THE IMPACT OF EXPENDITURE CATEGORY EXEMPTION ON THE INCIDENCE OF A RETAIL SALES TAX

by

Frederick Alonzo Judd IV

A thesis submitted in partial fulfillment
of the requirements for the degree

of

Master of Science

in

Applied Economics

MONTANA STATE UNIVERSITY
Bozeman, Montana

March 1987

APPROVAL

of a thesis submitted by

Frederick Alonzo Judd IV

This thesis has been read by each member of the thesis committee and has been found to be satisfactory regarding content, English usage, format, citation, bibliographic style, and consistency, and is ready for submission to the College of Graduate Studies.

Date	Chairperson, Graduate Committee

Approved for the Major Department

Date	Head, Major Department

Approved for the College of Graduate Studies

Date	Graduate Dean

STATEMENT OF PERMISSION TO USE

In presenting this thesis in partial fulfillment of the requirments for a master's degree at Montana State University, I agree that the Library shall make it available to borrowers under rules of the Library. Brief quotations from this thesis are allowable without special permission, provided that accurate acknowledgement of source is made.

Permission for extensive quotation from or reproduction of this thesis may be granted by my major professor, or in his absence, by the Dean of Libraries when, in the opinion of either, the proposed use of the material is for scholarly purposes. Any copying or use of the material in this thesis for financial gain shall not be allowed without my permission.

Signature_____

Date_____

ACKNOWLEDGMENTS

I would like to take this opportunity to thank my major advisors Dr. Jeffrey LaFrance, Dr. Douglas Young, and Dr. Bruce Beattie for their time, patience, and encouragement during my work on this thesis and in related class material. I would also like to give special thanks to Dr. Mike Copeland for his helpful comments and to Rudy Suta for all the time and effort he put into aggregating the data set.

Special appreciation is expressed to my family and classmates for their encouragement and patience during my time spent at Montana State University.

TABLE OF CONTENTS

	Page
APPROVAL	ii
STATEMENT OF PERMISSION TO USE	iii
ACKNOWLEDGMENTS	iv
TABLE OF CONTENTS	v
LIST OF TABLES	vii
LIST OF FIGURES	viii
ABSTRACT	ix
Chapter	
1 INTRODUCTION	1
Statement of Purpose	2
Equity in Taxation	2
A Conceptual Difficulty	2
Two Important Concepts Related to Tax Burden	3
Tax incidence	3
Tax base	4
Some Additional Definitions	4
Overview	5
Outline of Thesis	7
2 ANNUAL VS LIFETIME INCIDENCE: A REVIEW OF PREVIOUS STUDIES	8
Annual Incidence	9
Lifetime Incidence	11
History, Concepts, and Definitions	11
Life-Cycle Based Studies	13
A Proxy for Permanent Income	17

TABLE OF CONTENTS-Continued

Chapter		Page
3	DATA, EMPIRICAL MODEL, ESTIMATION PROCEDURES AND PARAMETER ESTIMATES	20
	Data	20
	Empirical Model	25
	Seemingly Unrelated Regression	27
	Instrumental Variables	28
	Tobit Regression Analysis	31
	Heteroskedasticity	31
4	INTERPRETATION OF MODEL RESULTS	47
	Interpretation of Tobit Estimates	48
	Impact of Expenditure Category Exemption on the Incidence of a Retail Sales Tax	51
	Total Dollar Burden	61
5	SUMMARY, CONCLUSIONS AND IMPLICATIONS	66
	Summary	66
	Conclusions	66
	Implications	72
LITERATURE CITED		74
APPENDICES		78
	A: Family Characteristics in Data Set FINDAT	79
	B: Fortran Program 1	81
	C: The 54 Expenditure Categories in Data Set FINDAT	83
	D: Fortran Program 2	87
	E: Fortran Program 3	94

LIST OF TABLES

Table		Page
1.	The 41 Categories of Expenditures on Consumption Goods and Services.....	23
2.	Parameter Estimates and T-Ratios for the Permanent Income Instrumental Variable.....	30
3.	Values of Log-Likelihood Function Under Different Assumptions of Heteroskedasticity.....	34
4.	Impact of Family Characteristics on Expenditures.....	36
5.	Marginal Income Effect on Expenditures and Share(%) for a Family Size of 2.7 at Different Levels of Permanent Income.....	53
6.	Base($) and Base Share(%) at Different Levels of Permanent Income for the Mean Family size--With and Without Exemptions.....	68
7.	Family Characteristics in Data Set FINDAT.....	79
8.	The 54 Expenditure Categories in Data Set FINDAT.....	83

LIST OF FIGURES

Figure		Page
1.	Marginal Share (%) vs Permanent Income: Food At Home	56
2.	Expenditure Shares (%) vs Permanent Income	58
3.	Marginal Share (%) vs Permanent Income: Utilities	59
4.	Marginal Share (%) vs Permanent Income: Prescription Drugs	60
5.	Marginal Expenditures ($) vs Permanent Income	63
6.	Total Expenditures ($) vs Permanent Income	64
7.	Tax Base Share (%) vs Permanent Income	70
8.	Tax Base ($) vs Permanent Income	71
9.	Fortran Program 1	81
10.	Fortran Program 2	87
11.	Fortran Program 3	94

ABSTRACT

Questions of equity and concerns over an escalating deficit have forced the Montana State Legislature to seek alternative and/or additional ways to raise revenue. One such proposal to raise revenue is a sales tax. Opposition toward a sales tax is based largely on the feeling that it is a regressive tax, and therefore distributes the burden unfairly. The purpose of this study is to determine the impact of expenditure category exemption on the incidence of a retail sales tax. The overall progressivity/regressivity of a retail sales tax is calculated, both with exemptions and without exemptions from the base of the tax.

The model used in this study is an expenditure function that is quadratic in family size and permanent income. Tobit regression analysis is used to derive maximum likelihood estimates for 41 expenditure categories. From these tobit estimates, expenditure shares (proportion of expenditures relative to permanent income) and the tax base share (proportion of total expenditures on those items included in the base relative to permanent income) are calculated at different levels of permanent income.

Exempting those goods and services that are a larger proportion of expenditures relative to permanent income for households in lower permanent income brackets (such as food purchased in grocery and convience stores and utilities) increases (decreases) the progressivity (regressivity) of a sales tax. A broad-based sales tax is regressive for households earning less than $5000 in permanent income. From approximately $5000 to $25,000 a broadly-based sales tax is progressive. For those households earning $25,000 or more, the tax is slightly regressive to progressive.

Exempting certain expenditure categories (Food at Home, Utilities, Telephone, Water and Other Public Services, Prescription Drugs and Education) from the base makes the tax progressive for households whose permanent income is $25,000 or less. From $25,000 to $60,000 the tax is slightly regressive. For households whose permanent income is greater than $60,000, the sales tax is fairly proportional.

CHAPTER 1

INTRODUCTION

Among the several issues involved in tax policy, equity or fairness of the burden distribution is often a major consideration. In the current tax reform debate in Montana this issue is often manifested concerning the propriety of a retail sales tax. Montana is one of only five states that does not have a retail sales tax. Over the years and in the current Montana tax reform debate the alleged regressivity of a sales tax is prominant in the discussion, especially among those individuals and interest groups opposing the addition of a sales tax to Montana's tax system.

Typical of the view held by many Montanans is that published in an editorial in the Bozeman Daily Chronicle, April 24, 1985:

> Still, the income tax is the fairest tax. The income tax is based on ability to pay. With study and minor reform, it can be the best hope for long-lasting tax policy in the state.
>
> The sales tax is not as fair. Its tax rates are not adjusted according to ability to pay; poor people are hit hardest. When a family making $10,000 a year buys a refrigerator it really needs, it pays the same tax as the family making $50,000. Because they spend virtually all they earn, the poor would pay taxes on virtually all of their income. Exclusions of essential purchases -- medicine and food are often mentioned -- does not change the fundamentally regressive nature of the tax.

It is probably not an exaggeration to say that the conventional wisdom in Montana is that retail sales taxes are undesirable, in part, because they are allegedly among the most regressive forms of taxation. This thesis tests this conventional wisdom.

Statement of Purpose

There are many advantages and disadvantages of alternative taxes; these often relate to matters of impact on economic growth, cost effectiveness of administration and compliance, economic efficiency, cyclical stability of revenue, and equity or fairness among other things (Musgrave and Musgrave, 1984, p.225). This study focusses on the general matter of equity as related to retail sales taxes.

The purpose of this study is to examine the validity of the assertion that retail sales taxes are regressive and to assess the impact of certain expenditure category exemptions on the incidence or "progressivity/regressivity" of a sales tax.

Equity in Taxation

One basic criterion for evaluating tax policy is equity. There is general agreement that a tax system should be equitable. Most citizens feel that each member of society should contribute his/her fair share toward the burden of financing publicly-supplied services. However, disagreement is commonplace regarding what represents an equitable share. This is because equitable taxation depends on ability to pay and on the benefits received from government outlays, relative to the tax payments, both of which are difficult to define and measure.

A Conceptual Difficulty

The ability to pay criterion should reflect a household's economic capacity to consume and save over its lifetime. Transitory fluctuations in income can substantially influence a household's economic capacity

from year to year. Accordingly, annual income or total annual expenditures (on all goods and services including major capital items such as automobiles) are not good indicators of ability to pay. In this study household permanent income is adopted as the ability to pay criterion. It is further assumed that a household's annual consumption of non-durable goods and services is an acceptable proxy for permanent income.

Two Important Concepts Related to Tax Burden

Two ideas are particularly germane in assessing the burden or who ultimately pays any tax, viz., a concrete idea of what is meant by tax incidence and tax base is essential.

Tax incidence. Tax incidence is defined as the ultimate or final redistribution of income due to the imposition of a tax. The final incidence of a tax is the burden placed on individual households from taxes payed over their lifetime, net of lifetime benefits received from government expenditure programs. Ignoring benefits received, the distribution of the burden of a sales tax across households depends on the breadth of the tax base (discussed later) and the market structure of expenditure categories included in the base (discussed in Chapter 2).

When calculating the incidence of a particular tax, the answer to who pays the tax, and who bears the burden are often different. One must look beyond those who are legally liable to find where the final burden lies. If taxes are collected from business firms, the final burden will be traced to individual households as owners of the firm,

employees, suppliers of other (nonlabor) inputs, or as consumers of the product. Regardless of the type of tax or point of legal liability of the tax, the entire tax burden is ultimately borne by people.

Tax base. The tax base is the subject (items) upon which the levy is formally imposed (Hellerstein, 1986). It is through the legislative process that the tax base is ultimately defined. Exemptions from a tax base are often considered on grounds of stimulating economic activity, equity, or political clout of particular interest groups. Assuming tax rates are held constant, an increase in the number of exemptions from a tax base has two impacts. First, it narrows the taxable base resulting in a reduction in the amount of revenue generated from the tax. The second impact is a reallocation of the burden of the tax. This reallocation of burden may be intended to stimulate certain types of economic activity in hopes of attracting businesses to a particular region or location or to provide relief to households in lower permanent income deciles on the grounds of equity. If exemptions are made from the base of a retail sales tax, the burden of the sales tax will be redistributed. If categories such as grocery or drug purchases were exempt from the tax base, then the overall progressivity or incidence of the sales tax would change. The direction and magnitude of the change would depend on how expenditure for these commodities varies as a fraction of permanent income; for a given change in permanent income.

Some Additional Definitions

There are two concepts of equity having to do with ability to pay. The first is horizontal equity which calls for equal treatment of households with the same level of ability to pay. This implies that

households with the same level of permanent income should contribute an equal amount in taxes. On the other hand, vertical equity has to do with differential treatment of households according to their ability to pay. Under this concept, households with higher levels of permanent income should pay a greater amount of tax.

The discussion of equity leads to the question how is the burden of a sales tax distributed relative to ability to pay. In other words how does the share (distribution) of taxes change as a fraction of permanent income as permanent income changes. A regressive tax is one in which the ratio of tax to permanent income decreases as permanent income increases. A regressive tax places a greater share of the burden on households in lower permanent income deciles. A progressive tax is one in which the ratio of tax to permanent income increases as permanent income increases, while a proportional tax does not change the tax to permanent income ratio for a given change in permanent income.

The assertion that a sales tax is regressive, implies that households in lower permanent income deciles pay a larger fraction of their total permanent income in sales tax than do households in higher permanent income deciles. As stated earlier the purpose of this study is to determine the validity of such assertions including the sensitivity of the progressivity or regressivity of a sales tax to certain expenditure category exemptions.

Overview

This study calculates the impact of expenditure category exemption on the incidence of a retail sales tax. The data source is

the "1982-1983 Interview Survey Public Use Tapes", U.S. Department of Labor, Bureau of Labor Statistics. Family characteristics and expenditure categories are generated for 3230 consumer units (households). Examples of the 41 expenditure categories are food consumed at home, utilities and drugs.

Annual expenditures on non-durable goods and services is the proxy used for a household's level of lifetime or permanent income. An instrumental variable is derived for this measure of permanent income based on family characteristics such as age of head of household, education, family size, reported income, and family type.

The expenditure categories are regressed on a function that is quadratic in family size and income. The dependent variable (level of expenditures in a particular category) is limited to a certain range of observations; therefore, heteroskedastic tobit regression analysis is used to calculate the relationship between different categories of expenditures and permanent income.

Finally, total burden and measures of expenditure incidence are calculated. The total burden indicates the directional change of the dollar burden placed on households for any expenditure category that is excluded from the base. It indicates how the total dollar burden changes among households in different income deciles for different family sizes. The incidence or progressivity that an expenditure category has on a sales tax is calculated. These measures of incidence are generated for different levels of permanent income and different family sizes.

Outline of Thesis

Chapter 2 presents selected elements of the theory of tax incidence. The chapter focuses on those matters particularly germane to assessing the incidence of a sales or consumption tax relative to ability to pay. The difference between lifetime and annual incidence analysis is stressed. Rationale motivating a lifetime perspective of tax incidence and the use of consumption of non-durable goods as this study's measure of permanent income is provided. A review of previous studies enables the reader to obtain a clearer understanding as to why results differ rather dramatically depending on whether a lifetime or annual income criterion is adopted.

Empirical considerations are the topic of Chapter 3. The data source and criteria used to aggregate household expenditures into different categories are described. The empirical model is presented and defended, including discussion of means to correct for violations of desirable economic and statistical properties implicit in the problem and data set.

Results are presented and discussed in Chapter 4; conclusions and implications of the empirical findings are drawn. Finally, Chapter 5 briefly summerizes the results and implications of the study.

CHAPTER 2

ANNUAL VS LIFETIME INCIDENCE: A REVIEW OF PREVIOUS STUDIES

The reported incidence of a sales or consumption tax varies among tax studies. The methodology used and assumptions made have significant impact on the results. One major difference among contradicting tax studies is the measure used for economic capacity or ability to pay. The definitions for regressivity and progressivity often implicitly assume annual income as the metric against which equity is judged. Not suprisingly, income is the most often cited measure of ability to pay in different incidence studies. Most often, surveys collecting household statistics report annual income. On the other hand, lifetime or permanent income pertains to the permanent level of income earned by a household over its lifecycle. (The permanent income concept is further discussed in a subsequent section.)

The determination of final incidence of a tax requires the analysis of how government revenue is generated and expended. As previously stated, final incidence depends on taxes paid over a lifetime, net of lifetime benefits received. Difficulty arises when estimating the benefits that a household receives through government programs. The twin questions of how sales tax revenue will likely be distributed among alternative government programs and across households are, for practical purposes unanswerable (Browning and Johnson, 1979). This study looks at the burden and incidence of a sales tax. The burden of a sales tax is

defined as the total sales tax dollars paid by a household. The incidence of a sales tax is defined as the proportion (share) of income that is the sales tax burden for the household. The benefits of government expenditures are ignorecd. This allows attention to be focused exclusively on the matter of tax incidence vis-a-vis ability to pay (or permanent income).

The purpose of this chapter is twofold. The first purpose is to motivate the use of permanent income as the preferred measure of a household's ability to pay. In so doing, literature is reviewed to present the differences that annual versus permanent income have on the calculation of incidence of a sales tax. Secondly, a rationale is presented for the permanent income proxy utilized in the study. Assumptions made in this study are interspersed thoughout the chapter.

Annual Incidence

Annual incidence is the calculation of tax incidence using annual reported income. Recent tax incidence studies that have calculated burden on the basis of annual income found the sales tax to be regressive (Musgrave and Musgrave, 1984; and Pechman, 1985). In both studies, the total burden of the sales tax was assumed equal to the proportion of expenditure outlays subject to the tax as a fraction of annual reported income. Total taxable expenditures, as a fraction of annual income, tend to decrease as income increases. Therefore, assessing tax burden in proportion to taxable expenditure outlays on an annual basis leads to the conclusion that a sales tax is regressive.

Disagreement exists among tax analysts as to the extent to which the tax burden falls in proportion to expenditure outlays. A sales tax can be passed forward to consumers through higher prices, passed back to factors of production (labor and capital), or a combination of both. This study assumes that the burden of the sales tax is in direct proportion to expenditure outlays and thus is borne totally by consumers. This is equivalent to saying that product supply functions are perfectly elastic or that product demand functions are perfectly inelastic for those items included in the taxable base. Either assumption alone can have a significant impact on the progressivity of a sales tax. However, to make the research task manageable, perfectly elastic product supply functions are assumed.

Serious questions revolve around the validity of tax incidence calculations computed on an annual basis. Analysts note that a stronger, more plausible basis for analyzing the burden of a sales tax is permanent income over the life cycle of the household. Browning and Johnson (1979) note that annual data are biased in reported statistics. They point out that individuals or households in lower income deciles may only be there for a short period of time (Browning and Johnson, 1979; pp. 24-25).

Pechman (1985) motivates the above point by emphasizing that the effective tax rates calculated in his study were based on income data for a single year. Therefore, these rates may not be representative of the tax burden a household faces due to unusually low (or high) income in that year. Earnings can be unexpectedly low as a result of unemployment or illness. Pechman points out that a household often

continues to consume at a level proportional to its longer run income. Often, the share of taxes to income is much higher on an annual basis than when viewed over a longer time period. In concluding, Pechman suggests that the regressivity found in the lowest income levels would be moderated, and possibly, eliminated if viewed from a life cycle perspective (Pechman, 1985; pp. 50-51).

Lifetime Incidence

History, Concepts, and Definitions

Lifetime incidence is the calculation of tax incidence using permanent or life cycle income and consumption. Much of the theory used in life cycle analysis today was introduced in the 1950s. The problems encountered in estimating a permanent relationship between household income and consumption dates back to the 1930s, and possibly earlier. In 1936, John Maynard Keynes wrote of the relationship:

> The fundamental psychological law, upon which we are entitled to depend with great confidence both **a priori** from our knowledge of human nature and from the detailed facts of experience, is that men are disposed, as a rule and on the average, to increase their consumption as their income increases, but not by as much as the increase in their income (Keynes, 1936, p.96).

When Modigliani and Brumberg (1954) first introduced the life cycle hypothesis, they pointed out that if a constant relationship between income and consumption could be established, it would prove invaluable for economic analysis. Since then, the life cycle hypothesis has been empirically tested. The hypothesis has been both supported (Ando and Modigliani, 1963), and rejected (White, 1978). Questions pertaining to the perfection of capital markets have led towards reluctancy of

acceptance. Although, the conclusions of a theory cannot be rejected based on the realism of its assumptions, skepticism still exists. Liquidity constraints are imposed on households in credit markets. These constraints can prevent households from consuming at their optimal or permanent level during certain periods of their life.

A similar theory to the Life Cycle Hypothesis has been advanced by Friedman (1957). Friedman argues that each household has a measured level of annual reported income (Y) and consumption (C) and that these variables are the in turn sum of a permanent component (YP, CP) and a transitory component (ξ_{1t}, ξ_{2t}). That is,

$$Y_t = YP + \xi_{1t}$$
$$C_t = CP + \xi_{2t} \qquad (1)$$

The permanent components of income and consumption are difficult to describe. Friedman (1957) suggests that permanent income and consumption depend on "those factors that the unit [income producing or consuming] regards as determining its capital value or wealth" [insertion added] (Friedman, 1957, p.21). Permanent Income can be thought of as the level of income which a consumer or household expects to receive over a long period of time. It is this amount to which it adjusts its permanent consumption. Factors affecting the permanent component of both income and consumption are education, family size and personal ability. The transitory components (ξ_{1t}, ξ_{2t}) represent fluctuations in permanent income and consumption due to chance or accidental disturbance. An example on the income side would be extremely low reported income for a cow-calf operator due to drought or depressed cattle prices. Similarly, if an individual were in a car

accident and was laid up for six months, his / her transitory consumption would be extremely large in absolute value. It is these transitory disturbances on the permanent component that incorporate bias in annual reported income and consumption statistics.

The life cycle view and the related ideas of permanent income and consumption are accepted as maintained hypotheses for purposes of this study. This author subscribes to the commonly held view that despite the ambiguities and methodolical/measurement problems posed by the life cycle perspective, it is a decidely more compelling approach than is the annual income approach. The conceptual difficulties related to the underlying motivation for household consumption behavior as well as the transitory component imbedded in income data render the annual income approach unquestionably more troublesome in contrast.

Life-Cycle Based Studies

Several studies have been conducted using a life cycle perspective to determine the burden distribution of a sales or consumption tax. The main difficulty with life cycle analysis is obtaining data that covers income and consumption over the life of a household. Many differences exist between annual and lifetime data. Contrasting these differences provides a clearer understanding of the opposing results obtained from the two types of analysis. Davies, et al. (1984) summarize these contrasting points:

1) The inequality in the distribution of lifetime income is smaller than for annual income. Therefore, lifetime data show a smaller variance of personal income tax rates amoung households when ranked by permanent data as opposed to annual data.

2) Transfer payments are less heavily concentrated in the bottom two deciles of the population, when viewed from a life cycle rather than an annual perspective.

3) The ratio of consumption to income varies less on a lifetime basis than on an annual basis (Davies, et al., 1984; pp. 640-641).

Several studies that have looked at the incidence of a sales tax given a lifetime or permanent income perspective have found the tax to be either slightly regressive or slightly progressive. The difference in the conclusions revolves around the assumptions made regarding bequests and the breadth of the tax base (Adams and Walker, 1977; Davies, et al., 1984; Davies, 1960). A sales or consumption tax is (by definition) a proportional tax when it is assumed that all goods and services are included in the tax base and that households leave no intergenerational transfers, either in the form of human capital or bequests. Adams and Walker (1977) conclude that if households leave no bequests, the burden is proportional across all lifetime income deciles. However, they found that non-zero bequests reduce the percentage of lifetime income that is taxed under a consumption tax. If the share of bequests as a fraction of income is not equal across all deciles, the tax is not proportional. Adams and Walker's conclusion is that if the share of bequests to income increases (decreases) as lifetime income increases, a consumption tax is regressive (progressive).

Davies, et al. (1984) conducted a similar study using a life cycle simulation model to produce a set of lifetime tax incidence calculations for Canada. Annual incidence calculations were also estimated from the same data set. The purpose was to calculate and

compare lifetime incidence of the Canadian tax structure to that of annual incidence of the same tax structure. The second objective was to compare the robustness of annual and lifetime calculations. The major findings were 1) that tax structure is mildly progressive for annual and lifetime calculations and 2) that lifetime incidence calculations were more robust to different "shifting" assumptions than were annual incidence calculations.

Another conclusion of Davies et al. is of particular interest in the context of this study. That is,it was found that lifetime incidence of sales and excise taxes is much less regressive than the annual incidence of the same tax calculated with the same data. The average lifetime sales and excise tax rate for Canadian households ranged from 15.0 in the lowest income deciles to 12.4 in the highest income deciles. This differs greatly from the average annual sales and excise tax rates which ranged from 27.2 in the lowest deciles to 8.5 in the highest decile (Davies, et al., 1984).

The extent to which a broadly-based sales tax is regressive depends upon the actual distribution of bequests (as well as exemptions from the base to be discussed momentarily). Due to the lack of data, reliable estimates are not available. It is therefore assumed in this study that the share of intergenerational transfers (both human capital and bequests) as a fraction of permanent income is proportional across all households.

The lifetime incidence studies reviewed so far assume that the base is broadly defined. States that have a sales tax, without exception allow for certain exemptions from the base. Davies (1960) calculated

the incidence of a sales tax allowing for alternative tax bases and using four different income concepts. The income concepts used were gross (before tax) money income, net (after tax) money income, Fisher income and permanent income. Fisher income is defined as "actual consumption expenditures." An elasticity coefficient was calculated to determine the incidence of a particular tax base for a given concept of income. If the elasticity of the base with respect to income equalled one, the tax was said to be proportional. If the coefficient was greater (less) than one, it was concluded that the tax base was progressive (regressive) (Davies, 1960).

The Davies study looked at hypothetical tax bases that the Ohio State Legislature had not proposed, or had proposed and rejected. The alternative tax bases included categories such as total consumption, non-food consumption, non-food consumption and food sold in restaurants and total food consumption. The results incidate that a sales tax is regressive under gross and net income concepts, regardless of the base. However, under the Fisher and permanent income concepts, the sales tax was determined to range from slightly regressive to progressive depending on the breadth of the base. In every scenario, Davies found that the exemption of food consumed off the premises of the place of sale increased the progressivity of the base. It was also found that non-food exemptions allowed under the law increased the progressivity of the base, but by a smaller magnitude than food exemptions (Davies, 1960, p.944).

The conclusion drawn from this literature, both life cycle and annual varieties, is that the incidence and progressivity/regressivity

of a sales tax depend on a number of factors and assumptions implicit in the analyses. It is clear that the calculation of incidence will be affected by the following factors: 1) whether a lifetime or annual time frame is accepted as the relevent perspective; 2) assumptions regarding the nature of the markets (elasticities of supply and demand) for those goods and services included in the base; and 3) the marginal share of goods and services included in the tax base related to total expenditures (or conversely, of those goods and services exempted from the base).

A Proxy for Permanent Income

The data used in this study were generated from household surveys. The quarterly data were aggregated to provide household income and expenditures for a single year. The transitory fluctuations present in annual reported income render annual income an undesirable measure for incidence calculations. Therefore, permanent income was the measure used to assess household ability to pay.

Not only do researchers lack a comprehensive and extended time series data set on household expenditures and income, but more importantly permanent income by its very nature can not be known for existing households at any point in time. Thus, the "true" level of permanent income for each household is unknown. Fortunately, the Permanent Income Hypothesis of Freidman (1957) provides a means for deducing an estimate of household permanent income. Freidman suggests that there is a linear relationship between permanent income and consumption and (as discussed previously) that current income

(consumption) is given by permanent income (consumption) plus a transitory component. Formally, these relationships are

$$CP = \beta YP$$

$$(2) \qquad Y_t = YP + \xi_{1t}$$

$$C_t = CP + \xi_{2t}$$

where CP, YP, C, Y, and (ξ_{1t}, ξ_{2t}) are as defined for (1), $E(\xi_{1t}) = 0$, $E(\xi_{2t}) = 0$, $E(\xi_{1t}\xi_{2t}) = 0$, $E(\xi_{1t}^2) = \sigma_1^2$, and $E(\xi_{2t}^2) = \sigma_2^2$. This study does not purport to test the Permanent Income Hypothesis. Rather, the relationships between consumption and income in (2) are used to derive a proxy for permanent income. Formal derivation and specification of the proxy variable is presented in Chapter 3.

Barro (1984) points out that fluctuations in permanent consumption are much greater due to changes in permanent income than due to changes in temporary income. If a household perceives its present level of income as temporary, it will either save or dissave to maintain its consumption patterns commensurate with its desired level of permanent consumption. Hall and Mishkin (1982) studied the sensitivity of consumption to changes in transitory income. They found that the marginal propensity to consume out of permanent income was much greater than for temporary income. Stated alternatively from equation (2), C_t is a preferred proxy for YP than Y_t if $\beta^2\sigma_2^2 > \sigma_1^2$. Barro (1984) summarizes the empirical evidence on the Permanent Income Hypothesis:

> More generally, statistical studies of consumer spending over time indicate that the propensity to consume out of permanent income is large and not much different from one (Barro, 1984, p.95).

The relationship between permanent income and consumption suggests the use of consumption as a proxy for permanent income. This study defines permanent consumption as the annual expenditure on all nondurable goods and services. Expenditures on durable goods are excluded from this measure. Bodkin (1959) notes that the element of savings in consumption of durable goods would overestimate a household's permanent level of consumption. However, he also notes that omitting annual service flows from (previously and currently acquired) durable goods underestimates permanent consumption. Still, the definition of permanent consumption would be overstated using total consumption expenditures during years when consumer expenditures on durables is rising (Bodkin, 1959, p.603). Therefore, expenditure on nondurable goods and services was adopted in this study as a proxy for permanent income (YP).

CHAPTER 3

DATA, EMPIRICAL MODEL, ESTIMATION PROCEDURES AND PARAMETER ESTIMATES

This chapter provides a description of how the data set used in this study was generated from the secondary data source. Criteria used to aggregate household expenditures are discussed. The empirical model is presented, and defended. Violations of assumptions of the classical linear regression model and the methods used to correct for these violations are discussed.

Data

The data used in this study were generated from the "1982-1983 Interview Survey Public Use Tapes" (U.S. Department of Labor, Bureau of Labor Statistics). The tapes present detailed data on income and expenditures for approximately 16,000 households. Each tape is divided into files which represent quarterly data on reported income, expenditures, and family characteristics by household. The data represents a random sample and are published in the Consumer Expenditure Survey: Interview Survey, 1982-83, Bulletin 2245.

From these tapes, a data file was generated consisting of 26 family characteristics and 52 categories of yearly expenditures for each of the 3230 households. The final data file includes those households that started the interview in the first or second quarter of 1982 or 1983. These four quarters are the earliest and latest dates that would

allow a household to start the survey and still report a full year's expenditure data before the termination date of the 82-83 tapes. The recession in the fourth quarter of 1982 adds bias to reported expenditures on durable goods. The 3230 households were chosen in such a manner to minimize the number of households that included data from the fourth quarter of 1982.

Reported expenditures were in nominal terms. Thus, 1982 expenditures were inflated to 1983 prices when the statistical analysis was done. The inflator used was the ratio of the Implicit Price Deflator for Personal Consumption Expenditures (IPD-PCE) from the first quarter of 1983 relative to 1982 (U.S. Department of Commerce, March 1983, August 1983)

$$\frac{\text{IPD - PCE 83:I}}{\text{IPD - PCE 82:I}}$$

The first step involved in generating the final data set was to read family characteristic information from the files BLS.INT.FMLY.Q8XX (XX represents the year and quarter of the interview, respectively). The family characteristic data included age and education of head of household, family size, and family type. An explicit breakdown of the family characteristics is presented in Appendix A, Table 7. The fortran program used to generate the family characteristics is presented in Appendix B (Figure 9).

Findat consists of one row of family characteristics and five rows of yearly reported expenditures for each household. There are 54 expenditure categories, including total expenditures and total expenditures on non-durable goods and services. Forty-one of the

expenditure categories are used in the Tobit regression analysis. Those categories omitted from the analysis do not represent expenditures for consumption goods and services that would possibly be subject to the base of a sales tax.

Household expenditures are read from the files BLS.INT.MTAB.Q8XX. Those files contain over 500 different classes of expenditures. All but approximately four of these expenditure classes (496) were combined into more aggregate expenditure categories. The resulting 41 categories of expenditures on consumption goods and services differ mainly on the basis of whether the items represent durable or non-durable and/or luxury or necessity goods and services. The 41 expenditure categories are listed in Table 1.

The breakdown of the classes in each of the 54 expenditure categories found in Findat are presented in Appendix C, Table 8. The only modification made to the data at this stage is to those classes that report reductions in mortagage principals. Catagories 8 and 52 contain reported reductions in principal mortgages. These classes are reported as negative expenditures in the survey. Therefore, the absolute value of these expenditure classes is taken prior to aggregation in their perspective categories. The fortran program used to aggregate household expenditures for a quarter is found in Appendix D (Figure 10).

The third step is to aggregate quarterly household expenditures for a year. Those households who report zero expenditures on consumption of non-durable goods for a single quarter are omitted from the data set. Catagories 40, 41, and 42 represent expenditures on drugs, medical

Table 1. The 41 Categories of Expenditures on Consumption Goods and Services.

Category No.	Description	Category No.	Description
1	Food at Home	21	Other Apparel
2	Food away from Home	22	Transportation Rental
3	Alcohol	23	New Cars
4	Tobacco	24	Other Transportation
5	Repair Material and Labor	25	Used Cars
6	Building Material	26	Gasoline and Diesel Fuel
7	Other Lodging	27	Vehicle Parts and Fluids
8	Household Textiles	28	Auto Services
9	Furniture	29	Transportation Fees
10	Floor Covering	30	Public Transportation
11	Small Appliances	31	Prescription Drugs
12	Large Appliances	32	Medical Supplies
13	Household Miscellaneous	33	Medical Services
14	Utilities[1]	34	Insurance
15	Telephone	35	Reading Material
16	Water and Other Public Services	36	Entertainment Equipment and Supplies
17	TV and Radio	37	Entertainment Fees and Admissions
18	Household Domestic Services	38	Entertainment Services
19	Household Services	39	Personal Care
20	Apparel	40	Education
		41	Miscellaneous Services

[1]Utilities = Fuel Oil + Gas (Bottled or Tank) + Coal + Wood and Other Fuel + Electricity + Natural Gas.

supplies, and medical services, respectively. Due to the wording of the interview questions, households could report negative expenditures in these three categories. If a household received reimbursement from an insurance company for medical services paid for and rendered, the reimbursement is reported as a negative expenditure. Therefore, those three categories are summed and set equal to zero if expenditures for the year are negative. The fortran program used to sum and merge quarterly expenditures with family characteristics is found in Appendix E (Figure 11). Finally, the four different files of family characteristics and yearly expenditures are merged into a single file called Findat.

Three additional modifications are made to the data in Shazam. As previously stated, 1982 expenditures are inflated to 1983 prices. Second, approximated property rental value is added to consumption of non-durables (category 54). This is to account for the amount of expenditure outlays for housing services. It represents the consumption of durable goods, which is an important part of permanent consumption. This value is equivalent to reported rental expenditures for families who live in rented housing. Third, categories 17 - 22 are aggregated into the category, utilities. These categories represent different sources of heating fuel and electricity. They are considered to be substitutes for each other. If one source of utility is taxed, the other sources are likely to be treated the same.

Empirical Model

The model used in this study is an expenditure function. The function, which is quadratic in family size and permanent income, is

$$(3)\quad e_{ij} = \alpha_i + \delta_i' Z_j + \gamma_i F_j + \varphi_i YP_j + \theta_i YP_j F_j + \Phi_i YP_j^2 + \Psi_i F_j^2 + \varepsilon_{ij}$$

$$(i = 1,2,3,\ldots,41)$$
$$(j = 1,2,3,\ldots,3230)$$

where

e_{ij} = expenditure on the i^{th} category for the j^{th} household,

Z_j = vector of family characteristics for the j^{th} household,

The Z_j vector is comprised of binary (0 or 1) variables as follows:

A25	age of head of household (years) < 25,
A35	25 $\leq$ age of head of household (years) < 35,
A55	35 $\leq$ age of head of household (years) < 55,
A65	55 $\leq$ age of head of household (years) < 65,
A100	65 $\leq$ age of head of household (years),
OWNER	head of household owns housing,
RENTER	head of household rents housing,
EDELEM	head of household is not high school graduate,
EDHIGH	head of household is high school graduate,
EDCOL	head of household attended college (1-4yrs), but not a college graduate,
EDGRAD	head of household a is college graduate or greater,
H/W	husband and wife family,
SINPAR	single parent family,
OTHERFAM	other type of family,

F_j = family size for the j^{th} household,

YP_j = permanent income for the j^{th} household,

and

ε_{ij} = stochastic disturbance on the i^{th} expenditure category for the j^{th} household.

As previously stated, the proxy for permanent income (YP) is consumption of non-durable goods.

The family characteristics included were those exogenous variables which a priori appeared to be important in explaining a household's level of expenditure for different expenditure categories. The variables family size and permanent income were the most significant factors in determining the level of household expenditures for the different categories. Equation (3) can be written as

$$\begin{aligned} \mathbf{e}_1 &= \mathbf{X}\boldsymbol{\beta}_1 + \boldsymbol{\epsilon}_1 \\ \mathbf{e}_2 &= \mathbf{X}\boldsymbol{\beta}_2 + \boldsymbol{\epsilon}_2 \\ &\vdots \\ \mathbf{e}_{41} &= \mathbf{X}\boldsymbol{\beta}_{41} + \boldsymbol{\epsilon}_{41} \end{aligned} \tag{4}$$

or in matrix notation as

$$\mathbf{e}_n = \mathbf{X}\boldsymbol{\beta}_n + \boldsymbol{\epsilon}_n \quad (n = 1,2,3,\ldots,41), \tag{5}$$

where $\mathbf{e}_n$ is a (3230 x 1) vector of total expenditures in the n^{th} category; $\mathbf{X}$ is a (3230 x 7) matrix of independent variables (family characteristics, family size, and permanent income); $\boldsymbol{\beta}_n$ is a (7 x 1) vector of regression coefficients; and $\boldsymbol{\epsilon}_n$ is a (3230 x 1) vector of stochastic disturbances.

Seemingly Unrelated Regression

The ordinary least squares (OLS) estimates of the classical linear regression model are unbiased and efficient under the following assumptions:

(6) $\mathbf{X}$ is uncorrelated with ϵ_n,

(7) $E(\epsilon_n) = \mathbf{0}$,

(8) $E(\epsilon_n \epsilon_n') = \sigma_{nn} I_k$ (I_k is the identity matrix (3230 x 3230),

and

(9) $E(\epsilon_n \epsilon_p') = \mathbf{0}$ $(n \neq p)$.

Assumption (9) requires that the disturbances from the different regression equations be uncorrelated with each other. In this study, violation of assumption (9) is likely. That is, many of the disturbances on the 41 expenditure equations are likely to be correlated with one or more disturbances from the other expenditure equations. For example, the disturbance on the equation for food consumed at home is likely to be correlated with the disturbance on the expenditure equation for food consumed away from home. If the regression disturbances are mutually correlated then

(10) $E(\epsilon_n \epsilon_p') = \sigma_{np} I_k$ $(n,p = 1,2,3,\ldots,41)$ and

the covariance (σ_{np}) is. This relationship between the disturbances is what Kmenta (1971) refers to as "seemingly unrelated regression". Ordinary least squares estimates of regression coefficients from seemingly unrelated regression equations are unbiased and consistent. In general, OLS estimates are not efficient (Kmenta, 1971, pp. 519-520). However, Zellner (1962) proves that ordinary least squares estimates are

efficient, when each of the seemingly unrelated regression equations have exactly the same explanatory variables.

Instrumental Variables

The presence of an endogenous variable on the right hand side of equation (3) violates the conditions for consistency of the OLS estimator (Johnston, 1963). Correlation can exist between permanent income and the disturbance from the same expenditure equation, i.e., $E(YP_t\varepsilon_{ij}) \neq 0$. This is due to the fact that consumption of non-durable goods and services is used as the proxy for permanent income.

The method used to provide consistent estimators is instrumental variable estimation. An instrumental variable ($\hat{YP}_t$) must fulfill two criteria:

$$1)\ \Sigma(\hat{YP}_t\varepsilon_{ij}) = 0 \qquad (t \neq j)$$
$$2)\ \Sigma(\hat{YP}_tYP_j) \neq 0.$$

Criterion one states that the instrumental variable ($\hat{YP}_t$) must be uncorrelated with the error term (ε_{ij}). The second criterion states that the correlation between the instrumental variable and the endogenous right hand side variable is not equal to zero. The greater the degree of correlation between $\hat{YP}^t$ and YP^j, the smaller is the variance of the instrumental variable estimator. For this reason, YP_j is regressed on those exogenous variables that provide the greatest explanatory power. The model to derive the instrument variable is

$$(11)\ YP_j = \alpha + \delta'Z_j + \Phi YB_j + \varphi YB_j^2 + \gamma F_j + \Psi F_j^2 + \theta FYB_j + \varepsilon_j$$
$$(j = 1,2,3,\ldots,3230)$$

where

YP_j = permanent income for the j^{th} household,

Z_j = vector of family characteristics for the j^{th} household, where Z_j is defined as for equation (3),

F_j = family size for the j^{th} household,

YB_j = before tax income for the j^{th} household,

and

ε_j = stochastic disturbance for the j^{th} household.

The ordinary least squares estimates for equation (11) are presented in Table 2.

Substituting the instrumental variable derived from equation (9) into equation (3), yields

$$(12)\quad e_{ij} = \alpha_i + \delta_i' Z_j + \gamma_i F_j + \varphi_i \hat{YP}_j + \theta_i \hat{YP}_j F_j + \Phi_i \hat{YP}_j^2 + \Psi_i F_j^2 + \mu_{ij}$$

$$(i = 1,2,3,\ldots,41)$$
$$(j = 1,2,3,\ldots,3230)$$

where

$$\mu_{ij} = \varepsilon_{ij} + \varphi_i(YP_j - \hat{YP}_j) + \theta_i(YP_j - \hat{YP}_j)F_j + \Phi_i(YP_j^2 - \hat{YP}_j^2).$$

McFadden, Puig, and Kirshner (1977) prove that least squares estimates are consistent, even with nonlinear functions of the instrumental variable on the right hand side of the regression equation.

Table 2. Parameter Estimates and T-Ratios for the Permanent Income Instrumental Variable.

Family Characteristics	Parameter Estimates (T-Ratio)
INTERCEPT	6518.2
	(13.037)
Z	
A25	-1846.0
	(-3.946)
A35	-1274.1
	(-4.030)
A55	809.78
	(2.777)
A65	1005.8
	(3.367)
OWNER	-523.24
	(-2.334)
EDHIGH	1857.3
	(7.546)
EDCOL	2952.4
	(10.604)
EDGRAD	4795.4
	(16.777)
SINPAR	-2548.5
	(-6.181)
OTHFAM	-2225.4
	(-8.366)
YB	0.0362
	(2.758)
YB^2	0.106E-05
	(9.556)
F	1490.8
	(6.511)
F^2	-95.145
	(-3.614)
FYB	0.303E-02
	(1.058)
R^2 = 0.4445	

Tobit Regression Analysis

Reported household expenditure data used in this study are, of course, non-negative. For many households, expenditures on durable goods during a year are zero. For example, expenditure categories such as cars and floor covering can have a large number of respondents reporting zero expenditures for any given year. This large concentration of observations at the lower limit of certain expenditure categories creates estimation problems. When this phenomenon is present the OLS estimator yields biased and inconsistent estimates. Tobin (1958) points out that when estimating the relationship between a limited dependent variable and exogenous variables, the concentration should be accounted for to avoid bias and inconsistency in the OLS estimator. The method employed in this study is called Tobit Regression Analysis. The Tobit procedure involves iterative maximum likelihood estimation on equation (12).

Heteroskedasticity

Assumption (8) of the classical linear regression model requires that the variance of the disturbances be constant across all observations, i.e.,

$$(13)\quad E(\varepsilon_{ij}^2) = \sigma_i^2 \qquad \begin{matrix}(i = 1,2,3,\ldots,41)\\ (j = 1,2,3,\ldots,3230).\end{matrix}$$

Violation of this assumption is prevalent in studies of this type. There tends to be greater variance in expenditures for households in higher income deciles than for those in lower income deciles. The result is heteroskedasticity which violates assumption (8) and (13).

The heteroskedatic regression disturbance is written as

$$(14)\quad E(\varepsilon_{ij}^2) = \sigma_{ij}^2 \qquad \begin{matrix}(i = 1,2,3,\ldots,41)\\ (j = 1,2,3,\ldots,3230).\end{matrix}$$

That is, variance is not constant across j. Unfortunately OLS estimates are inefficient with heteroskadastic disturbances (Maddala, 1983). Maddala and Nelson (1975) report that a limited dependent variable model is both inefficient and inconsistent if heteroskedasticity is ignored. Thus it is important to come to grips with this problem in this study.

Four different assumptions of heteroskedasticity were made to identify the variance of the disturbance ($Var(\varepsilon_{ij})$). The four different assumptions were:

1) $\sigma_{ij}^2 = YP_j^2\sigma_i^2$ (permanent income squared x variance).
2) $\sigma_{ij}^2 = YP_j\sigma_i^2$ (permanent income x variance).
3) $\sigma_{ij}^2 = F_j^2\sigma_i^2$ (family size squared x variance).
4) $\sigma_{ij}^2 = F_j\sigma_i^2$ (family size x variance).

Heteroskedastic tobit regression analysis was used to estimate the parameters of equation (12). The values for the log-likelihood function for the four assumptions of heteroskedasticity were estimated and compared to those from the homoskedastic model. These values are reported in Table 3. The values for $\sigma_{ij}^2 = YP_j^2\sigma_i^2$ are greater for each of the 41 expenditure equations than the values from the other four specifications of σ_{ij}^2. This indicates that the variation of the disturbance is more likely due to the level of permanent income than family size. However, it is extremely plausible that the inconsistent variance is due to a combination of permanent income and family size.

Nevertheless, the estimation procedure used was heteroskedastic tobit regression applied to the following model:

$$(15)\quad e_{ij} = \alpha_i + \delta_i' Z_j + \gamma_i F_j + \varphi_i \hat{YP}_j + \theta_i \hat{YP}_j F_j + \Phi_i \hat{YP}_j^2 + \Psi_i F_j^2 + \mu_{ij}$$

$$(i = 1,2,3,\ldots,41)$$
$$(j = 1,2,3,\ldots,3230)$$

where

$$E(\mu_{ij}^2) = \sigma_{ij}^2 = YP_j^2 \sigma_i^2.$$

The maximum likelihood estimates of parameters of equation (15) and the number of limit and non-limit observations are reported in Table 4 for each expenditure category.

The results given in Table 4 indicate that no single variable is statistically significant (all discussion of statistical significance assumes a 5% α-level) in explaining expenditures in all of the 41 expenditure categories. Permanent income ($\hat{YP}$) was statistically significant for 66 percent of the expenditure categories, while permanent income squared ($\hat{YP}^2$) was statistically significant for 49 percent of the expenditure categories. Family size (F) and family size squared (F^2) were significant for 51 and 29 percent of the expenditure categories, respectively. The iteration term on family size and income (FYP) was significant for 39 percent of the expenditure categories. Family size has the greatest level of statistical significance on expenditures for food consumed at home. Not surprisingly, the binary variable OWNER was significant on expenditures for building material, utilities, and public services. The results reported in Table 4 indicate the impact that the different family characteristics have on the level of expenditures varies from category to category.

Table 3. Values of Log-Likelihood Function Under Different Assumptions of Heteroskedasticity.

Expenditure Category		Source of Heteroskedasticity			
	σ^2	$YP^2\sigma^2$	$YP\sigma^2$	$F^2\sigma^2$	$F\sigma^2$
Food at Home	-26971.6	3575.7	-11603.9	-24237.2	-25369.1
Food away from Home	-24687.5	3407.6	-10551.8	-22939.9	-23626.7
Alcohol	-18773.4	3403.2	-7621.3	-17502.5	-17989.6
Tobacco	-14202.4	2169.4	-5979.1	-12905.2	-13446.9
Repair Material and Labor	-12516.8	-245.7	-6370.6	-11261.4	-11853.9
Building Material	-12768.7	1388.5	-5667.3	-11484.1	-12044.2
Other Lodging	-12804.0	2237.8	-5246.0	-11734.0	-12188.9
Household Textiles	-14934.5	4766.3	-5014.9	-13482.7	-14107.5
Furniture	-12820.4	584.9	-6087.9	-11620.2	-12146.1
Floor Covering	-6065.4	-20.3	-3028.1	-5458.9	-5732.0
Small Appliances	-14817.8	4810.6	-4944.2	-13196.0	-13920.3
Large Appliances	-10510.9	897.9	-4775.9	-9571.1	-9976.5
Household Miscellaneous	-18639.4	4834.4	-6846.6	-16872.6	-17628.9
Utilities	-23915.8	4465.9	-9622.5	-21909.3	-22678.4
Telephone	-22646.7	7082.1	-7679.1	-20534.4	-21359.1
Water and Other Public Services	-16100.3	5536.8	-5225.6	-14445.3	-15091.2
TV and Radio	-18757.8	4159.1	-7234.7	-17062.2	-17733.9
Household Domestic Services	-6447.1	-86.1	-3247.8	-5954.4	-6166.5
Household Services	-23630.1	2877.6	-10303.4	-21004.7	-22164.9
Apparel	-25527.8	4339.9	-10505.1	-23379.0	-24211.1
Other Apparel	-19802.3	5107.1	-7291.9	-18054.9	-18792.4
Transportation Rental	-2885.6	-84.1	-1480.6	-2695.6	-2778.9
New Cars	-3973.3	-1140.2	-2551.7	-3742.4	-3842.9
Other Transportation	-623.9	-184.9	-403.7	-594.3	-606.8
Used Cars	-6190.9	-1189.8	-3679.4	-5775.3	-5953.2
Gasoline and Diesel Fuel	-24135.9	3697.1	-10137.1	-21851.2	-22768.1
Vehicle Parts and Fluids	-16806.3	4866.9	-5915.1	-15228.5	-15843.4
Auto Services	-19553.9	3764.9	-7825.8	-17675.8	-18448.4
Transportation Fees	-21900.9	5194.0	-8282.3	-19711.4	-20611.9
Public Transportation	-15211.9	1669.4	-6732.0	-14029.7	-14521.2
Prescription Drugs	-17583.7	5227.8	-6108.7	-16220.9	-16767.9

Table 3. (continued)

Expenditure Category	σ^2	Source of Heteroskedasticity			
		$YP^2\sigma^2$	$YP\sigma^2$	$F^2\sigma^2$	$F\sigma^2$
Medical Supplies	-7777.3	1361.6	-3185.7	-7204.4	-7444.0
Medical Services	-23305.2	2387.9	-10387.9	-21915.8	-22461.2
Insurance	-26219.3	2688.0	-11720.9	-24044.8	-25048.7
Reading Material	-19291.2	9236.3	-4947.6	-17360.3	-18120.9
Entertainment Equipment and Supplies	-22686.5	2719.5	-9898.5	-19955.9	-21050.2
Entertainment Fees and Admissions	-21004.9	4558.2	-8156.4	-18835.1	-19793.1
Entertainment Services	-14843.5	5345.3	-4695.8	-13281.9	-13925.3
Personal Care	-4772.6	1305.6	-1721.3	-4335.8	-4548.3
Education	-11381.9	-23.8	-5677.5	-10330.2	-10777.1
Miscellaneous Services	-24938.6	3995.2	-10376.1	-23377.2	-24005.7

Table 4. Impact of Family Characteristics on Expenditures.

Family Characteristics	Expenditure Category Parameter (T-Ratio)			
	Food at Home	Food away from Home	Alcohol	Tobacco
CONSTANT	350.83	-1441.4	-1229.3	-550.26
	(1.767)	(-7.975)	(-10.568)	(-5.202)
Z				
A25	-315.77	494.50	609.17	226.25
	(-4.518)	(7.770)	(14.800)	(6.048)
A35	-181.74	427.40	427.93	231.36
	(-3.568)	(9.193)	(14.125)	(8.407)
A55	120.46	59.636	113.50	215.20
	(2.310)	(1.258)	(3.671)	(7.759)
A65	47.484	-47.713	-21.787	150.21
	(0.905)	(-0.994)	(-0.687)	(5.342)
OWNER	114.84	233.70	107.81	-6.392
	(3.284)	(7.259)	(5.070)	(-0.337)
EDHIGH	21.805	-142.96	-129.26	-81.801
	(0.401)	(-2.901)	(-4.087)	(-2.864)
EDCOL	-40.185	-239.36	-257.25	-201.41
	(-0.542)	(-3.578)	(-6.039)	(-5.136)
EDGRAD	-159.90	-342.02	-351.50	-416.47
	(-1.550)	(-3.680)	(-5.975)	(-7.601)
SINPAR	-24.496	239.97	79.469	-24.540
	(-0.284)	(3.056)	(1.574)	(-0.544)
OTHFAM	-190.06	342.34	286.93	84.392
	(-2.983)	(5.912)	(7.720)	(2.533)
F	440.46	-321.13	-182.83	40.789
	(6.519)	(-5.231)	(-4.602)	(1.171)
$\hat{Y}P$	0.0637	0.262	0.180	0.068
	(1.927)	(8.740)	(9.471)	(3.853)
$F\hat{Y}P$	0.0201	-0.145E-02	-0.209E-03	0.235E-03
	(4.451)	(-0.349)	(-0.079)	(0.100)
$\hat{Y}P^2$	-0.924E-06	-0.306E-05	-0.317E-05	-0.195E-05
	(-0.807)	(-2.950)	(-4.853)	(-3.168)
F^2	-39.771	17.819	7.363	-5.116
	(-7.033)	(3.341)	(2.170)	(-1.770)
OBSERVATIONS				
LIMIT	2	251	865	1486
NON-LIMIT	3228	2979	2365	1744

Table 4. (Continued)

Family Characteristics	Expenditure Category Parameter (T-Ratio)			
	Repair Material and Labor	Building Material	Other Lodging	Household Textiles
CONSTANT	-3109.0	-845.33	-519.49	-110.00
	(-4.904)	(-4.896)	(-5.411)	(-2.430)
Z				
A25	-977.40	435.85	161.84	23.206
	(-2.739)	(6.587)	(4.587)	(1.437)
A35	-504.97	328.18	80.738	4.720
	(-3.065)	(7.197)	(3.191)	(0.404)
A55	-548.04	136.67	-46.483	-34.953
	(-3.437)	(2.977)	(-1.773)	(-2.891)
A65	-238.66	-0.719	-64.739	-28.572
	(-1.570)	(-0.016)	(-2.431)	(-2.348)
OWNER	3512.1	602.18	179.11	51.967
	(15.955)	(16.744)	(9.619)	(6.333)
EDHIGH	242.01	-179.84	-47.790	2.045
	(1.4871)	(-3.906)	(-1.815)	(0.166)
EDCOL	459.20	-153.87	-48.189	9.897
	(2.141)	(-2.521)	(-1.391)	(0.596)
EDGRAD	818.72	-306.50	-64.814	-16.106
	(2.823)	(-3.635)	(-1.375)	(-0.699)
SINPAR	124.80	-86.680	45.517	18.254
	(0.414)	(-1.129)	(1.041)	(0.925)
OTHFAM	-16.077	-38.220	21.106	0.500
	(-0.085)	(-0.712)	(0.688)	(0.035)
F	-207.69	-107.43	-155.24	-11.888
	(-0.955)	(-1.879)	(-4.532)	(-0.773)
$\hat{Y}P$	-0.061	0.050	0.065	0.941E-02
	(-0.638)	(1.818)	(4.234)	(1.268)
$F\hat{Y}P$	-0.523E-02	0.012	-0.139E-02	0.479E-03
	(-0.367)	(2.925)	(-0.618)	(0.455)
$\hat{Y}P^2$	0.244E-05	-0.259E-05	-0.268E-06	0.103E-06
	(0.749)	(-2.712)	(-0.505)	(0.404)
F^2	8.584	-10.088	10.772	-1.119
	(0.438)	(-1.790)	(3.635)	(-0.769)
OBSERVATIONS				
LIMIT	1949	1731	1644	1159
NON-LIMIT	1281	1499	1586	2071

Table 4. (Continued)

Family Characteristics	Expenditure Category Parameter (T-Ratio)			
	Furniture	Floor Covering	Small Appliances	Large Appliances
CONSTANT	-868.47	-188.35	-231.38	-722.36
	(-3.600)	(-0.810)	(-5.034)	(-4.733)
Z				
A25	566.86	102.67	59.941	210.89
	(6.598)	(1.166)	(3.631)	(3.723)
A35	464.26	29.297	41.966	113.85
	(7.297)	(0.467)	(3.502)	(2.798)
A55	162.01	-3.330	0.799	75.537
	(2.470)	(-0.053)	(0.065)	(1.849)
A65	11.996	-19.788	-15.077	12.757
	(0.178)	(-0.312)	(-1.219)	(0.305)
OWNER	283.47	247.91	50.008	184.98
	(6.191)	(5.449)	(5.941)	(6.340)
EDHIGH	-174.26	18.123	-26.167	-83.975
	(-2.654)	(0.285)	(-2.090)	(-2.037)
EDCOL	-138.22	-11.519	-18.680	-88.737
	(-1.591)	(-0.136)	(-1.119)	(-1.623)
EDGRAD	-208.28	-71.310	-53.507	-56.656
	(-1.745)	(-0.613)	(-2.308)	(-0.764)
SINPAR	177.92	139.36	14.961	-10.090
	(1.731)	(1.396)	(0.743)	(-0.153)
OTHFAM	-3.533	-71.830	18.707	27.769
	(-0.046)	(-0.959)	(1.288)	(0.586)
F	-227.61	-114.67	-22.538	66.335
	(-2.811)	(-1.440)	(-1.453)	(1.319)
$\hat{Y}P$	0.065	-0.062	0.026	0.032
	(1.689)	(-1.677)	(3.495)	(1.307)
$F\hat{Y}P$	0.013	0.445E-02	-0.129E-02	-0.477E-02
	(2.172)	(0.851)	(-1.274)	(-1.424)
$\hat{Y}P^2$	-0.169E-05	0.124E-05	-0.814E-07	0.790E-07
	(-1.260)	(0.993)	(-0.318)	(0.096)
F^2	-5.044	2.697	1.997	-4.486
	(-0.605)	(0.366)	(1.545)	(-0.977)
OBSERVATIONS				
LIMIT	1826	2602	1147	2029
NON-LIMIT	1404	628	2083	1201

Table 4. (Continued)

Family Characteristics	Expenditure Category Parameter (T-Ratio) Household Miscellaneous	Utilities	Telephone	Water and Other Public Services
CONSTANT	-411.20	365.61	-71.079	-122.95
	(-5.701)	(2.781)	(-1.118)	(-2.636)
Z				
A25	146.94	-146.23	61.036	-14.477
	(5.720)	(-3.147)	(2.726)	(-0.799)
A35	125.96	-67.718	109.57	-5.120
	(6.751)	(-2.004)	(6.695)	(-0.415)
A55	16.452	57.628	81.467	23.382
	(0.860)	(1.668)	(4.866)	(1.906)
A65	-3.132	61.279	32.413	4.015
	(-0.162)	(1.762)	(1.923)	(0.329)
OWNER	115.17	542.71	45.260	223.11
	(8.789)	(22.540)	(4.032)	(25.079)
EDHIGH	-52.320	42.790	-19.122	-4.413
	(-2.662)	(1.190)	(-1.097)	(-0.349)
EDCOL	-54.244	3.729	31.197	11.059
	(-2.052)	(0.076)	(1.315)	(0.646)
EDGRAD	-120.99	65.781	-4.596	-19.770
	(-3.305)	(0.965)	(-0.139)	(-0.835)
SINPAR	23.505	-22.865	71.365	-26.645
	(0.742)	(-0.400)	(2.577)	(-1.278)
OTHFAM	28.506	-71.988	60.030	9.966
	(1.237)	(-1.711)	(2.942)	(0.674)
F	-91.154	204.80	36.103	23.298
	(-3.688)	(4.596)	(1.673)	(1.494)
$\hat{Y}P$	0.063	-0.027	0.029	-0.167E-02
	(5.331)	(-1.235)	(2.696)	(-0.218)
$F\hat{Y}P$	0.126E-02	-0.259E-02	-0.293E-02	-0.148E-03
	(0.739)	(-0.868)	(-2.027)	(-0.144)
$\hat{Y}P^2$	-0.888E-06	0.164E-05	0.197E-08	0.217E-06
	(-2.163)	(2.169)	(0.538E-02)	(0.830)
F^2	2.215	-10.402	1.259	0.065
	(0.965)	(-2.798)	(0.698)	(0.051)
OBSERVATIONS				
LIMIT	761	176	52	908
NON-LIMIT	2469	3054	3178	2322

Table 4. (Continued)

Family Characteristics	Expenditure Category Parameter (T-Ratio) TV and Radio	Household Domestic Services	Household Services	Apparel
CONSTANT	-716.01	-492.63	-128.43	-837.78
	(-7.947)	(-1.651)	(-0.673)	(-5.678)
Z				
A25	326.67	-23.574	-34.945	371.35
	(10.274)	(-0.220)	(-0.520)	(7.160)
A35	280.08	-4.983	-17.932	286.45
	(11.968)	(-0.064)	(-0.367)	(7.548)
A55	115.18	-508.69	-63.478	36.919
	(4.838)	(-5.861)	(-1.263)	(0.953)
A65	-0.344	-598.26	-96.996	-35.786
	(-0.014)	(-6.088)	(-1.921)	(-0.917)
OWNER	105.22	121.26	198.05	141.17
	(6.418)	(2.102)	(5.854)	(5.415)
EDHIGH	-114.62	204.88	10.376	-137.88
	(-4.663)	(2.448)	(0.199)	(-3.420)
EDCOL	-150.29	378.05	117.62	-154.26
	(-4.548)	(3.501)	(1.666)	(-2.814)
EDGRAD	-282.31	408.49	63.020	-187.03
	(-6.146)	(2.795)	(0.641)	(-2.450)
SINPAR	119.70	360.03	4.811	391.78
	(3.108)	(2.945)	(0.058)	(6.117)
OTHFAM	148.10	3.897	-0.498	214.36
	(5.145)	(0.041)	(-0.814E-02)	(4.541)
F	-73.374	200.02	-38.703	-164.29
	(-2.431)	(1.943)	(-0.599)	(-3.297)
$\hat{Y}P$	0.093	-0.122	0.016	0.141
	(6.306)	(-2.608)	(0.500)	(5.759)
$F\hat{Y}P$	0.723E-02	0.124E-02	-0.185E-02	0.770E-02
	(3.374)	(0.186)	(-0.429)	(2.307)
$\hat{Y}P^2$	-0.210E-05	0.412E-05	0.132E-05	-0.770E-07
	(-4.094)	(2.701)	(1.212)	(-0.911)
F^2	-8.215	-24.452	2.737	5.328
	(-2.737)	(-2.294)	(0.501)	(1.280)
OBSERVATIONS				
LIMIT	800	2561	474	94
NON-LIMIT	2430	669	2756	3136

Table 4. (Continued)

Family Characteristics	Other Apparel	Transportation Rental	New Cars	Other Transportation
	Expenditure Category Parameter (T-Ratio)			
CONSTANT	-606.77	-1146.6	-24057.0	-19503.0
	(-7.925)	(-4.237)	(-3.893)	(-3.603)
Z				
A25	227.05	414.23	7716.3	3563.0
	(8.393)	(4.156)	(3.178)	(1.786)
A35	137.97	289.61	7393.1	4073.8
	(6.984)	(3.839)	(4.518)	(2.860)
A55	28.610	85.670	-142.61	2624.1
	(1.417)	(1.110)	(-0.083)	(1.838)
A65	-41.873	-30.171	-2673.2	1055.9
	(-2.034)	(-0.364)	(-1.496)	(0.668)
OWNER	45.961	106.95	5382.4	1154.5
	(3.339)	(1.986)	(4.233)	(1.499)
EDHIGH	-121.08	-79.850	-3160.3	-750.75
	(-5.768)	(-1.034)	(-1.878)	(-0.714)
EDCOL	-120.42	-127.63	-6725.9	-1785.9
	(-4.290)	(-1.352)	(-2.987)	(-1.342)
EDGRAD	-163.80	-131.19	-8517.9	-3243.5
	(-4.217)	(-1.082)	(-2.899)	(-1.743)
SINPAR	99.637	198.16	-1736.9	2074.9
	(3.005)	(1.649)	(-0.526)	(1.361)
OTHFAM	131.88	136.08	3859.1	2924.9
	(5.394)	(1.613)	(1.992)	(2.494)
F	-73.959	-238.66	-3900.1	-2079.1
	(-2.851)	(-2.455)	(-1.805)	(-1.530)
$\hat{Y}P$	0.083	0.068	1.118	1.833
	(6.629)	(1.703)	(1.142)	(2.008)
$F\hat{Y}P$	0.356E-03	-0.843E-02	0.187	0.249
	(0.200)	(-1.441)	(1.186)	(1.880)
$\hat{Y}P^2$	-0.942E-06	-0.622E-06	-0.601E-04	-0.124E-03
	(-2.164)	(-0.476)	(-1.710)	(-2.950)
F^2	1.490	23.092	-122.35	-134.68
	(0.631)	(2.812)	(-0.527)	(-0.983)
OBSERVATIONS				
LIMIT	608	2937	2930	3183
NON-LIMIT	2622	293	300	47

Table 4. (Continued)

Family Characteristics	Expenditure Category Parameter (T-Ratio) Used Cars	Gasoline and Diesel Fuel	Vehicle Parts and Fluids	Auto Services
CONSTANT	-5918.5	-1609.4	-478.81	-581.76
	(-3.011)	(-9.954)	(-8.149)	(-5.343)
Z				
A25	5105.1	855.92	220.73	198.46
	(7.343)	(14.881)	(10.451)	(5.068)
A35	3006.0	624.38	186.04	154.58
	(5.355)	(14.892)	(12.187)	(5.510)
A55	2700.3	324.83	64.511	45.840
	(4.924)	(7.660)	(4.171)	(1.597)
A65	924.87	89.115	-1.039	4.931
	(1.549)	(2.084)	(-0.066)	(0.169)
OWNER	966.59	382.62	78.054	138.90
	(2.530)	(13.147)	(7.234)	(7.004)
EDHIGH	-485.44	-235.23	-74.124	-54.897
	(-0.936)	(-5.350)	(-4.673)	(-1.853)
EDCOL	-1586.4	-450.94	-110.27	-51.738
	(-2.259)	(-7.545)	(-5.153)	(-1.297)
EDGRAD	-3348.8	-729.84	-215.66	-135.68
	(-3.417)	(-8.774)	(-7.269)	(-2.460)
SINPAR	-113.00	-122.51	-33.810	37.798
	(-0.143)	(-1.751)	(-1.317)	(0.792)
OTHFAM	112.27	239.28	49.504	79.158
	(0.183)	(4.653)	(2.673)	(2.286)
F	38.875	-196.08	-91.901	-114.37
	(0.064)	(-3.606)	(-4.622)	(-3.077)
$\hat{Y}P$	-0.177	0.283	0.076	0.090
	(-0.579)	(10.557)	(7.957)	(5.027)
$F\hat{Y}P$	0.043	0.023	0.565E-02	0.665E-02
	(1.057)	(5.979)	(4.039)	(2.549)
$\hat{Y}P^2$	-0.569E-05	-0.732E-05	-0.213E-05	-0.195E-05
	(-0.564)	(-7.839)	(-6.363)	(-3.110)
F^2	-53.016	-18.061	-1.266	-3.965
	(-1.005)	(-3.592)	(-0.676)	(-1.142)
OBSERVATIONS				
LIMIT	2701	267	926	762
NON-LIMIT	529	2963	2304	2468

Table 4. (Continued)

Family Characteristics	Expenditure Category Parameter (T-Ratio) Transportation Fees	Public Transportation	Prescription Drugs	Medical Supplies
CONSTANT	-1093.5	-696.85	20.593	14.820
	(-11.808)	(-4.610)	(0.337)	(0.221)
Z				
A25	422.99	50.922	-142.66	-72.853
	(12.838)	(0.939)	(-6.485)	(-2.798)
A35	353.33	-18.256	-166.26	-63.554
	(14.763)	(-0.462)	(-10.442)	(-3.568)
A55	70.917	-105.24	-186.59	-58.865
	(2.945)	(-2.592)	(-11.437)	(-3.285)
A65	-3.442	-52.548	-96.275	-33.295
	(-0.141)	(-1.298)	(-6.018)	(-1.872)
OWNER	151.07	-13.486	39.043	27.340
	(9.031)	(-0.501)	(3.642)	(2.251)
EDHIGH	-169.54	-148.91	-57.816	-24.653
	(-6.787)	(-3.533)	(-3.458)	(-1.331)
EDCOL	-263.49	-95.115	-53.031	8.971
	(-7.795)	(-1.679)	(-2.333)	(0.360)
EDGRAD	-423.37	-52.961	-95.907	-10.628
	(-9.215)	(-0.678)	(-3.041)	(-0.309)
SINPAR	76.018	349.35	-45.626	-13.446
	(1.896)	(5.286)	(-1.693)	(-0.432)
OTHFAM	209.35	251.73	-61.368	-15.790
	(7.162)	(5.153)	(-3.140)	(-0.729)
F	-143.97	-43.823	-17.569	-34.041
	(-4.639)	(-0.855)	(-0.843)	(-1.492)
$\hat{Y}P$	0.160	0.081	0.033	-0.807E-02
	(10.510)	(3.243)	(3.265)	(-0.739)
$F\hat{Y}P$	0.683E-02	-0.012	0.238E-02	0.701E-03
	(3.127)	(-3.585)	(1.627)	(0.468)
$\hat{Y}P^2$	-0.315E-05	0.585E-06	-0.111E-05	0.982E-07
	(-5.965)	(0.688)	(-3.128)	(0.268)
F^2	-2.303	17.342	-3.957	1.943
	(-0.787)	(4.176)	(-2.019)	(1.016)
OBSERVATIONS				
LIMIT	379	1450	757	2249
NON-LIMIT	2851	1780	2473	981

Table 4. (Continued)

Family Characteristics	Expenditure Category Parameter (T-Ratio) Medical Services	Insurance	Reading Material
CONSTANT	-24.410	-517.67	-119.76
	(-0.104)	(-2.163)	(-4.481)
Z			
A25	-226.31	-213.20	-5.748
	(-2.719)	(-2.491)	(-0.609)
A35	-294.29	-244.78	-4.062
	(-4.889)	(-3.996)	(-0.593)
A55	-383.66	-268.04	-32.894
	(-6.214)	(-4.276)	(-4.678)
A65	-192.47	-247.97	-24.356
	(-3.145)	(-3.944)	(-3.442)
OWNER	159.30	395.91	29.074
	(3.871)	(9.398)	(6.157)
EDHIGH	-8.743	-144.61	-8.286
	(-0.137)	(-2.220)	(-1.138)
EDCOL	-34.914	-251.33	1.756
	(-0.405)	(-2.828)	(0.178)
EDGRAD	-24.916	-241.67	16.301
	(-0.209)	(-1.962)	(1.186)
SINPAR	-78.361	-161.44	5.320
	(-0.766)	(-1.528)	(0.456)
OTHFAM	-169.64	-37.005	10.953
	(-2.282)	(-0.483)	(1.284)
F	-189.17	-113.64	-32.142
	(-2.388)	(-1.388)	(-3.544)
$\hat{Y}P$	0.095	0.178	0.032
	(2.470)	(4.476)	(7.291)
$F\hat{Y}P$	0.016	0.664E-02	0.517E-03
	(2.925)	(1.150)	(0.851)
$\hat{Y}P^2$	-0.331E-05	-0.244E-05	-0.544E-06
	(-2.460)	(-1.747)	(-3.548)
F^2	-9.037	-12.772	0.590
	(-1.232)	(-1.672)	(0.769)
OBSERVATIONS			
LIMIT	452	197	214
NON-LIMIT	2778	3033	3016

Table 4. (Continued)

Family Characteristics	Expenditure Category Parameter (T-Ratio)		
	Entertainment Equipment and Supplies	Entertainment Fees and Admissions	Entertainment Services
CONSTANT	-1141.2	-536.15	-232.52
	(-5.814)	(-5.400)	(-5.964)
Z			
A25	658.99	210.33	88.773
	(9.480)	(5.950)	(6.277)
A35	636.90	160.96	80.620
	(12.383)	(6.282)	(7.902)
A55	188.86	62.436	28.950
	(3.595)	(2.373)	(2.777)
A65	50.707	-8.681	6.594
	(0.951)	(-0.323)	(0.624)
OWNER	247.66	131.25	74.257
	(6.839)	(7.215)	(10.143)
EDHIGH	-157.33	-31.295	-19.296
	(-2.942)	(-1.157)	(-1.825)
EDCOL	-312.83	-8.267	-13.894
	(-4.355)	(-0.228)	(-0.992)
EDGRAD	-443.93	51.613	-19.554
	(-4.461)	(1.029)	(-1.017)
SINPAR	274.51	167.16	36.132
	(3.281)	(3.918)	(2.140)
OTHFAM	150.93	92.013	17.838
	(2.413)	(2.907)	(1.446)
F	-360.30	-81.463	-50.764
	(-5.419)	(-2.440)	(-3.807)
$\hat{Y}P$	0.157	0.054	0.026
	(4.909)	(3.328)	(4.146)
$F\hat{Y}P$	0.020	0.296E-02	0.279E-02
	(4.486)	(1.282)	(2.988)
$\hat{Y}P^2$	-0.405E-05	0.877E-07	-0.552E-06
	(-3.691)	(0.156)	(-2.510)
F^2	4.639	-0.490	-1.506
	(0.838)	(-0.157)	(-1.147)
OBSERVATIONS			
LIMIT	601	558	1114
NON-LIMIT	2629	2672	2116

Table 4. (Continued)

Family Characteristics	Expenditure Category Parameter (T-Ratio) Personal Care	Education	Miscellaneous Services
CONSTANT	-98.526	-1246.7	-308.02
	(-3.361)	(-2.680)	(-1.966)
Z			
A25	40.552	1094.8	-94.899
	(3.777)	(6.408)	(-1.697)
A35	26.318	845.57	-76.033
	(3.234)	(6.319)	(-1.886)
A55	5.310	905.46	-47.765
	(0.642)	(6.695)	(-1.159)
A65	-10.657	289.58	-0.916
	(-1.211)	(1.888)	(-0.022)
OWNER	12.821	133.81	110.65
	(2.225)	(1.486)	(3.978)
EDHIGH	-11.699	241.94	-14.655
	(-1.430)	(1.918)	(-0.341)
EDCOL	-18.127	787.50	23.607
	(-1.697)	(4.978)	(0.405)
EDGRAD	-31.537	1402.9	-37.978
	(-2.187)	(6.579)	(-0.469)
SINPAR	25.456	194.43	96.827
	(2.034)	(1.126)	(1.414)
OTHFAM	18.453	175.58	60.929
	(1.946)	(1.266)	(1.215)
F	-16.989	469.44	-25.646
	(-1.698)	(3.652)	(-0.482)
$\hat{Y}P$	0.107E-02	-0.306	0.062
	(0.231)	(-4.392)	(2.381)
$F\hat{Y}P$	0.108E-02	0.026	-0.596E-02
	(1.634)	(3.021)	(-1.671)
$\hat{Y}P^2$	-0.510E-07	0.687E-05	0.249E-06
	(-0.327)	(3.106)	(0.277)
F^2	-0.428	-60.689	6.845
	(-0.466)	(-5.805)	(1.529)
OBSERVATIONS			
LIMIT	2614	2047	175
NON-LIMIT	616	1183	3055

CHAPTER 4

INTERPRETATION OF MODEL RESULTS

This chapter presents the expenditure category share results and implications for progressivity/regressivity of alternative tax bases. The results are derived from calculations based on the maximum likelihood estimates presented in Table 4. As a prelude to the results, a discussion is presented on the interpretation of the tobit estimates and the impact of this interpretation on the share and expenditure calculations. The impact that expenditure category exemption has on the incidence of a retail sales tax and on the total tax burden is discussed and presented diagramatically and in tabular form.

Recall, a regressive tax is one for which the share (amount) of taxes relative to permanent income decreases as permanent income increases. A tax can be regressive and simultaneously place a greater total dollar burden on households in higher permanent income groups. The burden of a sales tax depends upon a household's level of taxes paid from purchasing those commodities included in the base of a retail sales tax, while the incidence depends on the share of permanent income paid in the form of a sales tax on those commodities included in the base. To estimate the burden and incidence of a retail sales tax therefore requires estimates of

1) the change in the share (ratio of expenditures to permanent income) as permanent income changes; and

2) the change in the level of expenditures on those commodities exempted from the base of a retail sales tax as permanent income changes.

Interpretation of Tobit Estimates

The model used in this study is one in which the dependent variable is observed only in the nonnegative range. All other observations take the value of zero. The model first introduced by Tobin (1958) can be written as

$$(16)\quad e_{ij} = \mathbf{X}_j'\boldsymbol{\beta}_i + \varepsilon_{ij} \quad \text{if } e_{ij} \geq 0$$
$$= 0 \quad \text{otherwise.}$$

Where

e_{ij} = expenditures on the i^{th} category for the j^{th} household,

$\mathbf{X}_j' = [1\ Z_j'\ F_j\ YP_j\ YP_jF_j\ YP_j^2\ F_j^2]$,

$\boldsymbol{\beta}_i = [\alpha_i\ \delta_i'\ \gamma_i\ \varphi_i\ \theta_i\ \Phi_i\ \Psi_i]'$, and

ε_{ij} = the stochastic disturbance.

Equaiton (16) is the same as equation (12), but in more compact notation.

The regression equation of the limited dependent variable model is written as

$$(17)\quad E(e_{ij}) = F(Z_{ij})[\mathbf{X}_j'\boldsymbol{\beta}_i + E(\varepsilon_{ij}|e_{ij} > 0)],$$

where

$$E(\varepsilon_{ij}|e_{ij} > 0) = E(\varepsilon_{ij}|\varepsilon_{ij} > -\mathbf{X}_j'\boldsymbol{\beta}_j) = \sigma_i f(Z_{ij})/F(Z_{ij})$$

and

$$Z_{ij} = \mathbf{X}_j\boldsymbol{\beta}_i/\sigma_i.$$

The functions $f(Z_{ij})$ and $F(Z_{ij})$ are the standard normal probability density function and the cumulative distribution function, respectively.

Equation (17) can be expressed alternatively as

(18) $E(e_{ij}) = F(Z_{ij})[\mathbf{X}_j'\boldsymbol{\beta}_i + \sigma_i f(Z_{ij})/F(Z_{ij})]$,

or

(19) $E(e_{ij}) = F(Z_{ij})E(e_{ij}|e_{ij} \geq 0)$.

A problem confronted in this study involves the interpretation of the maximum likelihood coefficients estimated from the Tobit model. McDonald and Moffitt (1980) show that the total change in the mean level of expenditure in category i with respect to permanent income can be written as

$$(20)\quad \frac{\partial E(e_{ij})}{\partial YP_j} = F(Z_{ij})\frac{\&E(e_{ij}|e_{ij} > 0)}{\partial YP_j} + E(e_{ij}|e_{ij} > 0)\frac{\partial F(Z_{ij})}{\partial YP_j}.$$

The total change in $E(e_{ij})$ in (20) is separated into two parts. The first part is the rate of change in the mean expenditure on category i by household j, given a positive level of expenditure, weighted by the probability of being non-limit (i.e. strictly greater than zero). The second part is the marginal probability of being non-limit, weighted by the conditional mean of the non-limit e_{ij}. The unconditional mean of the marginal expenditure is therefore the sum of the change in the non-limit expenditure weighted by the probability of consuming a positive amount plus the marginal probability of consuming a positive amount weighted by the conditional expected value of the non-limit expenditure.

The point of interest in this discussion is the implication for calculation of marginal expenditures and marginal shares. The marginal change on those e_{ij} that are non-limit is

$$(21)\quad \frac{\partial E(e_{ij}|e_{ij} > 0)}{\partial YP_j} = \frac{\partial[\mathbf{X}_j'\boldsymbol{\beta}_i + \sigma_i f(Z_{ij})/F(Z_{ij})]}{\partial YP_j}$$

which reduces to

$$(22)\quad \frac{\partial E(e_{ij}|e_{ij} > 0)}{\partial YP_j} = [\varphi_i + \theta_i F_j + 2\Phi_i YP_j] - ([\varphi_i + \theta_i F_j + 2\Phi_i YP_j] \cdot [(Z_{ij})f(Z_{ij})/F(Z_{ij}) + (f(Z_{ij}))^2/(F(Z_{ij}))^2]).$$

Let

$$\beta_{ij} = [\varphi_i + \theta_i F_j + 2\Phi_i YP_j];$$

then (22) may be rewritten as

$$(23)\quad \frac{\partial E(e_{ij}|e_{ij} > 0)}{\partial YP_j} = \beta_{ij} - \beta_{ij}[(Z_{ij})f(Z_{ij})/F(Z_{ij}) + (f(Z_{ij}))^2/F(Z_{ij})^2].$$

Substituting (23) into (20) gives

$$\begin{aligned}(24)\quad \frac{\partial E(e_{ij})}{\partial YP_j} &= F(Z_{ij})\beta_{ij} - F(Z_{ij})\beta_{ij}[(Z_{ij})f(Z_{ij})/F(Z_{ij}) \\ &\quad + (f(Z_{ij}))^2/(F(Z_{ij}))^2] \\ &\quad + f(Z_{ij})(\beta_{ij}/\sigma_i)[\mathbf{x}_j'\boldsymbol{\beta}_i + \sigma_i f(Z_{ij})/F(Z_{ij})], \\ &= F(Z_{ij})\beta_{ij} - \beta_{ij}[(Z_{ij})f(Z_{ij}) + (f(Z_{ij}))^2/F(Z_{ij})] \\ &\quad + \beta_{ij}[(Z_{ij})f(Z_{ij}) + (f(Z_{ij}))^2/F(Z_{ij})], \\ &= F(Z_{ij})\beta_{ij}, \\ &= F(Z_{ij})[\varphi_i + \theta_i F_j + 2\Phi_i YP_j].\end{aligned}$$

Equation (24) implies that

$$|\partial E(e_{ij})/\partial YP_j| < |\beta_{ij}|, \text{ but } \operatorname{sign}\left(\partial E(e_{ij})/\partial YP_j\right) = \operatorname{sign}(\beta_{ij}).$$

The values presented in this chapter for marginal shares and marginal expenditures would be biased towards zero by a factor $F(Z_{ij})$ if caution was not taken when interpreting the tobit results. Therefore, the expected level of total expenditures in category i by household j is written as

$$(24)\quad E(e_{ij}) = F(Z_{ij})\mathbf{X}_j'\boldsymbol{\beta}_i + \sigma_i f(Z_{ij}).$$

Impact of Expenditure Category Exemption on the Incidence of a Retail Sales Tax

The most broadly-based retail sales tax would include all retail goods and services as part of its base. Exempting an expenditure category from the base of the tax changes the progressivity of the retail sales tax. The directional change of the progressivity (more or less progressive) depends on the distribution of the share of sales tax paid as a fraction of permanent income, from purchasing items in the exempted expenditure category for households in different permanent income brackets. The share of taxes paid by household j on expenditure category i is written as

$$\frac{e_{ij}}{YP_j} \cdot t = S_{ij} \cdot t = \frac{T_{ij}}{YP_j}$$

where

e_{ij} = expenditure on the i^{th} category of the j^{th} household,

YP_j = permanent income for the j^{th} household,

$S_{ij} = e_{ij}/YP_j$ = the share of expenditures on the i^{th} category as a fraction of permanent income for the j^{th} household,

t = sales tax rate,

T_{ij} = amount of sales tax household j pays when purchasing items in expenditure category i.

Assuming that the amount of tax collected under a retail sales tax is a constant rate (t) of the tax base, the marginal share of the exempted expenditure category with respect to permanent income is used to measure the impact on the incidence of a sales tax. If the marginal share on exempted expenditure category i with respect to permanent

income is less than zero, the sales tax becomes more progressive. This is written as

$$\frac{\partial S_{ij}}{\partial YP_j} < 0$$

where the constant tax rate (t) is omitted because it is equivalent for all households and all expenditure categories included in the base. If

$$\frac{\partial S_{ij}}{\partial YP_j} \geq 0$$

the incidence of the sales tax becomes less progressive, or does not change, respectively.

From equation (12) the (expected) mean value of the share on expenditure category i for household j is derived as

$$(26)\quad S_{ij} = \left[\frac{(\alpha_i + \delta_i' Z_j + \gamma_i F_j + \Psi_i F_j^2)}{YP_j} + \varphi_i + \theta_i F_j + \Phi_i YP_j \right] \cdot F(Z_{ij}) + \sigma_i f(Z_{ij}).$$

The marginal share is

$$(27)\quad \frac{\partial S_{ij}}{\partial YP_j} = \left[\frac{-(\alpha_i + \delta_i' Z_j + \gamma_i F_j + \Psi_i F_j^2)}{YP_j^2} + \Phi_i \right] F(Z_{ij}),$$

where $F(Z_{ij})$ and $f(Z_{ij})$ are the standard normal cumulative distribution function and probability density function respectively. By substituting different levels of permanent income into equation (27), the marginal share is calculated for different expenditure categories at different levels of permanent income. Table 5 presents the marginal share and marginal expenditure for all of the 41 expenditure categories for the mean family size of 2.7. The marginal share and marginal expenditure are calculated at different levels of permanent income, with $12,532

Table 5. Marginal Income Effect on Expenditures and Shares (%) for a Family Size of 2.7 at Different Levels of Permanent Income.

Expenditure Category		Permanent Income ($)					
		5000	10000	12532*	25000	50000	80000
Food At Home	EXP	0.10922	0.09975	0.09472	0.06957	0.02308	-0.02269
	SHARE	-0.00500	-0.00132	-0.00087	-0.00028	-0.00013	-0.00009
Food Away From Home	EXP	0.00568	0.13513	0.14885	0.09729	-0.03942	-0.10187
	SHARE	0.00018	0.00111	0.00076	0.00000	-0.00019	-0.00012
Alcohol	EXP	0.00019	0.05571	0.06764	0.01740	-0.05776	-0.00645
	SHARE	0.00001	0.00057	0.00043	-0.00006	-0.00011	-0.00001
Tobacco	EXP	0.01034	0.01606	0.01156	-0.01493	-0.02083	-0.00226
	SHARE	0.00034	0.00014	0.00005	-0.00006	-0.00003	0.00000
Repair Material and Labor	EXP	-0.00250	-0.00456	-0.00304	0.01723	0.09311	0.22693
	SHARE	0.00025	0.00025	0.00022	0.00016	0.00016	0.00019
Building Material	EXP	0.00267	0.00976	0.00666	-0.01855	-0.02287	-0.00303
	SHARE	0.00014	0.00018	0.00010	-0.00005	-0.00003	0.00000
Other Lodging	EXP	0.00018	0.01632	0.02498	0.03632	0.02858	0.01487
	SHARE	0.00001	0.00022	0.00021	0.00007	0.00000	-0.00001
Household Textiles	EXP	0.00227	0.00606	0.00722	0.01093	0.01659	0.02320
	SHARE	0.00010	0.00007	0.00005	0.00002	0.00001	0.00001
Furniture	EXP	0.00215	0.01954	0.02240	0.00790	-0.03133	-0.04500
	SHARE	0.00013	0.00032	0.00025	0.00002	-0.00005	-0.00004
Carpet	EXP	-0.00177	-0.00352	-0.00333	0.00363	0.03929	0.11213
	SHARE	0.00007	0.00006	0.00006	0.00005	0.00007	0.00010
Small Appliances	EXP	0.00117	0.00905	0.01123	0.01374	0.01152	0.00757
	SHARE	0.00005	0.00010	0.00008	0.00002	0.00000	0.00000
Large Appliances	EXP	0.00180	0.00655	0.00806	0.01211	0.01644	0.02068
	SHARE	0.00016	0.00014	0.00011	0.00004	0.00002	0.00001
Household Miscellaneous	EXP	0.00195	0.02514	0.02854	0.01728	-0.01460	-0.02539
	SHARE	0.00007	0.00025	0.00017	0.00000	-0.00004	-0.00003
Utilities	EXP	-0.01760	-0.00118	0.00670	0.04110	0.11880	0.22416
	SHARE	-0.00478	-0.00105	-0.00059	-0.00003	0.00010	0.00014
Telephone	EXP	0.02007	0.01890	0.01851	0.01757	0.01706	0.01693
	SHARE	-0.00060	-0.00014	-0.00009	-0.00002	0.00000	0.00000
Water and Other Public Services	EXP	0.00009	0.00165	0.00234	0.00586	0.01441	0.02710
	SHARE	-0.00034	-0.00006	-0.00003	0.00000	0.00001	0.00002
TV and Radio	EXP	0.00216	0.04027	0.04204	0.00599	-0.03806	-0.00646
	SHARE	0.00008	0.00037	0.00023	-0.00006	-0.00007	-0.00001
Household Domestic Services	EXP	-0.00663	-0.00544	-0.00283	0.03605	0.25084	0.53781
	SHARE	0.00006	0.00007	0.00009	0.00017	0.00035	0.00041
Household Services	EXP	0.01221	0.02175	0.02677	0.05415	0.11995	0.20752
	SHARE	0.00023	0.00012	0.00011	0.00010	0.00011	0.00012
Apparel	EXP	0.02566	0.11510	0.12404	0.11774	0.08135	0.03605
	SHARE	0.00070	0.00079	0.00053	0.00009	-0.00003	-0.00006
Other Apparel	EXP	0.00052	0.03108	0.03939	0.03146	-0.00763	-0.03262
	SHARE	0.00002	0.00032	0.00026	0.00002	-0.00005	-0.00004

Table 5. (Continued)

Expenditure Category		Permanent Income ($)					
		5000	10000	12532*	25000	50000	80000
Transportation Rental	EXP	0.00000	0.00089	0.00225	0.00419	-0.00667	-0.01840
	SHARE	0.00000	0.00004	0.00007	0.00005	0.00000	-0.00001
New Cars	EXP	0.00014	0.02261	0.01269	-0.27107	-0.32996	-0.04984
	SHARE	0.00002	0.00145	0.00159	-0.00014	-0.00035	-0.00003
Other Transportation	EXP	0.00000	0.00029	-0.01228	-0.00141	0.00000	0.00000
	SHARE	0.00000	0.00009	0.00005	0.00000	0.00000	0.00000
Used Cars	EXP	-0.00291	-0.02241	-0.03325	-0.07749	-0.12448	-0.12969
	SHARE	0.00045	0.00053	0.00040	0.00004	-0.00008	-0.00007
Gasoline and Diesel Fuel	EXP	0.02763	0.17530	0.15083	-0.01905	-0.06740	0.00000
	SHARE	0.00072	0.00108	0.00048	-0.00038	-0.00011	0.00000
Vehicle Parts and Fluids	EXP	0.00044	0.02621	0.02610	-0.01018	-0.01209	-0.00002
	SHARE	0.00002	0.00025	0.00015	-0.00007	-0.00002	0.00000
Auto Services	EXP	0.00671	0.04052	0.04058	0.00779	-0.03904	-0.01711
	SHARE	0.00023	0.00035	0.00021	-0.00005	-0.00007	-0.00002
Transportation Fees	EXP	0.00011	0.06618	0.07678	0.01813	-0.05720	-0.00198
	SHARE	0.00000	0.00062	0.00045	-0.00008	-0.00011	0.00000
Public Transportation	EXP	0.00280	0.02274	0.03094	0.05682	0.09313	0.13313
	SHARE	0.00015	0.00029	0.00025	0.00013	0.00008	0.00007
Prescription Drugs	EXP	0.00897	0.01043	0.00740	-0.00870	-0.01367	-0.00197
	SHARE	0.00025	0.00007	0.00002	-0.00004	-0.00002	0.00000
Medical Supplies	EXP	-0.00059	-0.00100	-0.00101	-0.00045	0.00161	0.00485
	SHARE	0.00005	0.00003	0.00002	0.00001	0.00001	0.00001
Medical Services	EXP	0.03493	0.04429	0.03599	-0.01592	-0.06125	-0.02692
	SHARE	0.00096	0.00029	0.00012	-0.00012	-0.00010	-0.00002
Insurance	EXP	0.07216	0.11332	0.10959	0.06212	-0.03424	-0.08748
	SHARE	0.00160	0.00059	0.00033	-0.00007	-0.00015	-0.00010
Reading Material	EXP	0.00664	0.01833	0.01733	0.00579	-0.01238	-0.00677
	SHARE	0.00017	0.00011	0.00006	-0.00002	-0.00003	-0.00001
Entertainment Equipment and Supplies	EXP	0.00213	0.05734	0.06338	0.00542	-0.06880	-0.01598
	SHARE	0.00009	0.00062	0.00043	-0.00008	-0.00012	-0.00001
Entertainment Fees and Admissions	EXP	0.00607	0.03626	0.04385	0.05717	0.06537	0.07191
	SHARE	0.00022	0.00032	0.00025	0.00009	0.00003	0.00002
Entertainment Services	EXP	0.00057	0.01003	0.01141	0.00429	-0.01079	-0.00856
	SHARE	0.00002	0.00011	0.00008	0.00000	-0.00002	-0.00001
Personal Care	EXP	0.00001	0.00030	0.00047	0.00053	-0.00048	-0.00171
	SHARE	0.00000	0.00001	0.00001	0.00001	0.00000	0.00000
Education	EXP	-0.07953	-0.02926	-0.01856	0.04565	0.37474	0.85632
	SHARE	-0.00152	-0.00008	0.00002	0.00023	0.00054	0.00067
Miscellaneous Services	EXP	0.02187	0.03200	0.03467	0.04323	0.05644	0.07177
	SHARE	0.00050	0.00019	0.00013	0.00005	0.00003	0.00002

* $12,532 is the mean level of permanent income for the 3230 in the data set.

being the mean for the 3230 households. The marginal shares in Table 5 are scaled by 100 to provide values in percent.

The marginal shares for the expenditure category, Food at Home, are all negative (Table 5). The marginal shares decrease in absolute value as permanent income increases. Therefore, households in lower permanent income brackets spend a larger fraction of their permanent income on food purchased in grocery and convenience stores than do households with the same family size earning higher levels of permanent income. Exempting food purchased at grocery and convenience stores from the base of a retail sales tax makes the tax more progressive.

These estimates were generated for different family sizes ranging from one to six. The impact of family size on expenditure category exemption was the same for all family sizes. The expenditure category, Food at Home, is negative and decreases in absolute value as permanent income increases. Exempting food purchased at grocery and convenience stores from the base of a retail sales tax will make the tax more progressive for all family sizes.

Figure 1 shows the marginal share for Food at Home for different levels of permanent income. The figure is a geometric generalization of the results found in Table 5. Once again, the share for Food at Home is larger in absolute value for households in lower permanent income brackets than for those in higher brackets and is negative. It is also clear from Figure 1 that past a certain level of permanent income (approximately $30,000) the marginal share is fairly proportional for households in higher permanent income brackets.

Figure 1.

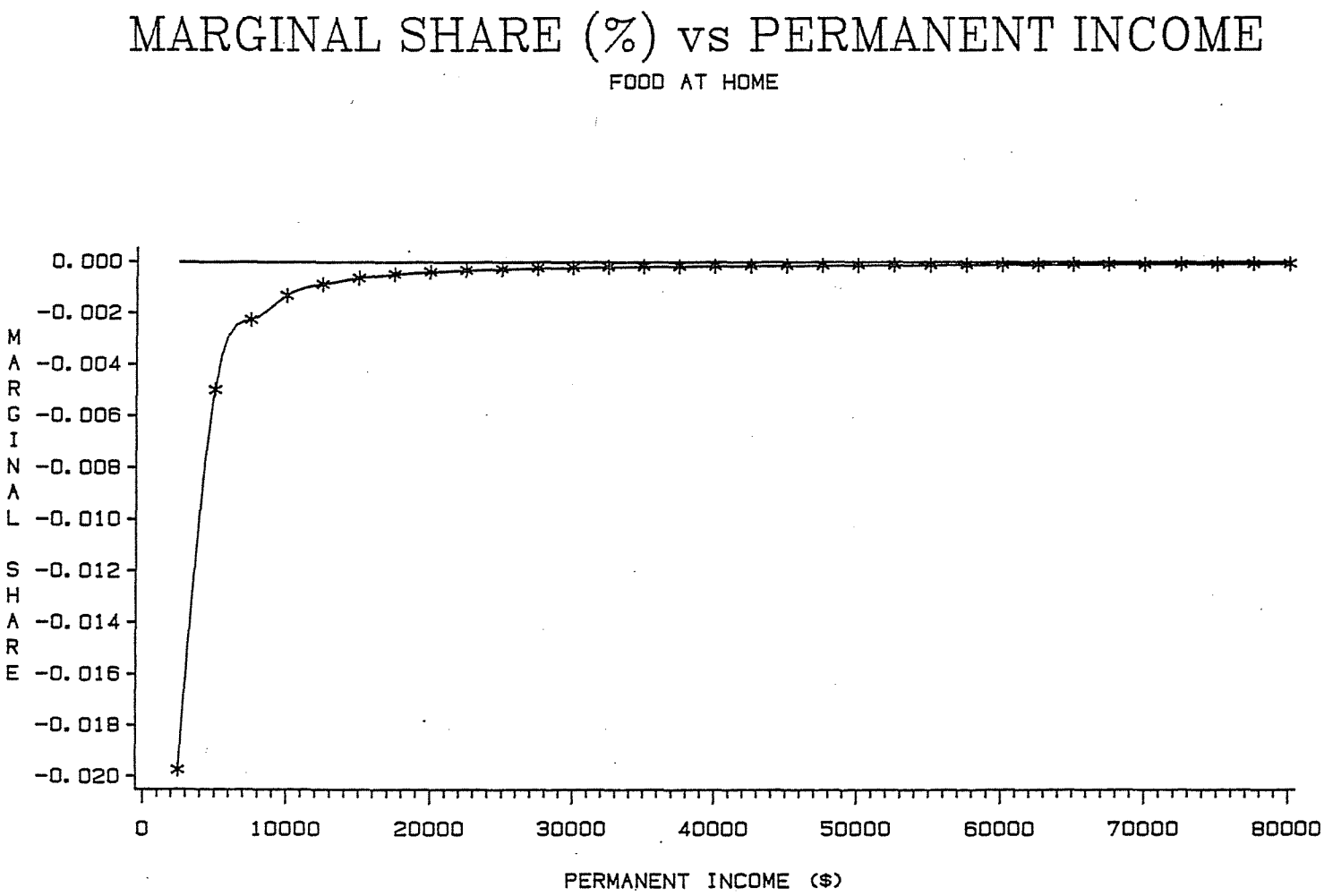

MARGINAL SHARE (%) vs PERMANENT INCOME
FOOD AT HOME
0.000
-0.002
-0.004
-0.006
-0.008
-0.010
-0.012
-0.014
-0.016
-0.018
-0.020
MARGINAL SHARE
0
10000
20000
30000
40000
50000
60000
70000
80000
PERMANENT INCOME ($)

Figure 2 shows the expenditure shares for Food at Home, Utilities, and Prescription Drugs for different levels of permanent income. The diagram of the expenditure share for Food at Home is, of course, consistent with Figure 1, i.e., Food at Home, as a fraction of permanent income, decreases as permanent income increases. Exemption from the base of a sales tax would make the tax more progressive.

The expenditure category, Utilities, exhibits a pattern similar to that for Food at Home. As seen in Figure 3, the marginal share for Utilities is larger in absolute value and negative for households in lower permanent income brackets than for those in higher brackets. This pattern is also consistent for different family sizes. The marginal share approaches zero as permanent income increases. Figure 2 also shows the relationship between expenditure shares for Utilities and permanent income. The implications are the same as for Food at Home, viz., if Utilities are exempt from the base of a retail sales tax, the tax will be more progressive.

Expenditures on Prescription Drugs has the opposite impact on incidence when exempted from the base of a sales tax. Figure 4 shows that the marginal share is larger for households in lower permanent income brackets, but is positive. The marginal share, increases then decreases, as permanent income increases and becomes slightly negative for middle permanent income households. If Prescription Drugs are exempted from the tax base, the sales tax would be less progressive for households in lower permanent income brackets, and fairly proportional to slightly more progressive for households in higher brackets.

Figure 2.

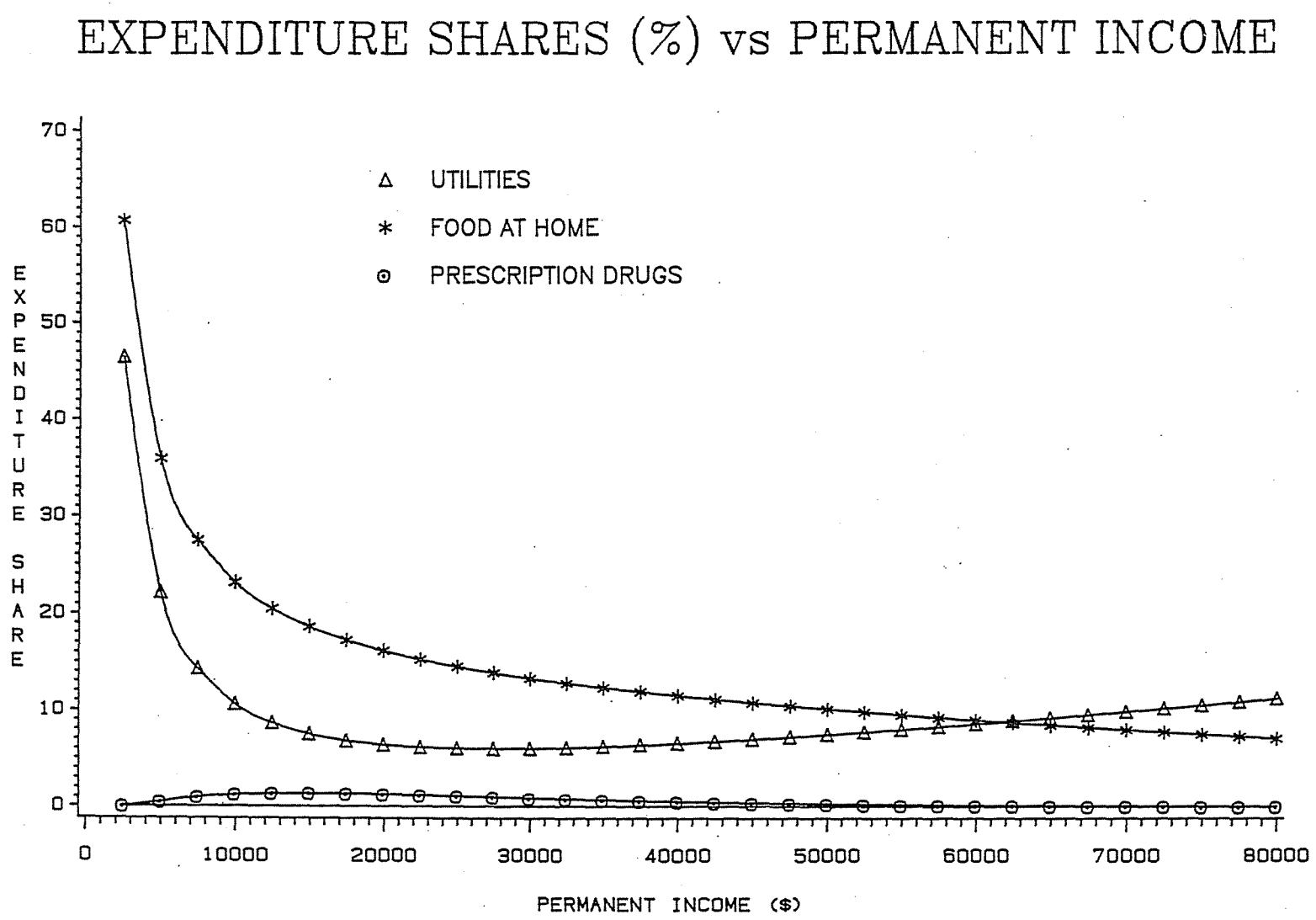

EXPENDITURE SHARES (%) vs PERMANENT INCOME
UTILITIES
FOOD AT HOME
PRESCRIPTION DRUGS
EXPENDITURE SHARE
0
10
20
30
40
50
60
70
0
10000
20000
30000
40000
50000
60000
70000
80000
PERMANENT INCOME ($)

Figure 3.

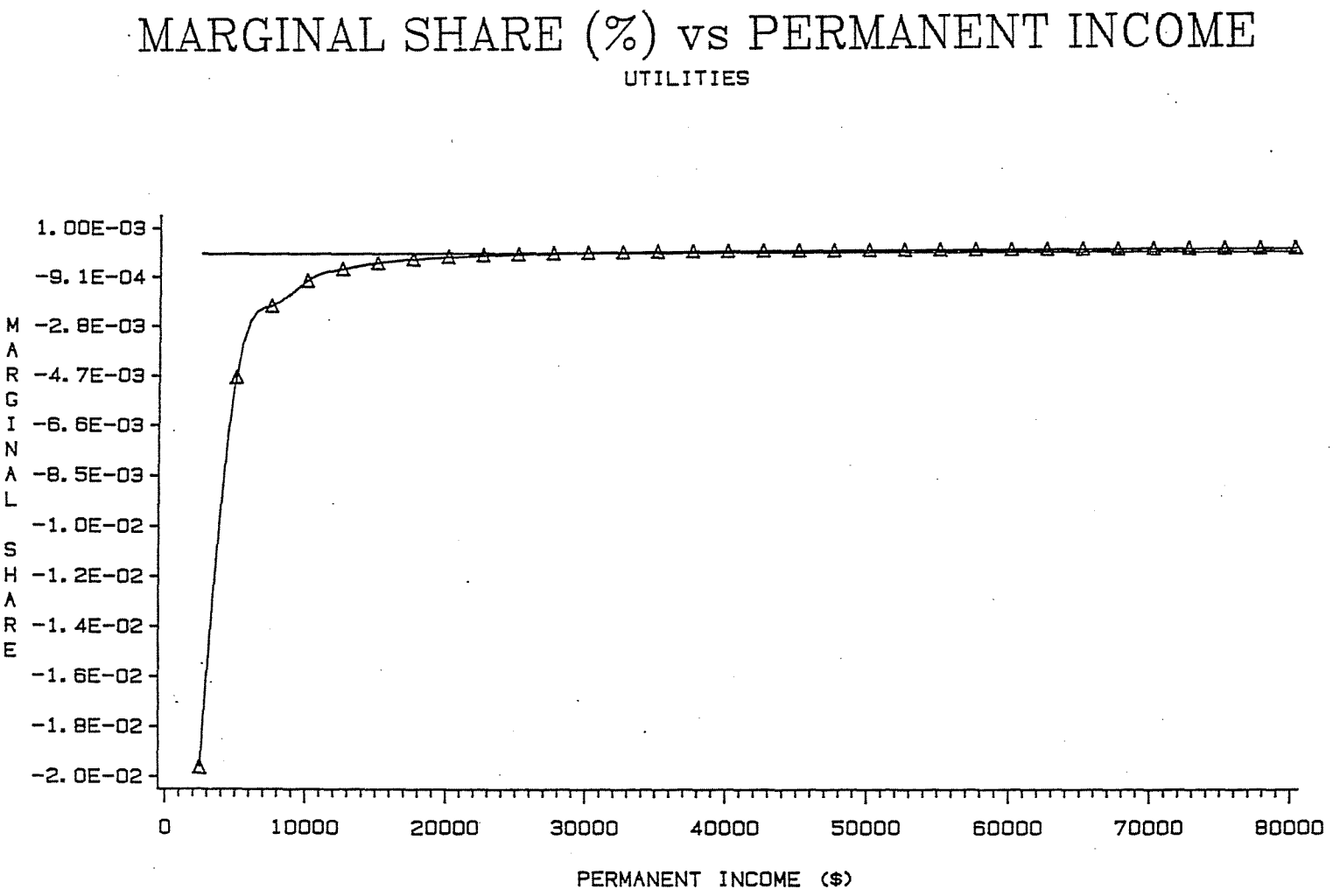
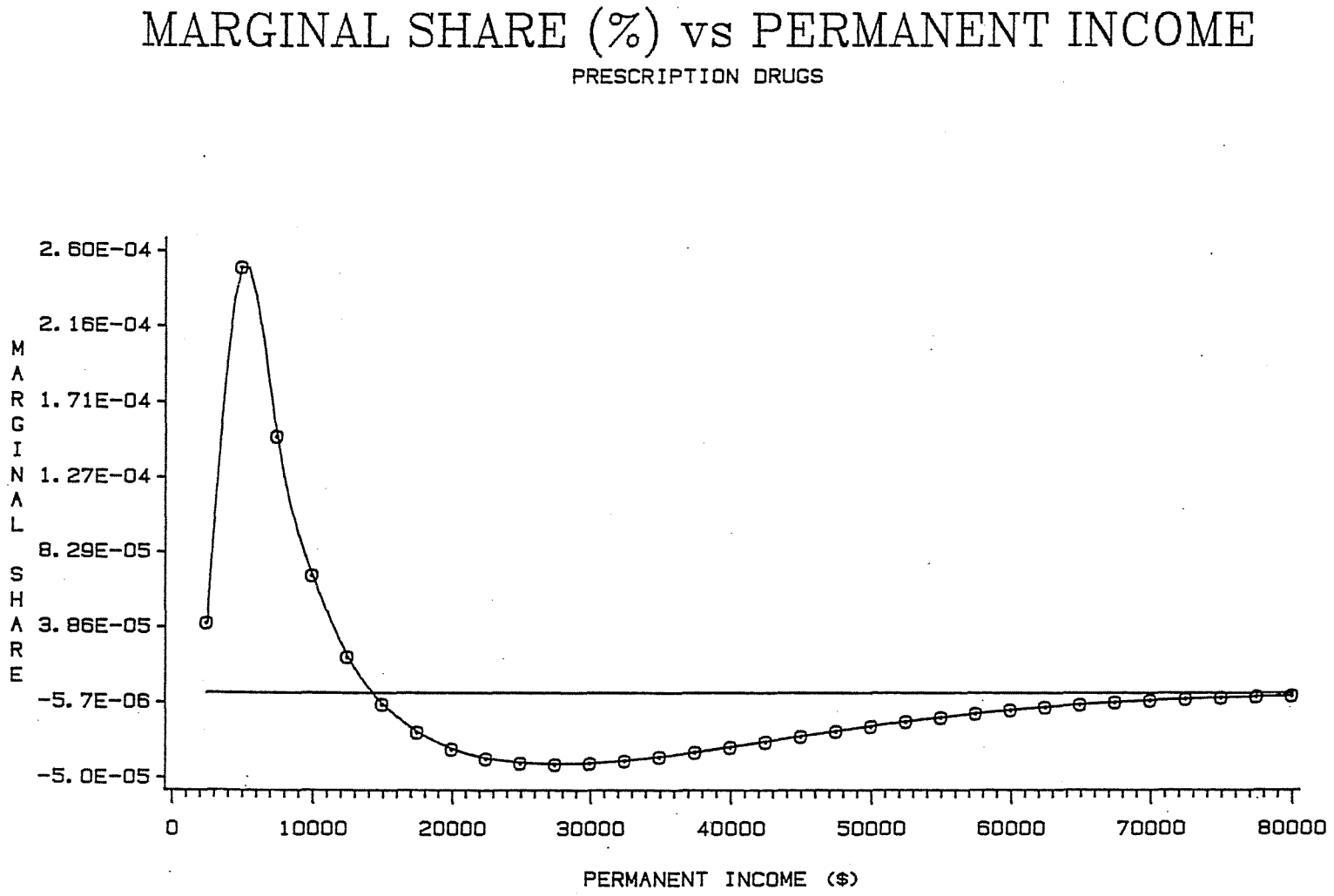

MARGINAL SHARE (%) vs PERMANENT INCOME
UTILITIES
1.00E-03
-9.1E-04
-2.8E-03
-4.7E-03
-6.6E-03
-8.5E-03
-1.0E-02
-1.2E-02
-1.4E-02
-1.6E-02
-1.8E-02
-2.0E-02
MARGINAL SHARE
0
10000
20000
30000
40000
50000
60000
70000
80000
PERMANENT INCOME ($)

Figure 4.


MARGINAL SHARE (%) vs PERMANENT INCOME
PRESCRIPTION DRUGS
MARGINAL SHARE
2.60E-04
2.16E-04
1.71E-04
1.27E-04
8.29E-05
3.86E-05
-5.7E-06
-5.0E-05
0
10000
20000
30000
40000
50000
60000
70000
80000
PERMANENT INCOME ($)

Diagrams similar to Figures 1 through 4 could be developed for all 41 expenditure categories. However, only the above cases are presented and discussed for sake of brevity.

Total Dollar Burden

The share of total sales tax revenue paid by each household is dependent upon each household's level of expenditures on those items defined to the base of the retail sales tax. The total dollar burden paid in sales tax by household j from purchasing items in expenditure category i is written as

$$e_{ij} \cdot t$$

where

e_{ij} = expenditures on the i^{th} category for the j^{th} household,

t = sales tax rate,

Once again, assuming that the tax rate is constant for all expenditure categories included in the base, the marginal expenditure for the exempted expenditure category with respect to permanent income is used to measure the impact on the total tax burden. If the marginal expenditure on the exempted expenditure category with respect to permanent income is less than zero, total taxes paid increases for those households in higher permanent income brackets. If

$$\frac{\partial e_{ij}}{\partial YP_j} \geq 0$$

for the exempted expenditure category, total sales tax paid decreases, or does not change as permanent income increases, respectively. From equation (12) the marginal expenditure on category i for household j is

written as

$$(28)\quad \frac{\partial e_{ij}}{\partial YP_j} = [\varphi_i + \theta_i F_j + 2\Phi_i YP_j]F(Z_{ij}).$$

By substituting different levels of permanent income into equation (28), the marginal expenditure is calculated for different expenditure categories at different levels of permanent income.

The marginal expenditure results are presented in Table 5. Figure 5 is a geometric representation of these results for Food At Home, Utilities, and Prescription Drugs. Both Figure 5 and Table 5 show that the marginal expenditures for expenditure category Food at Home are large and positive in lower permanent income brackets and decrease as permanent income increases. Exempting items in Food at Home from the base of a sales tax decreases the amount of total sales tax paid by households in lower permanent income brackets. It is also noted that the marginal expenditure for Food at Home increases as family size increases (for a given level of permanent income).

Figure 6 displays the Engel Curves for the expenditure categories Food at Home, Utilities, and Prescription Drugs. This figure shows the relationship between total expenditures and permanent income in these particular categories. Both Figures 5 and 6 show the change in expenditures for a change in permanent income. The marginal expenditure is the slope of the total expenditure function.

Figures 5 and 6 reveal that expenditures on Food at Home increase as permanent income increases, but at a decreasing rate. The total expenditure function in Figure 6 increases in lower income brackets exhibiting diminishing marginal expenditures. This is why the marginal

Figure 5.

MARGINAL EXPENDITURES ($) vs PERMANENT INCOME

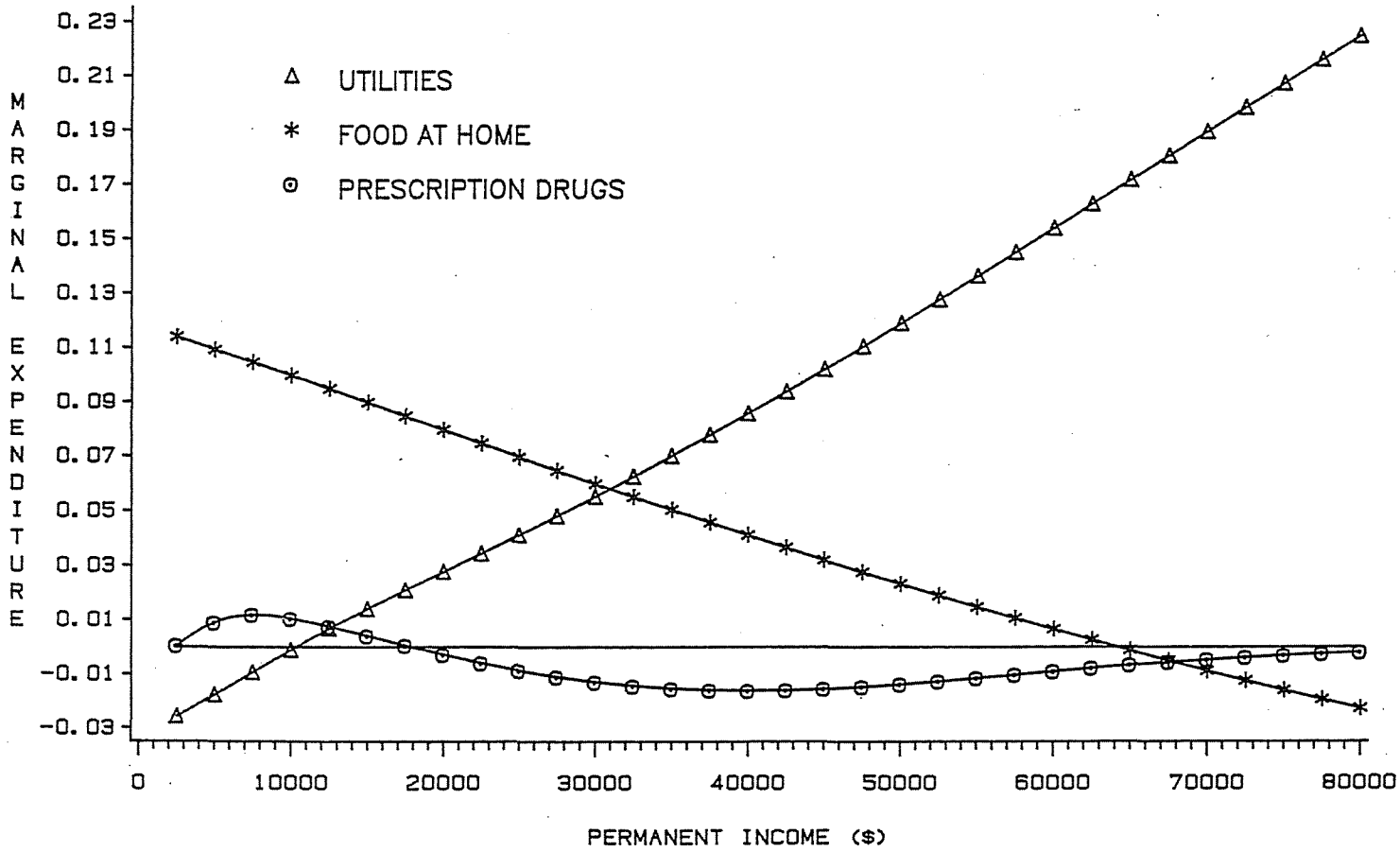
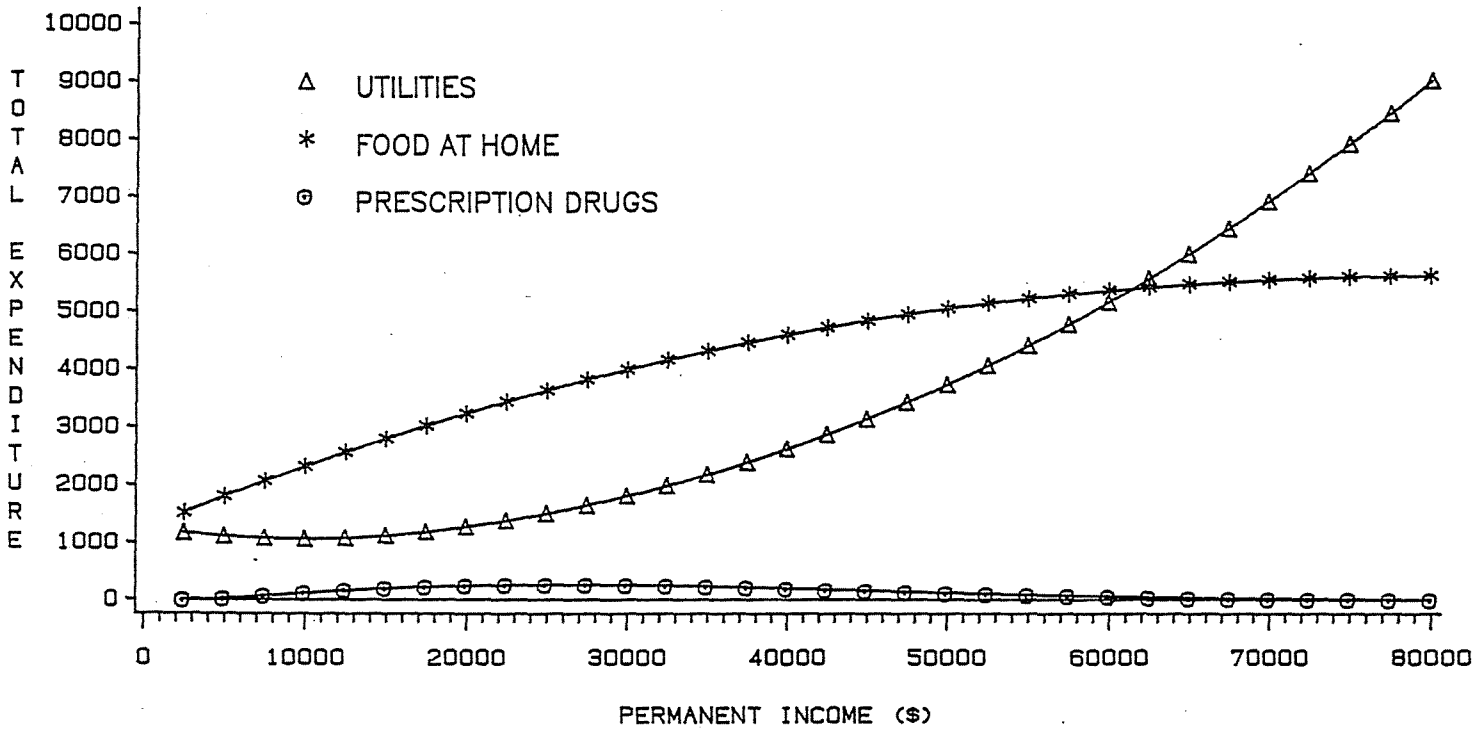


Figure 6.

TOTAL EXPENDITURES ($) vs PERMANENT INCOME



expenditure function (Figure 5) decreases throughout. The total expenditure function starts to decrease at some level of permanent income. This is where the marginal expenditure function crosses the zero axis. Exempting items in the expenditure category Food at Home reduces the share of total sales tax paid by households in lower permanent income brackets.

Figure 5 shows that the marginal expenditures for Utilities are negative at lower permanent income brackets. They are positive and increase at an increasing rate in higher permanent income brackets. Exempting Utilities from the base of a sales tax will increase the share of total sales tax paid by households in lower permanent income brackets. The same relationship is seen in Figure 6, where total expenditures on Utilities are lowest for households in the $1000 bracket and increase at an increasing rate as permanent income increases.

Finally, the marginal expenditures for Prescription Drugs (Figure 5) increases then decreases as permanent income increases. Exempting Prescription Drugs from the base of a retail sales tax would decrease the share of total sales tax paid by households in permanent income brackets from approximately $15,000 to $60,000.

CHAPTER 5

SUMMARY, CONCLUSIONS AND IMPLICATIONS

Summary

The purpose of this study was to estimate the impact of expenditure category exemption on the incidence of a retail sales tax. The results show that exempting certain expenditure categories from the base of a sales tax increase its progressivity. Those expenditure categories (such as Food At Home, Education, and Utilities) that constitute a larger fraction of permanent income for households in lower brackets increase the progressivity of the tax when exempted from the base. The final question addressed in this study is the incidence of a retail sales tax.

Conclusions

The calculations of incidence of a retail sales tax is estimated from the results in Chapter 4. The question of incidence is dependent upon how the tax base varies as a fraction of permanent income, for a given level of permanent income. The tax base (B) may be expressed as

(29) $B = \Sigma e_{ij}$,

where

e_{ij} = expenditures on category i included in the base of a sales tax for household j.

The base share is given by

$$(30)\quad \frac{B}{YP_j} = \frac{\Sigma e_{ij}}{YP_j} = \Sigma\left(\frac{e_{ij}}{YP_j}\right).$$

The change in the base share for different levels of permanent income equals the change in the sum of expenditure shares (for those expenditure categories included in the base) for different levels of permanent income.

Table 6 presents the two different bases and base shares for different levels of permanent income. Base1 and Base Share1 assumes all 41 expenditure categories are included in a retail sales tax base. Base2 and Base Share2 depict a sales tax scenario with selected exemptions from the base. The categories exempted for the Base2 and Base Share2 scenario are Food at Home, Utilities, Telephone, Water and Other Public Services, Prescription Drugs, and Education.

Table 6 and Figure 7 show the change in the base share for different levels of permanent income. Base Share1 and Base Share2 are denoted as "base without exemptions" and "base with exemptions", respectively, in Figure 7. A sales tax with no exemptions (Base Share1) is regressive for households between $1000 and $5000. From approximately $5000 to $25,000 a broadly-based sales tax (sales tax with no exemptions) is progressive. For those households whose permanent income is greater than $25,000, a broadly-based sales tax is slightly regressive to slightly progressive.

Exempting those expenditure categories which make up a larger share of the budget for lower permanent income households has significant impact on the incidence of the tax, especially in lower permanent income

Table 6. Base($) and Base Share(%) at Different Levels of Permenent Income for the Mean Family size--With and Without Exemptions.

Permanent Income	Base1	Base2	Base Share1	Base Share2
2500.00	3490.42	71.97	139.61	2.87
5000.00	4204.11	672.98	84.08	13.45
7500.00	6911.32	3052.03	92.15	40.69
10000.00	11540.09	7285.51	115.40	72.85
12500.00	17074.53	12383.07	136.59	99.06
15000.00	22762.65	17598.91	151.75	117.32
17500.00	28244.69	22574.40	161.39	128.99
20000.00	33379.32	27166.12	166.89	135.83
22500.00	38109.71	31313.00	169.37	139.16
25000.00	42418.65	34992.05	169.67	139.96
27500.00	46323.19	38213.53	168.44	138.95
30000.00	49869.37	41016.08	166.23	136.72
32500.00	53112.96	43447.86	163.42	133.68
35000.00	56125.07	45572.47	160.35	130.20
37500.00	58979.31	47456.36	157.27	126.55
40000.00	61750.95	49168.21	154.37	122.92
42500.00	64512.79	50775.00	151.79	119.47
45000.00	67331.50	52338.37	149.62	116.30
47500.00	70264.62	53911.75	147.92	113.49
50000.00	73359.33	55539.05	146.71	111.07
52500.00	76652.49	57254.65	146.00	109.05
55000.00	80171.70	59084.42	145.76	107.42
57500.00	83936.55	61046.83	145.97	106.16

Table 6. (Continued)

Permanent Income	Base1	Base2	Base Share1	Base Share2
60000.00	87959.97	63154.27	146.59	105.25
62500.00	92249.65	65414.30	147.59	104.66
65000.00	96809.30	67830.93	148.93	104.35
67500.00	101640.20	70406.02	150.57	104.30
70000.00	106742.07	73140.09	152.48	104.48
72500.00	112113.59	76032.84	154.63	104.87
75000.00	117752.71	79083.26	157.00	105.44
77500.00	123656.74	82289.78	159.55	106.18
80000.00	129823.54	85651.30	162.27	107.06

brackets. The tax base share is greatly reduced when exemptions such as Food At Home and Utilities are made from the base. These results are presented in Table 6 under Base Share2 and diagramatically in Figure 7 as "base without exemptions". Allowing for exemptions makes a sales tax progressive for households whose permanent income ranges from $1000 to approximately $25,000. From $25,000 to $60,000 the tax is slightly regressive. From $60,000 on, the sales tax with exemptions is fairly proportional.

The overall tax dollar burden that a retail sales tax places on households is dependent upon how expenditures on items included in the tax base varies as permanent income varies. These results are presented in Table 6 as Base1 and Base2. Figure 8 diagrams the values from Base1

Figure 7.

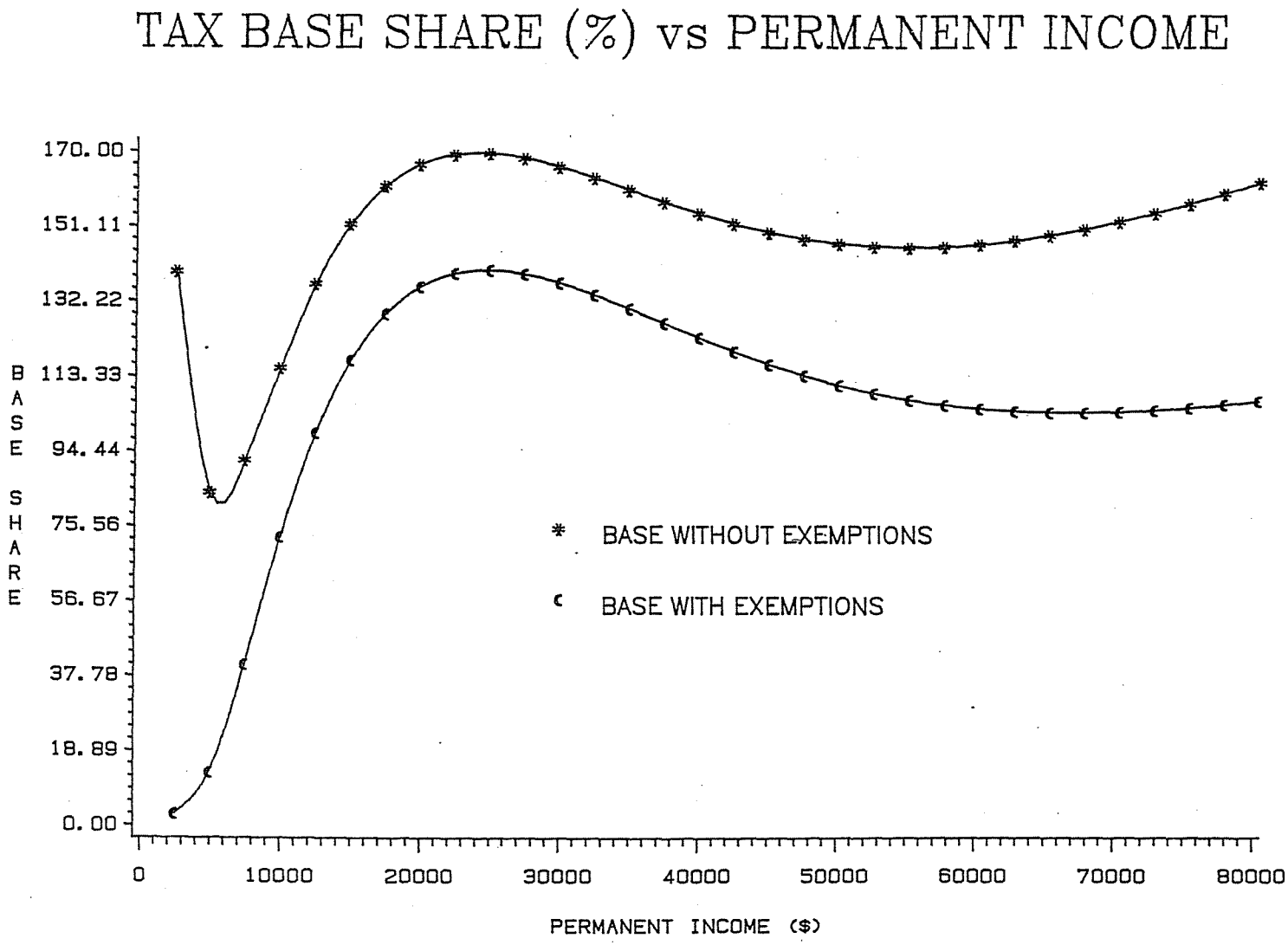
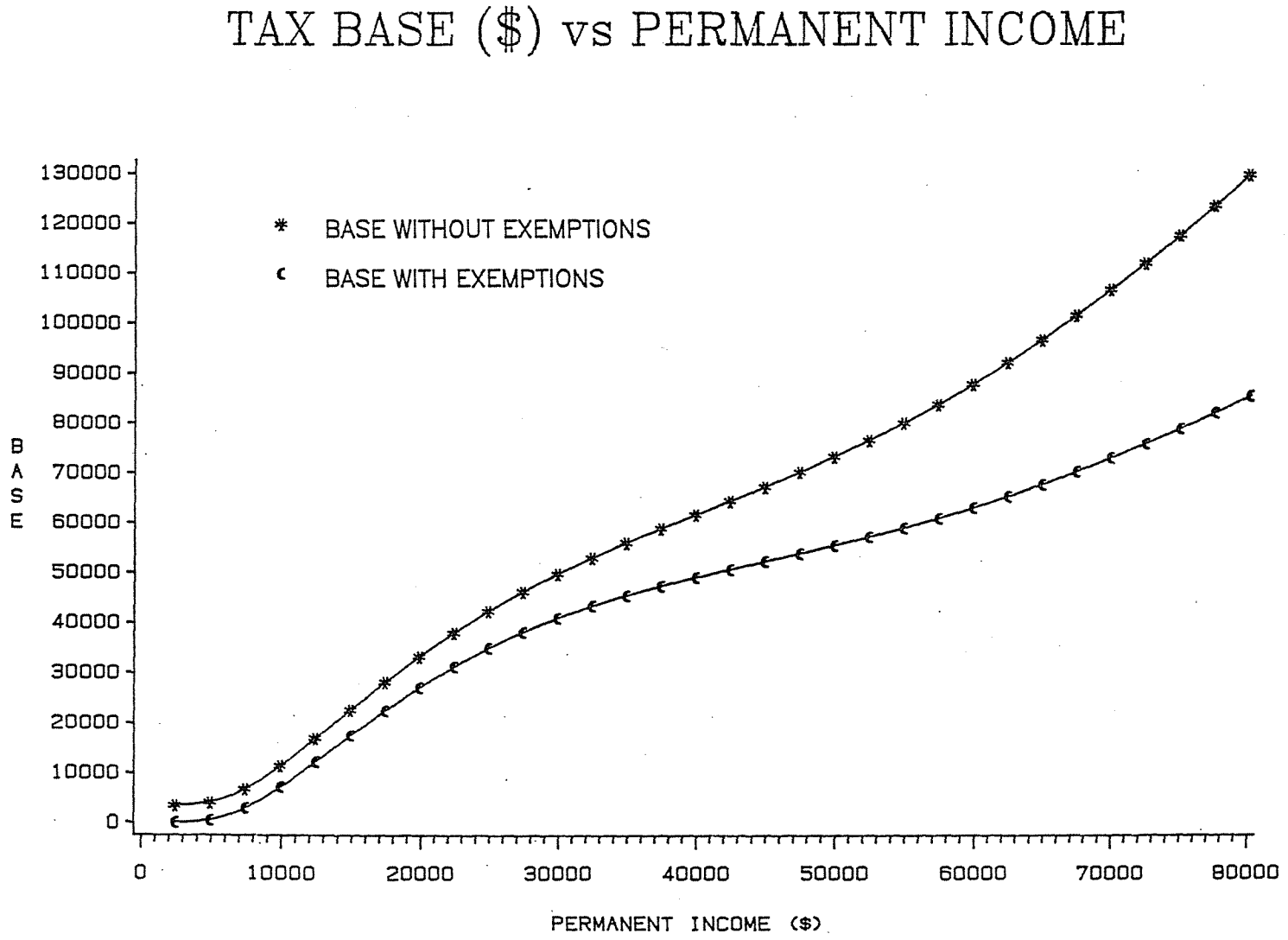

TAX BASE SHARE (%) vs PERMANENT INCOME
170.00
151.11
132.22
113.33
94.44
75.56
56.67
37.78
18.89
0.00
BASE SHARE
0
10000
20000
30000
40000
50000
60000
70000
80000
PERMANENT INCOME ($)
BASE WITHOUT EXEMPTIONS
BASE WITH EXEMPTIONS

Figure 8.


TAX BASE ($) vs PERMANENT INCOME
BASE WITHOUT EXEMPTIONS
BASE WITH EXEMPTIONS
BASE
130000
120000
110000
100000
90000
80000
70000
60000
50000
40000
30000
20000
10000
0
0
10000
20000
30000
40000
50000
60000
70000
80000
PERMANENT INCOME ($)

and Base2 as the total sales tax burden without exemptions and with exemptions, respectively.

The total tax dollar burden increases both with and without exemptions from the base of a sales tax. The major difference in total dollar burden between the two bases is seen in the higher brackets, where the exemption of Utilities greatly reduces the total burden on higher permanent income households. With or without exemptions the total tax dollar burden monotonically increases with permanent income.

Implications

The implications from this study are believed to be applicable to the State of Montana. First, given the assumptions of this study, a sales tax was found to be progressive for lower permanent income households when appropriate exemptions were made from the base of a sales tax, and slightly regressive for middle permanent income households.

Second, the results in Chapter 4 should be of use to policy makers in determining the impact of selected expenditure category exemptions on the incidence of a sales tax. It is important to note that although this study uses U.S. data, it is seems reasonable that the estimates (base share, marginal share, and expenditure share) would be representative of Montana Consumers as well as U.S. consumers generally.

Finally, the estimates reported in the conclusions portion of this chapter (Table 6, Figures 7 and 8) indicate where relief could be distributed (according to permanent income) to make a broadly-based sales tax progressive. An example would be to allow deductability of

sales tax for households in lower permanent income brackets when filing state income tax.

LITERATURE CITED

LITERATURE CITED

Adams, Roy D., and David John Walker. "The Lifetime Incidence of Consumption Sales Taxes." National Tax Journal. Volume 30, No.4, (December, 1977): 463-466.

Ando, Albert, and Franco Modigliani. "The " Life Cycle" Hypothesis of Savings: Aggregate Implications and Tests." American Economic Review. Volume 53, No.1, (March, 1963): 55-84.

Barro, Robert J. Macroeconomics. New York: John Wiley & Sons, 1984.

Bodkin, Ronald. "Windfall Income and Consumption." The American Economic Review. Volume 49, No.4, (September, 1959): 602-614.

Bradford, David F., "The Case for a Personal Consumption Tax." in What Should Be Taxed: Income or Expenditure?. ed. Joseph A. Pechman. 75-113. Washington, D.C.: The Brookings Institute, 1980.

Browning, Edgar K., and William R. Johnson. The Distribution of The Tax Burden. Washington, D.C.: American Enterprise Institute for Public Policy Research, 1979.

Davis, David G. "Progressiveness of a Sales Tax in Relation to Various Income Basis." The American Economic Review. Volume 50, No. 5, (December, 1960): 987-995.

Davies, James, France St-Hilaire, and John Whalley. "Some Calculations of Lifetime Tax Incidence." The American Economic Review. Volume 74, No. 4, (September, 1984): 633-649.

Friedman, Milton. A Theory of the Consumption Function. Princeton: Princeton University Press, 1957.

Hall, Robert E., and Frederick S. Mishkin. "The Sensitivity of Consumption to Transitory Income: Estimates from Panal Data on Households". Econometrica. Volume 50, No. 2, (March, 1982): 461-481.

Hellerstein, Walter. "Legal Perspectives on the Interstate Incidence and Shifting of State and Local Taxes." International Regional Science Review. Volume 10, No. 1, (April, 1986): 67-87.

"Idea of State Sales Tax has Nine Lives." Editorial. Bozeman Daily Chronicle. Section 3, Column 1, (April 24,1985): 4.

Johnston, J.. Econometric Methods. New York: McGraw-Hill, 1963.

Keynes, John Maynard. The General Theory of Employment, Interest, and Money. New York: Harcourt, Brace and Company, 1936.

Kmenta, Jan. Elements of Econometrics. New York: Macmillian Publishing Company, 1971.

Maddala, G. S. Limited-Dependent and Qualitative Variable in Econometrics. Cambridge: Cambridge University Press, 1983.

Maddala, G.S., and F. Nelson. "Switching Regression Models with Exogenous and Endogenous Switching." Proceedings of the American Statistical Association, Business and Economics Section. (1975):423-426.

McDonald, John F. and Robert A. Moffit. "The Uses of Tobit Analysis." The Review of Economics and Statistics. Volume 62, No.2, (May, 1980): 318-321.

McFadden, Daniel, Carlos Puig, Daniel Kirshner. "Determinants of the Long-Run Demand for Electricity." Proceedings of the American Statistical Association, Business and Economics Section. (1977): 109-119.

Menchik, Paul L., and Martin David. "The Incidence of a Lifetime Consumption Tax." National Tax Journal. Volume 35, No. 2, (June, 1982): 189-203.

Mississippi State Tax Commission, "Sales and Use Tax Survey By States", unpublished data, obtained through source, January 1, 1985.

Modigliani, Franco, and Richard Brumberg. "Utility Analysis and the Consumption function: An Interpretation of Cross-Section Data", in Post Kaynesian Economics, ed. Kenneth K. Kurihara, 388-436. New Brunswick: Rutgers University Press, 1954.

Musgrave, Richard A., and Peggy B. Musgrave. Public Finance In Theory and Practice. Part 3 and 4. New York: McGraw Hill, 1984.

Mutti, John H., and William E. Morgan. "The Exportation of State and Local Taxes in a Multilateral Framework: The Case of Household Type Taxes." National Tax Journal. Volume 35, No. 4, (December, 1983): 459-475.

Osberg, Lars. Economic Inequality in the United States. New York: M. E. Sharpe, Inc., 1984.

Pechman, Joseph A. Who Paid the Taxes, 1966-85. Washington, D.C.: The Brookings Institute, 1985.

Tobin, James. "Estimation of Relationships for Limited Dependent Variables." Econometrica. Volume 26, No. 1, (January, 1958): 24-36.

U.S. Department of Commerce. Bureau of Economic Analysis. Survey of Current Business. Volume 63, No. 3, Table 7.1. Washington, D.C.: Government Printing Office, March 1983.

U.S. Department of Commerce. Bureau of Economic Analysis. Survey of Current Business. Volume 63, No. 8, Table 7.1. Washington, D.C.: Government Printing Office, August 1983.

U.S. Department of Labor. "Interview Survey Public Use Tape." Magnetic Tapes C04972 and C04973. Washington, D.C.: Bureau of Labor Statistics, Office of Automatic Data Processing Support, 1982-1983.

U.S. Department of Labor.Bureau of Labor Statistics. "1982-1983 Interview Survey Public Use Tape Documentation." Washington D.C.: Government Printing Office, 1983.

White, B.. "Empirical Tests of the Life Cycle Hypothesis." American Economic Review. Volume 68, No. 4, (September, 1978): 547-560.

Zellner, A.. "An Efficient Method of Estimating Seemingly Unrelated Regressions and Tests for Aggregation Bias." Journal of Statistical Association. Volume 57, (June, 1962): 348-368.

APPENDICES

APPENDIX A

FAMILY CHARACTERISTICS IN DATA SET FINDAT

Table 7. Family Characteristics in Data Set FINDAT.

Variable	Description	Columns
NEWID	Consumer Unit Identification No.	1-7
	Interview No.	8
AGE_REF	Age of Referance Person	9-11
AS_COMP1	No. of males $\geq$ 16 Years of Age	12-13
AS_COMP2	No. of females $\geq$ 16 years of Age	14-15
AS_COMP3	No. of males 2 $\leq$ Years of Age $\leq$ 15	16-17
AS_COMP4	No. of females 2 $\leq$ Years of Age $\leq$ 15	18-19
CLLGEQTR	College Quarters	20
COMPLET1	Highest Grade Completed by Reference Person	21
CUTENURE	Housing Tenure	22
EARNCOMP	Composition of Earners	23
EDUC_REF	Education of Reference Person	24
FAM_SIZE	No. of Members in Consumer Unit(Household)	25-26
FAM_TYPE	Family Type	27
FINCATAX	Total Amount of After Tax Family Income	28-36
FINCBTAX	Total Amount of Before Tax Family Income	37-45
GOVTCOST	Government Paying Housing Costs	46
INCLASS	Income Class by Family Grouping	47
MARITAL1	Marital Status of Reference Person	48
NO_EARNX	Family Income Other than Earnings Before Taxes	49-57
PERSOT64	No. of persons over 64	58-59
QINTRVMO	Interview Month	60-61
QINTRVYR	Interview Year	62-63
REF_RACE	Race of Reference Person	64
RENTEQVX	Approximate Rental Value of Property on Todays Market	65-70
RESPSTAT	Completeness of Income Response	71
SEX_REF	Sex of Reference Person	72

APPENDIX B

FORTRAN PROGRAM 1

Figure 9. Fortran Program 1.

```
C     PROGRAM TO GENERATE DATA FROM FMLYQ832 FILE
C
      INTEGER IX(13)
      CHARACTER*1 IA(34)
      CHARACTER*2 IA28,IA29
C
      OPEN(105,RECL=1100,STATUS='OLD')
 10   READ(105,20,END=50) IX(1),
     *IX(2),IX(3),IA(1),IX(4),IA(2),IX(5),IA(3),IX(6),
     *IA(4),IX(7),(IA(J),J=5,15),IX(8),IA(16),IA(17),
     *IA(18),IX(9),IA(19),IX(10),(IA(K),K=20,25),IX(11),
     *IA(26),IX(12),IA(27),IA28,IA29,IA(28),IA(29),
     *IX(13),IA(30),IA(31),IA(32),IA(33),IA(34)
C
 20   FORMAT(I7,I1,2X,I3,A1,T32,I2,A1,I2,A1,I2,A1,I2,
     *A1,T102,A1,A1,T185,A1,A1,T249,A1,A1,T254,A1,A1,
     *T266,A1,A1,T297,I2,A1,A1,A1,T348,I9,A1,I9,A1,
     *T705,A1,A1,T757,A1,T851,A1,A1,T883,I9,A1,
     *T976,I2,A1,T1007,A2,A2,T1019,A1,A1,1X,I6,A1,
     *A1,A1,T1092,A1,A1)
C
      IF(IX(2) .NE. 2) GO TO 10
C
C
         DO 30, I=1,36
           IF(IA(I) .EQ. 'B' .OR. IA(I) .EQ. 'C') GO TO 10
 30   CONTINUE
C
C     DATA IS IN USABLE FORM TO BE PRINTED
C
      WRITE(108,40) IX(1),IX(2),IX(3),IX(4),IX(5),IX(6),
     *IX(7),IA(6),IA(8),IA(10),IA(12),IA(14),IX(8),IA(17),
     *IX(9),IX(10),IA(21),IA(23),IA(24),IX(11),IX(12),
     *IA28,IA29,IA(28),IX(13),IA(31),IA(33)
C
 40   FORMAT(I7,I1,I3,I2,I2,I2,I2,A1,A1,A1,A1,A1,I2,
     *A1,I9,I9,A1,A1,A1,I9,I2,A2,A2,A1,I6,A1,A1)
C
      GO TO 10
C
 50   END
```

APPENDIX C

THE 54 EXPENDITURE CATEGORIES IN DATA SET FINDAT

Table 8. The 54 Expenditure Categories in Data Set FINDAT.

Expenditure Category	Description	Universal Classification Code[1]
1	Food at Home	190901,190904,790220,790230,790430
2	Food away from Home	190902,190903,790410
3	Alcohol	200900,790310,790320,790420
4	Tobacco	630110,630210
5	Property Taxes	220211,220212
6	Repair Material and Labor	230112,230113,230114,230115, 230116,230141,230142,790610
7	Building Material	220512,220513,240111,240112,240113, 240121,240122,240123,240211,240212, 240213,240214,240221,240222,240223, 240311,240312,240313,240321,240322, 240323,320611,320612,320613,790690, 990910,990920,990930,990940,990950
8	Owned Dwelling Housing	220311,220312,220321,220322,220901, 220902,830101,830102,830201,830202
9	Other Lodging	210210
10	Rental Dwelling Housing	210110,210310,210901,210902
11	Household Textiles	280110,280120,280130,280210,280220, 280230,280900
12	Furniture	290110,290120,290210,290310,290320, 290410,290420,290430,290440,320901, 340904
13	Floor Covering	220511,220614,220615,230121,230122, 230123,230131,230132,320110,320161, 320162,320621,320622,320623
14	Small Appliances	320210,320220,320232,320310,320320, 320330,320340,320350,320360,320370, 320521
15	Large Appliances	220612,220613,230117,230118,230119, 300111,300112,300211,300212,300221, 300222,300311,300312,300321,300322, 300331,300332,300411,300412,320512, 690110,690210,690220,690230,690241, 690242,690243,690244,690245,790611, 990900
16	Household Miscellaneous	320120,320130,320150,320230,320231, 320410,320420,320511,320522,320631, 320632,320633,320902,320903,320904, 330511,340907,340908
17	Fuel Oil	250111,250112,250113,250114
18	Gas	250211,250212,250213,250214
19	Coal	250221,250222,250223,250224
20	Wood and Other Fuels	250901,250902,250903,250904

Table 8. (continued)

Expenditure Category	Description	Universal Classification Code[1]
21	Electricity	260111,260112,260113,260114
22	Natural Gas	260211,260212,260213,260214
23	Telephone	270000
24	Water and Other Public Services	270211,270212,270213,270214,270411, 270412,270413,270414,270901,270902, 270903,270904
25	TV, Radio and Sound Equipment	270310,310110,310120,310130,310210, 310220,310230,310311,310312,310313, 310320,310330,310341,310342,310343, 340902,340905,620912
26	Household Domestic Services	340210,340310,340906
27	Household Services	220611,230111,230901,230902,340410, 340420,340510,340520,340530,340610, 340620,340630,340901,340903,340911, 340912,440110,440120,440130,440150
28	Apparel and Footwear	360110 through 410904,440140
29	Other Apparel	420110,420120,430110,430120,430130, 440210,440900
30	Transportation Rental	520511,520512,520521,520522,520902, 520903,520904,520905,520906,520907
31	New Cars and Trucks	450110,450210
32	Other Transportation	450220,460902
33	Used Cars and Trucks	460110,460901
34	Trade-In Allowances for all Transportation	450116,450216,450226,460116,460907, 460908,600127,600128,600137,600138
35	Gasoline, Diesel Fuel and Motor Oil	470111,470112,470113,470211,470212
36	Vehicle Parts and Fluids	470220,480110,480211
37	Auto Services	490110,490211,490212,490220,490231, 490232,490311,490312,490313,490314, 490315,490317,490318,490411,490412, 490413
38	Finance Charges, Fees, and Interest for Transportation	510110,510901,510902,520110,520310, 520410,520530,520542,520550,520901, 710110,850300
39	Public Transportation	530110,530210,530311,530312,530411, 530412,530510,530901,530902
40	Prescription Drugs	540000
41	Medical Supplies	550110,550320,550330,570901
42	Medical Services	560110,560210,560310,560320,560330, 560900,570110,570210,570220,570230

Table 8. (continued)

Expenditure Category	Description	Universal Classification Code[1]
43	Insurance	002120,220111,220112,220121,220122, 350110,490900,500110,580110,580210, 580310,580901,580902,700110
44	Reading Material	590110,590210,590220,590230,660310
45	Entertainment Supplies and Equipment	600110,600121,600122,600131,600132, 600210,600310,600410,600420,600430, 600900,610110,610120,610130,610210, 610230,610320,610900,620902,620904, 620905,620906,620907,620908
46	Entertainment Fees and Admissions	620110,620121,620122,620211,620212, 620221,620222,620310
47	Entertainment Services	620330,620410,620420,620903
48	Personal Care	640130,640420
49	Education	660110,660210,660900,670110,670210, 670310,670901,670902
50	Miscellanous Services	650110,650210,650900,680110,680140, 680210,680220,680901,680902,790620, 790640
51	Contributions and Cash Gifts	800800
52	Assesments and Other Property Costs	790600,790630,790730,790830,790840, 790910,790920,810301,810302,820301, 820302,820401,820402,840101,840102
		Expenditure[2] Categories
53	Total Expenditures	1-52
54	Consumption of Non-Durable Goods and Services	1,2,3,4,9,10,11,17,18,19,20,21,22, 23,24,26,27,28,30,35,37,39,40,41, 42,43,44,46,47,50, and (Approximate Rental Value of Property. Added to Category 54 in Shazam.)

[1]-Word description of codes found in "1982-1983 Interview Survey Public Use Tape Documentation".

[2]-Categories 53 and 54 are the aggregation of the expenditure categories listed.

APPENDIX D

FORTRAN PROGRAM 2

Figure 10. Fortran Program 2.

```
C     PROGRAM TO SUM UP EXPENDITURE DATA INTO
C         EXPENDITURE CATAGORIES
C
      INTEGER EXPCOD,MEXPC(496)
C
      REAL VAL,SUMEXP(52),TOTEXP,CND
C
C     INITIALIZE ARRAYS
C
      DO 10, I=1,52
      SUMEXP(I)=0.0
 10   CONTINUE
      TOTEXP=0.0
      CND=0.0
C
C     READ & INDEX THE EXPENDITURE CODES
C
      DO 30, I=1,494
      READ(7,20) MEXPC(I)
 20   FORMAT(I6)
 30   CONTINUE
C
C
 40   READ(5,50,END=9999) CUID
 50   FORMAT(I7)
C
 60   READ(6,70,END=2000) FMLYID,EXPCOD,VAL
 70   FORMAT(I7,X,I6,F12.4)
C
C     COMPARE CU IDENTIFICATION NUMBERS FROM
C     BOTH FILES TO SEE IF THEY MATCH
C
      IF(FMLYID .LT. CUID) GO TO 60
C
      IF(FMLYID .GT. CUID) GO TO 2000
C
C     LOOP TO DETERMINE THE INDEX OF THE EXPENDITURE
C     CODE IN THE EXPENDITURE DATA FILE
C
      DO 80, J=1,494
      IF(EXPCOD .EQ. MEXPC(J)) GO TO 90
 80   CONTINUE
C
C     IF THERE IS NO MATCH
      GO TO 60
C
```

```
C     WE NOW HAVE AN INDEX NUMBER.  THE VALUE OF THE
C     EXPENDITURE IS PLACED INTO ITS PROPER CATAGORY
C     AND ALL OF THE CATAGORIES ARE SUMMED UP FOR
C     EACH CONSUMER UNIT
C
 90   GO TO (1043,1001,1002,1002,1001,1003,
     *1010,1009,1010,1010,1010,1043,1043,1043,1043,1005,
     *1005,1008,1008,1008,1008,1013,1007,1007,1027,
     *1015,1015,1013,1013,1008,1008,1027,1006,1006,
     *1006,1006,1006,1015,1015,1015,1013,1013,1013,
     *1013,1013,1006,1006,1027,1027,1007,1007,1007,
     *1007,1007,1007,1007,1007,1007,1007,1007,1007,
     *1007,1007,1007,1007,1007,1007,1007,1017,1017,
     *1017,1017,1018,1018,1018,1018,1019,1019,1019,
     *1019,1020,1020,1020,1020,1021,1021,1021,1021,
     *1022,1022,1022,1022,1023,1024,1024,1024,1024,
     *1025,1024,1024,1024,1024,1024,1024,1024,1024,
     *1011,1011,1011,1011,1011,1011,1011,1012,1012,
     *1012,1012,1012,1012,1012,1012,1012,1015,1015,
     *1015,1015,1015,1015,1015,1015,1015,1015,1015,
     *1015,1015,1015,1025,1025,1025,1025,1025,1025,
     *1025,1025,1025,1025,1025,1025,1025,1025,1013,
     *1016,1016,1016,1013,1013,1014,1014,1016,1016,
     *1014,1014,1014,1014,1014,1014,1014,1014,1016,
     *1016,1016,1015,1014,1016,1007,1007,1007,1013,
     *1013,1013,1016,1016,1016,1012,1016,1016,1016,
     *1016,1026,1026,1027,1027,1027,1027,1027,1027,
     *1027,1027,1027,1025,1027,1012,1025,1026,1016,
     *1016,1027,1027,1043,1028,1028,1028,1028,1028,
     *1028,1028,1028,1028,1028,1028,1028,1028,1028,
     *1028,1028,1028,1028,1028,1028,1028,1028,1028,
     *1028,1028,1028,1028,1028,1028,1028,1028,1028,
     *1028,1028,1028,1028,1028,1028,1028,1028,1028,
     *1028,1028,1028,1028,1028,1028,1028,1028,1028,
     *1028,1028,1028,1028,1028,1028,1028,1028,1028,
     *1028,1029,1029,1029,1029,1029,1027,1027,1027,
     *1028,1027,1029,1029,1031,1034,1031,1034,1032,
     *1034,1033,1034,1033,1032,1034,1034,1035,1035,
     *1035,1035,1035,1036,1036,1036,1037,1037,1037,
     *1037,1037,1037,1037,1037,1037,1037,1037,1037,
     *1037,1037,1037,1037,1043,1043,1038,1038,1038,
     *1038,1038,1038,1030,1030,1030,1030,1038,1038,
     *1038,1038,1030,1030,1030,1030,1030,1030,1039,
     *1039,1039,1039,1039,1039,1039,1039,1040,
     *1041,1041,1041,1042,1042,1042,1042,1042,1042,
     *1042,1042,1042,1042,1041,1043,1043,1043,1043,
     *1043,1044,1044,1044,1044,1045,1045,1045,1034,
     *1034,1045,1045,1034,1034,1045,1045,1045,
     *1045,1045,1045,1045,1045,1045,1045,1045,1045,
     *1045,1046,1046,1046,1046,1046,1046,1046,1046,
```

```
     *1047,1047,1047,1045,1047,1045,1045,1045,1045,
     *1045,1025,1004,1004,1048,1048,1050,1050,1050,
     *1049,1049,1044,1049,1049,1049,1049,1049,1049,
     *1050,1050,1050,1050,1050,1050,1015,1015,1015,
     *1015,1015,1015,1015,1015,1015,1043,1038,1001,
     *1001,1003,1003,1002,1003,1001,1052,1006,1015,
     *1050,1052,1050,1007,1052,1052,1052,1052,1052,
     *1051,1052,1052,1052,1052,1052,1052,1008,1008,
     *1008,1008,1052,1052,1038,1015,1007,1007,1007,
     *1007,1007), J
C
C
 1001 SUMEXP(1) = SUMEXP(1) + VAL
      GO TO 60
C
 1002 SUMEXP(2) = SUMEXP(2) + VAL
      GO TO 60
C
 1003 SUMEXP(3) = SUMEXP(3) + VAL
      GO TO 60
C
 1004 SUMEXP(4) = SUMEXP(4) + VAL
      GO TO 60
C
 1005 SUMEXP(5) = SUMEXP(5) + VAL
      GO TO 60
C
 1006 SUMEXP(6) = SUMEXP(6) + VAL
      GO TO 60
C
 1007 SUMEXP(7) = SUMEXP(7) + VAL
      GO TO 60
C
 1008 SUMEXP(8) = SUMEXP(8) + ABS(VAL)
      GO TO 60
C
 1009 SUMEXP(9) = SUMEXP(9) + VAL
      GO TO 60
C
 1010 SUMEXP(10) = SUMEXP(10) + VAL
      GO TO 60
C
 1011 SUMEXP(11) = SUMEXP(11) + VAL
      GO TO 60
C
 1012 SUMEXP(12) = SUMEXP(12) + VAL
      GO TO 60
C
 1013 SUMEXP(13) = SUMEXP(13) + VAL
      GO TO 60
C
 1014 SUMEXP(14) = SUMEXP(14) + VAL
```

```
      GO TO 60
C
 1015 SUMEXP(15) = SUMEXP(15) + VAL
      GO TO 60
C
 1016 SUMEXP(16) = SUMEXP(16) + VAL
      GO TO 60
C
 1017 SUMEXP(17) = SUMEXP(17) + VAL
      GO TO 60
C
 1018 SUMEXP(18) = SUMEXP(18) + VAL
      GO TO 60
C
 1019 SUMEXP(19) = SUMEXP(19) + VAL
      GO TO 60
C
 1020 SUMEXP(20) = SUMEXP(20) + VAL
      GO TO 60
C
 1021 SUMEXP(21) = SUMEXP(21) + VAL
      GO TO 60
C
 1022 SUMEXP(22) = SUMEXP(22) + VAL
      GO TO 60
C
 1023 SUMEXP(23) = SUMEXP(23) + VAL
      GO TO 60
C
 1024 SUMEXP(24) = SUMEXP(24) + VAL
      GO TO 60
C
 1025 SUMEXP(25) = SUMEXP(25) + VAL
      GO TO 60
C
 1026 SUMEXP(26) = SUMEXP(26) + VAL
      GO TO 60
C
 1027 SUMEXP(27) = SUMEXP(27) + VAL
      GO TO 60
C
 1028 SUMEXP(28) = SUMEXP(28) + VAL
      GO TO 60
C
 1029 SUMEXP(29) = SUMEXP(29) + VAL
      GO TO 60
C
 1030 SUMEXP(30) = SUMEXP(30) + VAL
      GO TO 60
C
 1031 SUMEXP(31) = SUMEXP(31) + VAL
      GO TO 60
```

```
C
 1032 SUMEXP(32) = SUMEXP(32) + VAL
      GO TO 60
C
 1033 SUMEXP(33) = SUMEXP(33) + VAL
      GO TO 60
C
 1034 SUMEXP(34) = SUMEXP(34) + VAL
      GO TO 60
C
 1035 SUMEXP(35) = SUMEXP(35) + VAL
      GO TO 60
C
 1036 SUMEXP(36) = SUMEXP(36) + VAL
      GO TO 60
C
 1037 SUMEXP(37) = SUMEXP(37) + VAL
      GO TO 60
C
 1038 SUMEXP(38) = SUMEXP(38) + VAL
      GO TO 60
C
 1039 SUMEXP(39) = SUMEXP(39) + VAL
      GO TO 60
C
 1040 SUMEXP(40) = SUMEXP(40) + VAL
      GO TO 60
C
 1041 SUMEXP(41) = SUMEXP(41) + VAL
      GO TO 60
C
 1042 SUMEXP(42) = SUMEXP(42) + VAL
      GO TO 60
C
 1043 SUMEXP(43) = SUMEXP(43) + VAL
      GO TO 60
C
 1044 SUMEXP(44) = SUMEXP(44) + VAL
      GO TO 60
C
 1045 SUMEXP(45) = SUMEXP(45) + VAL
      GO TO 60
C
 1046 SUMEXP(46) = SUMEXP(46) + VAL
      GO TO 60
C
 1047 SUMEXP(47) = SUMEXP(47) + VAL
      GO TO 60
C
 1048 SUMEXP(48) = SUMEXP(48) + VAL
      GO TO 60
C
```

```
 1049 SUMEXP(49) = SUMEXP(49) + VAL
      GO TO 60
C
 1050 SUMEXP(50) = SUMEXP(50) + VAL
      GO TO 60
C
 1051 SUMEXP(51) = SUMEXP(51) + VAL
      GO TO 60
C
 1052 SUMEXP(52) = SUMEXP(52) + ABS(VAL)
      GO TO 60
C
C     SUM UP TOTAL EXPENDITURES
C
 2000 DO 3000, K=1,52
      TOTEXP = TOTEXP + SUMEXP(K)
 3000 CONTINUE
C
      CND=SUMEXP(1)+SUMEXP(2)+SUMEXP(3)+SUMEXP(4)+
     *SUMEXP(9)+SUMEXP(10)+SUMEXP(11)+SUMEXP(17)+
     *SUMEXP(18)+SUMEXP(19)+SUMEXP(20)+SUMEXP(21)+
     *SUMEXP(22)+SUMEXP(23)+SUMEXP(24)+SUMEXP(26)+
     *SUMEXP(27)+SUMEXP(28)+SUMEXP(30)+SUMEXP(35)+
     *SUMEXP(37)+SUMEXP(39)+
     *SUMEXP(43)+SUMEXP(44)+SUMEXP(46)+
     *SUMEXP(47)+SUMEXP(50)
C
C     WRITE OUT EXPENDITURES BY CATAGORY
C
      WRITE(108,4000)CUID,(SUMEXP(L),L=1,52),TOTEXP,CND
 4000 FORMAT(1X,I7,4(12F10.0,/),6F10.0)
C
C     RE-INITIALIZE THE ARRAYS
C
      DO 5000, I=1,52
      SUMEXP(I) = 0.0
 5000 CONTINUE
      TOTEXP = 0.0
      CND = 0.0
C
C     SET POINTER BACK ONE SPACE
C     IN EXPENDITURE FILE
C
      BACKSPACE 6
C
      GO TO 40
 9999 END
```

APPENDIX E

FORTRAN PROGRAM 3

Figure 11. Fortran Program 3.

```
C     PROGRAM TO SUM UP QUARTERLY EXPENDITURE
C     DATA AND MERGE QUARTERLY EXPENDITURE
C     DATA WITH FAMILY CHARACTERISTICS
C
C
      INTEGER IX(13)
      CHARACTER*1 IA(14)
      CHARACTER*2 IA10,IA11
      DIMENSION Q1(54),Q2(54),Q3(54),Q4(54),SQ(54)
C
C     INITIALIZE ARRAYS
C
      DO 10, I=1,54
        SQ(I) = 0.0
        Q1(I) = 0.0
        Q2(I) = 0.0
        Q3(I) = 0.0
        Q4(I) = 0.0
 10   CONTINUE
C
C     READ IN THE DATA FROM THE FAMILY CHARACTERISTICS
C     FILE(FMLD___) AND FROM THE EXPENDITURE FILES(EXPD___)
C
 20   READ(5,30,END=99) IX(1),IX(2),IX(3),IX(4),IX(5),IX(6),
     *IX(7),IA(1),IA(2),IA(3),IA(4),IA(5),IX(8),IA(6),
     *IX(9),IX(10),IA(7),IA(8),IA(9),IX(11),IX(12),
     *IA10,IA11,IA(12),IX(13),IA(13),IA(14)
C
 30   FORMAT(I7,I1,I3,I2,I2,I2,I2,A1,A1,A1,A1,A1,I2,
     *A1,I9,I9,A1,A1,A1,I9,I2,A2,A2,A1,I6,A1,A1)
C
      READ(6,40) CUID,(Q1(J),J=1,54)
      READ(7,40) CUID,(Q2(K),K=1,54)
      READ(8,40) CUID,(Q3(L),L=1,54)
      READ(9,40) CUID,(Q4(M),M=1,54)
C
 40   FORMAT(1X,I7,4(12F10.0,/),6F10.0)
C
C     CHECK FOR CU'S THAT DID NOT RECORD THEIR
C     EXPENDITURES FOR ANY OF THE FOUR QUARTERS
C
      IF(Q1(54) .LT. 1.0 .OR. Q2(54) .LT. 1.0 .OR.
     *Q3(54) .LT. 1.0 .OR. Q4(54) .LT. 1.0)
     *GO TO 20
C
C
C     SUM UP QUARTERLY EXPENDITURES
C
      DO 50, I=1,54
        SQ(I) = Q1(I) + Q2(I) + Q3(I) + Q4(I)
```

```
 50   CONTINUE
C
C     SET ANY NEGATIVE MEDICAL EXPENSES EQUAL TO ZERO
C
      IF(SQ(40) .LT. 0.0) SQ(40) = 0.0
      IF(SQ(41) .LT. 0.0) SQ(41) = 0.0
      IF(SQ(42) .LT. 0.0) SQ(42) = 0.0
C
C     ADD YEARLY EXPENDITURES FROM MEDICAL
C     SUPPLIES,SERVICES,AND DRUGS TO CND
C
      SQ(54) = SQ(54) + SQ(40) + SQ(41) + SQ(42)
C
C     PRINT OUT THE CU'S EXPENDITURES FOR THE YEAR
C
      WRITE(10,60) IX(1),IX(2),IX(3),IX(4),IX(5),IX(6),
     *IX(7),IA(1),IA(2),IA(3),IA(4),IA(5),IX(8),IA(6),
     *IX(9),IX(10),IA(7),IA(8),IA(9),IX(11),IX(12),
     *IA10,IA11,IA(12),IX(13),IA(13),IA(14),
     *(SQ(I), I=1,54)
 60   FORMAT(I7,I1,I3,I2,I2,I2,I2,A1,A1,A1,A1,A1,I2,
     *A1,I9,I9,A1,A1,A1,I9,I2,A2,A2,A1,I6,A1,A1,/,
     *4(12F10.0,/),6F10.0)
C
C     REINITIALIZE CND(SQ(54))
C
      SQ(54) = 0.0
C
      GO TO 20
C
 99   END
```