of the sample regardless of the model. The coefficient on total expenditures is not statistically significant in any of the models tested. Part of the problem is that so many respondents report extremely large income shares. There are several observations exceeding 100 (meaning that total expenditures are 10,000 percent of wage and salary income). Fortunately, much better results are obtained when transformed incomes are regressed directly on transformed expenditures and demographic characteristics, as described below.

*Predictive Power of Expenditures.* For the salaried singles every expenditure tested is statistically significant at the 99 percent confidence. For self-employed singles only recreation and related expenditures fail the significance test at the 95 percent confidence level. The highest t-value once again belongs to total expenditures. Table 3 shows the t-values.

**Table 3. T-Statistics from Regressions of Income on Expenditures and Other Characteristics**

| Variable | Salaried | Self-employed |
|---|---|---|
| Total Expenditures | 20.804 | 5.802 |
| Food at Home | 2.848 | 2.125 |
| Shelter/Utilities | 11.231 | 3.175 |
| Telephone Services | 4.896 | 2.372 |
| Basic Goods/Services | 13.331 | 4.096 |
| Recreation Related | 11.067 | 1.105 |

But which of these variables adds the most to the $R^2$ value? The $R^2$ values for all models of income regressed on expenditures and characteristics are shown in Table 4.

**Table 4. $R^2$ Values Regressions of Income on Expenditures and Other Characteristics**

| Variable | Salaried | Self-employed |
|---|---|---|
| No Expenditures | 0.6498 | 0.6042 |
| Total Expenditures | 0.7091 | 0.7070 |
| Food at Home | 0.6512 | 0.6167 |
| Shelter/Utilities | 0.6690 | 0.6422 |
| Telephone Services | 0.6537 | 0.6209 |
| Basic Goods/Services | 0.6763 | 0.6617 |
| Recreation Related | 0.6687 | 0.6248 |

Whether wage and salary or self-employment income is examined, the order of increase in $R^2$ for each expenditure is the same. That is, in each case food at home adds the least to $R^2$, which becomes succeedingly larger in the regressions for telephone services, recreation and related expenditures, shelter and utilities, basic goods and services, and finally total expenditures.

*Mean Square Error Comparisons for Actual Income.* The models described above predict transformed incomes, but the real goal of imputation is to predict actual income values. To test how well expenditures predict actual income, a comparison of mean square errors (MSEs) for each expenditure category is proposed in which the transformed value of income is untransformed in the following way:

$$Y' = (\lambda y' + 1)^{1/\lambda}$$

where

$y'$ is the predicted value of transformed income

$\lambda$ is equal to 0.375 for wage and salary income and 0.2 for self-employment income

$Y'$ is the predicted value of actual income.

The MSE is then found by the formula:

$$MSE = \Sigma(Y - Y')^2/n$$

where

$Y$ is observed income

$n$ is the number of observations of $Y'$.

Table 5 shows the MSE values.

**Table 5. Comparison of Mean Square Errors (in Millions)**

| Variable | Salaried | Self-employed |
|---|---|---|
| No Expenditures | 165.37 | 345.56 |

| | | |
|---|---|---|
| Total Expenditures | 133.37 | 284.90 |
| Food at Home | 164.76 | 344.15 |
| Shelter/Utilities | 155.65 | 332.00 |
| Telephone Services | 163.73 | 339.23 |
| Basic Goods/Services | 152.49 | 323.41 |
| Recreation Related | 155.45 | 331.12 |

Once again, the results of the MSE test are similar for both salaried and self-employed singles. The largest MSE (and therefore the least tight fit) is found for the model in which no expenditures are included. The variables in descending order of MSE are the same as when ranked by increasing $R^2$ values for the models using transformed variables (Table 4).

*Comparisons of Means and Standard Errors.* Another way to determine which models are most useful is to compare the means and standard errors of the predicted incomes to those of the actual incomes to see which models produce the closest results. The income data shown in Table 6 are for the untransformed values. The standard errors of each mean are shown in parentheses below the mean. All statistics in Table 6 are unweighted.

**Table 6. Means and Standard Errors of Income: Observed and Predicted**

| Variable | Salaried | Self-employed |
|---|---|---|
| Observed | $15,953 | 14,830 |
| | (346.17) | (1,468) |
| No Expenditures | 14,428 | 11,034 |
| | (193.28) | (612.86) |
| Total Expenditures | 14,642 | 11,996 |
| | (206.33) | (765.08) |
| Food at Home | 14,434 | 11,116 |
| | (193.29) | (636.62) |
| Shelter/Utilities | 14,492 | 11,369 |
| | (198.52) | (654.53) |
| Telephone Services | 14,431 | 11,128 |
| | (193.44) | (627.11) |
| Basic Goods/Services | 14,521 | 11,490 |
| | (200.24) | (685.91) |
| Recreation Related | 14,502 | 11,215 |
| | (197.32) | (650.82) |

Based on the figures above, a series of t- and F-tests can be conducted to test for significant differences between the means and variances of predicted incomes from each of the models and of actual reported incomes. The results of these comparisons are shown in Table 7. In almost every case, the t-statistic comparing the mean of predicted incomes to actual incomes shown in Table 6 is statistically significant at the 95 percent confidence level. All the F-statistics are also significant. However, once again the smallest F-statistics are associated with the total expenditure models, and the largest with the no expenditure models. But caution should be taken when interpreting these statistics. When an ANOVA test is performed comparing the mean and variance of the *actual* incomes compared to the predicted values of the models, the F-statistic is statistically significant for both salaried and self-employed singles. However, when the model results are compared *to each other*, the F-statistic is not statistically significant, indicating that the hypothesis that all the models, whether or not they include expenditures, predict similarly on average cannot be rejected at a conventional level of statistical confidence.

**Table 7. T- and F-Statistics to Compare Means and Standard Errors of Predicted and Observed Income**

| Variable | Salaried | Self-employed |
|---|---|---|
| No Expenditures | | |
| t-statistic: | -3.846 | -2.386 |
| F-statistic: | 3.208 | 5.738 |
| Total Expenditures | | |
| t-statistic: | -3.253 | -1.702 |
| F-statistic: | 2.815 | 3.682 |
| Food at Home | | |
| t-statistic: | -3.831 | -2.321 |
| F-statistic: | 3.207 | 5.317 |
| Shelter/Utilities | | |
| t-statistic: | -3.661 | -2.153 |
| F-statistic: | 3.041 | 5.030 |
| Telephone Services | | |
| t-statistic: | -3.838 | -2.319 |
| F-statistic: | 3.202 | 5.480 |
| Basic Goods/Services | | |
| t-statistic: | -3.581 | -2.059 |
| F-statistic: | 2.989 | 4.528 |
| Recreation Related | | |
| t-statistic: | -3.642 | -2.251 |
| F-statistic: | 3.078 | 5.088 |

## V. Conclusions

If expenditures are to be used to impute income, total expenditures emerge as the best choice by every criteria considered here. However, this study only addresses single persons. The relationship of expenditures to income becomes more complex as family size, and particularly number of earners, increases. These relationships warrant fuller examination before expenditures can be recommended for use in imputation.

## APPENDIX A: About the Consumer Expenditure Survey (CE)

The CE Interview sample is composed of over 5,000 consumer units per quarter. During the second and fifth interviews the respondent is asked detailed information about several sources of income for the members of the consumer unit who are at least 14 years old; other sources of income are collected for the consumer unit as a whole. Sources include:

Collected for each member: Wages and salaries; self-employment, including owned farms; Social Security and Railroad benefit checks; and supplemental security income.

Collected for the family as a whole: Unemployment compensation; workers' compensation and veteran's benefits; public assistance and welfare; interest (savings accounts and bonds); regular income from dividends, royalties, estates, or trusts; pensions or annuities from private, military, or other government sources; net income or loss from roomers and boarders or other payments received; regular contributions for support, such as alimony and child support; money income from care for foster children, cash scholarships, and fellowships or stipends not based on working; and food stamps.

*Consumer Unit:* a single person either living alone or sharing a household with others from whom the single person is financially independent; two or more members of a household related by blood, marriage, adoption, or other legal arrangement; or two or more persons living together who share responsibility for at least 2 out of 3 major types of expenses--food, housing, and other expenses.

*"Complete" Income Reporters.* Families that fit one of the following criteria are complete reporters:

1. All major sources of income for each member are reported as zero or valid blank, and at least one member reported a valid, non-zero value for another source of income.

2. The reference person (i.e., the first member mentioned when the respondent is asked to "Start with the name of the person or one of the persons who owns or rents the home") reports zero or valid blanks for all major sources of income, and at least one other member reported a valid, non-zero amount for at least one major source of income.

3. The reference person reported a valid, non-zero amount for at least one major source of income.

Valid blanks result when there is a good reason to leave a question unanswered; for example, a nonworking member has a valid blank for wage and salary income. For some sources (e.g., self-employment income) negative amounts can be valid responses.

## APPENDIX B: Variable Description

Note: All income and expenditure variables are divided by CPI for month of interview, and subjected to Box-Cox transformation.

**Dependent Variables.**

**BOXSELF:** Self-employment income (business and farm).

**BOXWGSAL:** Wage and salary income.

**Expenditure Variables.**

**BOXEXP:** Total expenditures.

**BOXFOODH:** Food at home.

**BOXSHELU:** Shelter (rent or owned dwelling expenditures for primary home) and utilities.

**BOXTELE:** Telephone services.

**BOXBASIC:** Basic goods and services (food at home, shelter and utilities, apparel and services.)

**BOXRLFUN:** Recreation and related expenditures (entertainment, food away from home, lodging away from home).

**Other Independent Variables.**

**AGE:** Age of the respondent.

**AGESQ:** Squared age of the respondent.

**EDUCLEVL:** Educational attainment; 0 is no school; 18 is at least 2 years of graduate school.

**AGEEDUC:** AGE*EDUCLEVL.

**AGESQED:** AGESQ*EDUCLEVL.

**TM_INTER:** Length of interview in minutes.

**HOURYEAR:** Number of hours per year worked.

**FULLTIME:** Dummy variable; equals one if HOURYEAR equals 2080.

**OVERTIME:** Dummy variable; equals one if HOURYEAR exceeds 2080.

**OTSLOPE:** OVERTIME*HOURYEAR.

**OCCUPATIONAL CLASSES:**

TECHSALE: Respondent is in technical/sales work.

PRECPROD: Respondent is in precision/production work.

OPERATOR: Respondent is an operative or machinist.

SERVICES: Respondent is in service work.

Control group is managers and professionals.

**OTHLBINC:** Dummy variable; indicates secondary source of labor income.

**BLACK:** Respondent is black.

**FEMALE:** Respondent is female.

**BLACKFEM:** BLACK*FEMALE.

**STUDENT:** Respondent is enrolled in college full- or part-time.

**REGION OF RESIDENCE:**

NOREAST/MIDWEST/WEST: Indicate region in which consumer unit is located.

Control group is located in Southern region.

**RURAL:** Consumer unit is located in a rural area.

**RENTER:** Respondent rents primary dwelling.

**OWNOMORT:** Respondent owns primary dwelling outright (i.e., no mortgage).

**NOMRT*EXP:** Interaction term of expenditure and OWNOMORT (e.g., OWNOMORT*BOXEXP).

**SEASON OF INTERVIEW:**

QUARTER2/QUARTER3/QUARTER4: Indicate in which part of the year the interview takes place. Control group is the first quarter of the year (January, February, or March).

**RECESS:** Interview took place in 1991 or 1992.

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**Key to Descriptive Statistics:**

[a] The standard error of the mean is $s/n^{0.5}$ where $s^2 = \sum w_i (x_i - X_w)^2 / \sum w_i$, where $w_i$ is the population weight for the ith observation for variable x; $x_i$ is the value of the ith observation of x; $X_w$ is the weighted mean of x; and n is the sample size.

[b] Total quarterly expenditures multiplied by four to annualize for easier comparison to income data. All other expenditures are in quarterly form.

[c] Values for this variable (population weight for each observation) are unweighted.

DESCRIPTIVE STATISTICS FOR VARIABLES USED IN REGRESSIONS

| VARIABLE | Salaried: N | MEAN (WEIGHTED) | STD ERROR OF MEAN[a] | Self-Employed: N | MEAN (WEIGHTED) | STD ERROR OF MEAN[a] |
|---|---|---|---|---|---|---|
| **Demographic Characteristics** | | | | | | |
| AGE_REF | 2207 | 35.9333 | 0.300 | 202 | 47.7447 | 1.27 |
| AGESQ | 2207 | 1490.3087 | 25.493 | 202 | 2607.3266 | 132.17 |
| EDUCLEVL | 2207 | 13.9802 | 0.057 | 202 | 13.7187 | 0.23 |
| AGEEDUC | 2207 | 493.7117 | 4.235 | 202 | 637.7585 | 18.12 |
| AGESQED | 2207 | 20039.2677 | 334.623 | 202 | 33738.2580 | 1633.30 |
| TM_INTER | 2207 | 64.5619 | 0.619 | 202 | 68.7011 | 2.23 |
| HOURYEAR | 2207 | 1826.1561 | 17.644 | 202 | 1683.9985 | 74.38 |
| FULLTIME | 2207 | 0.2812 | 0.010 | 202 | 0.1896 | 0.03 |
| OVERTIME | 2207 | 0.2808 | 0.010 | 202 | 0.2571 | 0.03 |
| OTSLOPE | 2207 | 761.3508 | 26.400 | 202 | 779.1944 | 95.83 |
| TECHSALE | 2207 | 0.3065 | 0.010 | 202 | 0.2185 | 0.03 |
| PRECPROD | 2207 | 0.0600 | 0.005 | 202 | 0.0901 | 0.02 |
| OPERATOR | 2207 | 0.1485 | 0.008 | 202 | 0.2163 | 0.03 |
| SERVICES | 2207 | 0.1518 | 0.008 | 202 | 0.1312 | 0.02 |
| OTHLBINC | 2207 | 0.0407 | 0.004 | 202 | 0.1180 | 0.02 |
| BLACK | 2207 | 0.1005 | 0.006 | 202 | 0.0480 | 0.02 |
| FEMALE | 2207 | 0.4616 | 0.011 | 202 | 0.3168 | 0.03 |
| BLACKFEM | 2207 | 0.0519 | 0.005 | 202 | 0.0166 | 0.01 |
| STUDENT | 2207 | 0.2231 | 0.009 | 202 | 0.1353 | 0.02 |
| NOREAST | 2207 | 0.2147 | 0.009 | 202 | 0.1735 | 0.03 |
| MIDWEST | 2207 | 0.2580 | 0.009 | 202 | 0.2213 | 0.03 |
| WEST | 2207 | 0.2458 | 0.009 | 202 | 0.2850 | 0.03 |
| RURAL | 2207 | 0.0857 | 0.006 | 202 | 0.1410 | 0.02 |
| RENTER | 2207 | 0.7030 | 0.010 | 202 | 0.4986 | 0.04 |
| OWNOMORT | 2207 | 0.0864 | 0.006 | 202 | 0.2313 | 0.03 |
| QUARTER2 | 2207 | 0.2589 | 0.009 | 202 | 0.2591 | 0.03 |
| QUARTER3 | 2207 | 0.2433 | 0.009 | 202 | 0.2427 | 0.03 |
| QUARTER4 | 2207 | 0.2261 | 0.009 | 202 | 0.2380 | 0.03 |
| RECESS | N/A | N/A | N/A | 202 | 0.3937 | 0.03 |
| **Expenditure Variables (Divided by CPI)** | | | | | | |
| Total Exps.[b] | 2207 | 14944.9054 | 237.622 | 202 | 16700.1001 | 776.64 |
| Food at home | 2207 | 328.2091 | 5.603 | 202 | 365.4856 | 21.29 |
| Shelter/Util. | 2207 | 979.5326 | 15.736 | 202 | 1096.2962 | 62.32 |
| Telephone | 2207 | 95.0666 | 2.096 | 202 | 115.7552 | 7.69 |
| Basics | 2207 | 1526.5115 | 22.033 | 202 | 1661.3813 | 76.92 |
| Recreation | 2207 | 521.7984 | 20.080 | 202 | 648.0917 | 62.76 |
| Box-Cox Transformations | | | | | | |
| BOXEXP | 2207 | 18.0095 | 0.045 | 202 | 18.3802 | 0.15 |
| BOXFOODH | 2207 | 23.4407 | 0.182 | 202 | 20.0170 | 0.49 |
| BOXSHELU | 2207 | 49.2783 | 0.425 | 202 | 31.4277 | 0.77 |
| BOXTELE | 2207 | 10.2545 | 0.121 | 202 | 11.4699 | 0.40 |
| BOXBASIC | 2207 | 32.6774 | 0.172 | 202 | 20.5279 | 0.29 |
| BOXRLFUN | 2207 | 10.4707 | 0.094 | 202 | 14.5529 | 0.55 |
| Interaction of Box-Cox Transformations with Owned Home, No Mortgage | | | | | | |
| Total Exps.[b] | 2207 | 1.5196 | 0.106 | 202 | 4.1795 | 0.54 |
| Food at home | 2207 | 2.1958 | 0.160 | 202 | 4.7305 | 0.63 |
| Shelter/Util. | 2207 | 3.5749 | 0.263 | 202 | 6.4439 | 0.88 |
| Telephone | 2207 | 0.9081 | 0.067 | 202 | 2.7203 | 0.34 |
| Basics | 2207 | 2.6015 | 0.184 | 202 | 4.4420 | 0.58 |
| Recreation | 2207 | 0.8334 | 0.066 | 202 | 3.2757 | 0.50 |
| **Income Values (Means for those reporting. Real indicates original value is divided by CPI.)** | | | | | | |
| Wage/Salary | 2207 | 19546.6633 | 415.612 | 23 | 3287.3582 | 651.06 |
| Business | 67 | 2727.9686 | 1288.260 | 188 | 17865.1069 | 1790.00 |
| Farm | 8 | 2739.2412 | 1285.686 | 15 | 17238.0755 | 6960.53 |
| Real Wage/Sal | 2207 | 15727.2585 | 331.410 | N/A | N/A | N/A |
| Real Self-Emp. | N/A | N/A | N/A | 202 | 13872.4929 | 1324.44 |
| BOXWGSAL | 2207 | 87.7270 | 0.715 | N/A | N/A | N/A |
| BOXSELF | N/A | N/A | N/A | 202 | 24.5975 | 0.60 |
| **Other Variables** | | | | | | |
| CPI | 2207 | 124.1431 | 0.114 | 202 | 129.8007 | 0.59 |
| Pop. Weight[c] | 2207 | 4591.7086 | 49.772 | 202 | 4877.6637 | 187.76 |

Table 8: Results of Wage and Salary Income Data Regressed on Expenditures and Other Characteristics: Parameter Estimates and t-Statistics

| | No Expenditures | | Total Expenditures | | Food at Home | | Shelter & Utilities | | Telephone Services | | Basic Goods & Services | | Recreation & Related Expenditures | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Variable Names | Param. Est. | t-value | Param. Est. | t-value | Param. Est. | t-value | Param. Est. | t-value | Param. Est. | t-value | Param. Est. | t-value | Param. Est. | t-value |
| $R^2$ | 0.6498 | N/A | 0.7091 | N/A | 0.6512 | N/A | 0.6690 | N/A | 0.6537 | N/A | 0.6763 | N/A | 0.6687 | N/A |
| INTERCEPT | 26.455 | 1.339 | -24.942 | -1.372 | 24.419 | 1.237 | 38.749 | 2.011 | 36.352 | 1.840 | 30.380 | 1.598 | 15.319 | 0.796 |
| EXPENDITURES | N/A | N/A | 5.344 | 20.804 | 0.158 | 2.848 | 0.302 | 11.231 | 0.411 | 4.896 | 0.886 | 13.331 | 1.242 | 11.067 |
| AGE_REF | 0.412 | -0.440 | -1.072 | -1.250 | 0.338 | 0.361 | -0.419 | -0.458 | -0.097 | -0.104 | -0.692 | -0.765 | 0.474 | 0.520 |
| AGESQ | -0.003 | -0.268 | 0.010 | 1.158 | -0.002 | -0.209 | 0.003 | 0.360 | 0.002 | 0.237 | 0.006 | 0.654 | -0.003 | -0.367 |
| EDUCLEVL | -1.006 | -0.697 | -3.117 | -2.361 | -0.977 | -0.677 | -2.219 | -1.573 | -1.788 | -1.237 | -2.550 | -1.830 | -1.180 | -0.840 |
| AGEEDUC | 0.136 | 1.969 | 0.196 | 3.109 | 0.133 | 1.931 | 0.163 | 2.425 | 0.164 | 2.384 | 0.178 | 2.681 | 0.130 | 1.939 |
| AGESQED | -0.001 | -2.202 | -0.002 | -3.129 | -0.001 | -2.156 | -0.001 | -2.436 | -0.001 | -2.581 | -0.001 | -2.682 | -0.001 | -2.111 |
| TM_INTER | 0.090 | 5.606 | 0.031 | 2.082 | 0.089 | 5.538 | 0.072 | 4.590 | 0.080 | 4.951 | 0.064 | 4.130 | 0.066 | 4.171 |
| HOURYEAR | 0.026 | 22.897 | 0.022 | 21.639 | 0.026 | 22.912 | 0.024 | 21.926 | 0.025 | 22.491 | 0.024 | 22.245 | 0.025 | 22.870 |
| FULLTIME | -0.564 | -0.381 | -0.204 | -0.151 | -0.480 | -0.325 | -0.267 | -0.183 | -0.354 | -0.240 | -0.303 | -0.213 | -0.660 | -0.458 |
| OVERTIME | 48.746 | 9.054 | 42.141 | 8.566 | 48.154 | 8.952 | 45.541 | 8.683 | 48.027 | 8.963 | 45.430 | 8.762 | 48.277 | 9.215 |
| OTSLOPE | -0.022 | -10.106 | -0.019 | -9.938 | -0.021 | -10.028 | -0.020 | -9.806 | -0.021 | -9.989 | -0.021 | -10.020 | -0.022 | -10.398 |
| TECHSALE | -6.531 | -5.713 | 4.374 | -4.167 | -6.271 | -5.476 | -6.253 | -5.615 | -6.510 | -5.724 | -5.588 | -5.060 | -5.713 | -5.121 |
| PRECPROD | -8.397 | -4.139 | -5.270 | -2.838 | -8.562 | -4.223 | -7.534 | -3.815 | -8.206 | -4.065 | -7.358 | -3.765 | -6.313 | -3.184 |
| OPERATOR | -11.818 | -7.815 | -7.388 | -5.291 | -11.754 | -7.779 | -10.479 | -7.089 | -11.226 | -7.433 | -9.881 | -6.742 | -9.776 | -6.586 |
| SERVICES | -13.471 | -9.377 | -9.003 | -6.730 | -13.272 | -9.195 | -12.722 | -9.028 | -13.470 | -9.383 | -11.702 | -8.353 | -11.620 | -8.186 |
| OTHLBINC | -1.194 | -0.546 | -1.413 | -0/708 | -0.977 | -0.447 | -0.607 | -0.285 | -1.406 | -0.646 | -0.245 | -0.116 | -2.003 | -0.940 |
| BLACK | -2.665 | -1.284 | 0.367 | 0.194 | -2.768 | -1.335 | -2.189 | -1.084 | -2.265 | -1.096 | -2.659 | -1.332 | -0.872 | -0.430 |
| FEMALE | -6.365 | -6.503 | -3.737 | -4.146 | -6.173 | -6.304 | -6.087 | -6.394 | -6.620 | -6.789 | -6.345 | -6.741 | -4.799 | -4.985 |
| BLACKFEM | 5.635 | 1.965 | 2.968 | 1.134 | 5.670 | 1.981 | 3.930 | 1.408 | 4.736 | 1.657 | 4.054 | 1.469 | 5.819 | 2.086 |
| STUDENT | -6.390 | -4.877 | -4.300 | -3.585 | -6.123 | -4.666 | -4.638 | -3.613 | -6.425 | -4.929 | -4.158 | -3.270 | -6.308 | -4.948 |
| NOREAST | 4.554 | 3.557 | 4.211 | 3.604 | 4.421 | 3.455 | 4.254 | 3.412 | 4.655 | 3.654 | 3.827 | 3.102 | 4.388 | 3.521 |
| MIDWEST | 0.820 | 0.668 | 1.080 | 0.965 | 1.036 | 0.844 | 0.747 | 0.626 | 0.771 | 0.632 | 0..981 | 0.832 | 0.771 | 0.646 |
| WEST | 1.385 | 1.148 | 1.237 | 1.125 | 1.307 | 1.085 | 0.657 | 0.560 | 1.569 | 1.307 | 0.442 | 0.381 | 1.252 | 1.068 |
| RURAL | -9.140 | -5.822 | -6.959 | -4.841 | -9.019 | -5.740 | -7.966 | -5.200 | -8.942 | -5.722 | -7.261 | -4.776 | -8.966 | -5.866 |
| RENTER | -11.590 | -9.876 | -6.463 | -5.877 | -11.482 | -9.793 | -8.942 | -7.673 | -10.887 | -9.252 | -8.691 | -7.556 | -9.697 | -8.394 |
| OWNOMORT | -12.282 | -6.566 | 30.953 | 2.614 | -12.936 | -2.417 | 6.414 | 1.351 | -11.995 | -2.632 | 10.241 | 1.400 | -4.363 | -1.273 |
| NOMRT*EXP | N/A | N/A | -2.117 | -3.214 | 0.023 | 0.120 | -0.327 | -3.174 | 0.010 | 0.028 | -0.575 | -2.488 | -0.701 | -2.416 |
| QUARTER2 | 1.409 | 1.193 | 1.505 | 1.399 | 1.512 | 1.283 | 1.491 | 1.299 | 1.304 | 1.110 | 2.077 | 1.827 | 1.408 | 1.225 |
| QUARTER3 | -1.956 | -1.626 | -1.934 | -1.764 | -1.962 | -1.634 | -1.399 | -1.195 | -2.052 | -1.715 | -0.985 | -0.851 | -1.883 | -1.609 |
| QUARTER4 | -0.625 | -0.510 | -1.881 | -1.679 | -0.596 | -0.487 | -0.697 | -0.584 | -0.826 | -0.677 | -0.534 | -0.453 | -0.675 | 0.565 |

NOMRT*EXP: Interaction of owned home, no mortgage and expenditures.

Table 9: Results of Self-Employment Income Data Regressed on Expenditures and Other Characteristics: Parameter Estimates and t-Statistics

| | No Expenditures | | Total Expenditures | | Food at Home | | Shelter & Utilities | | Telephone Services | | Basic Goods & Services | | Recreation & Related Expenditures | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Variable Names | Param. Est. | t-value | Param. Est. | t-value | Param. Est. | t-value | Param. Est. | t-value | Param. Est. | t-value | Param. Est. | t-value | Param. Est. | t-value |
| $R^2$ | 0.6042 | N/A | 0.7070 | N/A | 0.6167 | N/A | 0.6422 | N/A | 0.6209 | N/A | 0.6617 | N/A | 0.6248 | N/A |
| INTERCEPT | 31.013 | 1.539 | 5.3040. | 0.299 | 25.170 | 1.245 | 34.695 | 1.797 | 38.407 | 1.919 | 24.094 | 1.283 | 24.604 | 1.239 |
| EXPENDITURES | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| AGE_REF | -0.645 | -0.894 | -0.679 | -1.077 | -0.535 | -0.736 | -0.874 | -1.257 | -0.971 | -1.347 | -0.719 | -1.066 | -0.466 | -0.654 |
| AGESQ | 0.003 | 0.556 | 0.004 | 0.909 | 0.002 | 0.416 | 0.005 | 0.892 | 0.006 | 1.016 | 0.004 | 0.736 | 0.002 | 0.401 |
| EDUCLEVL | -0.834 | -0.574 | -0.949 | -0.746 | -0.582 | -0.398 | -1.385 | -0.987 | -1.529 | -1.051 | -1.057 | -0.778 | -0.317 | -0.220 |
| AGEEDUC | 0.0457 | 0.855 | 0.042 | 0.909 | 0.035 | 0.654 | 0.058 | 1.143 | 0.068 | 1.281 | 0.046 | 0.928 | 0.025 | 0.478 |
| AGESQED | -0.000 | -0.634 | -0.000 | -0.818 | -0.000 | -0.427 | -0.000 | -0.887 | -0.000 | -1.055 | -0.000 | -0.689 | -0.000 | -0.308 |
| TM_INTER | 0.021 | 1.449 | 0.013 | 1.039 | 0.020 | 1.410 | 0.017 | 1.236 | 0.023 | 1.615 | 0.017 | 1.278 | 0.020 | 1.447 |
| HOURYEAR | 0.006 | 5.444 | 0.005 | 5.947 | 0.005 | 5.137 | 0.006 | 5.585 | 0.006 | 5.538 | 0.005 | 5.441 | 0.006 | 5.688 |
| FULLTIME | -4.534 | -2.682 | -4.298 | -2.928 | -3.991 | -2.342 | -4.933 | -3.046 | -4.552 | -2.733 | -4.461 | -2.838 | -4.422 | -2.666 |
| OVERTIME | 11.859 | 2.676 | 9.838 | 2.559 | 11.055 | 2.503 | 10.357 | 2.435 | 12.148 | 2.783 | 9.769 | 2.358 | 12.129 | 2.794 |
| OTSLOPE | -0.006 | -3.472 | -0.005 | -3.786 | -0.005 | -3.162 | -0.005 | -3.464 | -0.006 | -3.600 | -0.005 | -3.304 | -0.006 | -3.653 |
| TECHSALE | -2.564 | -2.105 | -2.787 | -2.643 | -2.509 | -2.076 | -2.578 | -2.208 | -2.928 | -2.384 | -2.470 | -2.172 | -2.548 | -2.135 |
| PRECPROD | -2.634 | -1.510 | -2.007 | -1.322 | -2.693 | -1.558 | -2.467 | -1.477 | -2.288 | -1.310 | -2.488 | -1.530 | -2.686 | -1.571 |
| OPERATOR | -1.212 | -0.865 | 0.175 | 0.143 | -1.132 | -0.815 | -0.610- | -0.452 | -0.854 | -0.607 | -0.688 | -0.526 | -0.960 | -0.698 |
| SERVICES | -4.013 | -2.541 | -2.285 | -1.650 | -3.965 | -2.535 | -3.458 | -2.281 | -4.038 | -2.590 | -3.355 | -2.274 | -3.878 | -2.488 |
| OTHLBINC | -1.968 | -1.356 | -2.072 | -1.649 | -1.736 | -1.203 | -1.858 | -1.330 | -1.882 | -1.317 | -2.013 | -1.489 | -2.363 | -1.654 |
| BLACK | 4.497 | 1.772 | 2.970 | 1.345 | 3.990 | 1.581 | 3.881 | 1.595 | 3.892 | 1.543 | 3.612 | 1.524 | 5.154 | 2.064 |
| FEMALE | 0.207 | 0.177 | -0.224 | -0.221 | -0.001 | -0.002 | -0.440 | -0.391 | -0.252 | -0.216 | -0.682 | -0.621 | 0.639 | 0.554 |
| BLACKFEM | -6.628 | -1.530 | -5.087 | -1.348 | -7.366 | -1.713 | -5.124 | -1.228 | -6.060 | -1.416 | -6.307 | -1.563 | -8.046 | -1.882 |
| STUDENT | -2.491 | -1.727 | -1.381 | -1.097 | -1.814 | -1.224 | -1.017 | -0.701 | -2.041 | -1.427 | -0.718 | -0.510 | -2.533 | -1.788 |
| NOREAST | 0.832 | 0.600 | -0.920 | -0.752 | 0.375 | 0.268 | -0.457 | -0.333 | 0.214 | 0.154 | -0.683 | -0.511 | 0.812 | 0.598 |
| MIDWEST | 2.280 | 1.839 | 2.251 | 2.097 | 2.582 | 2.088 | 2.031 | 1.698 | 2.260 | 1.851 | 2.455 | 2.121 | 2.287 | 1.883 |
| WEST | 2.826 | 2.425 | 2.249 | 2.205 | 2.732 | 2.353 | 1.688 | 1.429 | 2.517 | 2.175 | 1.882 | 1.676 | 2.835 | 2.474 |
| RURAL | -0.820 | -0.595 | -1.057 | -0.882 | -1.328 | -0.951 | -0.395 | -0.299 | -1.251 | -0.914 | -0.662 | -0.515 | -0.860 | -0.634 |
| RENTER | 0.002 | 0.002 | 0.961 | 0.955 | 0.201 | 0.180 | 0.942 | 0.834 | 0.105 | 0.095 | 1.068 | 0.979 | -0.037 | -0.034 |
| OWNOMORT | 1.542 | 1.047 | -11.901 | -1.586 | 0.673 | 0.147 | -1.173 | -0.330 | 0.562 | 0.201 | -4.346 | -0.796 | -2.912 | -1.195 |
| NOMRT*EXP | N/A | N/A- | 0.726 | 1.812 | 0.038 | 0.187 | 0.132 | 1.217 | 0.063 | 0.306 | 0.353 | 1.346 | 0.274 | 2.102 |
| QUARTER2 | -0.666 | -0.514 | -0.107 | -0.094 | -0.418 | -0.316 | -0.598 | -0.481 | 0.264 | 0.200 | -0.122 | -0.100 | -1.053 | -0.814 |
| QUARTER3 | -1.606 | -1.292 | -0.738 | -0.679 | -1.510 | -1.214 | -1.826 | -1.533 | -1.465 | -1.193 | -1.685 | -1.456 | -1.977 | -1.603 |
| QUARTER4 | -2.542 | -1.955 | -1.021 | -0.887 | -2.581 | -1.950 | -2.336 | -1.875 | -2.088 | -1.617 | -2.062 | -1.691 | -2.276 | -1.764 |
| RECESS | -0.133 | -0.138 | -0.506 | -0.601 | -0.318 | -0.332 | -0.571 | -0.611 | -0.627 | -0.647 | -0.501 | -0.554 | -0.333 | -0.352 |

NOMRT*EXP: Interaction of owned home, no mortgage and expenditures.