Revenue Growth and a State's Tax Structure: the Case of Louisiana.

Lloyd Wayne Shell

Louisiana State University and Agricultural & Mechanical College

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1977
REVENUE GROWTH AND A STATE'S TAX STRUCTURE:
THE CASE OF LOUISIANA

A Dissertation

Submitted to the Graduate Faculty of the Louisiana State University and Agricultural and Mechanical College in partial fulfillment of the requirements for the degree of Doctor of Philosophy in The Department of Economics

by
Lloyd Wayne Shell
B. A., Rice University, 1966
M. A., Louisiana State University, 1969
May, 1977
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ABSTRACT

The primary aim of this dissertation was to develop and test hypotheses relating to the constancy of the income elasticities of individual taxes levied by the State of Louisiana and of its aggregate tax structure. These hypotheses were then incorporated into ordinary least squares regressions to provide long-run forecasts of tax revenues.

The earliest researchers on the subject of forecasting state tax receipts by use of the elasticities approach either made no mention of the possibility of changing income elasticities or assumed them constant. Dockel, and Legler and Papke, reached conclusions inconsistent with their assumptions of constant elasticities. Singer utilized dummy variables to allow for shifting in income elasticities due to changes in tax rates, bases, or administration. Wilford explicitly labelled his elasticity coefficients as averages for the time series studied. Richardson was the first to make explicit a cause of the phenomenon of increasing income elasticity of a tax structure, which was that the relatively more elastic taxes grew faster over time than the less elastic taxes, and hence acquired greater weights in the determination of average income elasticity of the tax structure.
This dissertation formally models three causes of changing income elasticities. First, income elasticities of individual taxes might rise or fall with time or income. These were modelled by loglinear functions, with tax revenue dependent on personal income. Second, income elasticities might rise or fall as various tax rate or base changes occur, or as administrative changes influence tax revenues. These were modelled by a dummy variable technique similar to Singer's. Third, the income elasticity of a tax structure would rise as income rose, toward a limit of the most elastic component of that tax structure.

These concepts were applied to the Louisiana tax structure, which was partially disaggregated into six tax groups, five sensitive to income movements, and the sixth, the severance taxes, largely independent of the level of income. The time period 1948 to 1974 was selected to test the hypotheses described above. This was a period of relative stability in the tax structure, although many rate, base, and enforcement changes occurred.

The primary results were first, that the income elasticity of the income tax and the sumptuary taxes declined over time, while the income elasticities of the other three groups increased. Second, the income elasticity of the tax structure was shown to increase over time, approaching unity in ten to fifteen years.
Chapter 1

INTRODUCTION

The level of expenditures by Louisiana state government, over the very long run, is presumably determined by a public choice mechanism. If this public choice mechanism works well, expenditures will tend toward that level which provides exactly those goods and services which Louisiana citizens demand of their state government. This collective decision is a part of the overall process by which owners of purchasing power allocate their expenditures among all possible goods and services, public as well as private. However, over shorter time spans, due to budget constraints and other constitutional limitations, expenditures are normally constrained to an amount approximately equal to anticipated receipts from state sources.

This view is in contrast to that of Milton Friedman, who wrote that

\[\ldots\text{ in the long run the level of taxes comes closer to determining the level of spending than the other way around} \ldots\] [0]nce the new level of taxes is in place, it tends to become permanent or nearly so, and thereafter spending is determined in large part by how much the revenue structure will raise.\[1\]

\[\text{---}\]

Professor Friedman's statement was written about federal revenues and expenditures, but it is more applicable to state government, since the state of Louisiana, like most states, has more limited ability for deficit spending than does the federal government. The state's new constitution sets important limits on the ability of state government to borrow funds, especially for non-capital purposes, and to incur deficits.2

The level of tax revenue is vital, whether viewed from short run or long. This dissertation attempts to measure the ability of the present structure of state taxes to provide revenues for future fiscal operations. By placing attention only on the level of revenues, this dissertation assumes that expenditures by state government will at least maintain the scope and quality of current programs.

In merely maintaining the present scope of state government programs it is likely that more dollars will be required in future years than now. Many programs have expenditures in part determined by the number of people who benefit; as the state's population continues to grow, and more persons benefit, expenditures on these programs must also grow. Some programs require purchases of materials; if these goods rise in price over time, then

2Constitution of the State of Louisiana, especially Article VII. Part I. Section 6(A), Section 7(C), and Section 10(B).
larger expenditures will be required to purchase the same real quantity as before. As wage rates rise throughout the economy, so must wages paid by state government if it is to attract the same quality work force as now exists. Thus in the context of an economy which displays growing population and upward trends in wage and price levels, nominal state government expenditures must increase if the current scope and quality of programs is to be maintained. Further, a rising standard of living may lead to demands for new public services. Thus state government expenditures can be expected to rise markedly in the years of the decade ahead. If these expenditures are to be financed by tax revenues, these revenues must rise accordingly.

It is appropriate here to define certain terms used in this dissertation. The base of a tax is the definition, by statute or by constitutional provision, of what is taxed. The schedule of tax rates is an algorithm for determining the tax liability incurred by a taxpayer with a given tax base. The aggregation of tax liabilities over all taxpaying units thus measures the entire amount due the state from the tax. The quality of enforcement of the tax laws may affect the fraction of that liability actually remitted to the state. Certain administrative details relating to due dates, source withholding, and cost-of-collection rebates complete the list of items which determine the timing and quantity of tax receipts. The above-mentioned items, aggregated over all taxes levied
by the state, comprise the tax structure.

Individual taxes and the aggregate tax structure possess certain measures of responsiveness called elasticities. The simplest definition of an elasticity is the ratio of the percentage change in tax revenues to the percentage change in the variable, the responsiveness to which is being studied. This general form can be presented as

$$\epsilon_V = \frac{\partial TR}{\partial V} \cdot \frac{V}{TR},$$

where $\epsilon_V$ is the calculated elasticity of tax revenue $TR$ with respect to the variable $V$. Income elasticity is measured by replacing $V$ with some measure of income. Similarly, the commonly used rate and base elasticities are created by the appropriate substitutions.

The ability of the tax structure to generate revenues can be discussed using income elasticity as the focal point. The income elasticity of a tax (or of an aggregate of taxes) is but one criterion of the "adequacy" of a tax, but it is the measure that has received the most attention in academic debates on tax structures. The elasticity of tax revenue with respect to aggregate personal income, $\epsilon_y$, is a measure which indicates whether the rate of growth of revenue from a tax can be expected to exceed, equal, or fall short of the rate of growth in personal income. As $\epsilon_y > 1$, tax revenues should grow faster than personal income; as $\epsilon_y < 1$, the personal income growth rate should exceed the tax revenue growth rate.
A similar set of statements can be made about the elasticities of tax revenues with respect to other exogenous variables.

State-federal revenue sharing is still an experimental program, and should not be treated as a permanent part of the state financial resources. Deficit financing cannot be regarded as a significant source of funds over the long run. The severance taxes are levied on resources that are declining in quantity. Even if these taxes are based on rapidly rising product prices, they cannot be expected to continue as the dominant revenue producer of the state.

The reasons above indicate that primary interest must fall on the revenues of the remainder of the state's tax structure. Of primary interest are forecasts for fiscal years 1977, 1980, and 1985. These forecasts will provide both intermediate- and long-term projections of the yields of selected state taxes, and of the aggregate of revenues responsive to income levels, at the current structure of bases and rates. Constitutionally imposed obstacles to altering the state's tax structure provide adequate reason for projecting revenues from the current structure. Such projections can be used as planning aids for the appropriate state legislators and officials.

The primary contributions of this dissertation are as follows. Previous efforts in the areas of tax revenue forecasting, tax revenue responsiveness to economic change,
and Louisiana tax structure are studied for their possible contributions. The tax structure of the state of Louisiana is examined in detail in order to determine how (or whether) the responsiveness of tax revenues generated by the tax structure varies over time. Intermediate range forecasts are made of tax revenues, particularly those varying with income. These forecasts provide additional insight to the state's agencies and planning authorities, and provide empirical evidence concerning the hypotheses related to variations in income elasticities.

METHODOLOGY

For the general purpose of tax revenue forecasting, two techniques are commonly used. One technique uses appropriate econometric devices to forecast values of the tax bases, then applies existing tax rates to those values to obtain the forecasts of tax revenues. This approach is referred to as the rate-base method. The other method, the elasticities approach, assumes that changes in general economic conditions are responsible for changes in tax revenues, at fixed tax rates, base definitions, and administrative efficiency. Regressing tax revenues against certain macroeconomic variables yields estimates of the responsiveness (elasticity) of tax revenues to economic changes. The former method is better suited to short-term forecasting; the latter, to long-term forecasting.
Both methods can take advantage of the variety of econometric methods now available. The dependencies of one tax upon another can be accommodated by proper specification of the model: by utilizing simultaneous-equation estimation methods, or by utilizing data aggregated in such a way that the dependencies are concealed in the aggregation. If, for example, auto license revenues are correlated with gasoline tax collections, then an estimate of their sum avoids a separate statement of the dependency.

This study began as an attempt to apply simultaneous-equation techniques to forecast the tax revenues and expenditures of Louisiana's state government; however, the course of further research indicated that the interdependency of relationships was not a significant characteristic of the tax revenue models. The revenue of tax "A" was not a significant explanation of the revenue of tax "B"; nor did any major non-severance tax rates or revenues exert significant causation on the variables designated as independent, which included personal income, per capita personal income, and population. Thus multiple regression analysis utilizing the method of ordinary least squares proved sufficient to display adequately the important economic relationships that determine the levels of tax revenues.

This dissertation will utilize the elasticities approach for two reasons. First, the aim of this
research is two-fold; to obtain reliable estimates of future tax revenues and to measure the responsiveness of the tax revenues to income change. The latter aim can best be accommodated by the elasticities approach. Forecasts of total income-related tax revenues are desirable, and it is felt that the estimate of the aggregate of revenues by the elasticities approach will be preferred to the aggregate arrived at by summing the forecasts of the individual taxes by the rate-base method. Since this dissertation attempts to provide clues for long-run state planning, long-run estimates of tax revenues are required. Long-term revenue movements are best fit by a logarithmic function. The coefficients of such a log-linear regression can be interpreted as elasticities.

The other major consideration leading to adoption of the elasticities approach over the rate-base procedure is the very complexity of the state's tax structure. The state levies many taxes, most of which are subject to large numbers of exemptions and other forms of special treatment. Furthermore, the rate schedules for some taxes, notably the severance, alcoholic beverage, excise license, and tobacco taxes, are quite complex. These problems

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For example, see the Department of Revenue Tax Guide, 1975 edition for lists of exemptions from sales tax and income tax.

See Ibid., for examples. The actual rates may have been altered since this book was published, but the degree of complexity is practically unchanged.
combine to make the use of the rate-base estimating method a difficult task. This is not to deny the importance of tax rates; certainly statutory or constitutional tax rate and tax base changes affect tax revenues. These phenomena must be included in the models if the elasticities method is to provide valid results.

PLAN OF THE PAPER

The problem set out in earlier paragraphs is treated in the following steps. First, the relevant literature concerning the responsiveness of tax revenues to economic growth is briefly reviewed. This survey serves to place the present study in proper perspective. Three areas within the literature are examined in Chapter 2. Responsiveness of revenues derived from fixed tax structures in general, from theoretical and empirical standpoints, is the first of these, and is followed by a survey of works on the responsiveness of other state tax systems and on long-term tax revenue forecasting in other states. Finally, attention is given to articles oriented toward the Louisiana tax structure and toward revenue estimation and responsiveness for the State of Louisiana.

Chapter 3 briefly describes the current tax structure of the State of Louisiana in order to provide the appropriate background. This discussion includes a review of significant events in the evolution of the state's tax structure, particularly those rate, base, and
administrative changes that have occurred during the time span of this project, 1948 to 1974. Chapter 3 also contains the master data record for the dissertation; this record is an account of revenues of currently levied taxes, and is organized both by individual taxes and by the relevant tax groups. A discussion of data sources and data-gathering difficulties is included. The second major section of the chapter is devoted to the definition of the forecasting base: which taxes (licenses, fees, etc.) should be included in the aggregate to be forecast.

Chapter 4 contains the theoretical aspects of this dissertation. For certain special cases, the desirability of incorporating time-dependent income elasticities into the structure of the model is demonstrated. This approach allows for movement of income elasticities of individual taxes, and allows for significant changes in the income elasticity of a tax structure over time.

The fifth chapter contains an analysis of the empirical results of this research. The models introduced in Chapter 4 are tested for their ability to provide adequate explanation of the revenue generating processes. Where models prove to be inadequate, attempts are made to improve them through variations in the real and dummy variables which appear, and in the forms taken by the income elasticities. Following this analysis of the different models is a section discussing those equations
to be used as the elements of the forecasting models. Each tax and tax group is represented by at least one equation.

Those equations are used in Chapter 6 to produce the tax revenue forecasts. The first major section provides the extrapolation of values of income, price level, and population statistics, which are the exogenous variables. Several extrapolated series are produced, reflecting differing assumptions concerning the future course of United States and Louisiana economic growth. The tax revenue forecasts are made from the independent variable extrapolations and regression results; forecasts are presented for the current tax structure and for some tax structure variations. These forecasts are used to test the hypotheses of Chapter 4 concerning the Upward-Bound Elasticity Theorem. The final section reviews the progress of the research and recapitulates the major findings of the dissertation.
This chapter serves to provide appropriate recognition of the works of previous researchers relevant to the present study. Articles concerned with theoretical issues relating to income elasticities, or to state and regional revenue growth problems, and works on revenue projections and revenue responsiveness in other states, are discussed in chronological fashion. A section discussing prior contributions concerned with the Louisiana tax structure concludes the chapter.

THE ELASTICITIES APPROACH AND STATE TAX REVENUE GROWTH: GENERAL

William Vickrey, in an important 1949 article, proposed several theorems about the responsiveness of income tax yields to movements in National Income.¹ His aim was to prove that income taxes were not elastic enough to be as counter-cyclical as Musgrave and Miller

had earlier proposed. The first of Vickrey's theorems stated that the income elasticity of a group of taxes could not exceed the elasticity of its most elastic component; and that the elasticity of the tax system was the weighted average of the elasticities of the component taxes. The second theorem stated that

The income elasticity of the yield of any tax is unaffected by a proportionate change in all the rates, if avoidance and incentive effects be neglected.

The third theorem was

There exists a simple income tax, consisting of a flat rate of tax on all income above a given exemption, that has an elasticity at least equal to that of any income tax.

These results held if the components were independent and additive. Independence implied that the yield of one tax was not dependent on the yield of some other tax. The additive characteristic required that the total tax yield was the sum of the yields of the individual taxes. It was not clear why the first theorem required these assumptions. Vickrey stated that, for a "simple" income tax (i.e., a tax with only a single rate and exemption), the income elasticity depended only upon the size of the exemption, and that "the elasticity of a simple tax is equal to the ratio of the total income of the persons taxed to the income


3Vickrey, op. cit., p. 140.
above the exemptions to which the tax rate is applied." This definition of income elasticity of the income tax was dependent on assumptions about income distribution. Vickrey had assumed that as national income varied, the Lorenz curve of income distribution was constant.

Many of Vickrey's conclusions depended on the pattern and time path of income distribution; his primary conclusion was that it was improbable that a tax of major revenue producer status could be designed with elasticity that exceeded 2.0. Vickrey did not mention possible changes in income elasticities except through changes in bases and exemptions.

One article of importance appeared in the *American Economic Review* in 1952. Groves and Kahn conducted an investigation into the income elasticity of various taxes, attempting to measure the effects of income growth on tax revenue changes. The principal aim of this article was to determine whether the taxes were "adequate;" that is, whether they could, over time, generate revenues to maintain the volume and quality of governmental services.

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To this end, they felt it desirable to have taxes whose "yields... vary in the same direction as total income, but... less than in proportion to the variation in total income."\(^7\)

Emphasis was placed on a "built-in stability" different from the current usage of the term; to Groves and Kahn it meant to protect state governments from revenue losses due to recession or deflation.

Hence, if it is desired to maintain intact at all times the level of government services and to finance them from taxes primarily, the total of state and local tax revenues has to be of less than unit income elasticity.\(^8\)

Groves and Kahn clearly did not gear their analysis to an era of pressing demand for new state government services, for increasing volume and faster increasing costs of existing services. The same tax designed to prevent the rapid fall of revenues during the recession will most likely prevent the rapid rise of revenues during boom, as the percentage increase in tax revenue must by definition fall short of the percentage increase in income.

In his doctoral dissertation, and in articles derived from it, Robert W. Rafuse, Jr., estimated income elasticities of state and local taxes in order to determine whether state and local governments acted counter-
cyclically. He found that state and local government receipts were stabilizing during expansions and destabilizing in contractions, and that expenditures were stabilizing during contractions, destabilizing during expansions. He attempted to measure the responsiveness of various state and local taxes to movements in GNP. His estimate of the income elasticity of general sales tax collections was $E_T = 1.27$, and he noted that this measure was larger than that found by other investigators. This estimate was derived by regressing percentage changes in general sales tax collections against percentage changes in GNP, for the period 1949-1960, in constant dollars. The regression coefficient could be interpreted as the income elasticity.

In a 1964 article in the *National Tax Journal*, D. G. Davies discussed the estimation of the elasticity of motor fuel taxes with respect to income. (The exact measure of income used was not disclosed in the article).

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10 Ibid., p. 117.

11 Ibid., pp. 95-97, especially note 32.

Davies referred to this measure as "secular" income elasticity, and estimated this value by utilizing a log-linear regression of tax yield against income, so that the regression slope was the elasticity in question.\textsuperscript{13} This process assumed constant income elasticity and Davies recognized this fact. Some states were omitted from his study because Davies was unable to obtain satisfactory results with constant elasticities.\textsuperscript{14} In discussing the "three groups" into which elasticities may be classified, he wrote of an increasing average effective rate of taxation.\textsuperscript{15} By a common definition of income elasticity, $\varepsilon = \text{marginal tax rate} \div \text{average tax rate}$. If the average tax rate rose, all else unchanged, then the income elasticity must have decreased. Thus Davies implied changing elasticities.

W. T. Wilford turned to an elasticities approach in order to provide new light on the "adequacy" of a tax structure.\textsuperscript{16} He wrote that:

The problem of adequacy is basically two-fold, for it involves, on the one hand, stability of the revenue structure during changes in levels of economic activity,

\begin{itemize}
  \item \textsuperscript{13}Ibid., p. 381.
  \item \textsuperscript{14}Ibid., p. 383.
  \item \textsuperscript{15}Ibid., pp. 381-382.
\end{itemize}
and, on the other hand, the ability of the tax structure to increase yields to meet new social needs . . . . These two goals are basically in conflict . . . .

He then wrote that in the face of general economic expansion states were slow to recognize this conflict, and hence slow to redirect their tax structures toward greater responsiveness to income increases.

In addition to the point just made, Wilford's article made three other contributions. First, he noted that the elasticity coefficient e, from the equation

$$\log R = \log C + e \log y$$

was an average value, calculated over the time period studied. R is tax revenue, C is a constant, y is aggregate personal income. He advised that the annual values of

$$\frac{dR}{dy} \cdot \frac{y}{R},$$

which is the income elasticity, be studied for possible time trend. Wilford was thus concerned that elasticities might vary with time or with income.

Second, he incorporated statutory rate changes into his model. This was a feature Groves and Kahn had not treated, by assuming unitary rate elasticities. Wilford's model was thus formulated as

$$\log R = \log C + e \log y + f \log r$$

where r is the tax rate, and other variables are as defined for equation 2.1.

Finally, Wilford suggested

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distinguishing between economic "growth" and "development." To him, the former implied aggregate personal income growth; the latter, per capita income growth. He argued that economic "growth" might have varying effects on tax revenues, depending on how much "development" was present.\textsuperscript{20} He particularly noted that rising per capita incomes might lead to changing patterns of household consumption, generating a different impact on sales tax revenues than if the same aggregate income growth were caused by increased population.

Wilford reported estimated income and rate elasticity coefficients, using data for the state of Texas, for several tax categories. All the rate elasticities were less than unity; none were negative. The elasticities with respect to aggregate personal income were generally greater than unity; only alcoholic beverage and cigarette taxes showed less than unit income elasticity. There were some anomalies among the results: the income elasticity of motor vehicle licenses exceeded that of motor vehicle sales, and the \textit{ad valorem} (property) tax had a greater than unitary income elasticity. He did not estimate elasticities for a general sales tax.\textsuperscript{21}

Pivotal research on the subjects of state tax revenue functions and the elasticities approach was done

\textsuperscript{20}Ibid., pp. 306-307.

\textsuperscript{21}Ibid., pp. 308-309.
They wrote that previous studies, by Groves and Kahn and by Wilford, of the relationship between personal income growth and state tax revenue growth possessed two weaknesses, in (1) ignoring the specific linkages between personal income and tax revenues, and (2) assuming that individual taxes could be studied independently of one another. They then attempted to build a theoretical model of state tax revenue generation. This model assumed a tax structure of an income tax and a sales tax with rates \( r_1 \) and \( r_2 \), respectively. Thus their tax revenue function was

\[
R = r_1 \cdot Y + r_2 \cdot C_t
\]  

(2.3)

where \( R \) = state tax revenues, \( Y \) = aggregate personal income, and \( C_t \) = taxable consumption spending. \( C_t \) was treated as a function of income, of relative prices (of taxed versus untaxed goods), and of the sales tax rate. Thus the revenue function became

\[
R = R(y, N, p, r_1, r_2)
\]  

(2.4)

where \( y \) = per capita income, \( N \) = population, and \( p \) = relative before-tax price. The arguments \( y \) and \( N \) have replaced \( Y \). The total derivative with respect to time of the logarithm of equation 2.4 was

\[\frac{d}{dt} \log R = \frac{d}{dt} \log R(y, N, p, r_1, r_2)\]

\[\frac{d}{dt} \log R = \frac{1}{R} \frac{dR}{dt} = \frac{1}{R} \left[ r_1 \frac{dY}{dt} + r_2 \frac{dC_t}{dt} \right]
\]

\[= \frac{1}{r_1 Y + r_2 C_t} \left[ \frac{dY}{dt} \frac{r_1}{Y} + \frac{dC_t}{dt} \frac{r_2}{C_t} \right]
\]


23 Ibid., p. 46.
\[
\frac{\dot{R}}{R} = e_1 \frac{\dot{y}}{y} + e_2 \frac{\dot{N}}{N} + e_3 \frac{\dot{r}_1}{r_1} + e_4 \frac{\dot{r}_2}{r_2} + e_5 \frac{\dot{p}}{p} \quad (2.5)
\]

Each of the coefficients \(e_1\) was a partial derivative; for example \(e_1 = \frac{\partial \ln R}{\partial \ln y}\). Each \(e_1\) was thus an elasticity of \(R\) with respect to the appropriate argument.

Legler and Shapiro argued that if the \(e_1\) were constant over time, then the functional equation 2.4 became the specific form

\[
R = A \cdot y e_1 \cdot N e_2 \cdot r_1 e_3 \cdot r_2 e_4 \cdot p e_5 \quad (2.6)
\]

where \(A\) is the antilog of the constant of integration. In the appendix of the article, Legler and Shapiro described a method of testing the hypothesis of constant elasticities over time. For each state of the Legler-Shapiro study, this hypothesis could not be rejected "at high levels of significance."\(^{24}\)

Legler and Shapiro assumed, as had Wilford before them, that aggregate personal income could be treated as the product of per capita income and population. If aggregate income growth were due entirely to population growth, or entirely to per capita income growth, the effects on tax revenues might be different. In particular, they argued that a rising per capita income, by changing the "market basket" of goods consumed, might alter sales tax revenues by an amount different from that produced by the

\(^{24}\text{Ibid., p. 52.}\)
same increase in aggregate income due to population increase.  

Two criticisms can be raised against this important work. First, the model did not reflect the interdependency stated earlier in their article:

If, as in many states, a taxpayer is allowed to deduct sales tax payments from his taxable income, it is clear that a rise in sales tax receipts resulting from an increase in the sales tax rate or changes in consumer preferences leads to a decline in the income tax base and receipts.  

The revenues of both taxes depend, not on taxable income as implied in the above quotation, but on aggregate personal income. The argument lists for the two taxes do not include any variables that would lead to interdependence; the level of income does not depend on the level of tax revenues.

Second, some of the estimated elasticity coefficients were negative. Legler and Shapiro argued correctly that negative elasticities are plausible in the real world, due to the interdependence of taxes. But within the context of their own model, which as argued above lacks interdependence, negative rate elasticities are not to be expected.

Two articles appeared in the *National Tax Journal* in response to the article by Legler and Shapiro. The

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first of these was by Ben-chieh Liu, who pointed out a technical error in their work.\textsuperscript{27} Liu argued that Legler and Shapiro were incorrect in stating unit rate elasticities occurred only when the demand for taxable goods was perfectly inelastic with respect to price. Liu suggested the following correction:

\begin{quote}
the only condition under which the percentage change in sales tax revenues equals the percentage change in tax rate is, that the consumption expenditures on the taxable goods are perfectly inelastic with respect to the tax rate.\textsuperscript{28}
\end{quote}

Liu stated that the difference arose on goods subject to two or more levels of taxation, whereby one tax could affect the price of a good, and hence the revenues of the other tax.\textsuperscript{29} Wilford made the same error, according to Liu.\textsuperscript{30} Legler and Shapiro replied that Liu's correction was valid. They had omitted from the article an assumption of perfectly elastic supply of taxable goods. According to Legler and Shapiro, this assumption would have led to equivalence of the two positions.\textsuperscript{31}

\begin{flushright}
\textsuperscript{27}Ben-chieh Liu, "Comments on the Responsiveness of State Tax Revenue to Economic Growth," National Tax Journal, XXII (June, 1969), 294-298. \\
\textsuperscript{28}Ibid., p. 295. \\
\textsuperscript{29}Ibid., p. 296. \\
\textsuperscript{30}Ibid., p. 295. \\
\end{flushright}
The second article in response to the work of Legler and Shapiro was more fundamental and less technical in its criticism. Professors Friedlander, Swanson, and Due took issue with the specific form of the aggregate tax revenue function (equation 2.6) posited by Legler and Shapiro. The multiplicative revenue function was unrealistic and should have been replaced with an additive function. According to these critics, Legler and Shapiro did no more to explore the mechanisms linking income to tax revenue than previous researchers had done. Further, the negative rate elasticities found by Legler and Shapiro were due to model misspecification.

Friedlander, Swanson, and Due then developed their own model of tax revenue generation. The assumptions of the model were: (1) the tax structure consists of an income tax and a sales tax, (2) taxes are independent of one another, (3) the supply of taxable commodities is infinitely elastic, (4) per capita income and its growth rate are exogenous variables, and (5) the estimates to be obtained are short-run.

Assumption (2) went contrary to the work of

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33 Ibid., p. 103.

34 Ibid., p. 106.
Legler and Shapiro, who had attempted to build into their model the interdependence of taxes. Friedlander, et al. explained that over a short period of time, the interdependence of taxes was presumed unchanging, and hence an unnecessary part of the model.35

Friedlander, et al. conducted empirical work on a cross section of fifteen states. Like Wilford and Legler and Shapiro, they treated aggregate personal income as the product of per capita income and population. Relative prices of taxed versus untaxed goods had been among the arguments of the tax revenue function, but was dropped when it contributed nothing statistically. The empirical phase of this project thus treated sales tax revenues as a log-linear function of the sales tax rate, per capita income, and population.36

They argued that states with food included in the sales tax base should have higher rate elasticities. This should be so since food demand was generally price inelastic; the lower the price elasticity, the higher the rate elasticity.37 The average rate elasticity for the fifteen states was 0.93; the average for states exempting food was 0.87. Interestingly, the extreme values of the

35Ibid., p. 106.
36Ibid., p. 107.
37Ibid., p. 107.
rate elasticity were both found in states which excluded food from the sales tax base: Maine (0.71) and Florida (1.18). 38

J. A. Dockel's dissertation, *The Responsiveness of the Iowa Tax Structure*, had many elements in common with this current study. His primary interest was long-run tax revenue projections; his basic analytical tool was the use of income elasticities as the measure of response- ness; he expressed interest in testing for changes in income elasticities. 39 After demonstrating that the Iowa tax structure had undergone significant rate changes as well as administrative changes, Dockel discussed the separation of tax yield elasticity into a base elasticity and a rate elasticity. 40 This concept had previously been elaborated by Rafuse, and was designed to account for the effect of a tax rate increase on the purchases of a good or service not completely inelastic in demand. 41

For the Iowa income tax specifically, Dockel regressed income tax revenues against total personal income


41 Rafuse, *op. cit.*, p. 91n.
in log-linear form, so that the regression coefficient would be the yield elasticity (and base elasticity as well, as there was no rate increase to consider). He utilized step variables to determine whether shifts had occurred in tax yields as a result of administrative changes. He also used another dummy variable, equal to the logarithm of personal income when the step variable equalled one, and zero otherwise, to determine whether the slope of the regression line had changed. However, he did not state specifically that a slope change implied an income elasticity change.

For the Iowa tax structure, Dockel estimated an overall income elasticity of .85, up from .81 due to administrative changes in 1967. This relatively low value is due in part to the state's heavy reliance on an inelastic property tax. He did not mention the possible change in that income elasticity due to economic factors.

This dissertation suggests in Chapter 4 that the income elasticity of a tax structure changes as income

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42Dockel, op. cit., p. 45.
43Ibid., p. 48.
44This device is discussed later in this chapter, on page 33.
45Dockel, op. cit., p. 104-105.
46Ibid., p. 40.
changes. Those taxes more income elastic than the average for the tax structure will rise in the proportion of tax revenues generated, those less income elastic than average will decline.\textsuperscript{47} Dockel's projections of Iowa's tax revenues were not consistent with those results. Particularly, he estimated that the property tax, less elastic than average for the Iowa structure, would gain in share of tax revenues produced: that the sales tax, approximately average in elasticity, would lose share; and that the income tax, corporate income tax, and insurance premium tax, all greater than average elasticity, would remain about the same in share of tax revenues produced.\textsuperscript{48}

The American Council on Intergovernmental Relations pointed out the desirability of unit or greater income elasticity in a state-local tax system. In particular, an elasticity of unity would allow a state tax structure to grow as fast as the economy around it; an elasticity of 1.2 would promote a state-federal balance; state sources would grow as rapidly as federal sources.\textsuperscript{49} But this seems undesirable from two standpoints. The federal system is so elastic that fiscal drag is a problem forcing occasional

\textsuperscript{47}See pp. 129-134.

\textsuperscript{48}Dockel, op. cit., p. 123.

tax cuts of varying scope. While state tax revenues do not have the same impact as federal tax revenues in terms of a macroeconomic leakage, the lack of appreciable fiscal drag creates no cause for a system of such high elasticity. Second, the income elasticity of the state tax structure will grow as income grows; if the system has an initial income elasticity of 1.2, that elasticity will rise to even higher levels, if any individual tax has an elasticity larger than the average elasticity for the tax system. Thus while the income elasticity of a tax structure can be too small, it might also be too large. ACIR suggested that state personal income taxes should produce about 25 percent of state revenues in order to get adequate elasticity and to avoid inequities of property and sales taxes.50

In an article attempting to explain a recent phenomenon of state tax rate and base reductions, Leon Rothenberg wrote that an inflationary economy was beneficial to state government financing. He argued that state governments' revenues would rise faster than expenditures; that revenues were more responsive to inflation than were expenditures. Amplifying this statement, he wrote that such levies as sales taxes and income taxes (the latter due to withholding) responded quickly to price and wage level changes. Expenditures, on the other hand, were much

50Ibid., p. 1.
slower to respond, as wage and salary payments and many other state government expenditures were due to contractual or constitutional restrictions, stable over the short run.51

Rothenberg's opening statement became less profound as it was developed. He was not discussing the amount, either percentage or absolute, by which revenues and expenditures changed. Rather, he was writing about different time lags in the adjustment process.

His arguments are perhaps sound, as short-run analysis. Over a longer time frame, it seems plausible that expenditures would go through a "catching-up" phase, particularly as wages and salaries rise to remain as competitive as before. Of importance to this dissertation is not the lag structure by which revenues and expenditures react to price level changes, but the longer term percentage and absolute dollar amount adjustments, for which short-run timing differences would have been washed out.

In the first of two important contributions to the literature concerning state tax revenue growth and income elasticities, Neil M. Singer applied the technique of dummy variables to a state income elasticity study. Recognizing the inability of some earlier works to effectively deal with statutory rate and base changes,

Singer utilized dummy variables to measure the impact of these discretionary changes. He wrote that the frequency with which some states had changed rates and bases might have led other researchers not to use the dummy variable technique. Singer assumed constant income elasticities; he found that the dummy variables were generally significant, and that aggregate personal income generated better regression fits than other income measures. He noted that some state income taxes allowed the deduction of federal income taxes; in these states, income tax revenues were dependent on the Federal income tax laws, and thus required dummy variables to account for the effect of changes in federal tax laws.

Michael Wasylenko noted that Singer's dummy variable method tested only for change in the intercept of regression, while discretionary changes in income tax laws might have altered slopes (elasticities) as well. Wasylenko wrote that the addition of another dummy variable would have provided a test of slope change, but would at the same time have reduced the degrees of freedom of the regression. He also noted that the frequency of discretionary changes would require several sets of dummy variables. Rather than

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53 Ibid., pp. 201-203.
54 Ibid., p. 201.
sacrifice degrees of freedom by using the dummy variables necessary to test for the impacts of several discretionary changes, Wasylenko developed an alternate methodology. He estimated income tax elasticities and income tax revenues by utilizing a simulation of the income tax revenue generating process. The process he developed was similar in many respects to the "synthetic" tax revenue series used earlier by Robert Harris. The pattern of income distribution was pivotal to Wasylenko's model. He first computed the "effective base ratio" of taxable income to total income for each income class. Then he computed the "effective tax rate" for each income class; these rates were the ratios of tax liability to taxable income. He then projected future total income values, and simulated future tax revenues for each income class by applying the previously calculated ratios. This method allowed Wasylenko to determine rate, base, and total elasticity coefficients, which by his assumptions were constant. In avoiding a problem associated with Singer's method,


57Wasylenko, op. cit., pp. 140-141.

58Ibid., p. 141.
Wasylenko developed a technique which lacked an important feature of the Singer model: the ability to compare policy alternatives.

The February 1970 *American Statistician* published an article describing a test which involved the use of two types of dummy variables to test for changes in both intercept and slope of the regression surface. A set of zero-one variables allowed a test for change of intercept. If the coefficient of this variable were significant, then the data accompanied by the dummy variable value 1 were responsible for a shift of intercept. A second set of dummy variables took on the value zero or $X_{ij}$, where $X_{ij}$ is the $i$th observation on the $j$th independent variable, as the first set took values zero or one. These variables performed a test to determine whether the slope of the regression (with respect to the variable $j$) had changed. An intercept change could be interpreted as a once-for-all increase (or decrease) in revenues; a slope change would imply a change in the effective rate at which tax revenues grow.

Singer's second contribution treated analytically the concept of income-dependent income elasticities of

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state income taxes. Although most previous researchers discussed the possibility of non-constant elasticities, few had actually formulated models which specified elasticities which varied. Musgrave and Miller, writing about the elasticity of the federal income tax, noted that the income elasticity varied with income. Dockel used dummy variables which tested for changes in the slope of the regression; he never explicitly associated this slope shift with an elasticity shift.

Wasylenko noted that elasticities could be shifted but his research did not further investigate that possibility. Wilford urged researchers to examine the time-trend of the year-to-year elasticity values. Legler and Shapiro assumed constant elasticities; their empirical work led them not to reject an hypothesis of constant elasticities. Groves and Kahn, and Singer in a previous article, had assumed constant income elasticities. Thus this second Singer article presented the first model of state income taxes which explicitly specified variable income elasticities. Singer noted that the income elasticity of a state income tax should not be treated as constant over wide ranges of income. He listed three effects which caused income elasticity to vary with income. The

"exemption effect" generated high income elasticities for those taxpayers whose incomes just exceeded the tax exemption. This effect disappeared as all incomes exceeded the exemption. The "rate effect" generated changing elasticities so long as effective marginal and average tax rates changed. According to Singer, this effect continued until the highest marginal rate had been reached by all taxpayers. However, the average tax rate would continue to change (as income changed) even after all taxpayers had reached the highest marginal tax rate. Thus the "rate effect" would not vanish when Singer claimed. Singer did not mention that the same effect might operate on a regressive tax structure as well. The "base effect" caused the income elasticity to vary as the income aggregate grew at a different rate than taxable income. Capital gains and transfer payments were noted as the primary sources of variation between the two income measures.\(^{61}\)

Singer then posed the hypothesis that income elasticity was dependent on the rate structure. Assuming constant statutory rates, this implied that income elasticity was a function of the effective tax rate.\(^{62}\) He found the rate effect to be significant, and concluded that for a progressive tax, income elasticity declined

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\(^{61}\)Ibid., pp. 427-428.

\(^{62}\)Ibid., pp. 428-429.
toward unity as the effective tax rate rose. 63

Williams, Anderson, Froehle, and Lamb attempted to define more precisely and to establish quantitative measures for the tax criteria of yield stability, yield growth, and countercyclical stabilizing influence. 64 Yield stability was measured by the reciprocal of the standard deviation of the logarithms of tax revenues. Yield growth was measured by a long-run income elasticity. Stabilizing influence was measured by a short run income elasticity. 65 A linear regression of the percentage change in tax revenue against the percentage change in aggregate personal income was used to estimate the latter measure. The long-run income elasticity was measured by a log-linear regression of tax revenue against aggregate personal income. As no adjustments were made for rate or base changes, this method was equivalent to that used by Groves and Kahn. For the cross-section of states studied, most income elasticities were estimated to be at or above unity. 66

63 Id., pp. 429-430.


65 Id., pp. 269-270.

66 Id., p. 271.
W. T. Wilford responded to the Williams, et al. article with sharp criticism. He wrote that the method of estimating long-run income elasticities gave spurious results for two reasons. First, in not specifying rate and base adjustments, the method used measured an income elasticity which was biased upward by including the impact of these discretionary changes. Second, Wilford argued that the income elasticity measured was an average value for the time period studied, and that inflationary times result in increasing elasticities for income taxes. The possibility of time-dependent income elasticities, Wilford wrote, made "... even more imperative trend analysis of the elasticities." Wilford further argued that rate and base adjustments should be explicitly built into models concerned with income elasticity and revenue growth. Williams, et al. had omitted specific treatment of rate and base changes on the grounds that such statutory and administrative changes were so frequent and regular that they could be treated as commonplace, and expected to continue.

Having argued that the Williams et al. elasticity estimates were biased upward, Wilford provided a set of

68 Ibid., pp. 452-453.
69 Ibid., p. 453.
income elasticity estimates for the Louisiana tax structure to further support his point. He accounted for rate changes explicitly by including a rate variable in the regression; he accounted for base changes by utilizing dummy variables. Only two taxes, the excise license tax and the personal income tax, had income elasticities greater than unity. Wilford's elasticity estimates are shown in Table 2.1.

A recent contribution by Berney and Frerichs evaluated several methods of estimating income elasticities. They argued that since tax revenue is defined by the product of tax rate and tax base, that models not reflecting that definition were most likely misspecified. The model used by Groves and Kahn would be correctly specified only if the tax rate and tax base were functions only of the income aggregate. Inclusion of the tax rate, as done by Wilford, led to a misspecified model if the income aggregate were not the only determinant of the tax base. Berney and Frerichs noted that failure to

\[ \text{Ibid., p. 457.} \]
\[ \text{Ibid., pp. 410-411.} \]
\[ \text{Ibid., pp. 411, 415-416.} \]
### Table 2.1

**Estimated Income Elasticities of Selected Louisiana Taxes, 1956-1972**

<table>
<thead>
<tr>
<th>Tax</th>
<th>Elasticity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alcoholic Beverage</td>
<td>.50</td>
</tr>
<tr>
<td>Beer</td>
<td>.60</td>
</tr>
<tr>
<td>Corporate Franchise</td>
<td>.94</td>
</tr>
<tr>
<td>Corporate Income</td>
<td>.96</td>
</tr>
<tr>
<td>Excise License</td>
<td>1.06</td>
</tr>
<tr>
<td>Personal Income</td>
<td>1.71</td>
</tr>
<tr>
<td>Inheritance</td>
<td>.95</td>
</tr>
<tr>
<td>Occupational License</td>
<td>.68</td>
</tr>
<tr>
<td>Public Utilities</td>
<td>.73</td>
</tr>
<tr>
<td>Sales</td>
<td>.66</td>
</tr>
<tr>
<td>Tobacco</td>
<td>.39</td>
</tr>
<tr>
<td>Fuels</td>
<td>.59</td>
</tr>
<tr>
<td>Motor Vehicle Licenses</td>
<td>.76</td>
</tr>
</tbody>
</table>

include both rate-revenue and base-revenue elasticities resulted in substantial and unpredictable bias in the income elasticity.\textsuperscript{74}

They concluded that the preferred form of a model designed to estimate income elasticities and to project tax revenues would be log-linear and would include variables to explicitly detail the effects of tax rate and tax base changes. These conclusions were based on their observations that the logarithmic models yielded more conservative results, and that the models including rate and base variables were theoretically stronger, than other models surveyed.\textsuperscript{75} Another conclusion reached by Berney and Frerichs was that "income elasticities by themselves may be of minimal value for short-run revenue forecasting."\textsuperscript{76}

\textbf{INCOME ELASTICITY AND TAX REVENUE GROWTH: LOUISIANA}

Thomas R. Beard wrote of recent uncertainty in revenues from severance taxes and non-tax mineral resources. He stated that Louisiana, among the fifty states, was most reliant on this form of revenue, and that

The remainder of Louisiana's state government revenue sources are simply not sufficiently responsive to

\textsuperscript{74}\textit{Ibid.}, p. 417.
\textsuperscript{75}\textit{Ibid.}, p. 422-423.
\textsuperscript{76}\textit{Ibid.}, p. 423.
economic growth to provide a very rapid rate of expansion in total revenues.77

Of course, federal grants (revenue-sharing funds going into the state's general fund) and other non-tax revenues were included in that study, and their responsiveness to economic growth is suspect. Thus Beard did not directly state that the state government's tax structure was "not sufficiently responsive." Beard wrote extensively on the most troublesome area of this dissertation: the fact that projections of future revenues are dependent on the political acts of the state legislature, on the federal government's revenue-sharing plans and legislative acts, and on the fate of petroleum prices in the international political arena.

He mentioned the slow-down in collections of sales taxes, and the decline in income tax revenues, laying the cause of the reduced revenues at legislative acts reducing the base of each of these taxes.78 But both of these taxes have income elasticities at or above unity; after these once-for-all base adjustments have been felt, these taxes will again take on the role of growth leaders in state tax collections.


78Ibid., pp. 115-116.
In three papers prepared for the state of Louisiana Coordinating Council for Higher Education, James A. Papke, on one occasion with John B. Legler, projected tax revenues and state government expenditures for the State of Louisiana. Since the projections techniques used in these papers were quite similar to those used here, and since the time frame for the projections was the same, it was important to devote space for an analysis of these works.

Legler and Papke wrote in the appendix of their article that their revenue estimates were obtained from the formal model

\[ R_t = A \cdot y_t^{e_1} \cdot N_t^{e_2} \cdot r_t^{e_3} \] (2.7)

where

- \( R_t \) = revenue of tax
- \( y_t \) = per capita income
- \( N_t \) = population
- \( r_t \) = tax rate
- \( t \) = time index

\( A, e_1, e_2, e_3 \) are parameters, all but \( A \) being partial elasticities. This log-linear model utilized constant partial elasticities of the tax to be treated.

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following equation for the estimation of future values of total taxes for the state.\textsuperscript{81}

\[ R_t = -10.0374 + 0.5056 y + 2.3715 N \ (r^2 = .9944) \]  

(2.8)

In utilizing this model, Legler and Papke correctly reasoned that future tax revenues would not grow according to some linear pattern of relatively constant year-to-year change, but rather would grow more like a sum deposited at compound interest. The partial income elasticity of \( .5065 \) is obviously less than unity. As will be shown in a later section of this dissertation, the overall income elasticity can be found by averaging the partial elasticities, using the growth rates of the respective variables as weights. The weighted average elasticity (with respect to personal income) is \( 0.96 \), or slightly less than unity.\textsuperscript{82}

This is in contrast to the value 1.05 reported by Legler and Papke in the conclusion of that article.\textsuperscript{83}

Given that the basic form of the model is acceptable for the purpose of intermediate- and long-term projections, emphasis can be shifted to some details of implementing the model. Legler and Papke argued that while severance taxes have no clear bond to levels of income and population,

\textsuperscript{81}Ibid., p. 192.

\textsuperscript{82}\( \varepsilon_y = \frac{.5065 \times 5.15\% + 2.3715 \times 1.65\%}{5.15\% + 1.65\%} = \frac{6.523}{6.80} = 0.96 \)

\textsuperscript{83}Legler and Papke, \textit{op. cit.}, p. 193.
past movement; show a close statistical relationship.\textsuperscript{84}

Thus the high correlation coefficients were used to justify the use of an equation not suggested by \textit{a priori} information. Since oil and gas production have begun to decline in recent years, this form of association must be viewed as invalid. Severance tax revenues should not be treated by the elasticities approach.

The study by Legler and Papke made no attempt to project nominal per capita income by first projecting real per capita income, then multiplying those results by a factor representing anticipated inflation. This would seem preferable, in light of the current instability of prices and the reasonable stability of real per capita income growth. Such a series as would be generated by the two-stage technique could very easily be revised simply by utilizing more current expectations toward inflation.

Papke stated that his model assumed the major taxes, aggregated, would be a constant fraction of total tax revenues.\textsuperscript{85} As shown later, the model actually assumed growing shares for the relatively elastic taxes. Thus the validity of his assumption lies in the relative elasticities of the major and minor taxes. Papke's assumption would be

\textsuperscript{84}Ibid., p. 175.

correct only if the weighted average income elasticity of the major taxes equalled that of the minor taxes. This assumption could perhaps have been avoided if other taxes, as an aggregate, had been estimated using the same techniques as applied to the major taxes.

Legler and Papke reported the results of their regressions in tabular form. Some peculiarities emerged, hinting that the regressions could have been improved by some altered specifications. For example, the estimating equation for the Corporate Franchise tax had no significant variables in it. Only two taxes had all three coefficients $a$, $\epsilon_1$, $\epsilon_2$ significantly different from zero, and one of these, the Tobacco Tax, had a negative estimated income elasticity. Thus some of the equations might have more meaningfully been estimated by using population as the sole independent variable, or by using a regression forced through the origin.

W. T. Wilford's article "Is Louisiana's Revenue Structure Responsive to Economic Growth" attempted to measure the responsiveness of "self-generated" state revenues to Gross State Product. This revenue concept included all state taxes, licenses, fees, royalties, etc., and excluded only federal grants and Medicare/aid funds,

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86 Legler and Papke, op. cit., p. 192.
87 Louisiana Business Survey, VI (April, 1975), 6-7, 10-11.
and thus is more broadly defined than the concept of Total Taxes used in this dissertation. Gross State Product is also a broader concept than Total Personal Income as used here. Wilford reported a 1972 weighted average elasticity of 0.83, for self-generated tax revenues with respect to Gross State Product. This was a bit confusing; in his Table 2 he divided state revenue into "income-related" and "nonincome related," while Table 4 displayed elasticities of "Tax Revenue" and "Total Revenue" to Gross State Product. The text explained that "Tax Revenue" of Table 4 is in reality "Income-related" revenue, and "Total Revenue" is the sum of "income-related" and "nonincome related" revenues.°° A terminological problem still existed, however, since the severance tax revenues were included in "nonincome-related" revenues. Wilford noted a tendency for this elasticity to rise over time. The 0.83 value of 1972 represented an increase from an estimated 0.71 in 1956. The equations used to estimate the revenue-income elasticities contained no formal provision for changing elasticities of individual taxes.

This feature did not represent a flaw, however, when used to estimate elasticities of individual revenue sources. As pointed out elsewhere in this dissertation, there are two sources of a changing income elasticity of the revenue system. One of these is that the elasticities

°°Ibid., p. 11.
of individual taxes may change with time and/or income; if this be the case, the estimating equations should reflect the fact in the modelling process. Wilford recognized the second source of elasticity change, at least implicitly, that the income-elastic revenue sources will produce larger proportions of Total Revenues (or income-related revenues, at least) as income grows, and thus increase the weighted average elasticity of the revenue system.

There are yet other reasons for the projections of this dissertation to differ from Professor Wilford's. He utilized a broader revenue base, which included more nonincome-related revenue. This would cause his income elasticity measure to be downward-biased from that of this dissertation. He utilized Gross State Product, which, according to the data he presented, grew on the average, 6.79% annually (from 1956-1972). By contrast, Total Personal Income grew slightly faster, at 6.95% annually over the same period; this would make Wilford's elasticity estimates slightly upward-biased from those of this dissertation.

A second article by Wilford was more complete than the first in its treatment of the subject of the income

\[89\text{Ibid., p. 7.}\]
elasticity of the Louisiana tax structure.\textsuperscript{90} The more recent article utilized the same methodology, reached the same conclusions, and was subject to the same criticisms as the article above. In addition, the second article presented two new points for comparison to the methodology of this dissertation.

Citing the difficulty of empirically measuring effective statutory tax rates, Wilford utilized dummy variables instead of rate variables to account for rate changes.\textsuperscript{91} Thus qualitative variables were substituted for quantitative ones. Such dummy variables also accounted for base changes. Wilford's models thus did not attempt to differentiate effects on revenue resulting from rate and from base shifts. The equations were also incapable of modelling shifts in rate or income elasticities.

Second, the formulation of the dummy variables may have been misspecified. Wilford's equations (5) and (6) purport to be the same economic model,\textsuperscript{92} but this is unlikely. As is shown later in this dissertation, equation (5) should be

\[(5') \ X_1 = a_1 Y^b \ 10^{d1} , \ not \ (5) \ X_1 = a_1 Y d_1^{d1}\]


\textsuperscript{91} \textit{Ibid.}, p. 5.

\textsuperscript{92} \textit{Ibid.}, pp. 7-8.
in order for equation (6) to be correct.

Wilford recently published a third article on the Louisiana tax structure. Noting the volatility and uncertainty surrounding severance tax revenues, Wilford stated that the purpose of this article was to examine the "dependability" of the major nonseverance taxes. More than one-half of Louisiana's total revenues (total state sources, less Federal Grants and Medicare receipts) was generated by five nonseverance taxes: Gasoline, Personal Income, Corporate Income, Sales, and Tobacco. Wilford produced several tables of revenue and percentage change in revenue forecasts, based on varying assumptions concerning Gross State Product growth. The implicit income elasticities of these estimates were different from those of the two previous articles, although the data and methodology were the same. Both income taxes were income-inelastic; the sales tax income elasticity was approximately one-half. Indeed, all five taxes were income inelastic. These calculations led Wilford to the conclusion that

... in the absence of new tax rate or base adjustments, the five sources will contribute a progressively smaller percentage to revenues as the State Legislature is forced to search out additional revenue sources to meet rising expenditures.94


94Ibid., p. 8.
Such a conclusion is a tautology. Naturally, if more money is to be raised from other sources, a smaller share of the total is generated by the five taxes in question.

There is a very good reason for Wilford's estimates to exhibit low income elasticities. Despite the long-run nature of the forecasts, Wilford utilized a linear model. The resulting estimates tend to understate the responsiveness of tax revenues to changes in Gross State Product, and hence understate the income elasticity. As argued in this dissertation, a log-linear formulation would have been more appropriate, and would have led to higher income elasticity coefficients.

Professors Beard and Scott in their article, "Revenue Projections for Louisiana State Government, Fiscal Years 1974-75--1979-80", provided two sets of estimates of revenues for state government; both sets are pessimistic in outlook. In only one year (of the six for which estimates are provided) do anticipated revenues exceed the anticipated amount of inflation. The estimating process is similar to that used later in this dissertation. Severance tax revenue and mineral resource revenue estimates were based on predictions of future oil output and prices. Revenues of all other state sources (except federal grants) are

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95Ibid., p. 6.
96Louisiana Business Review, XXXIX (February, 1975), 2-5, 11-14, 16.
were estimated using an elasticities approach: income tax revenues were based, in Estimate I, on an assumed income elasticity of 1.25 (1.35 in Estimate II). Sales tax revenue estimates were generated on the basis of an assumed income elasticity of .95 (1.05 in Estimate II).

Beard and Scott displayed their results in two tables, the bottom line of each showing the year-to-year percentage increase in revenues. Interestingly, this percentage is constantly increasing for Department of Revenue sources (which include most of the states important taxes). Since income is assumed to grow at 9% in the first year, and 10% in succeeding years, and since the income elasticity is the ratio of the tax revenue growth rate to the respective income growth rate, it seems that Professors Beard and Scott have predicted an increase in the income elasticity of the state's revenue system, although they do not explicitly state such a conclusion. Table 2.2 displays the forecasts by Beard and Scott for growth rates in tax revenues and in total personal income. Table 2.3 shows the income elasticities implicit in those forecasts.
Table 2.2
Revenue and Income Projections, 1975-76 - 1979-80

<table>
<thead>
<tr>
<th></th>
<th>1975-76</th>
<th>Projected Annual Growth Rates</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1) Department of Revenue Sources(^2)</td>
<td>3.5</td>
<td>3.9</td>
</tr>
<tr>
<td>(2) All state sources(^3)</td>
<td>4.9</td>
<td>3.4</td>
</tr>
<tr>
<td>(3) Total Taxes Licenses Fees, etc.(^4)</td>
<td>5.4</td>
<td>3.7</td>
</tr>
<tr>
<td>(4) Total Personal Income</td>
<td>9.</td>
<td>10.</td>
</tr>
</tbody>
</table>


\(^2\) Includes Beer Tax, Corporate Franchise Tax, Income Tax, Sales Tax (General), Severance Tax, Tobacco Tax, Gasoline and Special Fuels Tax, alcoholic beverage tax, alcoholic beverage permits, anhydrous ammonia, electricity tax on cooperatives, power use (none after 1974-75), gift, inheritance, inspection fees on petroleum, liquified petroleum permits, motor carrier fees, natural gas franchise, occupational licenses, public utilities, reforestation, soft drinks, supervision and inspection fees, and unknown owners.

\(^3\) Includes Department of Revenue receipts, Mineral Resources, Other Taxes, Licenses, Fees, Department of Public Safety, and Federal Revenue Sharing Receipts.

\(^4\) All State Sources less Federal Revenue Sharing Receipts.
<table>
<thead>
<tr>
<th>Table 2.3</th>
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<tbody>
<tr>
<td>Implied Income Elasticity Coefficients</td>
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</tbody>
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<table>
<thead>
<tr>
<th></th>
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</thead>
<tbody>
<tr>
<td>Department of Revenue Sources</td>
<td>.39</td>
<td>.39</td>
<td>.47</td>
<td>.55</td>
<td>.62</td>
</tr>
<tr>
<td>(Row 1 - Row 4, Table 5.1)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>All state sources</td>
<td>.54</td>
<td>.34</td>
<td>.51</td>
<td>.47</td>
<td>.62</td>
</tr>
<tr>
<td>(Row 2 - Row 4, Table 5.1)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total Taxes, Licenses, Fees, etc.</td>
<td>.60</td>
<td>.37</td>
<td>.55</td>
<td>.51</td>
<td>.68</td>
</tr>
<tr>
<td>(Row 3 - Row 4, Table 5.1)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Source: Table 5.1
The purpose of this chapter is two-fold. First, the tax structure of the state is examined briefly, in order to analyze changes in that structure that have occurred during the period 1948-49 to the present. This analysis is required if a meaningful econometric model of the tax structure is to be built. Second, the tax revenue data for the taxes to be studied is presented. These revenue data, singly and in aggregates, with the various income, price level, and population data, provide the quantitative base for the regression studies which follow in Chapter 5.

The discussion on this and the following pages summarizes the major tax changes in recent Louisiana history. The legislating of new taxes and new tax rates, the redefining of tax bases, the transferring of a tax from one collecting agency to another, and changing the administration or enforcement of tax collections, are some of the important features that are considered. Some readers will find this discussion incomplete for some purposes; for a fuller description of rate changes and of statutory references, the Louisiana State Tax

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Handbook is recommended. This source also provides a concise treatment of the exemptions to the various taxes. For a fuller treatment than is available even here, the reader is urged to consult the Louisiana Revised Statutes directly, or the latest Department of Revenue Tax Guide.

HISTORY OF TAX STRUCTURE CHANGES

Few of Louisiana's taxes have remained unchanged over the passage of the nearly thirty years under study. Changes in tax rates, definition of the tax base, methods of collection, and changes in the degree of enforcement have taken place in nearly every tax levied by the State of Louisiana. In addition, several taxes have been repealed. The tax structure has been altered by each of these changes. It is the function of the following sections to outline briefly the important changes that have taken place in the administration of each tax. This analysis facilitates the construction of a model of the tax structure. This model separates those changes in revenues that are due to changing economic conditions from those revenue changes that are due to structural changes in the individual taxes.

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This report looks first at those taxes that have been repealed; then individual taxes are examined for structural changes.

**Repealed Taxes**

Several taxes were repealed during the period of this study; most of these were not significant income producers. In 1956, the severance taxes on frogs and lignite were repealed. The tax on frogs contributed, for example, less than $1000 in both 1950-51 and 1951-1952.\(^3\)

In 1960 the Kerosene Tax was repealed. Collections from this tax had declined steadily during the decade of the 1950's to just over $200,000 annually.\(^4\) The Oleomargarine Tax, which frequently generated no revenue at all, was one of the four taxes repealed in 1962. Also in this group was the Dog Racing Tax, which was not a tax revenue producer as no dog races were held in the state. The Amusement License Tax and the Auctioneers License Tax were the other two taxes repealed.\(^5\) The former produced about $25,000 in 1955-56; the latter, only $1000.\(^6\)

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\(^4\)**State of Louisiana, Department of Revenue Annual Report,** fiscal years 1950-51 to 1960-61.


The Gas Gathering Tax was the largest revenue producer to be repealed prior to the major changes of 1970-73. Suspended December 1, 1958, the Gas Gathering Tax was later found unconstitutional, and was repealed.\textsuperscript{7} The state Ad Valorem Tax was eliminated in 1972 amid growing questions of the constitutionality of the way in which it was administered. The tax had produced over $20 million in revenues annually since 1961-62.\textsuperscript{8}

The 1973 Special Session of the Louisiana legislature repealed three taxes: the Power Use Tax, the Lubricating Oils Tax, and the Tax on Generation and Sale of Electricity. Each of these taxes individually was a modest revenue producer; the three taxes combined contributed over $10 million annually in recent years.\textsuperscript{9} The tax repeals of 1973, in addition to being politically favorable, had two side effects. Among other critics, Public Affairs Research Council had argued for years that Louisiana had too many taxes that were small revenue producers and "nuisance" taxes; and that the administration of these taxes was an undesirable drain on state finances.\textsuperscript{10}

\begin{itemize}
\item \textsuperscript{7}Louisiana State Tax Handbook: 1969, p. 2.
\item \textsuperscript{8}State of Louisiana, Office of the Governor, Division of Administration, Financial Report, Fiscal Year Ended June 30, 19-- (Various years); and Louisiana State Tax Handbook: 1969, pp. 114-115.
\item \textsuperscript{9}Louisiana Financial Statement 1972-73, pp. 20,24.
\end{itemize}
Thus with the repeal of the dozen taxes outlined above, total costs of collection decreased. For example, the three taxes repealed in the 1973 Special Session cost $75,000 to collect in fiscal 1972. This amount represented 0.35 percent of the revenues produced by those three taxes.\textsuperscript{11} While this figure is well below 0.78 percent, which was the average cost of collection for the Department of Revenue in that year,\textsuperscript{12} it is well above the 0.14 percent cost of collecting the Severance Tax.\textsuperscript{13} As is discussed in later paragraphs, these recent repeals were part of a legislative package that increased severance tax rates significantly. The extra severance revenues generated should not have increased collection costs greatly, so that the net effect should be more tax revenue at lower total cost of collection.

Second, the income elasticity of the tax structure increased with the repeals discussed. The Ad Valorem Tax especially was regarded as a tax highly insensitive to income changes. The three taxes repealed in 1973 would,

\begin{thebibliography}
\bibitem{11} State of Louisiana, Office of the Governor, Division of Administration \textit{Budget, Fiscal Year 1972-73}, pp. 10-11.
\bibitem{12} State of Louisiana, Department of Revenue 33rd \textit{Annual Report}, p. 5.
\bibitem{13} 1972-73 \textit{Budget}, p. 10.
\end{thebibliography}
as a group, probably be judged slightly income-elastic. Thus the result of these changes, whether intended or not, was to give up current revenues for more rapid rate of revenue growth in future years. More is said on this subject in the next chapter.

The Severance Taxes

As the title implies, these are taxes levied on the severance (extraction) of natural resources from the land and territorial waters of Louisiana. While the severance tax on crude oil and condensate, natural gas, and sulphur provide almost all of the severance tax revenues, there are taxes levied on several of Louisiana's other natural resources.

Revenues of some minor severance taxes are dedicated to the Conservation Fund; while this dedication does not make the assessment any less a tax, the revenues thus generated are not counted as tax revenues by the Division of Administration, by Public Affairs Research, or (by default) by this dissertation. The amount of tax revenue involved is but a few million dollars annually.\(^\text{15}\)

\(\text{14}\)Taxes on oysters, salt water shrimp, sand and gravel, shells, and skins and hides, are collected by Wild Life and Fisheries Conservation Fund. Generally, the revenues are expended on behalf of the contributors. For example; revenues from the tax on skins and hides serve to benefit trappers.

\(\text{15}\)Louisiana State Tax Handbook: 1969, p. 88. The total in 1967-68 was $1,405,293.15.
bill recently introduced into the legislature would have returned unused funds in Wild Life and Fisheries accounts to the State General Fund. Had this move succeeded, it would have become necessary to include these minor severance taxes in the aggregate total taxes. However, the bill was not passed, and these tax revenues are still spent (or accumulated) by Wild Life and Fisheries, and are unavailable to any other state agency.

Another complicating factor in this series is the changing of the due dates for remitting tax collections. Collections were advanced one month on one occasion, (1960-61), and two months on another (1958-59).16

In the years prior to 1948 the base of all severance taxes was altered several times: the original tax (1910) was on quantity; in 1912 the base was changed to value. In 1916 the base changed to quantity, and in 1920 the base again became value. In 1928 the base became quantity, where it remained until 1973. Crude oil and condensate and natural gas provide almost all of the revenue of the severance tax. Crude oil and condensate, prior to 1974, were taxed on a quantity base. Rates varied from 18 to 26 cents per barrel, dependent on the specific gravity of the product. Output of so-called "incapable" wells (wells of low productivity) was taxed at one-half the full rate.17

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16Ibid., p. 2.
17Ibid., p. 87.
Currently, crude oil and condensate are taxed ad valorem. The ordinary rate is 12\%\textsuperscript{a} percent of the value of the product. Special rates of one-half and one-quarter the ordinary rate apply to incapable and stripper wells. Prior to 1958, natural gas was taxed at 3/10 cents per thousand cubic feet (MCF). In 1958, in order to avoid the loss of tax revenues as the Gas Gathering Tax was suspended, the severance tax rate on natural gas was increased. The rate on the outgoing Gas Gathering Tax and the increase in the rate of Severance Tax on natural gas were the same, 2 cents per thousand cubic feet.\textsuperscript{18} Thus a much longer historical series of severance tax data can be assembled if the revenues for the Gas Gathering Tax are added to the revenues of the other severance taxes. For a short period of time in 1972, natural gas was taxed at the greater of 3.3 cents per MCF or 11\%\textsuperscript{b} percent of value.\textsuperscript{19} Natural gas is currently taxed on a quantity basis, the full rate being 7 cents per MCF. Four reduced rates apply to low productivity wells and to gas sold under certain contracts.\textsuperscript{20}

As prices rise for oil and other increasingly scarce natural resources, the value extracted rises at a faster rate than the quantity extracted. This change provides a tax structure with greater potential revenue

\textsuperscript{18}Ibid., p. 2.
\textsuperscript{19}Department of Revenue 1973 Tax Guide, p. 63.
\textsuperscript{20}Department of Revenue 1975 Tax Guide, pp. 73-75.
growth. It would be improper to discuss the income elasticities of the old and new structures, as growth in severance tax revenues may be much more dependent on resource availability than on the income-derived demand for the resource. Federal regulation of oil and gas output and prices may also limit the responsiveness of these goods to economic conditions. However, if output can expand as economic conditions raise incomes and prices (including the price of oil), the responsiveness of the severance tax on oil to economic change is greater if levied on the value, rather than that the quantity of oil severed.

The Louisiana Sales Tax

Louisiana is one of many states that depends heavily upon a general sales tax for revenues. The levy dates to 1938, when a 1 percent general sales tax was enacted. This tax became permanent in 1944; the rate was raised to 2 percent in 1948. In 1970, the tax rate was raised to 3 percent; food and prescription drugs were exempted from the 1 percent surtax. In the 1973 legislative special session, food and prescription drug items were exempted from the other 2 percent as well. The actual sales tax paid by the customer varies from 4 percent to

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6 percent, reflecting various city and parish sales taxes. Many of these were increased or initiated in recent years. It is possible that rising city and parish taxes, by increasing the final prices of products, have caused state sales tax revenues to rise less rapidly than would have been the case in the absence of these local taxes. The increase in the prices of consumed goods and services may have effected a marginal move toward saving.

In addition to rate changes, there were administrative changes to consider. The most important of these was the change in collection procedures. Originally collected by and from the retailer, the sales tax is now collected from wholesalers. This 1964 move resulted in a much smaller degree of tax avoidance, as there are far fewer wholesalers than retailers to supervise. The retailer then remits an amount that reflects the sales tax on his sales, less the amount of sales tax paid the wholesaler.

The amount of sales tax revenue generated is reported differently by the Financial Statement of the Division of Administration and by the Department of Revenue Annual Report. These small differences aside, the sales tax series displays two major base changes

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24The Financial Statement appears to include the "Parish Service Change," while the Annual Report does not. There are small discrepancies in some recent years even with this adjustment.
The Income Tax

The income tax levied by the State of Louisiana taxes the net income of both corporations and individuals. Corporations pay a four percent tax on net income derived from sources within the state. Each corporation is entitled to an exemption of up to $2,000, the exemption depending on the ratio of net income derived from state sources to total net income. For individuals, the rate structure is slightly progressive. The maximum marginal rate is 6 percent, levied on net income in excess of $50,000. These rates were in effect from 1934 to 1974, but numerous changes in the tax base occurred during that time. In 1951-52 the tax base was reduced by an increase in exemptions. The 1961-62 fiscal year showed increased collections as a result of instituting general withholding in that year. In 1970, federal income taxes paid was disallowed as a special deduction, but was reinstated in 1973. In 1971-72, the incoming Edwards administration adopted stricter enforcement guidelines, in part by requiring the filer to show the amount of income reported on the appropriate federal income tax return. Income tax revenues for fiscal year 1972-73 were decreased by the passage of a law, later found unconstitutional, giving state income tax credit for tuition paid to nonpublic schools. Income tax returns for calendar or fiscal 1975 and thereafter will be
prepared on a form substantially simpler than that of previous years.

Legislation accompanying the new state constitution changed the definition of income to coincide with the definition utilized by federal income tax returns. Previously, certain forms of income were taxable at the state level, but not at the federal level; and certain items were deductibles or adjustments for state purposes but not for federal, and vice versa. For example, FICA (Social Security) payments made by Louisiana residents were previously deductible on state income tax returns, but taxable for federal returns. Conversely, most medical payments were not deductible at the state level, but were allowable on federal returns. Two exceptions still remain: federal income taxes paid are still deductible from state income tax returns, and interest earned on government bonds is treated differently by state and federal laws.

The State of Louisiana gained in two distinct ways by moving toward greater compatibility with federal income definitions. The cost of auditing state returns was greatly diminished, by having reduced the amount of extra effort that once went into searching out those parts of a state return that were not subject to federal audit inspection. The cost of enforcement was reduced and the degree of enforcement increased. Second, the new definitions mean that there now exists a unique relationship between federal income taxes paid and state tax liability. A Louisiana
taxpayer now merely uses a table to look up state income tax liability, based on federal tax liability. This table still takes into account the dollar value of personal exemptions in Louisiana, and the 2, 4, and 6 percent marginal tax brackets.\(^5\)

These gains in simplicity and ease of administration were not without cost. The new state income tax schedules, in tying state income tax liability to federal income tax liability, make Louisiana's state income tax revenues more sensitive to changes in federal income tax laws. For example, the special tax credit employed on federal income tax returns for 1975 reduced federal income tax liability, and in turn reduced state income tax liability. The special tax credit for 1976 is generally larger than that for 1975, and hence will reduce state income tax liability by a larger amount. These revenue losses are on the order of several million dollars per year. This experience should not be treated as a temporary one. The federal income tax structure is relatively income-elastic, and thus exerts "fiscal drag" as income grows. Further federal income tax cuts are a plausible policy option to relieve this growth-stunting phenomenon.

Gasoline Tax

The State of Louisiana first levied a tax on gasoline in 1921. The tax has been levied on a cents-per-gallon basis throughout its history. State sales tax is not collected on gasoline sales. In 1948 the gasoline tax rate was increased from 7 cents per gallon to 9 cents per gallon. This additional tax was repealed in 1952. The tax rate remained at the 7 cents per gallon level until the legislature voted a 1 cent per gallon increase, which became effective January, 1969, and remains in effect at this writing. Exemptions from the tax are minor, but tax rebates are allowed for certain users. As noted in Public Affairs Research Council's Louisiana State Tax Handbook, 1969, fuel used in commercial fishing, school buses, aviation, and agriculture is subject to a refund of state gasoline tax paid.26

Federal gasoline tax was 4 cents per gallon throughout the period 1948 to the present; state gasoline taxes have been deductible on federal income tax returns for the entire period as well. The most notable influence on gasoline usage, and hence on tax revenues, has been the increase in living standards. This rising standard of living has been responsible for the trend of Louisiana residents to own more cars, bigger cars, and to travel

longer distances. Post-war changes in life style have increased the average distance from home to work; the nation's highway system is significantly improved over the system of 1948. Both of these factors have led to greater per capita gasoline consumption. Recent rapid increases in the price of gasoline have caused some decreases in the rate of gasoline usage, and perhaps have caused a reversal of the trends suggested earlier. In Chapter 4, the income elasticity of the gasoline tax will be analyzed.

Tobacco Tax

The state's Tobacco Tax was first levied in 1926. In 1948, rates were increased to a level which remained in effect until 1972 when rates were again increased.

Cigarettes are taxed on a unit basis: 8 cents per pack from 1948 to 1972; thereafter, the rate is 11 cents per pack. Cigars are taxed on a unit basis, but are scheduled as well on an ad valorem basis: the tax per 1000 cigars increases with the retail price of the cigar. Higher priced cigars pay proportionately higher effective tax rates, until the top schedule is reached. Smoking tobacco is taxed ad valorem. The schedule of taxes on this form of tobacco is relatively flat rate: approximately 27 percent of the retail price prior to 1972, now 33 percent of value.27

Revenues from sales of the dominant revenue producer, cigarettes, thus rise only as unit sales rise, but revenues from sales of other tobacco forms rise as dollar sales rise. This is an important consideration in inflationary periods.

Beer Tax

The beer tax in Louisiana originated in 1933 as a quantity-based tax. The original rate was increased the following year, from $1 to $1.50 per standard barrel. The next change in rate occurred in 1948, when the per barrel levy increased to the current rate of $10 per barrel.28 No significant changes in the definition of the tax base have occurred during the period under study.

Alcoholic Beverage Tax

The same legislative act that increased the beer tax in 1934 enacted the taxes on other forms of alcoholic beverages. Unlike the beer tax, the Alcoholic Beverage Tax has undergone several rate changes. In 1935, 1938, 1940, 1948, 1956, 1964, 1968, and 1972, either rates were increased, or administration of tax collection was improved. This tax also is a levy on the quantity of goods sold. Liquor tax rates have risen from $1.58 per gallon in 1948 to $1.68 per gallon in 1956, to $2.50 per gallon in 1972.

Still wine rates, which depend on alcohol content, were constant from 1948 to 1968. Sparkling wines, which were on a variable rate basis until 1956, are now taxed $1.58 per gallon.29

The administration of the Alcoholic Beverage Tax collection was improved in 1964 with a change in the collection procedure, from tax stamps to a tax reporting basis.30 The collecting authority for Alcoholic Beverage permits has changed three times in the period studied. Until 1951-52, the Alcoholic Beverage Control Board (ALBC) collected permits, while the Department of Revenue collected all other beverage taxes. From 1952-53 to 1955-56, the Department of Revenue collected taxes and permits. The ALBC collected permits again from 1956-57 to 1971-72. Since that time the Department of Revenue again collects all beverage taxes and permits.31

Corporate Franchise Tax

The Corporate Franchise tax originated in 1932. The only rate changes were in 1935 and 1946. For the period under investigation, the tax rate was $1.50 per $1,000 of capital stock, surplus, undivided profits, and borrowed capital of firms doing business in Louisiana.

311951-52 Department of Revenue Annual Report, p. 12; 1956-57 Department of Revenue Annual Report, p. 5.
Non-profit firms are generally exempted, as are insurance companies and new industries granted specific waivers. As of 1969, no new industry exemptions had been granted.32

Two factors have influenced the pattern of tax receipts. As new industry is exempted from this tax, its rate of growth would be reduced. Second, the basis of the tax is a firm's capital stock of the prior fiscal year, and the tax is due three and one-half months later. Thus there can be a significant lag between the economic events that alter capital stock and the payment of the tax. Prior to a 1958 change in the due date of this tax, the time lag was several months longer.33

Motor Vehicle Licenses

At the close of the administration of Governor Jimmy Davis, the procedure for collecting the fees for motor vehicle licenses was changed. Act 318 of the 1962 Legislature made the purchase of private passenger vehicle licenses biennial rather than annual. This resulted in increased collections of these revenues in fiscal 1963-64, the last year of Davis' administration, and reduced collections in fiscal 1964-65, the first year of the McKeithen administrations. This change caused the revenues of motor vehicle license fees to vary in a biennial cycle. Since

the due date for private passenger vehicle licenses is in
the spring of even-numbered years, collections are greater
in those years than in odd-numbered years. Thus a fiscal
year beginning in an even-numbered calendar year will have
vehicle license revenues approximately twice those of the
preceding year. Fiscal years beginning in odd-numbered
calendar years generate revenues from this tax only on new
vehicle sales, on truck and trailer licenses, on tractor,
school bus, and other commercial vehicles, all of which
continue to purchase licenses annually.34

The preceding paragraphs have outlined some of the
more important changes that took place in the state's
revenue structure during the period of time under investi-
gation. Emphasis was placed on identifying the shifts in
tax revenues of the more important taxes levied by the
state, as brought about by legislative or administrative
action. The following section of this chapter examines
the current structure of taxes to point out which individual
taxes should be examined for the task of projecting future
tax revenues.

The remaining sections of this chapter accomplish
two objectives. First, it describes the process of
collecting the data: the time series of revenues of the
taxes selected for study. Second, the time series so
collected are organized by logical units, generally in

accordance with the economic factors which cause their revenues to change.

**TAXES TO BE DELETED**

The next task is to assemble from original data, generally State of Louisiana documents such as the divisional Annual Reports and Financial Statements, the time series for the revenues of the taxes relevant for the problem at hand. Where possible, these series will exclude all "inspection fees", as they are self-generating and self-sufficient. Also, the data will exclude funds that are strictly dedicated to be spent on behalf of the contributors, as these are not taxes in the true sense of the word, but special industry assessments. As mentioned in an earlier paragraph, those taxes collected by and dedicated exclusively to certain agencies are not counted. This study is not concerned with those taxes which the state government collects for local and parish governmental units. Thus the Chain Store Tax, the City/Parish beer and sales taxes, and Hotel/Motel Occupancy taxes are not considered. Finally, there is no need to include in this dissertation

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35 This item may seem trivial, but such taxes were included in the measure of Total Taxes by Public Affairs Research Council. See *Louisiana State Tax Handbook: 1956*, pp. 82, 96-97.
those taxes which yield no revenues whatsoever. The following paragraphs will examine each of the above cases in turn.

**Self-Generating Inspection Fees**

Certain taxes levied by the State of Louisiana do no more than raise enough revenue to recover the cost of services provided. These taxes are for the most part inspection fees; the fees assessed are in an amount just sufficient to provide the inspection services. Their revenues are either completely or predominately withheld as a cost of collection.\(^{36}\) To project these revenues would serve no purpose. These taxes are self-generating and self-sufficient; they neither add to nor subtract from the ability of the state to provide other governmental goods or services. Thus such items as the Motor Carrier Regulatory Fees, Motor Vehicle Certificate of Title Fees, and Petroleum Products Inspection Fees do not appear in the list of taxes studied, nor do their revenues appear in the measure of Total Taxes.

**Special Industry Assessments**

There are several levies in the State of Louisiana that, despite their being named taxes, and despite their being collected by the various state tax collection

agencies, are really no more than special industry assessments. The nature of these assessments is such that producers, growers, and sellers of certain goods contribute to an advertising fund or industry development fund, which is then expended on behalf of the contributors. The so-called taxes perform no allocative, distributive, or stabilization function, and thus are not considered taxes for purposes of this dissertation. Assessments that fall into this category include the Sweet Potato Tax, Egg Tax, Soybean Tax, and Strawberry Tax. The Egg Tax and the Soybean Tax were authorized by the state legislature in 1968; the Strawberry Tax was suspended in 1966.37

Taxes Collected for Local Government

To promote efficiency of collection, the state provides certain collection services for subsidiary levels of government. In particular, the state collects the Chain Store Tax, the Hotel/Motel Occupancy Tax, and various city and parish beer and sales taxes. The local governmental units pay a service charge for this state activity. Certainly the revenues produced by the tax

collection process should not be included if the funds play no part in the provision of state governmental services. Thus, where possible, the above-named taxes are not included in this dissertation.

**Dedicated Severance Taxes**

Reasoning along similar lines, the revenues raised by minor severance taxes will not be included. These revenues remain dedicated to use by the Wild Life and Fisheries Department, and hence are not available for the provision of any governmental service other than that to which they are dedicated.

**No-Yield Taxes**

The State of Louisiana has legislated some taxes that now yield no tax revenues whatever. These include the Bank Tax and the Royalty Gas Excise Tax. The Bank Tax would tax at a rate of 5 percent the interest earned by banks which do business in Louisiana but which are domiciled outside the state. However, such a form of bank organization has been declared illegal by the Federal Reserve System. The Royalty Gas Excise Tax insured that natural gas producers did not profit by reselling royalty owners' interest. The tax confiscates the difference between the higher price realized by the producer and the price originally paid. This tax had no yield in 1967-68, but had occasionally provided a few thousand dollars annually. The Oleomargarine Tax and the Dog Racing Tax
were no-yield taxes but have now been repealed.

**MAJOR TAX GROUPINGS**

The preceding section pointed out taxes which are of little value in a model designed to project the state's ability to provide governmental goods and services. This amounts to specifying which taxes are to be included in the study. They are presented alphabetically in Table 3.1, and by tax groups in Table 3.2. The taxes are grouped into some logical arrangement to reduce the number of individual items to analyze and forecast. This is reasonable since the primary aim is to achieve productive forecasts of tax revenues in the aggregate.

First, those taxes based on resource extraction are grouped together; these comprise the Severance Tax Group. Those taxes which stem from use of internal-combustion engines comprise the Automotive Tax Group. The Sumptuary Tax Group includes levies on beverages and tobacco products, since these are the goods typically singled out by most state legislatures, including that of Louisiana, as "sin taxes" for the purpose of raising tax revenues. Certain major taxes are treated singly: these are the Sales Tax and the Income Tax. All other taxes comprise a residual group, Other Taxes. This system of organizing the state's taxes put practically all of its tax revenues into six categories. These groups and their aggregate do not include
any funds received from federal grants, Medicare or Medicaid, non-tax assessments, rentals, royalties, or bonuses, since these funds are less subject to state legislation and other state policy action.

The severance tax group includes Severance Tax-General, Severance Tax-Reforestation (since the data cannot for all years be segregated from the former), and the now-unconstitutional Gas Gathering Tax. This tax group contributed a large and stable share of Louisiana's tax

Table 3.1
List of Taxes Comprising Total Taxes

1. Alcoholic Beverage Dealer Permits
2. Alcoholic Beverage Tax
3. Anhydrous Ammonia Permits
4. Beer Permits
5. Beer Tax
6. Corporate Franchise Tax
7. Electric Cooperative Fees
8. Excise License Tax
9. Gas Gathering Tax
10. Gasoline Tax
11. Gift Tax
12. Income Tax
13. Inheritance Tax
14. Liquified Petroleum Gas Permits
15. Motor Vehicle Licenses
16. Natural Gas Franchise Tax
17. Occupational Licenses
18. Public Utilities Tax
19. Sales Tax
20. Severance Tax-General
21. Severance Tax-Reforestation
22. Soft Drink Tax
23. Special Fuels Tax
24. Tobacco Tax

Source: Primary
revenue collections, ranging from 37.4% to 32.4% of Total Taxes during the decade of the 1960's. The portion of total taxes contributed by these taxes rose significantly during the 1950's to the current level; an almost uniform increase can be noted from 21.7 percent in 1948 to 31.7 percent in 1958.

The sumptuary tax group includes the Alcoholic Beverage Tax, but not gallonage and inspection fees; Alcoholic Beverage Dealer Permits; Beer Tax; Beer Permits; Tobacco Tax; Soft Drink Tax. Generally, dealer permits are included and inspection fees are not. In some years all three items—tax, dealer permits, and inspection fees—are aggregated; in others, only the tax is present. One reason for such vagaries in reporting is that the responsibility for collecting dealer permits has oscillated between the Alcoholic Beverage Control Board and the Department of Revenue. Inspection fees, since they are withheld in their entirety as a cost of collection, are not to be included here, as such fees do not contribute to fiscal operations. Thus, considerable searching of state documents is necessary in order to obtain a series that contained only tax and dealer permits for the relevant time period, 1948-49 to 1973-74.

The automotive group includes Gasoline, Special Fuels, and Vehicle License Taxes. The remaining ten taxes make up the category "Other Taxes": Corporate Franchise Tax, Excise License Tax, Inheritance Tax, Electric Cooperative
Fees, Gift Tax, Occupational License Taxes, Public Utilities Tax, Natural Gas Franchise Tax, Liquified Petroleum Gas Permits, and Anhydrous Ammonia Permits. Thus the taxes appropriate to this study have been grouped as shown in Table 3.2.

Table 3.3 displays the time series of revenues of each of the individual taxes listed in tables 3.1, and 3.2, and the time series of revenues of the Gas Gathering Tax. Table 3.4 shows the revenues of each tax or group of taxes, as described above, for the period 1948 to 1974. Table 3.5 shows the revenues of each tax or tax group as a fraction of Total Taxes, as defined in this dissertation.

The revenues for the above twenty-four taxes only is measured by the category "Total Taxes". With the exception of the Gas Gathering Tax, a tax repealed between the fiscal years of 1948-49 and 1973-74 would therefore not be included in "Total Taxes". This category measures the

39Most of the taxes in this list are collected by the Department of Revenue, while some are collected by other State agencies. Thus the label "Total Taxes" as employed in this dissertation does not coincide with the total of taxes collected by the Department of Revenue. Similarly, "Total Taxes" is not the same as the list of tax and non-tax revenues reported by the Division of Administration in its Financial Statement, which includes several minor taxes excluded by the definition used in this dissertation. The Division of Administration also includes in revenues received the receipts of Medicare, Medicaid, Rentals, Royalties and Bonuses, Unemployment Compensation, and Federal grants paid to the state. In earlier years, it was common to refer to the amount "Revenues Affecting the General Fund," which excluded revenues specifically dedicated to state agencies or projects. The new constitution removed almost all such dedications.
Table 3.2

Six Major Taxes and Tax Groups

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<th>Automotive tax group</th>
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<td>Special fuels tax</td>
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<td>Motor vehicle license tax(^a)</td>
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<tr>
<th>Income tax(^b)</th>
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<table>
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<th>Sales tax(^c)</th>
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<td>Severance tax-general</td>
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<tr>
<td>Severance tax-reforestation</td>
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<td>Beer permits</td>
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<tr>
<td>Beer tax</td>
<td></td>
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<tr>
<td>Soft drink tax(^d)</td>
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<tr>
<td>Tobacco tax(^d)</td>
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<table>
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<th>Other taxes</th>
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<td>Electric cooperative fees</td>
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<tr>
<td>Gift tax</td>
<td></td>
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<tr>
<td>Inheritance tax</td>
<td></td>
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<tr>
<td>Liquified petroleum gas permits</td>
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<tr>
<td>Natural gas franchise tax</td>
<td></td>
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<tr>
<td>Occupational Licenses</td>
<td></td>
</tr>
<tr>
<td>Public utilities tax</td>
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</tr>
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</table>

| Total taxes |  |

\(^a\)excludes Certificate of Title fees
\(^b\)personal and corporate
\(^c\)includes tax on automotive sales
\(^d\)includes dealer permits
\(^e\)repealed December 1, 1958
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<td>8.9</td>
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Table 3.3 (Continued)
Table 3.3 (Continued)

Source: Division of Administration Financial Statement, Fiscal year 19 -19 and Department of Revenue Annual Report, Fiscal year 19 -19.

1 Excludes gallonage and inspection fees
2 Excludes parish tax
3 Rate doubled by 1958 regular session; tax suspended in 1958 special session, effective December 1, 1958
4 Includes Severance Tax—Reforestation.
5 Includes dealer permits
a Included in Beer Tax
b No revenues after tax repealed

c Parish service charge inseparable in 1973-74. Sales tax separated from motor vehicle sales tax. Parish charge included in latter.
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<th>Automotive Tax Group</th>
<th>Sumptuary Tax Group</th>
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1Line 19, Table 3.3
2Lines 9, 20, Table 3.3
3Line 12, Table 3.3
4Lines 10, 15, 22, Table 3.3
5Lines 1, 2, 4, 5, 21, 23, Table 3.3
6Lines 3, 6, 7, 8, 11, 13, 14, 16, 17, 18, Table 3.3
7Lines 1-23, Table 3.3
Table 3.5
Ratio of Tax Group Revenues to Total Taxes

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<th>Year</th>
<th>Sales Tax</th>
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<td>.307</td>
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Source: Table 3.4
inconsistencies brought about by change of base, change of rate, or change of efficiency of administration, but will not reflect revenues of taxes not now in effect.

This measure of Total Taxes includes some funds which were restricted in use by legislation under the old constitution or amendments to it. Thus sizeable amounts of tax revenue generated by the taxes under consideration here could not be utilized freely by legislators. It might appear more practical to estimate general revenues and dedicated revenues separately, and in fact, such was commonly done in past years. However, two considerations lead this study to continue efforts to estimate the aggregate Total Taxes, as defined earlier. First, if dedicated revenues exceed expenditures, excess funds are returned to the general fund in many dedications. Should dedicated revenues fall short of anticipated expenditures, appropriations from the general fund would fill the gap. Thus the general fund serves as the account-balancing agent even where funds are dedicated. The total of tax revenues would be important even in this case. Second, the new constitution contains considerably less revenue dedication than was present under the old. Thus the general fund is nearer to the aggregate total taxes than was previously true. For

40Note the previous importance of "Revenues Affecting the General Fund" in many tax revenue projections by state government and private researchers.
both reasons, it is relevant to work with the concept of tax revenues, whether dedicated or not, used to provide public goods and services which perform some stabilization, distribution, or allocation function. The term Total Taxes still excludes those self-supporting items as inspection fees and special severance taxes. Total Taxes is thus an aggregate that has been developed for the purposes of this dissertation. It is not the measure "Total Taxes" used by Public Affairs Research Council or by the state's Financial Statement. Rather, it is the total, for each year, of those taxes levied by the state, less inspection fees and other self-financing assessments, which are currently in existence. Thus this measure will be less than total taxes reported by other researchers in earlier years, as it will exclude taxes levied in those years but which are now repealed. This provides a consistent revenue base on which to make forecasts of future tax receipts.
Chapter 4

ANALYSIS OF LOUISIANA'S TAX STRUCTURE

The previous chapter examined in detail the individual taxes levied by the State of Louisiana. One purpose of that examination was to enable a logical arrangement of the many taxes into a few tax groups. The base for forecasting future tax revenues was divided into six functional categories: Sales Tax, Severance Taxes, Income Tax, Automotive Tax Group, Sumptuary Tax Group, and Other Taxes. A second major purpose was to provide details of the rates and bases of the individual taxes, so that theories of tax revenue generation could be formulated.

The construction of these models of tax revenue generation for the six taxes and tax groups is a major purpose of this chapter. The first section of this chapter investigates the relationships between changes in revenues of each of these six categories and movements in total personal income and other income measures. These models explicitly include, where appropriate, income elasticities which vary with time, with income, or with legislative or administrative changes in the individual taxes. These models are tested in Chapter 5. The best regression fits are used in Chapter 6 to forecast future revenues of the six taxes and tax groups.
The second purpose of this chapter is to analyze possible movement in the income elasticity of the tax structure of the State of Louisiana. This is accomplished in two stages. First, the Upward-Bound Elasticity Theorem is set forth and demonstrated by hypothetical cases. This theorem suggests that, under certain conditions, the weighted average income elasticity of a tax structure rises with the level of income. The Upward-Bound Elasticity Theorem is then combined with the models previously constructed. The result is a model of the time path of the income elasticity of a hypothetical tax structure similar to that of the State of Louisiana. This model demonstrates that, even where the income elasticities of some individual taxes may decline, the income elasticity of the entire tax structure may continue to rise.

MODELS OF REVENUE GENERATION
FOR LOUISIANA TAXES
AND TAX GROUPS

Each of the tax groups being estimated must be represented by a mathematical model. This model must meet four criteria. First, it should provide for estimates of future tax revenues that are of a reasonable and consistent quality. Second, the model should provide for a test of the hypothesis that tax revenues for the group in question are sensitive to movements of some measure of income. Third, the model should provide for a test of the hypothesis that the income-elasticity of the tax or tax group in
question varies with time or income in a predictable manner. Fourth, the equation chosen to represent the determination of tax revenues for a particular tax or group must make good economic sense, yet not be an identity or tautology. The second and third criteria are rather direct; it is easy to ascertain whether they have been met by a particular equation. The first and fourth criteria are much more judgmental: how does one measure the "reasonableness" of an estimate, or grade the "economic good sense" of a particular equation?

The basic form of the models treated the revenue of each specific tax or group of taxes as the dependent variable. In this way, estimates of the revenue of each tax or tax group were made independently, then aggregated. The independent variables were those whose behavior should logically have a significant influence on the level of tax revenue of the tax or tax group in question. Thus some measure of income was present as an independent variable. For the most part, total personal income was the measure chosen. In some equations, this measure was decomposed into two or three multiplicative components, so that the "income variable" became two or three independent variables. If the tax rate had been changed during the study period, efforts were made to include it as an independent variable. Regressing tax revenue against only the tax rate and tax base in log-linear form was avoided. This is obviously a tautology, represented mathematically by the form TR = r·B.
Several dummy variables were introduced to reflect shifts in revenues brought about by factors other than the variables already described as the set of independent variables. A dummy variable is normally a zero-one variable: zero when not present, one otherwise. In logarithmic form this is satisfied by using a zero-one power of ten, since $\log_{10} 1 = 0$, and $\log_{10} 10 = 1$. Assume that the model

$$ Y = A \cdot X_1^a $$

(4.1)
is incorrectly specified, and that it requires the addition of the shift variable $X_2$; the resulting model will appear as $Y = A \cdot X_1^a \cdot 10^{b \cdot X_2}$. When $X_2 = 0$, $10^{b \cdot X_2} = 10^0 = 1$, and does not change the value of the independent variable $Y$. When $X_2 = 1$, $10^{b \cdot X_2} = 10^b$, and does affect the regression by showing the impact of $X_2$. The regression is linear in its logarithms:

$$ \log Y = \log A + a \cdot \log X_1 + b \cdot X_2 $$

(4.2)

If the model is still not properly specified, and requires an elasticity shift variable, it can be incorporated into the model as

$$ Y = A \cdot X_1^a + c X_2 \cdot 10^{b \cdot X_2} $$

(4.3)

This model is also log-linear:

$$ \log Y = \log A + a \cdot \log X_1 + c X_2 \cdot \log X_1 + b \cdot X_2 $$

(4.4)

The constant $\log A$ represents the value of $Y$ which is independent of $X_1$ and $X_2$. The coefficient $a$ is the elasticity of $Y$ with respect to $X_1$. The term $b \cdot X_2$ is the shift in the regression intercept ($\log A$) due to the influence of $X_2$. 
Since the term $b \cdot X_2$ is a logarithm, its numerical value indicates a percentage shift in the value of $Y$, rather than an absolute shift. The term $c \cdot X_2$, finally, is the change in the elasticity of $Y$ with respect to $X_1$.

The models were generally constructed in log-linear form. This method provides the best fit in most cases, but equally important, is preferable a priori. This latter fact is best explained by the following hypothetical example. Figure 4.1 shows a relationship between total tax revenues.
and time, and shows the straight line representing the simple linear regression of tax revenues on time. While this fit may seem quite good, it is inferior, for purposes of forecasting, to a log-linear regression. Forecasts taken from this regression will be along the vector A, while actual values will be near the vector B. The linear regression, even for forecasts just beyond the observation period, seriously understates the growth in tax revenues, and hence understates the income elasticity of the tax.

It is apparent that a tax revenue function which has an exponential shape on a linear scale has a linear appearance on a logarithmic scale. The vector of forecasts and the vector of future values will be much closer together. Thus the log-linear form of regression can be used to reduce forecast error, and to improve regression fit, in cases where the underlying trend is exponential in nature.

Long-term predictions of tax revenues will require long-term predictions of income in order to establish those gross revenue movements. For this purpose, it is appropriate to separate total personal income, or other appropriate income measure, into various components. For example, total personal income divided by total population equals per capita income, and that total personal income divided by the consumer price index equals real per capita income. Combining these two results, it is apparent that total personal income is the product of three factors: real per capita income, population, and the consumer price
index. Regressing revenues of a specific tax or aggregate of taxes against these three variables will yield not one elasticity, but three partial elasticities. The regression will show the responsiveness of tax revenues to movements in each of the three factors separately.

The important reason for treating total personal income as the product of three component parts is that it may provide better estimates of future tax revenue movements. Since an important aim of this project is revenue estimates, this fact alone would make the disaggregation preferable. A one percentage point rise in total personal income could be due solely to a movement in any one of the component parts. A one percent change in population might not yield the same change in revenues as a one percent change in real per capita income or a one percent change in the price level, all else being equal. Total personal income would rise one percent in each case, but the tax revenue impact might be different in all three cases. Thus the cause of the change in income needs to be considered.

The disaggregation provided adds flexibility to the model. In predicting future tax revenues, the future values of total personal income must also be estimated. As these estimates are in error, so are the resulting revenue estimates. The disaggregation used here allows for more useful alternative series. For example, a predicted series might be altered by examining the effect of only a changed rate of growth in population, all else remaining
equal. Alternative series might be compiled using the same real per capita income and total population figures, but reflecting different future price level movements.

The following example illustrates the regression of tax revenues against the independent variables per capita income (PCI) and population (POP), and shows the method of incorporating partial elasticities that change over time.

\[ TR = A \cdot PCI^a \cdot POP^b \]  \hspace{1cm} (4.5)

The time-dependency of the elasticities is found in the coefficient \( a \); \( a = a^\cdot(1-\delta t) \), where \( t \) is the variable time. Thus the equation 4.5 can be rewritten as

\[ TR = A \cdot PCI^a^\cdot(1-\delta t)^.POP^b \]  \hspace{1cm} (4.6)

\[ \log TR = \log A + a^\cdot(1-\delta t)^\cdot\log PCI + b\cdot\log POP \]  \hspace{1cm} (4.7)

\[ \log TR = \log A + a\cdot\log PCI - \eta t \log PCI + b\cdot\log POP \]  \hspace{1cm} (4.8)

where \( \eta \) replaces \( a^\cdot\delta \). Equation 4.8 is linear in its logarithms. Thus to incorporate the time-dependent elasticities, an additional variable \( t\cdot PCI \) was added. An additional parameter must now be estimated; the set of parameters for equation 4.8 is \( a^\cdot, \delta, \) and \( b \). The parameter \( \delta \) can be found by returning to the relationship \( \eta = a^\cdot\delta \). The equivalent model, when income is broken down into three components, is

\[ TR = A \cdot (RPY\cdot CPI)^a^\cdot(1-\delta t)^.POP^b \]  \hspace{1cm} (4.9)

which becomes

\[ \log TR = \log A + a^\cdot\log RPY + a^\cdot\log CPI - a^\cdot\delta \log RPY \]
\[ - a^\cdot\delta t \cdot \log CPI + b\cdot\log POP \]  \hspace{1cm} (4.10)

Another necessary step is to ascertain whether there
is an analytical way to reconstruct the income elasticity if the appropriate regression utilized as independent variables not total personal income, but per capita income and population, or real per capita income, consumer price index, and population. As the following simple example shows, a weighted average of the partial elasticities is the total elasticity with respect to total personal income.

Let population grow 1 percent each year, and let the partial elasticity of tax revenue with respect to population \((e_2)\) be 2. Let per capita income grow 10 percent per year, and let the partial elasticity of tax revenue with respect to per capita income \((e_1)\) be 1. These assumptions comprise the model

\[
TR = A PCI^1 POP^2
\]

Over the time interval of one year, total personal income will grow \((1.01 \times 1.10 - 1) \times 100 = 11.1\) percent, while tax revenue will grow \(1\% \times 2 + 10\% \times 1 = 2\% + 10\% = 12\) percent.

The total income elasticity will then be

\[
\varepsilon_y = \frac{\%\Delta TR}{\%\Delta TPY} = \frac{12\%}{11.1\%} = 1.081
\]

For small growth rates, this result can be approximated by

\[
\varepsilon_y = \frac{\varepsilon_1 \cdot G_1 + \varepsilon_2 \cdot G_2}{G_1 + G_2}
\]

In the general case, the total income elasticity can be approximated by the formula

\[
\varepsilon_y = \frac{\sum_{i=1}^{k} \varepsilon_1 \cdot G_1}{\sum_{i=1}^{k} G_1}
\]
where the $\epsilon_i$ are the partial elasticities of the independent variables, and the $g_i$ are their respective growth rates. Thus the total elasticity is a weighted average of the partial elasticities, with growth rates being the weights.

Thus Chapter 4 investigates the relationships between income movements and income elasticity movements for each of the major taxes and tax groups. The question of whether such an income elasticity exists, and if so, whether it is influenced by income movements is entertained. In turn, the discussion focuses on the Sales Tax, the Severance Tax, the Income Tax, the Automotive Tax Group, the Sumptuary Tax Group, and the residual group Other Taxes.

**Sales Tax**

Prior to 1970, the State Sales and Use Tax would have been considered regressive with respect to income, because the two percent levy applied to most goods and services sold at retail. As it applied only to consumption items, the tax would have tended to distort the savings-consumption choice, and tax relatively more heavily those households that, voluntarily or not, had the higher consumption/income ratios. This led to the conclusion that the sales tax was regressive with respect to an income base, exacting a larger percentage of smaller incomes than of larger ones, as larger incomes had generally lower consumption/income ratios.

When the state sales tax rate was increased to three cents in 1970, prescription drugs, prosthetic devices,
and food consumed off premises were exempted from this surtax. In 1973, these items were exempted from the two cent state sales tax as well. The food exemption especially should serve to moderate or erase the regressivity of the sales tax with respect to income, in that a variable expenditure exclusion is introduced. It is believed that the sales tax as now enforced is very nearly proportional with respect to income. However, the regressivity or progressivity of a tax does not bear directly on its income elasticity.

If the sales tax is roughly proportional to income, the percentage of income paid in sales taxes will be approximately the same at all income levels. A one percent increase in disposable income will generate a one percent increase in consumption of taxed goods and in sales tax revenues. The marginal propensity to consume taxed goods is equal to the average propensity to consume taxed goods. The relationship between income and consumption of goods subject to state sales tax is thus proportional.

Disposable income does not rise as rapidly as adjusted gross income or total personal income, due to the progressive impact of federal income tax liabilities. Thus the consumption function assumes a flatter slope as income

---

grows, and successive one percent increases in total personal income generate ever smaller percentage increases in sales tax revenues.

As living standards rise, the portion of income spent on subsistence declines. Food, housing, and prescription drugs are part of that subsistence, and all are now exempt from the state sales tax. Thus, over time, an ever larger portion of income earned in Louisiana becomes subject to the sales tax. This statement should hold true even though absolute expenditures on these exempt items also increase over time, as the standard of subsistence changes. These exemptions should make the sales tax elastic with respect to income; the decline of exempt items relative to total income should give the sales tax an increasing income elasticity. Sales tax revenue is proportional to consumption spending (spending on taxable commodities), and takes the form

\[ TR_{sal} = r_s \cdot C, \]  

(4.14)

where \( TR_{sal} \) = sales tax revenues, in dollars

\( r_s \) = the sales tax rate, and

\( C \) = spending on taxed goods.

The paragraphs above have given reasons for modelling the sales tax, not with a constant income elasticity, but with an income elasticity which varies with total personal income or time. Thus a consumption function of the form

\[ C = TPI^{bt} \]  

(4.15)

where \( TPI \) = total personal income, in dollars
b = parameter determining time path of income elasticity
and t = time index, might be appropriate. Thus the following basic model was suggested.

\[ TR_{sal} = r_s a \cdot TPI \cdot b^t \] (4.16)

where \( a \) = rate elasticity.

This equation, in logarithmic form, appears as

\[ \log (TR_{sal}) = a \cdot \log r + b \cdot t \cdot \log TPI \] (4.17)

The shift in sales tax revenues which occurred due to the change to collections at wholesale rather than retail was modelled by the dummy variable D2. Revenue growth changed noticeably when food and prescription drugs were exempted, first from the third cent of the state sales tax, then from all three cents of the state sales tax. Both administrative and legislative base shifts were accommodated by the dummy variable D6. The income elasticity of the sales tax should have increased with the introduction of those exemptions. Incorporating both dummy variables into the sales tax model resulted in the following equation:

\[ TR_{sal} = r a \cdot TPI \cdot b^t + D2 + eD6 + fD2 \cdot gD6 \] (4.18)

Two more models of the sales tax revenue generation function will now be examined. Income elasticity is viewed as a constant, but subject to shifts. A consumption function which meets this criterion is

\[ C = A^b^t \cdot TPI^c \] (4.19)

In this model, \( A \) is a constant representing the relation-
ship between total personal income and taxable expenditures. The income elasticity is not time-dependent. The wholesale collections shift variable D2 was omitted from these formulations. This function resulted in the sales tax revenue equation

\[ \text{TR}_{\text{sal}} = r_g a \cdot Ab t \cdot \text{TPIC} + dD2 + eD6 \cdot 10fD2 \cdot 10gD6 \]  

(4.20)

The log-linear form of this model is

\[ \log \text{TR}_{\text{sal}} = a \cdot \log r_g + b^t + c \cdot \log \text{TPIC} + d \cdot (D2 \cdot \log \text{TPIC}) \]
\[ + e(D6 \cdot \log \text{TPIC}) + fD2 + gD6 \]  

(4.21)

where \( b^t = b \cdot \log A \). The multiplicative term \( dD6 \) shows the shift in revenues due to the exemption of food and prescription drugs from the sales tax.

Severance Tax

The various severance taxes are levied on the extraction of generally non-renewable resources. At fixed tax schedules, the tax revenues generated can be viewed as dependent on the value or volume of the resource removed. For a variety of reasons, this tax base is not related to the level of income in Louisiana.

The extraction of some taxed commodities is occurring at near maximum rates, limited by availability of the resource. Extraction of other resources, notably natural gas, is at rates well below maximum, limited by factors more political than income-related. Much of the extracted material is exported from the state of Louisiana; this volume is largely independent of the level of income.
in Louisiana. For the above reasons, it is appropriate that the models constructed here assign severance tax revenues an income elasticity of zero, that remains zero over all income levels.

One of the two major objectives of this dissertation is to investigate the role of income growth in determining future levels of tax revenues. While changes in severance tax revenues are not thought to be caused by changes in economic activity, it remains necessary to forecast severance tax revenues in order to forecast future levels of total tax revenues. Since severance tax forecasts will be by methods other than those developed elsewhere in this dissertation, the forecasts which follow are largely drawn from those recently done by Beard and Scott, and by Richardson.²

Income Tax

This dissertation will attempt in later sections of this chapter to analyze some of the relevant characteristics of the tax structure of the state of Louisiana. One of the most important single taxes is the income tax, which has both personal and corporate components. The following

paragraphs will examine some of the economic characteristics of the state's personal income tax payers; later paragraphs will study the corporate income tax.

Theoretical Considerations. It is the primary purpose of this section to discuss the possible range of values of the income elasticity of the Louisiana personal income tax. The initial points to consider are first, that the personal income tax is progressive in that rates are moderately graduated with respect to income and there is an income exclusion; and second, that the effective rate of taxation is reduced by the fact that federal income taxes paid are a special deductible item tantamount to an exclusion for state income tax purposes. It should be noted that the income elasticity of the income tax exceeds unity, by virtue of the above-mentioned exclusions and graduated rates.

The actual income elasticity of the income tax at a point in time could be computed as follows:

1. determine total tax paid and total income earned by taxpayers in each of the three (2, 4, 6 percent) marginal brackets

2. compute average rate of taxation for each of these brackets

3. compute the average elasticity for each bracket, using the relationship: 
   \[ \epsilon_y = \text{Marginal tax rate} \div \text{Average tax rate} \]

4. compute the average elasticity by weighting each elasticity by the respective portion of income earned by taxpayers in that marginal bracket.

Two points should be noted here. First, the weights of item 4 can be expected to change over time. During a
general rise in money incomes, more taxpayers will move to higher tax brackets than vice versa. In particular, the weight appropriate for the open-ended 6 percent marginal tax rate bracket should rise during periods of rising money incomes. Second, incomes below the taxable threshold represent a fourth marginal bracket (0 percent); elasticity for this group is indeterminate. Thus the elasticity computed above applies only to those householders who actually had state income tax liability.

An alternative computation would measure the average tax rate of each tax return, compute the elasticity for each taxpayer, and compile the weighted average of all returns, using shares of taxed income as the weights. Lacking facility for such a census, the same result might be achieved by use of a stratified sample of Louisiana taxpayers.

The above techniques give a value to the income elasticity of the state's personal income tax at a single point in time, and hence at a particular pattern of income distribution. The discussion below points out the minimum and maximum values of elasticity that might be obtained over time and over different income distribution patterns.

Income elasticity of the income tax is generally larger where income is equally distributed among all residents of the state than for any other distribution of the same aggregate income. The following statements provide an intuitive proof of this hypothesis. At this distribution,
all individuals would pay the same marginal tax rate. The average tax rate would be at its minimum value, assuming a progressive schedule of tax rates. If any one individual, by virtue of an income redistribution, earned enough more than the other individuals to be taxed at the next higher marginal rate, the average rate of taxation (and tax revenue) would rise, and income elasticity would fall. Similarly, an income redistribution placing one individual only into a lower bracket, tax revenue also rises. Again, the average tax rate rises and income elasticity falls.

The following hypothetical cases illustrate some preliminary findings concerning the income elasticity of the income tax. The first example (Case A) makes the following assumptions:

1. the household consists of husband, wife, and one other dependent
2. the household takes standard exemptions
3. the household has deductible expenses equal to the greater of the standard deduction (15% of AGI, $2000 maximum) or 10% of AGI
4. the household files a joint return
5. perfect income equality exists.

To illustrate the calculations, let adjusted gross income (AGI) in each household be $10,000. Utilizing 1974 tax laws, Federal income tax is $1047.50. Louisiana

---

3Assume n taxpayers each earning an income that is the dividing line between marginal tax rates r₁ and r₂. Let n-1 taxpayers each gain an amount of income δ. The taxpayer loses an amount of income (n-1)δ. Tax revenue changes by r₂δ(n-1) less r₁(n-1)δ. If the tax is progressive, r₂ > r₁, and tax revenue rises.
income tax = \(0.02 \times 2,552.50 = 51.05\) 4 The average tax rate is \(\frac{51.05}{10,000} = 0.51\) percent. The income elasticity is therefore \(2\) percent ÷ \(0.51\) percent = \(3.92\).

Now let income change by 1 percent to $10,100. Federal taxes become $1063.65. Louisiana taxable income becomes $2626.5 Louisiana income tax will be \(0.02 \times 2626.35 = 52.53\). The \(\frac{52.53-51.05}{51.05} = 2.89\) percent increase in income generated a 2.89 percent increase in state income tax revenues. Thus the effective elasticity is not 3.92, but 2.89. The reason for the difference is that a one percent increase in adjusted gross income does not generate a one percent increase in income taxable in Louisiana. For example, an extra dollar earned in this case yields \((1.00 - 0.15) \times 0.19 = 0.16\) in federal taxes, a deductible item. At an AGI of $10,100, the marginal tax rate is 19 percent. Income taxable in Louisiana rises by

---

4 Taxable income in Louisiana would be $2,552.50. This figure is obtained as follows:

<table>
<thead>
<tr>
<th>$10,000</th>
<th>Adjusted Gross Income</th>
</tr>
</thead>
<tbody>
<tr>
<td>-1,000</td>
<td>Itemized Deductions</td>
</tr>
<tr>
<td>-5,400</td>
<td>Personal Exemptions</td>
</tr>
<tr>
<td>-1,047.50</td>
<td>Federal Income Tax Paid</td>
</tr>
<tr>
<td>$ 2,552.50</td>
<td>Income Taxable in Louisiana</td>
</tr>
</tbody>
</table>

5 The calculations are as follows:

<table>
<thead>
<tr>
<th>$10,100</th>
<th>Adjusted Gross Income</th>
</tr>
</thead>
<tbody>
<tr>
<td>-1,010</td>
<td>Itemized Deductions</td>
</tr>
<tr>
<td>-5,400</td>
<td>Personal Exemptions</td>
</tr>
<tr>
<td>-1,064</td>
<td>Federal Income Tax Liability</td>
</tr>
<tr>
<td>$ 2,626</td>
<td>Income Taxable in Louisiana</td>
</tr>
</tbody>
</table>
$1.00 - $0.10 - $0.162 = $0.7385. This reduces the measured elasticity from 3.92 to \( 0.7385 \times 3.92 = 2.89 \), the actual percentage change in tax revenues. The two measures of income elasticity arise because two definitions of the concept are being used. The larger value of income elasticity is calculated by \( \varepsilon_y = \text{marginal tax rate} \div \text{average tax rate} \). The smaller value, the "effective income elasticity," is calculated by

\[
\varepsilon_y' = \frac{\% \text{ change in tax revenue}}{\% \text{ change in income}},
\]

where "income" refers to adjusted gross income.

Income elasticity would be undefined until household income reached almost $6600, since the tax liability and hence the average tax rate are zero. For an income incrementally larger than $6600, income elasticity would become infinitely large, declining as household income grows. At a household income of approximately $36,000, elasticity will have fallen to its minimum value in this range, as the marginal rate becomes 4 percent for further increases in income. Elasticity at this point will be 1.87. At an incrementally larger income, \( \varepsilon_y \) doubles, to 3.74; then declines toward a second minimum at incomes of approximately $275,000. The average effective tax rate at this extreme would be 1.31 percent—lower than in other brackets because of deduction of progressive federal taxes. Elasticity at this extreme will be \( \frac{4\%}{1.31\%} = 3.06 \). A $1 increase in AGI increases taxable income by 90¢; increases federal income taxes by $0.7 \times 90 = 63¢; and increases Louisiana taxable
income by $1 - 10\$ - 63\$ = 27\$. Louisiana taxes rise by 
$0.04 \times 0.27 = 1\$. Even though the marginal rate is 4 percent,
it applies to only 27\$ of each new dollar of AGI. The $1
increase in income represents an increase of $0.000364$
percent. The 1\$ rise in Louisiana income taxes represents
a rise of $0.000278$ percent. This ratio is the income
elasticity $\frac{0.000278}{0.000364} = 0.764$. As income increases beyond this
second breaking point, elasticity begins a steady decline.
However, very few individuals in Louisiana are taxed at the
70 percent maximum federal income tax bracket. Such large
income values as these are for the most part, not important.
The path of the income elasticity is shown in Table 4.1.

Similar calculations, under different assumptions
concerning the taxpaying units, are made to generate two
additional cases. Case B is typical of a Louisiana family
unit; Case C is typical of an unrelated individual. Series
B assumes a household taking four exemptions, filing
jointly and itemizing deductions equalling 15 percent of
AGI. Series C assumes a taxpaying unit with one exemption,
itemizing deductions totalling 15 percent of AGI. The
calculations for cases B and C are summarized in Tables 4.2
and 4.3. The $\varepsilon_y$ values are plotted and shown for comparison
in Figure 4.2.

Thus the elasticity of the state personal income tax
is a variable dependent on income and tax filing conditions.
It is important to discuss how much that elasticity might
change during the relevant time frame for these projections.
### Table 4.1

**Relationship between Adjusted Gross Income and Income Elasticity of the Louisiana Income Tax: Case A**

#### Series A

<table>
<thead>
<tr>
<th>Adjusted Gross Income</th>
<th>Federal Income Tax</th>
<th>State Income Tax</th>
<th>$\varepsilon_y$</th>
<th>$\varepsilon'_y$</th>
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</thead>
<tbody>
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<td>$6600$</td>
<td>$511$</td>
<td>$0$</td>
<td>$--$</td>
<td>$0$</td>
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<tr>
<td>8000</td>
<td>705</td>
<td>22</td>
<td>7.30</td>
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</tr>
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<td>51</td>
<td>3.92</td>
<td>2.89</td>
</tr>
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<td>1371</td>
<td>81</td>
<td>2.98</td>
<td>2.05</td>
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<tr>
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<td>2146</td>
<td>137</td>
<td>2.33</td>
<td>1.64</td>
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<td>3031</td>
<td>191</td>
<td>2.09</td>
<td>1.41</td>
</tr>
<tr>
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<td>4011</td>
<td>244</td>
<td>1.97</td>
<td>1.27</td>
</tr>
<tr>
<td>28000</td>
<td>5111</td>
<td>294</td>
<td>1.91</td>
<td>1.17</td>
</tr>
<tr>
<td>34000</td>
<td>6986</td>
<td>364</td>
<td>1.87</td>
<td>1.08</td>
</tr>
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<td>36000</td>
<td>7678</td>
<td>386</td>
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<td>1.02</td>
</tr>
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<td>9115</td>
<td>460</td>
<td>3.49</td>
<td>1.82</td>
</tr>
<tr>
<td>70000</td>
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<td>1010</td>
<td>2.52</td>
<td>1.76</td>
</tr>
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<td>Adjusted Gross Income</td>
<td>Federal Income Tax</td>
<td>State Income Tax</td>
<td>$\varepsilon_y$</td>
<td>$\varepsilon_y'$</td>
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<td>-------------------</td>
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<td>----------------</td>
<td>-------------</td>
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<td>$335$</td>
<td>$2.03$</td>
<td>$1.10$</td>
</tr>
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<td>$1.04$</td>
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<td>$2.02$</td>
<td>$0.94$</td>
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<td>$2.62$</td>
<td>$1.05$</td>
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<td>$0.83$</td>
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<td>$3.22$</td>
<td>$0.82$</td>
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<td>$147290$</td>
<td>$3715$</td>
<td>$4.85$</td>
<td>$1.24$</td>
</tr>
<tr>
<td>$1000000$</td>
<td>$563790$</td>
<td>$14425$</td>
<td>$4.16$</td>
<td>$1.06$</td>
</tr>
</tbody>
</table>
### Table 4.3

Relationship between Adjusted Gross Income and Income Elasticity of the Louisiana Income Tax: Case C

<table>
<thead>
<tr>
<th>Adjusted Gross Income</th>
<th>Federal Income Tax</th>
<th>State Income Tax</th>
<th>$\varepsilon_y$</th>
<th>$\varepsilon_y'$</th>
</tr>
</thead>
<tbody>
<tr>
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<td>$ 18</td>
<td>4.44</td>
<td>3.14</td>
</tr>
<tr>
<td>5000</td>
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<td>2.73</td>
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<td>681</td>
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<td>2.15</td>
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<tr>
<td>7000</td>
<td>942</td>
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<td>1.87</td>
</tr>
<tr>
<td>8000</td>
<td>1122</td>
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<td>2.52</td>
<td>1.63</td>
</tr>
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<td>10000</td>
<td>1530</td>
<td>89</td>
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<tr>
<td>12000</td>
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<td>115</td>
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<td>1.33</td>
</tr>
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<td>16000</td>
<td>2876</td>
<td>164</td>
<td>1.95</td>
<td>1.17</td>
</tr>
<tr>
<td>18800</td>
<td>3591</td>
<td>198</td>
<td>1.90</td>
<td>1.11</td>
</tr>
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<td>19000</td>
<td>3644</td>
<td>200</td>
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</tr>
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<td>223</td>
<td>3.58</td>
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</tr>
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<td>25000</td>
<td>5420</td>
<td>333</td>
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<td>7090</td>
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<td>2.75</td>
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</tr>
<tr>
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<td>623</td>
<td>2.57</td>
<td>1.09</td>
</tr>
<tr>
<td>50000</td>
<td>15352</td>
<td>786</td>
<td>2.55</td>
<td>0.97</td>
</tr>
<tr>
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<td>25615</td>
<td>1055</td>
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</tr>
<tr>
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<td>42280</td>
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<td>2.84</td>
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</tr>
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<td>3.05</td>
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</tr>
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</tr>
<tr>
<td>170000</td>
<td>83715</td>
<td>2297</td>
<td>4.44</td>
<td>1.13</td>
</tr>
</tbody>
</table>
Figure 4.2
Income Elasticity of Louisiana
Personal Income Tax

Source: Tables 4.2, 4.3, and 4.4
It will be sufficient to show how elasticity changes in only one of the cases previously presented; Series B is chosen as most typical. Beginning with AGI of $12,000, let income grow at 5 percent per annum. After five years time, the elasticity measure will have fallen from 3.78 to 2.84. After ten years, income will have grown to $19,547, and elasticity fallen to 2.40. This decline will be more rapid as income changes are more rapid. In these times of significant inflation, it will not be surprising that money incomes grow at least as fast as the value used for this example.

Partial Elasticities. The previous section suggests that the elasticity of the state personal income tax with respect to total personal income (and per capita income under the assumption of income equality), must decline as those measures of income rise. The partial elasticity with respect to population is unity, if an increase in population does not alter the patterns of income distribution or consumption. This project will assume that such is the case and test its results for proof of this hypothesis.

Tax liability is a function of money income rather than real income. An increase in real per capita income, all else unchanged, will cause an increase in tax revenues through the increase in nominal income (PCI), which is the

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6At that point in time, AGI will be $15,315, which generates $108 in Louisiana Personal Income Tax liability.
product of the change in real per capita income (R\_PY) times the price level (CPI), or \( \Delta \text{PCI} = \Delta \text{PY} \times \text{CPI} \). A given percentage change in real income generates an equal percentage change in nominal income. A similar result holds for increases in the general price level: the revenue effect is only felt through the increase in money income.

Corporate Income Tax. The state corporate income tax, assessed at a single rate and having rather modest exemption, should be a nearly proportional tax. As such, its income elasticity should be quite stable in value. The paragraphs which follow will discuss these statements in more detail.

The exemption makes the income elasticity of the corporate income tax exceed unity, but decline as net income rises. In the limit, this elasticity would approach unity as the exemption becomes relatively less important. The federal corporate income tax is progressive, and thus has a higher average tax rate at larger values of net income. This reduces the taxable base for Louisiana income tax purposes. In the limit, only 52 cents of each dollar of net income is taxable in Louisiana. Thus the average effective tax rate has a limiting upper value of \( .04 \times (1-.48) = .0208 \) or 2.08 percent and a limiting maximum elasticity of 1.92. The income elasticity of this tax is largest, when viewed in the aggregate of all corporate taxpayers, if all corporations earn the same net income.
Table 4.4 and Figure 4.3 illustrate the range of values for the income elasticity of the corporate income tax.

Table 4.4
Corporate Income Tax Elasticity

<table>
<thead>
<tr>
<th>Net Income</th>
<th>Federal Income Tax</th>
<th>State Income Tax</th>
<th>( \varepsilon ) MTR/ATR</th>
<th>( \varepsilon' ) %ATR/%( \Delta Y )</th>
</tr>
</thead>
<tbody>
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<td>$ 0</td>
<td>$ 0</td>
<td>--</td>
<td>0</td>
</tr>
<tr>
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<td>400</td>
<td>0</td>
<td>--</td>
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<td>2.79</td>
</tr>
<tr>
<td>5000</td>
<td>1100</td>
<td>76</td>
<td>2.63</td>
<td>2.05</td>
</tr>
<tr>
<td>10000</td>
<td>2200</td>
<td>232</td>
<td>1.72</td>
<td>1.34</td>
</tr>
<tr>
<td>20000</td>
<td>4400</td>
<td>544</td>
<td>1.47</td>
<td>1.15</td>
</tr>
<tr>
<td>24700</td>
<td>5434</td>
<td>691</td>
<td>1.43</td>
<td>1.12</td>
</tr>
<tr>
<td>25000</td>
<td>5500</td>
<td>700</td>
<td>1.43</td>
<td>0.74</td>
</tr>
<tr>
<td>50000</td>
<td>17500</td>
<td>1220</td>
<td>1.64</td>
<td>0.85</td>
</tr>
<tr>
<td>100000</td>
<td>41500</td>
<td>2260</td>
<td>1.77</td>
<td>0.92</td>
</tr>
<tr>
<td>200000</td>
<td>89500</td>
<td>4340</td>
<td>1.84</td>
<td>0.96</td>
</tr>
<tr>
<td>500000</td>
<td>233500</td>
<td>10580</td>
<td>1.89</td>
<td>0.98</td>
</tr>
</tbody>
</table>

The assumption underlying the illustration is that the corporation taken to be typical does all business in Louisiana, and thus obtains the largest possible exemption. Relaxing this assumption causes the elasticities to more quickly approach their limiting values. Methods of determining the income elasticity of the Louisiana personal income tax aggregated over all taxpayers, have been discussed. Let the value of the elasticity so obtained be \( \varepsilon_p \). A method of determining the elasticity of the corporate income tax with respect to changes in net corporate income was presented in the preceeding paragraphs. Let the elasticity so obtained
Figure 4.3

Corporate Income Elasticity of Louisiana Corporate Income Tax

Source: Table 4.4
be $\varepsilon_c$. Each of these elasticities is a pure number. It makes no difference at this point that these two elasticities are calculated from different bases. Let the fraction of total income tax revenues derived from individual sources be $W_p$, and the fraction derived from corporate income be $W_c$, where $W_p + W_c = 1$. Then the elasticity of the income tax, with respect to movements in the tax base (personal plus corporate net income) is

$$\varepsilon_y = \varepsilon_p \cdot W_p + \varepsilon_c \cdot W_c.$$

This measure is properly a base elasticity, and not an income elasticity since two different incomes comprise the base of the tax. However, the two elements of the base generally move in the same direction, although the corporate component is the more volatile of the two. Thus it should not be misleading to refer to the measure calculated above as an income elasticity, and to calculate that elasticity with respect to total personal income.

**Income Tax Estimating Equations.** Of all taxes and tax groups included in this dissertation, the personal income tax has the strongest link to the independent variables which measure income because the base of this tax is not very different from the income measures used. For this reason, and for the fact that the income tax is one of the most productive individual taxes levied by the State of Louisiana, it is important that the tax revenue estimating equation provide a measure of the income elasticity of the tax.
Over the period studied, the rate structure of the income tax had remained constant. Thus there was no need to incorporate into the model a variable for the tax rate.

There were shifts in tax revenues due to factors other than movements of the economic variables. Institution of a system of general withholding and the temporary non-deductibility of federal income taxes paid resulted in shifts in tax revenues significant enough that the estimating model should measure their effects. Thus dummy variables D4 and D5 were constructed: D4 is unity for the years 1970-1971-1972, and zero otherwise; and variable D5 is zero for years before 1961, unity thereafter.

The income elasticity of the state income tax is increased if federal income taxes paid are deductible for purposes of computing state income tax liability. The extra deduction leads to lower tax bills, while most taxpayers remain in the same marginal tax bracket as before. There is some offset to this, as some taxpayers revert to a lower marginal tax rate, hence lowering income elasticity. It is presumed that the elasticity-increasing effect is much stronger than the elasticity-decreasing effect. State personal income tax brackets are broad enough that few taxpayers will shift to a lower marginal rate.

A purpose of modelling this shift was to determine how much state income tax revenue was foregone by excluding federal income tax, what would be the new growth rate of tax revenues with respect to income growth, and how long
Figure 4.4
Schematic Representation of Shifts in Income Tax Revenues

Log of Income Tax Revenues


\[ \text{Log of Income Tax Revenues} \]

\[ 1960 \quad 1965 \quad 1970 \quad 1975 \]

\[ a \quad b \quad c \quad d \quad e \]

\( a \) Withholding is instituted; many individuals who previously failed to file commence filing.

\( b \) Withholding becomes near-universal; again some non-reporters are forced to comply.

\( c \) Federal income tax paid loses and regains its status as a special deductible item on state tax returns; those taxpayers at the taxable margin begin to pay income tax, then cease to pay income tax.

\( d \) State income tax returns are tied to federal tax returns; greater compliance results.

\( e \) New state constitution defines taxable income to be almost identical to Federal Adjusted Gross Income.
it would take the system to make up for those lost revenues. The base shifts described above are shown graphically in Figure 4. It was further argued that the income elasticity of the state income tax could be expected to decline over time. An equation which models the features just described would appear as

\[ TR_{\text{inc}} = A \cdot TPI (a + bt + eD4 + fD5) \cdot 10^{cD4} \cdot 10^{dD5} \]  

(4.22)

The constant A reflects the system of deductions, exemptions, and marginal tax rates; t is a time index. The coefficients a and b determine the time path of income elasticity; coefficients e and f measure the shifts in income elasticities resulting from tax base changes. Coefficients c and d measure the shifts in the tax revenue function as a result of those base changes. No rate variable appears in this equation, or in other income tax models, because the income tax rate schedules remained constant during the relevant time period.

A second model of the income tax revenue function, presented below, explicitly includes a declining income elasticity.

\[ TR_{\text{inc}} = A \cdot TPI \cdot (k - t) + bD4 + cD5 \cdot 10^{dD4} \cdot 10^{eD5} \]  

(4.23)

where k is a constant, and all other symbols are as previously defined.

The models discussed above utilized the income measure total personal income. Those models readily converted to models using either the per capita income-population, or the real per capita income-consumer price
index-population measures. The model

\[ TR_{inc} = A \cdot PCI + bt \cdot cD^4 + dD^5 \cdot POP \cdot 10^4 D^4 + 10^6D^5 \quad (4.24) \]
displayed a structure similar to that of equation 4.22. The elasticity shift variables were not appended to the population variable.

Automotive Tax Group

Revenues of the three taxes comprising the automotive tax group should be expected to rise as the state's total personal income rises. The taxed items are in part consumer goods, and are not considered to be inferior goods. In part the taxed goods are destined for business use; but the end result is the same. Higher income and higher spending levels will require more vehicles and fuel to transport the merchandise. As services constitute an increasing portion of total output, this increase will be more moderate. Thus the income elasticity of the revenues of this tax group should be positive. Since most individuals in this state are dependent on automotive transportation, this income elasticity might be thought to be less than unity.

Progressive federal income tax schedules exact ever higher percentages of earned income as income rises. This in turn leaves progressively less disposable income. Thus a one percent increase in income at a high income level will cause a smaller percentage increase in spending on goods in the automotive tax group than a one percent
income increase at a lower income level. Changes in work and living patterns in the future may alter the dependence of Louisiana citizens on automobiles, and hence change the income elasticity.

In addition to the various forms of income variables, a variable to reflect rate changes seemed necessary to properly model this tax group. Both dummy variables and actual rate variables were tried, with better results (larger values of the $t$, $F$, and $R^2$ coefficients) obtained using the actual rate. This variable was generally the cents-per-gallon rate on gasoline, since this commodity was the major revenue producer in this group, and since some of the other rates moved much in line with that rate. The sales tax rate was included, since automobile sales are subject to that tax. The dummy variable $D_3$, to account for shifts in tax revenues due to the change to biennial collections for passenger auto licenses, also was necessary. Thus the automotive tax revenue function which modelled the above features was

$$TR_{aut} = r_s a_r g^b T_{PIc} + d + e D_3 + f D_3,$$

(4.25)

where

- $TR_{aut}$ = tax revenue of automotive tax group
- $r_s$ = sales tax rate
- $r_g$ = gasoline tax rate
- $c$, $d$ = parameters denoting time path of income elasticity
- $e$ = parameter denoting shift in income elasticity
- $f$ = parameter denoting shift in tax revenue function
A second model of revenue generation of this group of taxes was
\[ TR_{aut} = r_g A \cdot TPI^{b+c} \cdot 10^{dD3}, \]  
where \( A = \) constant

This model assumed a negligible impact on revenues by sales tax rate changed, and a negligible influence on elasticity by \( D3 \).

**Sumptuary Tax Group**

The income elasticity of the revenues of the sumptuary tax group should be positive, as the goods are not inferior goods in any general sense. The income elasticity is probably less than unity, as the consumption of these goods (taxed on nonprogressive schedules) rises less rapidly than does TPI. The income elasticity will decline as incomes grow, as federal income taxes rise faster than income, leaving smaller proportions of disposable income.

The taxes in the sumptuary tax group have a more tenuous link to income levels than do the other non-severance taxes studied. It was therefore important to carefully study the empirical results with respect to the significance of the income variable. While it was possible that the income variable would add no explanatory value to the models, such was not generally the case.

The model which would seem best suited *a priori* to estimation of the sumptuary tax group revenues would contain an income variable, a variable to test for time-
dependent income elasticity, and variables to reflect shifts in revenue and in income elasticity at the two major rate shifts. In the sumptuary tax group, rates were changed on several occasions, but the rates were several in number, and many were complex schedules. Rather than utilize a single rate to represent all rates and rate schedules, these rate changes were treated by a dummy variable Dl. The simplest model which meets these criteria was

$$TR_{sum} = A \cdot TPIA + bt + cDl \cdot 10dDl$$

Equation 4.27 displayed declining income elasticity if the coefficient $b$ was estimated to be negative. A second possible type of sumptuary tax group model explicitly included a declining income elasticity.

$$TR_{sum} = A \cdot TPIA(k-t) + bDl \cdot 10cDl$$

Both models could be reformulated by substituting PCI--POP and RPY--CPI--POP for the income measure TPI.

**Other Taxes**

This residual grouping of taxes contains some items that should not be considered income related, and some that should be. The Corporate Franchise Tax, Occupational License Taxes, and the Excise License Tax should rise with income, reflecting greater production and general business expansion. These are the major components of Other Taxes, and should dominate the effects of the remaining items. Thus a positive income elasticity is expected. But the direction of movement of this elasticity is not obvious.
It will be left to the regression analysis to determine whether any significant change has occurred.

Only one of several administrative and legislative rate and base changes seemed of sufficient magnitude to model. That event was the change in the collection date of the Corporate Franchise Tax, in 1958. The significance of this change was tested by a variable taking on the value 1 in fiscal 1958, 0 otherwise. This variable was not significant in any models for this tax group, and so was deleted. Thus the basic model was

$$T_{oth} = A \cdot TPI_a + bt$$

(4.29)

An alternative form, using PCI and POP as the independent variables, was

$$T_{oth} = A \cdot PCI_a + bt \cdot POP_c$$

(4.30)

Summary

For four of the five taxes and tax groups studied, a priori information and analysis suggests that the income elasticity of individual taxes and tax groups varies with time or income. These hypotheses will be tested in the regressions which follow, as income- or time-dependent elasticities will be incorporated into the forecasting equations, in the same manner as changing elasticities were built into the model to forecast income tax revenues.

Contrasting with the content of the next section, these changes in income elasticities may be a partial offset to the phenomenon that the income elasticity of a
tax structure rises toward that of the most elastic tax of the structure. Thus income elasticity of a tax structure can be considered to be increasing toward a decreasing limit.

ANALYSIS OF THE DEPENDENCY OF THE INCOME ELASTICITY OF A TAX STRUCTURE UPON THE LEVEL OF INCOME

Previous sections have shown that it is possible for individual taxes to have elasticities which vary with income changes. This section will prove that it is possible for a structure of constant elasticity taxes to have a system elasticity that changes with income changes. These two results will be combined in a later section to illustrate movements in elasticity of a more realistic tax structure. Finally, these results are extended to provide an analysis of the time path of the income elasticity of the current Louisiana tax structure.

The Upward-Bound Elasticity Theorem

The following example suggests that the income elasticity of a tax structure grows as income grows. The example is purposely simplified, involving only two taxes, each of constant elasticity. Let tax A be elastic with respect to income ($\varepsilon_A = 2$), and let it account for .5 of tax revenue at $t = 0$. Let tax B be inelastic with respect to income ($\varepsilon_B = .5$) and let it account for .5 of tax revenue at $t = 0$. Let income grow at a constant rate of
Table 4.5
Symbols Utilized In Elasticity Exercise

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Y</td>
<td>Adjusted Gross Income (the tax base)</td>
</tr>
<tr>
<td>TRA</td>
<td>tax revenue generated by tax A</td>
</tr>
<tr>
<td>TRB</td>
<td>tax revenue generated by tax B</td>
</tr>
<tr>
<td>TTR</td>
<td>total tax revenue (TRA + TRB)</td>
</tr>
<tr>
<td>α</td>
<td>share of total tax revenues generated by tax A (TRA / TTR)</td>
</tr>
<tr>
<td>1−α</td>
<td>share of total tax revenues generated by tax B (TRB / TTR)</td>
</tr>
<tr>
<td>εA</td>
<td>income elasticity of tax A (percentage change in TRA / percentage change in Y)</td>
</tr>
<tr>
<td>εB</td>
<td>income elasticity of tax B (percentage change in TRB / percentage change in Y)</td>
</tr>
<tr>
<td>εS</td>
<td>income elasticity of tax structure, computed by $εS = εA \cdot \frac{TRA}{TTR} + εB \cdot \frac{TRB}{TTR}$; thus $εS$ can be written $α \cdot εA + (1−α) \cdot εB$</td>
</tr>
</tbody>
</table>
The weighted average income elasticity of the tax structure is \( .5 \times 2 + .5 \times .5 = 1.25 \). As income grows by 4 percent, revenue grows by 4 percent \( \times 1.25 = 5 \) percent from \( t = 0 \) to \( t = 1 \). As income grows 4 percent, \( \varepsilon_A \) remains 2, \( \varepsilon_B \) remains .5; but \( TR_A \) has risen 8 percent, \( TR_B \) only 2 percent. At \( t = 1 \) the share of total tax revenues generated by tax A was

\[
a = .5 \times \frac{1 + (0.04 \times 2)}{1 + (0.04 \times 1.25)} = .514;.
\]
The share of total tax revenues from tax B was

\[
1-a = .5 \times \frac{1 + (0.04 \times .5)}{1 + (0.04 \times 1.25)} = .4857.
\]
The elasticity of the tax structure has risen to \( .5143 \times 2 + .4857 \times .5 = 1.2715 \), up from 1.25.

Income again rises 4 percent between \( t = 1 \) and \( t = 2 \). A revenues rise 8 percent, B revenues, 2 percent. This will remain unchanged, since the individual tax revenue income elasticities are here defined as constants. The system shows a revenue increase of \( .08 \times .5143 + .02 \times .4857 = .0509 \), reflecting the increase in elasticity over the previous year. This same value could have been obtained by multiplying the income changes by the new elasticity: \( .04 \times 1.2715 = .0509 \). The ratio \( TR_A/TTR \) is now \( .5143 \times \frac{1.08}{1.0509} = .5286 \); \( TR_B/TTR \) has fallen to \( .4857 \times \frac{1.02}{1.0509} = .4714 \); system elasticity has risen to \( .5286 \times 2 + .4714 \times .5 = 1.2929 \).

The elasticity of the system will continue to rise over time (as income increases), approaching a limit of
The rate of change slows over time as the ratio \( \frac{\text{TRA}_k}{\text{TRA}_{k-1}} \) approaches unity, and \( \frac{\text{TRB}_k}{\text{TRB}_{k-1}} \) approaches \( 1.02 = .944 \). Thus the elasticity of this simple tax structure is dependent on the level of income, and, as income grows over time, is dependent on time. However, it is not true that after \( k \) years of income increases that A's share = \( .5 \left( \frac{108}{105} \right)^k \) because the denominator is rising as overall elasticity rises. The time path of the income elasticity of this same tax structure, over ten time periods, is given in Table 4.6.

Elasticity is increasing by decreasing amounts, falling by less than .001 per year. Elasticity will show almost linear trend over short to intermediate time frame.

System elasticity \( \varepsilon_S \) changes over time, as \( \alpha_t \) changes:

\[
\alpha_t = \alpha_{t-1} \times \left( \frac{1 + \frac{\Delta Y}{Y} \varepsilon_A}{1 + \frac{\Delta Y}{Y} \cdot \varepsilon_{St-1}} \right)
\]

\[
= \alpha_{t-1} \times \left( \frac{1 + \frac{\Delta Y}{Y} \varepsilon_A}{1 + \frac{\Delta Y}{Y} [\alpha_{t-1} \cdot \varepsilon_A + (1-\alpha_{t-1}) \cdot \varepsilon_B]} \right)
\]

This formula is obviously recursive. That is, given a set of initial values, a time series for \( \alpha_t \) can be obtained.

\[
\varepsilon_{St} = \alpha_t \cdot \varepsilon_A + (1-\alpha_t) \cdot \varepsilon_B
\]

\[
= \alpha_{t-1} \left( \frac{1 + \frac{\Delta Y}{Y} \varepsilon_A}{1 + \frac{\Delta Y}{Y} \cdot \varepsilon_{St-1}} \right) \cdot \varepsilon_A + \left[ 1-\alpha_{t-1} \cdot \frac{1 + \frac{\Delta Y}{Y} \varepsilon_A}{1 + \frac{\Delta Y}{Y} \cdot \varepsilon_{St-1}} \right] \cdot \varepsilon_B
\]

\[\text{(4.34)}\]
This gives system elasticity in terms of its previous value and other system parameters.

\[
\varepsilon_{St} = \alpha_{t-1} \cdot \left( \frac{1 + \frac{\Delta Y}{Y} \varepsilon_A}{1 + \frac{\Delta Y}{Y} [\alpha_{t-1} \cdot \varepsilon_A + (1-\alpha_{t-1}) \cdot \varepsilon_B]} \right) \cdot \varepsilon_A \\
+ \left( 1-\alpha_{t-1} \cdot \frac{1 + \frac{\Delta Y}{Y} \varepsilon_A}{1 + \frac{\Delta Y}{Y} [\alpha_{t-1} \cdot \varepsilon_A + (1-\alpha_{t-1}) \cdot \varepsilon_B]} \right) \cdot \varepsilon_B
\]

(4.35)

These formulae show that changes in the weights \( \alpha \) and \( 1-\alpha \) are responsible for the increase in the income elasticity of the tax structure. The weights in turn are changing because the revenues of the taxes of the structure grow at different rates. The relatively more elastic taxes of a tax structure grow faster than the relatively less elastic taxes. Thus the weights assigned to the relatively more elastic taxes rise, while the weights

Table 4.6

Time Path of Income Elasticity, Original Two-tax Model

<table>
<thead>
<tr>
<th>t</th>
<th>( \varepsilon_S )</th>
<th>( \varepsilon_{St} - \varepsilon_S(t-1) )</th>
<th>( \alpha )</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>1.2500</td>
<td>--</td>
<td>.5000</td>
</tr>
<tr>
<td>1</td>
<td>1.2714</td>
<td>.0214</td>
<td>.5143</td>
</tr>
<tr>
<td>2</td>
<td>1.2928</td>
<td>.0214</td>
<td>.5285</td>
</tr>
<tr>
<td>3</td>
<td>1.3142</td>
<td>.0214</td>
<td>.5428</td>
</tr>
<tr>
<td>4</td>
<td>1.3354</td>
<td>.0212</td>
<td>.5569</td>
</tr>
<tr>
<td>5</td>
<td>1.3565</td>
<td>.0211</td>
<td>.5710</td>
</tr>
<tr>
<td>6</td>
<td>1.3774</td>
<td>.0209</td>
<td>.5849</td>
</tr>
<tr>
<td>7</td>
<td>1.3981</td>
<td>.0207</td>
<td>.5987</td>
</tr>
<tr>
<td>8</td>
<td>1.4186</td>
<td>.0205</td>
<td>.6124</td>
</tr>
<tr>
<td>9</td>
<td>1.4388</td>
<td>.0202</td>
<td>.6258</td>
</tr>
<tr>
<td>10</td>
<td>1.4586</td>
<td>.0198</td>
<td>.6391</td>
</tr>
</tbody>
</table>

Source: Primary
attached to the relatively less elastic taxes fall. The income elasticity of the tax structure thus rises as income rises.

The rate of change of the income elasticity of a tax structure will be more or less rapid according to several factors. The rate of change in the income elasticity of a tax structure is more rapid as the relatively more elastic individual taxes generate less revenue (have smaller weights) than the less elastic taxes. The more rapid the rate of increase in income, the more rapid will be the change in income elasticity. The greater the disparity in the income elasticities of the individual taxes, the faster will be the change in the system income elasticity. Other simplified models will now be examined in order to provide support for these statements.

A model differing from the previous two-tax model only in the weights assigned to the taxes A and B was examined. The new weights were $\alpha = 0.2$ and $1 - \alpha = 0.8$. Initially, $\varepsilon_S = 0.8$; after ten years of income growth of 4 percent per year, $\varepsilon_S$ rose to 0.96033, a 20.0 percent increase. In the original model, $\varepsilon_S$ increased 16.7 percent, from 1.25 to 1.43877. If the initial weights had been $\alpha = 0.4$ and $1 - \alpha = 0.6$, and all else unchanged, the income elasticity of the tax structure would have increased by
17.3 percent.

In comparing the rates of change of $\varepsilon_S$ across the three variations above, a pattern was noted in the rate of change of $\varepsilon_S$ within each of the models. Where the relatively more elastic tax contributed less than half of total tax revenues ($\alpha < 0.5$), system income elasticity grew by increasing increments. Where $\alpha > 0.5$, $\varepsilon_S$ grew by decreasing increments. The intuitive extension of this phenomenon is that, in a system of $k$ taxes, $\varepsilon_S$ increases at an increasing rate as the relatively more elastic taxes contribute shares of total tax revenues smaller than $1/k$.

The original two-tax model was altered to have a rate of income increase of 10 percent per year, rather than 4 percent; no other initial conditions were changed. The system income elasticity grew over ten years from $\varepsilon_S = 1.25$ to $\varepsilon_S = 1.65236$. This was an increase of 32.2 percent, compared to 16.7 percent for the original model. As expected, faster rates of income growth generated faster increases in the income elasticity of the tax structure.

Finally, the original model was altered to examine the role of disparity of the income elasticities of the individual taxes of a tax structure. The new set of income elasticities were $\varepsilon_A = 1.5$ and $\varepsilon_B = 1.0$, all else unchanged. This structure had the same initial system income elasticity as the original model, although the individual tax elasticities were much nearer each other in size. After
ten years of income growth at 4 percent per year, $g$ rose only to 1.27138, a 1.7 percent increase. The less disparate set of income elasticities in this variation of the model led to a slower rate of change in the income elasticity of the tax structure.

These models have demonstrated that the income elasticity of a tax structure can vary over time, even though the income elasticities of the individual taxes are constant. This demonstration and the accompanying analysis constitute intuitive proof of the Upward Bound Elasticity Theorem. The model which follows applies this principle to a tax structure similar to that of the state of Louisiana.

An Extended Example of the Upward-Bound Elasticity Theorem

As indicated in an earlier paragraph, the income elasticity of the tax structure can be expected to move in the same direction as total personal income moves. This statement is true, regardless of the absolute size of the individual tax elasticities, and regardless of their weights in the tax structure, so long as they are positive and unequal. The impact of this statement will be demonstrated in the following example.

This second model utilizes a structure of five tax groups, each of which has a constant income elasticity. The initial conditions, while hypothetical, are similar in
magnitude to those of the current Louisiana tax structure. Let the current value of Total Personal Income be $10,000 million, and let that income grow at a constant rate of 5 percent per year. Let the tax structure be given by the following table. The current elasticity of this tax structure is $\varepsilon_{S0} = 0.0 \times 0.30 + 1.0 \times 0.25 + 1.4 \times 0.20 + 0.8 \times 0.15 + 0.7 \times 0.10 = 0.72$. Thus the system is at this point relatively inelastic.

In the next year, income will rise to $10,500 million. The tax revenues are now $1036. The details of the revenue and share movements are to be found in the body of Table 4.7. Revenues rise by 3.6 percent while income rises 5 percent; this simply shows the elasticity of the

Table 4.7

<table>
<thead>
<tr>
<th>Tax</th>
<th>Income Elasticity</th>
<th>Tax Revenue ($10^9)</th>
<th>Proportion of Total Taxes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Severance tax</td>
<td>0.0</td>
<td>$300</td>
<td>0.30</td>
</tr>
<tr>
<td>Sales tax</td>
<td>1.0</td>
<td>250</td>
<td>0.25</td>
</tr>
<tr>
<td>Income tax</td>
<td>1.4</td>
<td>200</td>
<td>0.20</td>
</tr>
<tr>
<td>Automotive taxes</td>
<td>0.8</td>
<td>150</td>
<td>0.15</td>
</tr>
<tr>
<td>Sumptuary taxes</td>
<td>$\varepsilon_{S0} = 0.720$</td>
<td>100</td>
<td>0.10</td>
</tr>
</tbody>
</table>

Source: Primary
structure to be 0.72, as shown above. The severance tax already is declining in share of total revenues. The elasticity of the overall tax structure is now: \( \varepsilon_{S1} = 0.0 \times 0.250 + 1.0 \times 0.266 + 1.4 \times 0.234 + 0.8 \times 0.152 + 0.7 \times 0.099 = 0.79. \)

Ten years into the future tax revenues will have grown to $1463.7, and the elasticity of the tax structure will be \( \varepsilon_{S10} = 0.0 \times 0.205 + 1.0 \times 0.278 + 1.4 \times 0.269 + 0.8 \times 0.152 + 0.7 \times 0.096 = 0.84. \)

The relatively inelastic Automotive Tax group gains slightly in its share of total tax revenues before \( t = 10. \) This is so because this tax is more elastic than the system as a whole at that time. Over time, or more precisely, with income growth, this advantage will vanish, and this group eventually declines in share. Since the system elasticity will exceed the Automotive Tax group elasticity before ten years have passed in the above example, its share will have begun to decline at that point. Of those taxes whose revenues vary with income, only the Sumptuary Tax group revenues decline from the outset. By reasoning similar to that employed above, this must be due to the fact that this tax group alone is less elastic than the tax structure as a whole.

As can be seen in Table 4.8, this structure achieves unitary income elasticity at \( t = 26, \) and that elasticity will continue to grow. This is so even though the income elasticities of individual taxes did not change. Another
Table 4. Movement of Income Elasticity of A Structure of Five Taxes

<table>
<thead>
<tr>
<th>Tax</th>
<th>Income Elasticity</th>
<th>Tax Revenue (X10^9)</th>
<th>Proportion of Total Taxes</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$</td>
<td></td>
<td></td>
</tr>
<tr>
<td>t=0</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Severance Tax</td>
<td>0.0</td>
<td>$ 300.0</td>
<td>0.30</td>
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<tr>
<td>Sales Tax</td>
<td>1.0</td>
<td>250.0</td>
<td>0.25</td>
</tr>
<tr>
<td>Income Tax</td>
<td>1.4</td>
<td>200.0</td>
<td>0.20</td>
</tr>
<tr>
<td>Automotive Taxes</td>
<td>0.8</td>
<td>150.0</td>
<td>0.15</td>
</tr>
<tr>
<td>Sumptuary Taxes</td>
<td>0.7</td>
<td>100.0</td>
<td>0.10</td>
</tr>
<tr>
<td>εS0=0.720</td>
<td>TTR=$1000.0</td>
<td>1.00</td>
<td></td>
</tr>
<tr>
<td>t=1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Severance Tax</td>
<td>0.0</td>
<td>$ 300.0</td>
<td>0.2896</td>
</tr>
<tr>
<td>Sales Tax</td>
<td>1.0</td>
<td>262.5</td>
<td>0.2534</td>
</tr>
<tr>
<td>Income Tax</td>
<td>1.4</td>
<td>214.0</td>
<td>0.2066</td>
</tr>
<tr>
<td>Automotive Taxes</td>
<td>0.8</td>
<td>156.0</td>
<td>0.1506</td>
</tr>
<tr>
<td>Sumptuary Taxes</td>
<td>0.7</td>
<td>103.5</td>
<td>0.0999</td>
</tr>
<tr>
<td>εS1=0.733</td>
<td>TTR=$1036.0</td>
<td>1.0000</td>
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</tr>
<tr>
<td>t=5</td>
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<tr>
<td>Severance Tax</td>
<td>0.0</td>
<td>$ 300.0</td>
<td>0.2498</td>
</tr>
<tr>
<td>Sales Tax</td>
<td>1.0</td>
<td>319.0</td>
<td>0.2657</td>
</tr>
<tr>
<td>Income Tax</td>
<td>1.4</td>
<td>280.6</td>
<td>0.2336</td>
</tr>
<tr>
<td>Automotive Taxes</td>
<td>0.8</td>
<td>182.5</td>
<td>0.1520</td>
</tr>
<tr>
<td>Sumptuary Taxes</td>
<td>0.7</td>
<td>118.7</td>
<td>0.0989</td>
</tr>
<tr>
<td>εS5=0.784</td>
<td>TTR=$1200.8</td>
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</tr>
<tr>
<td>t=10</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Severance Tax</td>
<td>0.0</td>
<td>$ 300.0</td>
<td>0.2050</td>
</tr>
<tr>
<td>Sales Tax</td>
<td>1.0</td>
<td>407.2</td>
<td>0.2782</td>
</tr>
<tr>
<td>Income Tax</td>
<td>1.4</td>
<td>393.2</td>
<td>0.2688</td>
</tr>
<tr>
<td>Automotive Taxes</td>
<td>0.8</td>
<td>222.0</td>
<td>0.1517</td>
</tr>
<tr>
<td>Sumptuary Taxes</td>
<td>0.7</td>
<td>141.1</td>
<td>0.0964</td>
</tr>
<tr>
<td>εS10=0.843</td>
<td>TTR=$1463.7</td>
<td>1.0000</td>
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</tr>
</tbody>
</table>
Table 4.8 (Continued)

<table>
<thead>
<tr>
<th>Tax</th>
<th>Income Elasticity</th>
<th>Tax Revenue (X10^9)</th>
<th>Proportion of Total Taxes</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>t=20</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Severance Tax</td>
<td>0.0</td>
<td>$300.0</td>
<td>0.1325</td>
</tr>
<tr>
<td>Sales Tax</td>
<td>1.0</td>
<td>663.3</td>
<td>0.2929</td>
</tr>
<tr>
<td>Income Tax</td>
<td>1.4</td>
<td>773.9</td>
<td>0.3417</td>
</tr>
<tr>
<td>Automotive Taxes</td>
<td>0.8</td>
<td>328.7</td>
<td>0.1451</td>
</tr>
<tr>
<td>Sumptuary Taxes</td>
<td>0.7</td>
<td>199.9</td>
<td>0.0879</td>
</tr>
<tr>
<td><strong>TTR</strong></td>
<td></td>
<td>$2265.0</td>
<td>1.0000</td>
</tr>
<tr>
<td><strong>(\epsilon_{S20}=0.949)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>t=25</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Severance Tax</td>
<td>0.0</td>
<td>$300.0</td>
<td>0.0994</td>
</tr>
<tr>
<td>Sales Tax</td>
<td>1.0</td>
<td>846.6</td>
<td>0.2952</td>
</tr>
<tr>
<td>Income Tax</td>
<td>1.4</td>
<td>1085.5</td>
<td>0.3785</td>
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<td>Automotive Taxes</td>
<td>0.8</td>
<td>400.0</td>
<td>0.1395</td>
</tr>
<tr>
<td>Sumptuary Taxes</td>
<td>0.7</td>
<td>236.3</td>
<td>0.0824</td>
</tr>
<tr>
<td><strong>TTR</strong></td>
<td></td>
<td>$2868.4</td>
<td>1.0000</td>
</tr>
<tr>
<td><strong>(\epsilon_{S25}=0.994)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>t=26</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Severance Tax</td>
<td>0.0</td>
<td>$300.0</td>
<td>0.0994</td>
</tr>
<tr>
<td>Sales Tax</td>
<td>1.0</td>
<td>888.9</td>
<td>0.2952</td>
</tr>
<tr>
<td>Income Tax</td>
<td>1.4</td>
<td>1161.5</td>
<td>0.3858</td>
</tr>
<tr>
<td>Automotive Taxes</td>
<td>0.8</td>
<td>415.9</td>
<td>0.1381</td>
</tr>
<tr>
<td>Sumptuary Taxes</td>
<td>0.7</td>
<td>244.6</td>
<td>0.0812</td>
</tr>
<tr>
<td><strong>TTR</strong></td>
<td></td>
<td>$3010.9</td>
<td>1.0000</td>
</tr>
<tr>
<td><strong>(\epsilon_{S26}=1.003)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Source: Primary
of the important assumptions of this hypothetical example is that no exogenous change, such as legislative action with respect to tax bases and rates, occurs. Thus the model shows the smooth time path of an unchanging tax structure. The increase in income elasticity which accompanies economic growth would occur even if all taxes in the tax structure were relatively income-inelastic, and if no income-independent revenues, such as the severance taxes, existed.

An Example of a Tax Structure with Changing Individual Tax Income Elasticities

The Upward-Bound Elasticity Theorem holds for a structure of taxes whose income elasticities are non-negative, unequal, and constant. Vickrey's independence assumption is not required, but his additive assumption is.

The Louisiana tax structure does not meet these requirements: the income elasticities are not constant over wide ranges of income. This section will analyze changes in the income elasticity of a tax structure, the individual taxes of which have changing income elasticities. This prepares the way for practical application of the knowledge previously gained concerning movements of tax structure income elasticity.

The tax structure to be considered at this time consists of six taxes and tax groups, to conform with the

7Vickrey, op. cit., p. 140.
forecasting base used throughout this dissertation. The parameters of this model are in Table 4.9. The initial shares are the actual shares of the six taxes of the forecasting base in fiscal 1973-74. Under this proposed structure, system elasticity will still move toward the most elastic component as income rises; but the elasticities of all components are slowly falling, largely the result of progressive federal income taxation. Thus the limit toward which the system moves is itself declining. This structure has an initial income elasticity of 0.688. Given a constant rate of income increase of 10 percent per year, the elasticity of the tax structure rises slowly, peaking at \( \varepsilon_s = 1.2303 \) at \( t = 88 \).

### Table 4.9

<table>
<thead>
<tr>
<th>Tax</th>
<th>Initial Share of Tax Revenue</th>
<th>Initial Income Elasticity</th>
<th>Definition of Elasticity Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Severance Tax</td>
<td>.3063</td>
<td>0.0</td>
<td>none</td>
</tr>
<tr>
<td>Sales Tax</td>
<td>.2667</td>
<td>1.0</td>
<td>( \varepsilon_0 \cdot (1 - .001 \cdot t) )</td>
</tr>
<tr>
<td>Income Tax</td>
<td>.1323</td>
<td>1.4</td>
<td>( \varepsilon_0 \cdot (1 - .002 \cdot t) )</td>
</tr>
<tr>
<td>Automotive Tax</td>
<td>.1379</td>
<td>0.8</td>
<td>( \varepsilon_0 \cdot (1 - .001 \cdot t) )</td>
</tr>
<tr>
<td>Sumptuary Tax</td>
<td>.0780</td>
<td>0.7</td>
<td>( \varepsilon_0 \cdot (1 - .001 \cdot t) )</td>
</tr>
<tr>
<td>Other Taxes</td>
<td>.0788</td>
<td>0.9</td>
<td>( \varepsilon_0 \cdot (1 - .001 \cdot t) )</td>
</tr>
</tbody>
</table>

Source: Primary

At the point of maximum system elasticity, the individual income elasticities are:
Thereafter $e_S$ declines, reflecting the fact that individual tax elasticities are declining. In fact, the largest revenue producer has the fastest decreasing elasticity, at the time elasticity peaks. Variations of this model suggest that faster income change and/or slower elasticity decline lead to larger values for peak elasticity.

The importance of the model is this: the regressions of tax revenues against the appropriate income and dummy variables, as described in an earlier section, provide estimates of the individual tax income elasticities and of their rates of change. Thus the model described here could use the parameters as provided by the regressions, and show the possible time path of the income elasticity of the current Louisiana tax structure.

The chapter containing the revenue forecasts will also forecast the time path of the income elasticity of the Louisiana tax structure. The forecasting method will use the technique just developed. By combining reliable estimates of elasticities and their rates of change with the known current shares of revenues generated by the respective taxes, the future path of the income elasticity of Louisiana's tax structure can be charted. It is obvious that, given the appropriate estimates and parameters of
another tax structure, the future path of its income
elasticity can be predicted. Thus the technique developed
here, to incorporate changing income elasticities into the
regression model, can be of value to other tax structures,
notably those of other states whose tax revenues are
predominately income-related.
Chapter 5

EMPIRICAL RESULTS OF THE TAX REVENUE MODELS

It is the purpose of this chapter to test the models developed in Chapter 4. The reader is first reminded of the specific goals of this research. The mechanics of the regressions are explained in detail. The models are then tested to determine which will be used to produce the tax revenue forecasts. These forecasts appear in Chapter 6. The results of the forecasting are discussed from three viewpoints: the future trend of tax revenues for the State of Louisiana, possible alternative tax policies, and the proof of the hypotheses presented in Chapter 4.

This paragraph serves to remind the reader of the two-fold intent of the research undertaken here. First, the research is to provide intermediate and long-run (two to ten year horizon) estimates of the revenues of certain taxes levied by the State of Louisiana, to provide additional data for those individuals and agencies that are responsible for the planning of the state's future fiscal activities. For longer-term estimates, if reliable enough, will provide an extra measure of knowledge about future revenues, and hence set the stage for determining what the state can or cannot "afford" in terms of its
offerings of public goods and services. This is more important for those state activities which require long periods of time—two years to twenty years or more—to plan, activate, and bring to fruition. The second major purpose is to seek substantiation of the hypotheses proposed in Chapter 4. The first of these hypotheses was that as income grows, the income elasticity of the tax structure also grows; this is the so-called "Upward-Bound Elasticity Theorem" of Chapter 4. Evidence of the validity of this hypothesis will be obtained by examining the statistical significance of the relevant coefficients of the independent variables of the regressions performed and analyzed in later sections of this chapter. By similar examination, tests will confirm or deny the hypothesis of time-dependent income elasticities of the individual taxes being modelled.

All models of the tax revenue functions were estimated by Ordinary Least Squares (OLS), a single-equation econometric technique. OLS is appropriate in such cases where the variable labelled as dependent has no influence over the variables labelled independent. This implies that, for the tax revenue models, the amount of tax revenue for a specific tax must have no influence over the current level of income.

It seems unreasonable that a higher tax rate on sales, alcohol, or tobacco would so alter spending habits as to significantly alter the aggregate level of income. Clearly, such tax rate changes could cause some economic
dislocation, but the aggregate number of jobs and level of income should be relatively unaffected. The state income tax rate could conceivably affect the level of income by making job opportunities in Louisiana more or less favorable to opportunities elsewhere. Thus a high income tax rate might encourage job seekers to go to neighboring states. But the income tax is only one influence on mobile job seekers. Certainly they should consider the entire tax burden, not just the income tax liability; and the tax burden itself is probably a small influence over job location.

The severance taxes perhaps have the greatest potential for reverse causation. Increased severance tax revenues, rather than the result of higher incomes, may be the cause of higher incomes. Since the petroleum industry is such a large component of the state's employment and income, its success, through multiplier effects, affects the employment and income of the state. This does not create a need for simultaneous equations, since the revenues of the severance taxes are not to be estimated by using income as an independent variable. Rather, severance tax revenue estimates will be adapted from other sources.

Another cause for use of estimating methods other than OLS would be that one tax influences the revenues of another tax. For the most part, these influences seem negligible: how much would gasoline tax revenues rise or fall if Corporate Franchise tax revenues rose by $1 million? Certainly, some interdependencies do exist: as vehicle
license revenues rise, gasoline tax revenues will also. As alcoholic beverage dealer permits rise, so might alcoholic beverage tax revenues. These interdependencies have been negated by the use of tax groups. In most cases, taxes dependent on one another are in the same tax group, so that their revenues are treated as an aggregate and not as individual tax revenues. In this way, the use of OLS would still be valid.

The models introduced in Chapter 4 were fitted by a step-wise regression program which allowed the user to "force" selected variables into or out of the regression. The variable labels used are listed in Table 5.1. The particular package utilized in these and other regressions of this dissertation was BMD-02R.1 The results of these curve-fittings are given in the following paragraphs.

Before proceeding to the testing phase, some brief mention of the criteria used to judge the empirical results is necessary. Use of $R^2$ as a criterion for selecting equations was of limited value, since all $R^2$ values were quite acceptable, with few falling below .90. Most importance was placed on the significance (t-values) of the variables judged a priori and by the analysis of Chapter 4.

---

1BMD Biomedical Computer Programs, W. J. Dixon, editor. University of California Press, 1974. BMD-02R is the Stepwise Regression program and is discussed on pages 305-331 of this manual.
### Figure 5.1

List of Tax, Income, and Dummy Variables Used in Regression Studies

<table>
<thead>
<tr>
<th>Variable Name</th>
<th>Variable Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>LSAL</td>
<td>Base 10 logarithm of Sales Tax revenues in 10^3 dollars</td>
</tr>
<tr>
<td>LINC</td>
<td>Base 10 logarithm of Income Tax revenues in 10^3 dollars</td>
</tr>
<tr>
<td>LAUT</td>
<td>Base 10 logarithm of Automotive Tax Group revenues in 10^3 dollars</td>
</tr>
<tr>
<td>LSUM</td>
<td>Base 10 logarithm of Sumptuary Tax Group revenues in 10^3 dollars</td>
</tr>
<tr>
<td>LOTH</td>
<td>Base 10 logarithm of Other Taxes revenues in 10^3 dollars</td>
</tr>
<tr>
<td>LSR</td>
<td>Base 10 logarithm of Sales tax rate</td>
</tr>
<tr>
<td>LGR</td>
<td>Base 10 logarithm Gasoline tax rate</td>
</tr>
<tr>
<td>RPY</td>
<td>Real per capita income, in dollars, 1967 base</td>
</tr>
<tr>
<td>CPI</td>
<td>Consumer price index, in decimal value, 1967 base</td>
</tr>
<tr>
<td>POP</td>
<td>Louisiana population, in thousands</td>
</tr>
<tr>
<td>PCI</td>
<td>Louisiana per capita income, in current dollars ( PCI = RPY \times CPI )</td>
</tr>
<tr>
<td>TPI</td>
<td>Louisiana total personal income in 10^3 dollars ( TPI = PCI \times POP )</td>
</tr>
<tr>
<td>LRPY</td>
<td>Base 10 logarithm RPY</td>
</tr>
<tr>
<td>LCPI</td>
<td>Base 10 logarithm CPI</td>
</tr>
<tr>
<td>LPOP</td>
<td>Base 10 logarithm POP</td>
</tr>
<tr>
<td>LPCI</td>
<td>Base 10 logarithm PCI</td>
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</table>
### Figure 5.1 (Continued)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>LTPI</td>
<td>Base 10 logarithm TPI</td>
</tr>
<tr>
<td>D1</td>
<td>Dummy variable = 1 for years prior to 1952, after 1967 for significant general tax changes; otherwise 0</td>
</tr>
<tr>
<td>D2</td>
<td>Dummy variable = 1 for years with wholesale sales tax collections, otherwise 0</td>
</tr>
<tr>
<td>D3</td>
<td>Dummy variable for years of biennial license collections = 1 for even years, 1964 and after</td>
</tr>
<tr>
<td>D4</td>
<td>Dummy variable = 1 when federal income tax was not deductible, otherwise 0</td>
</tr>
<tr>
<td>D5</td>
<td>Dummy variable = 1 after general withholding instituted for income tax, otherwise 0</td>
</tr>
<tr>
<td>D6</td>
<td>Dummy variable = 1 when food and drugs exempt from sales tax, otherwise 0</td>
</tr>
<tr>
<td>SD11</td>
<td>Dummy variable, = LTPI when D1 = 1, otherwise 0</td>
</tr>
<tr>
<td>SD12</td>
<td>Dummy variable, = LTPI when D2 = 1, otherwise 0</td>
</tr>
<tr>
<td>SD13</td>
<td>Dummy variable, = LTPI when D3 = 1, otherwise 0</td>
</tr>
<tr>
<td>SD14</td>
<td>Dummy variable, = LTPI when D4 = 1, otherwise 0</td>
</tr>
<tr>
<td>SD15</td>
<td>Dummy variable, = LTPI when D5 = 1, otherwise 0</td>
</tr>
<tr>
<td>SD16</td>
<td>Dummy variable, = LTPI when D6 = 1, otherwise 0</td>
</tr>
<tr>
<td>SD21</td>
<td>Dummy variable, = LPCI when D1 = 1, otherwise 0</td>
</tr>
<tr>
<td>SD22</td>
<td>Dummy variable, = LPCI when D2 = 1, otherwise 0</td>
</tr>
<tr>
<td>SD23</td>
<td>Dummy variable, = LPCI when D3 = 1, otherwise 0</td>
</tr>
<tr>
<td>SD24</td>
<td>Dummy variable, = LPCI when D4 = 1, otherwise 0</td>
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<tr>
<td>SD25</td>
<td>Dummy variable, = LPCI when D5 = 1, otherwise 0</td>
</tr>
<tr>
<td>SD26</td>
<td>Dummy variable, = LPCI when D6 = 1, otherwise 0</td>
</tr>
<tr>
<td>SD31</td>
<td>Dummy variable, = LPOP when D1 = 1, otherwise 0</td>
</tr>
<tr>
<td>SD32</td>
<td>Dummy variable, = LPOP when D2 = 1, otherwise 0</td>
</tr>
</tbody>
</table>
Figure 5.1 (Continued)

SD33 Dummy variable, = LPOP when D3 = 1, otherwise 0
SD34 Dummy variable, = LPOP when D4 = 1, otherwise 0
SD35 Dummy variable, = LPOP when D5 = 1, otherwise 0
SD36 Dummy variable, = LPOP when D6 = 1, otherwise 0
SD41 Dummy variable, = LRPY when D1 = 1, otherwise 0
SD42 Dummy variable, = LRPY when D2 = 1, otherwise 0
SD43 Dummy variable, = LRPY when D3 = 1, otherwise 0
SD44 Dummy variable, = LRPY when D4 = 1, otherwise 0
SD45 Dummy variable, = LRPY when D5 = 1, otherwise 0
SD46 Dummy variable, = LRPY when D6 = 1, otherwise 0
SD51 Dummy variable, = LCPI when D1 = 1, otherwise 0
SD52 Dummy variable, = LCPI when D2 = 1, otherwise 0
SD53 Dummy variable, = LCPI when D3 = 1, otherwise 0
SD54 Dummy variable, = LCPI when D4 = 1, otherwise 0
SD55 Dummy variable, = LCPI when D5 = 1, otherwise 0
SD56 Dummy variable, = LCPI when D6 = 1, otherwise 0
YT1 Product of LTPI and t, where t = calendar year at beginning of fiscal year
YT2 Product of LPCI and t
YT3 Product of LRPY and t
PT1 Product of LPOP and t
PT2 Product of LCPI and t
XT1 Product of LTPI and (k-t), where k = 3000, an arbitrary constant
to be important to the model structure. Thus an equation with a very high $R^2$, but with an insignificant income relationship, would have a low chance of being selected as the estimating equation. Although no specific criteria were used, there was a tendency to require higher levels of significance ($\alpha = .01$ or .02) of the variables judged more important; less essential variables were subject to less stringent tests ($\alpha = .05$ or .10).

Among empirical results roughly equal in quality according to the partially subjective tests above, preference was given to results with smaller standard errors. A standard error of 1.0 represents an order of magnitude, since the models are log-linear. Thus a calculated standard error of 0.25 would build a 2σ confidence interval, the upper and lower ends of which were an order of magnitude apart.

SALES TAX MODEL SELECTION

In Chapter 4, several models of sales tax revenue generation were considered. Those models, with the appropriate regression equations, are shown below. The paragraphs which follow describe the process by which these models and certain variations of them were used to arrive at the best model of the sales tax revenue function. Standard errors are shown in parentheses below the respective coefficients. The first sales tax model was

$$TR_{sal} = r_s a \cdot TP_{ibt}$$  \hspace{1cm} (4.16)
\[
LSAL = 0.68154 \text{ LSR} + 0.00046 \text{ YT1} \\
(0.03127) \quad (0.00000)
\]

\[
R^2 = 1.0000 \quad (5.1)
\]

The average deviation of the residuals of this equation was 0.0137, or approximately 3.2 percent of sales tax collections. The extremely large \( R^2 \) value was generated by the origin force, as this model has no constant term or intercept. Thus an "uncorrected" \( R^2 \) value is presented. The residuals of this regression appeared to follow a cyclical pattern, with turning points in 1956, 1961, and 1966. No explanation of this possibly autocorrelated phenomenon is provided.

The second model explaining sales tax revenues was

\[
TR_{sal} = r_{s, a} \cdot TPIbt + c \cdot D2 + d \cdot D6 + 10 \cdot e \cdot D2 \cdot 10 \cdot f \cdot D6 \quad (4.18)
\]

\[
LSAL = 0.56096 \text{ LSR} + 0.00045 \text{ YT1} - 0.09096 \text{ SD12} \\
(0.13885) \quad (0.00002) \quad (0.09367)
\]

\[
+ 0.45035 \text{ SD16} + 0.63874 \text{ D2} - 3.15257 \text{ D6} \\
(0.21367) \quad (0.64298) \quad (1.51263)
\]

\[
R^2 = 1.0000 \quad (5.2)
\]

Neither \( SD12 \) nor \( D2 \) were significant; repeating the computations without these variables produced the regression

\[
LSAL = 0.61456 \text{ LSR} + 0.00045 \text{ YT1} - 2.42303 \text{ D6} \\
(0.07544) \quad (0.00001) \quad (1.40276)
\]

\[
+ 0.34399 \text{ SD16} \\
(0.19764)
\]

\[
R^2 = 1.0000 \quad (5.3)
\]

which was the best fit of the model

\[
TR_{sal} = r_{s, a} \cdot TPIbt + c \cdot D6 \cdot 10 \cdot d \cdot D6 \quad (5.4)
\]

This equation has an income elasticity which grows slowly.
over time, and which is shifted (upward) by the food and drug exemption. The residuals followed a pattern similar to that described in equation 5.1 above.

Regressing sales tax revenues against the sales tax rate, total personal income, and the two dummy variables D2 and D6 produced no improvement; the coefficient of D2 was not significant.

\[ TR_{\text{sal}} = r_s a \cdot TPI_{\text{b}} + cD6 \cdot 10dD2 \cdot 10eD6 \]

resulted in the regression equation

\[ LSAL = .50468 LSR + .00044 YT1 + .01456 D2 \]
\[ (-.12601) \quad (.00002) \quad (.01340) \]
\[ - 2.62365 D6 + .37531 SD16 \]
\[ (1.40922) \quad (.19893) \]
\[ R^2 = 1.0000 \]

The third sales tax model was

\[ TR_{\text{sal}} = r_s a \cdot A_{\text{b}} \cdot TPI_{\text{c}} + dD2 + eD6 \cdot 10fD2 \cdot 10gD6 \]

\[ LSAL = 1.06019 LSR + 1.00327 LTPI + .31946 SD16 \]
\[ (.08474) \quad (.02144) \quad (.19715) \]
\[ - 2.33014 D6 \]
\[ (1.39908) \]
\[ R^2 = 1.0000 \]

The failure of the variable \( t \) to appear in equation 5.7 suggests that the term \( A_{\text{b}} \) is in reality constant.\(^2\) Neither dummy variable associated with wholesale collections appeared. Thus the results shown in equation 5.7 were

\(^2\)The variables \( t \), SD12, and D2 were not admitted by the regression algorithm; the F value of the regression could not be improved by .00001.
for the model

$$TR_{sal} = r_s^a \cdot TPI^b \cdot 10^{D6}$$  \hspace{1cm} (5.8)

The coefficient of SD16 suggested that the income elasticity of the sales tax rises from 1.00327 to

$$\varepsilon_y = 1.00327 + 0.31946$$

$$= 1.3227,$$

with the exemption of food and drugs from the tax. Since the elasticity shift coefficient was not highly significant ($t = 1.6204$), this model was tested:

$$TR_{sal} = r_s^a \cdot TPI^b \cdot 10^{D6}$$  \hspace{1cm} (5.9)

It generated the regression fit

$$LSAL = 1.07512 \cdot LSR + 1.00705 \cdot LTPI - 0.06346 \cdot D6$$

\hspace{1cm} (5.10)

In this model, income elasticity is a constant, at approximately unit value. The exemption of food and drugs causes a downward shift in revenues of approximately 16 percent (antilog of 0.06346).

A final variation of equation 4.21 deleted all dummy variables, but retained the constant:

$$TR_{sal} = A \cdot r_s^a \cdot TPI^b$$  \hspace{1cm} (5.11)

The regression fit for this model was

$$LSAL = -0.61220 + 0.71476 \cdot LSR + 1.00704 \cdot LTPI$$

\hspace{1cm} (5.12)

This comparatively naive model displayed a rate elasticity of 0.71476, which as expected was less than unity. The
equation also displayed an income elasticity of 1.00704, or approximately unity. The absolute deviation of the residuals was .0132, or approximately 3 percent of sales tax receipts.

All models above used total personal income as the income measure. These models were transformed into two variations. First, total personal income was replaced by per capita income and population. Second, total personal income was replaced by real per capita income, consumer price index, and population.

Varying the model of equation 5.11 to use the set of income variables PCI—POP resulted in the regression

\[
LSAL = -.72275 + .72794 \text{LSR} + .98683 \text{LPCI} \\
(\text{.10791}) (\text{.12041})
\]

\[+ 1.06367 \text{LPOP} \]

\[\text{(.33224)}\]

\[R^2 = .9955 \quad (5.13)\]

A slightly more sophisticated model;

\[
TR_{sal} = r_s^a \cdot A \cdot PCI^b + cD6 \cdot POP^d + eD6 \quad (5.14)
\]

was attempted, but the variable representing the coefficient \(e\) was not admitted by the regression. The resulting fit was

\[
LSAL = -1.21648 + .73484 \text{LSR} + 1.41919 \text{LPCI} \\
(\text{.11618}) (2.28257)
\]

\[+ .98882 \text{LPOP} - .00003 \text{SD26} \]

\[\text{(.52074)} \text{ (.00016)}\]

\[R^2 = .9958 \quad (5.15)\]

Neither LPCI nor SD26 were significant. Other models utilizing the pair of variables PCI—POP, and all models
utilizing RPY—CPI—POP, were of little value. While all equations tested had very high $R^2$ values and $F$ values, those equations including RPY, CPI, and POP as the primary set of independent variables had a marked tendency to show no significant relationship of sales tax revenues to the income measure. Further, the sales tax rate was frequently not admitted by the stepwise regression, even though program tolerances were set to encourage additional variables to be introduced. Finally, as the number of variables present was increased, there was a tendency for the significance of coefficients to decline and for standard errors to increase. This final problem was undoubtedly due to increased multicollinearity.

In summarizing the sales tax equation selection process, it was noted that the dummy variable D2 and its related slope-shift variables were seldom significant. The variable D6 and the related slope-shift variables were typically significant. Thus the best model included D6, but not D2. The tax rate variable was generally significant, so it was included in the model selected. In choosing the variable (or set of variables) which represented income, there was some evidence that using the measure TPI led to more credible results than did the use of (1) PCI and POP, or (2) RPY, CPI, and POP. The final decision for this model selection concerned the type of time-dependent elasticity. The best results were found in elasticities which increased linearly over time. Thus the preferred
sales tax model was that of equation 5.4

\[ TR_{sal} = r_s a \cdot TP_{Ibt} + cD_6 \cdot 10^{dD_6} \]  \hspace{1cm} (5.4)

**INCOME TAX MODEL SELECTION**

The paragraphs which follow outline the results of testing the income tax revenue generating models of Chapter 4, and variations thereof. The empirical results of all three models 4.22-4.24 were similar in that the use of both revenue shift and elasticity shift dummy variables rendered most coefficients nonsignificant. Therefore, some simpler models were formulated. The first of these utilized only the revenue shift dummy variables in a variation of equation 4.24. This implied that the effect on income elasticity of removing the deduction for Federal income taxes paid was negligible. The model tested was

\[ TR_{inc} = A \cdot TP_{Ia} + bT \cdot 10^{cD_4} \cdot 10^{dD_5} \]  \hspace{1cm} (5.16)

\[ LINC = -15.8827 + 1.72453 \cdot LTPI - .00237 \cdot YT1 \]
\[ \hspace{5cm} \text{(93270)} \text{ (0.00403)} \]
\[ + .21592 \cdot D5 + .47468 \cdot D4 \]
\[ \hspace{5cm} \text{(15420)} \text{ (10951)} \]
\[ R^2 = .9680 \]  \hspace{1cm} (5.17)

The coefficient of LTPI was 1.72, but the income elasticity is the exponent \( a + bt \), which was, for the year 1975,

\[ \epsilon_y = 1.72453 - .00237 \ (1975) \]
\[ = 1.72453 - 4.68075 \]
\[ = -2.95622 \]
This result carried little weight since the coefficient of \( YT_1 \) was not significant.

Fitting the model of equation 5.17 resulted in the variable \( YT_1 \) not being significant. This would imply that the coefficient \( b \) of the exponent \( a + bt \) was zero. Dropping the non-significant variable resulted in the simplified model

\[
TR_{inc} = A \cdot TPI^a \cdot 10^bD_4 \cdot 10^cD_5
\]  

(5.18)

This formulation assumed that the secular decline in income elasticity discussed in Chapter 4 was not a significant magnitude. Equation 5.18 was thus a model of constant income elasticity. The regression results for this equation were

\[
LINC = -3.38874 + 1.17608 \; LTPI + 0.20889 \; D_4
\]

\[
+ 0.06604 \; D_5
\]

\[
(0.11884) \quad (0.04704)
\]

\[
R^2 = 0.9671
\]

(5.19)

All coefficients were highly significant. The elimination of \( YT_1 \) from equation 5.17 did not significantly reduce the \( R^2 \) of the relationship.

Altering the form in which the variables \( D_4 \) and \( D_5 \) appeared generated the model

\[
TR_{inc} = A \cdot TPI^{a+b}D_4 + cD_5
\]  

(5.20)

This equation assumed that the revenue shifts accompanying the variables \( D_4 \) and \( D_5 \) were not significant features.

\[
LINC = -3.30053 + 1.16263 \; LTPI + 0.02947 \; SD_{14}
\]

\[
0.01034 \; SD_{15}
\]

\[
(0.12109) \quad (0.00658)
\]

\[
R^2 = 0.9675
\]

(5.21)
All coefficients were significant. Surveying the equations 5.19 and 5.21, it appeared that the shifts which occurred in 1964 and 1970 were both significant, but the form in which they should be modelled was left ambiguous.

Variations of equation 4.23 were tested in a similar manner. The most important such model was

\[ TR_{inc} = A \cdot TPIa(k-t) \cdot 10^bD^4 \cdot 10^cD^5 \] (5.22)

The dummy variables shift the revenue function, but do not alter the income elasticity. This reformulation produced a much better fit than did equation 4.23:

\[
\begin{align*}
LINC & = -5.47984 + .00143 \times T1 + .20755 \times D4 \\
& \quad + .08303 \times D5
\end{align*}
\]

(5.23)

All variables were significant at \( \alpha = .01 \) or .02; the \( R^2 \) value was acceptable.

The income elasticity of this model declines slowly over time. In 1975, that elasticity would be

\[ \varepsilon_y = .00143 \quad (3000-1975) \]

\[ = 1.4658 \]

Omitting the elasticity shift variables from equation 4.24 left the equation

\[ TR_{inc} = A \cdot PCIa + bt \cdot POPc + dt \cdot 10^eD^4 \cdot 10^eD^5, \] (5.24)

but the resulting regression showed the coefficient of D5 nonsignificant, and showed large standard errors for the coefficients of LPCI and LPOP. Omitting the nonsignificant
D5 left

\[ TR_{inc} = A \cdot PCI + bt \cdot POP + dt \cdot 10eD4, \]  

which gave the following result:

\[
\begin{align*}
LINC &= -22.015 - 2.51198 \cdot LPCI + 6.26945 \cdot LPOP \\
&\quad + 0.12523 \cdot YT2 - 0.11057 \cdot PT1 + 0.33512 \cdot D4 \\
&\quad (1.12715) (4.42164) \\
R^2 &= 0.9840 
\end{align*}
\]

To determine the income elasticity of this result, note that the partial elasticities (for fiscal 1975) were

\[
\begin{align*}
\epsilon_{PCI} &= -2.51198 + 0.12523 \cdot 1975 \\
&= 244.81925 \\
\epsilon_{POP} &= 6.26945 - 0.11057 \cdot 1975 \\
&= -212.1142
\end{align*}
\]

Letting \( g_1 \) and \( g_2 \) assume their historical averages of 9 percent and 1.5 percent, then the total income elasticity is

\[
\epsilon_y = \frac{0.09 \cdot 244.82 - 0.015 \cdot 212.11}{0.09 + 0.015} = 30.30
\]

This clearly unreasonable result was undoubtedly due to the increased standard errors of the coefficients of LPCI and LPOP. The true values of the parameters estimated by equation 5.25 could conceivably have quite a wide range: from 0.258 to 4.766 for LPCI, and from -2.574 to 15.113 for LPOP (using the estimate plus or minus two standard errors as an approximate measure). Once again, the problem of multicollinearity has reduced the value of the regressions.

In fitting such variations as

\[ TR_{inc} = A \cdot PCI at \cdot POPb \cdot 10cD4 \cdot 10dD5 \]  

(5.27)
and

\[ TR_{\text{inc}} = A \cdot PCI^{a} \cdot D^{4+c} \cdot POP^{d} \]  \hfill (5.28)

the results, as determined by a stepwise regression, did not admit the variable PT2, which is associated with the coefficient \( a \). Finally, the model

\[ A \cdot PCI^{a} \cdot POP^{b} \cdot 10^{c} \cdot D^{4} \cdot 10^{d} \]  \hfill (5.29)

generated the result

\[ LINC = 2.81858 + 1.84400 \cdot LPCI - 1.21981 \cdot LPOP \]
\[ + .15978 \cdot D^{4} + .10292 \cdot D^{5} \]
\[ R^2 = .9754 \]  \hfill (5.30)

However, this model contains no provision for the shift or time path of the elasticities with respect to per capita income and population. The formulation is thus inferior to the other models. Since the coefficient of LPOP is not significant, and since the \( R^2 \) value is not greatly larger than that of other models, this result will not be retained.

In testing models of the income tax revenue function using the set of income variables RPY—CPI—POP, few usable results were obtained. In order to build meaningful models, as many as ten or twelve independent variables had to be included; but those variables caused so much multi-collinearity that very few variables emerged significant. There were several cases of very unreasonable coefficients, and of coefficients of perverse sign. An example of these unreasonable results was

\[ TR_{\text{inc}} = A \cdot RPY^{a} \cdot D^{4+f} \cdot CPI^{b} \cdot D^{5} + POP^{ct+g} \cdot D^{5} \cdot 10^{d} \]  \hfill (5.31)
The resulting regression was

\[
LINC = -20.57549 - .00115 YT3 - .00284 PT2 \\
\quad (0.00084) (0.00114)
+ .00468 PT1 + 1.16107 SD35 + .79173 SD44 \\
\quad (0.00165) (1.44174) (2.11862)
+ 6.96142 SD45 - .98999 SD55 + .06340 D4 \\
\quad (2.17376) (1.35611) (1.17443)
\]

\[R^2 = .9859\quad (5.32)\]

As can be observed, most of the slope-shift variables (SD35, SD44, and SD55) were not significant; the standard errors were far too large to generate usable results.

In summary, the various models of the income tax revenue function using income measure TPI proved more reliable than either (1) PCI and POP or (2) RPY, CPI and POP. The latter two forms often resulted in regression fits in which estimated coefficients had perverse signs and large (greater than unity) standard errors. The dummy variables D4 and D5 were generally both significant. The time-dependent elasticities were generally nonsignificant. The model with the combination of best fit and most reasonable coefficients was

\[TR_{inc} = A \cdot TPIa + bD4 + cD5\quad (5.20)\]

which is the model of the fit shown in equation 5.21. An alternative equation had a slightly smaller \(R^2\) and generally smaller t-values, but modelled a declining income elasticity. This equation was thus preferred a priori and by the analysis of Chapter 4. The model in question was

\[TR_{inc} = A \cdot TPIa(k-t) \cdot 10bD4 \cdot 10cD5\quad (5.22)\]
In Chapter 4, various models of revenue generation for this tax group were proposed. Those models, and important variants of them, gave the empirical results which follow.

In testing equation 4.25, the coefficient of LTPI was not significant, and its standard error quite large. Income elasticity showed a tendency to rise over time in this relationship. This led to the formulation of an alternative model, omitting the constant term \( c \) in the exponent of TPI:

\[
TR_{aut} = r_s a r_g b TPI d t + e D3.10 f D3
\]  

\[
LAUT = -0.10817 LSR + 0.44533 LGR + 0.00039 YT1
\]

\[
-0.60929 D3 + 0.08323 SD13
\]

\[
R^2 = 1.0000
\]

The second automotive tax group revenue function presented in Chapter 4 was

\[
TR_{aut} = A r_a TPI^b + c t + d D3.10 e D3,
\]  

which generated the empirical equation

\[
LAUT = 1.62129 + 0.44449 LGR - 1.70347 LTPI
\]

\[
+ 0.00116 YT1 - 0.48162 D3 + 0.06524 SD13
\]

\[
R^2 = 0.9960
\]

This equation estimates \( \varepsilon_y \) to be

\[
\varepsilon_y = -1.70347 + 0.00116 t + 0.06524.
\]
For fiscal 1975, this would be
\[ \varepsilon_y = -1.70347 + 0.00116 \cdot 1975 + 0.06524 \]
\[ = -1.70347 + 2.291 + 0.06524 \]
\[ = 0.65277 \]

Here too, the elasticity displays a slow upward trend.

The standard error of the LTPI coefficient is quite large, and neither dummy variable is significant.

Deleting the elasticity shift effect of D3 left the model

\[ TR_{aut} = A \cdot r_a \cdot TPI^b + ct \cdot 10^{eD3} \] (5.36)

\[ LAUT = 1.33489 + 0.46230 \cdot LGR - 1.31985 \cdot LTPI \]
\[ (0.06196) \quad (1.20242) \]
\[ + 0.00098 \cdot YT1 - 0.02692 \cdot D3 \]
\[ (0.00055) \quad (0.00722) \]

\[ R^2 = 0.9958 \] (5.37)

Equation 5.37 estimates the income elasticity of the automotive tax group to be

\[ \varepsilon_y = -1.31985 + 0.00098 \cdot t \]

This elasticity rises slowly over time. For fiscal 1975, this would result in

\[ \varepsilon_y = -1.31985 + 0.00098 \cdot 1975 \]
\[ = -1.31985 + 1.93550 \]
\[ = 0.61565 \]

Still, the coefficient b was not significant. This suggested that an improved equation could be formulated as

\[ TR_{aut} = A \cdot r_a \cdot TPI^b \cdot ct \cdot 10^{eD3} \] (5.38)

\[ LAUT = 0.33559 + 0.44764 \cdot LGR + 0.00038 \cdot YT1 - 0.02621 \cdot D3 \]
\[ (0.06078) \quad (0.00001) \quad (0.00722) \]

\[ R^2 = 0.9956 \] (5.39)
The $R^2$ value was not significantly lower than in 5.35 or 5.37. All coefficients were significant; standard errors were small. This result indicated that income elasticity would be, in 1975

$$
\varepsilon_y = .00038 \cdot 1975
$$

$$
= .75050
$$

Substituting the pair of variables PCI--POP for TPI in 5.40 generated the model

$$
TR_{aut} = A \cdot r_g \cdot PCI_{bt} \cdot POP\cdot 10^{D3}
$$

(5.40)

$$
L_{AUT} = -0.07687 + 0.50756 \cdot LGR - 0.02721 \cdot D3
$$

(0.08914) (0.00733)

$$
+ .00035 \cdot YT2 + .00049 \cdot PT1
$$

(0.00004) (0.00012)

$$
R^2 = .9958
$$

(5.41)

The income elasticity exhibited by this model was, for 1975

$$
\varepsilon_y = \frac{\varepsilon_1 \cdot B1 + \varepsilon_2 \cdot B2}{B1 + B2}
$$

$$
= (0.00035 \cdot 1975) \cdot .09 + (0.00049 \cdot 1975) \cdot .015
$$

$$
= .087673
$$

$$
= .667
$$

The following model of the automotive tax group revenue function utilized the set of income variables RPY--CPI--POP. It was constructed on the same theoretical considerations as equations 5.38 and 5.40.

$$
TR_{aut} = A \cdot r_g \cdot RPY_{bt} \cdot CPI_{ct} \cdot POP_{dt} \cdot 10^{D3}
$$

(5.42)
LAUT = -0.11435 + 0.50669 LGR + 0.00036 YT3
      (.09131)     (.00008)
+ 0.00033 PT2 + 0.00048 PT1 - 0.02766 D3
      (.00008)     (.00013)     (.00776)

R^2 = .9957

While all coefficients were highly significant, the R^2 value
showed no improvement over either of the comparable models,
the results of which were shown in equations 5.39 and 5.41.
In all of the automotive tax group revenue models considered
above the elasticity of tax revenue with respect to the gasoline tax rate varied little: the range of estimates was 0.43811 to 0.55202. This estimate is perhaps more inelastic than previously suspected.

In estimating the coefficients of the various models for this tax group, the gasoline tax rate was generally a significant variable, as was the dummy variable D3. The income measure TPI was not the only one capable of producing credible results. The following equations adequately modelled the revenue function of the automotive tax group.

TR_{aut} = r_s \cdot r_g \cdot TPI dt + e^{D3} \cdot 10^{D3} \cdot 10^{D3} \cdot 10^{D3} \cdot 10^{D3}

TR_{aut} = A \cdot r_g \cdot TPI ct \cdot 10^{D3}

TR_{aut} = A \cdot r_g \cdot PCI bt \cdot POP ct \cdot 10^{D3}

All three models displayed an increasing income elasticity. Equation 5.33 was preferred to the others on the basis of the inclusion of an additional significant independent variable, the sales tax rate.
SUMPTUARY TAX GROUP
MODEL SELECTION

The models suggested by equations 4.27 and 4.28 and variations thereof were empirically tested. The results are shown in the paragraphs below. Equations 5.44 shows the regression which best fitted the model of equation 4.27.

\[
LSUM = 2.81813 - 2.41347 \text{LTP} + 0.00137 \text{YT} + 0.16892 \text{D} + 0.02847 \text{SD} \\
R^2 = .9853 \tag{5.44}
\]

None of the independent variables were significant.

Dropping the slope-shift variable SD from equation 4.27 left the model

\[
TR_{\text{sum}} = A \cdot \text{TPI} \cdot \text{YT} \cdot \text{D} \\
LSUM = 5.32637 + 0.33816 \text{LTP} + 0.00116 \text{YT} + 0.05097 \text{D} \\
R^2 = .9838 \tag{5.46}
\]

While all coefficients were significant at \( \alpha = .10 \), further improvements were desired. Since the coefficient of YT was positive, the regression indicated that income elasticity was rising. An increasing income elasticity could also be modelled by the equation

\[
TR_{\text{sum}} = A \cdot \text{TPI} \cdot \text{YT} \cdot \text{D} \\
LSUM = 0.90209 + 0.00029 \text{YT} + 0.02037 \text{D} \\
R^2 = .9844 \tag{5.48}
\]
The regression results for equation 4.28 displayed problems similar to those of 5.44: large standard errors and nonsignificant variables. Thus a simpler model was constructed, which omitted the elasticity shift variable associated with D1. This model was

\[ TR_{sum} = A \cdot TPI^{a(k-t)} \cdot 10^bD1 \] (5.49)

\[ LSUM = -0.83081 + 0.00079 XT1 + 0.01752 D1 \]

\[ R^2 = 0.9815 \] (5.50)

was the best regression fit of this model.

Equations modelled after the PCI—POP and RPY—CPI—POP sets of income variables were generally unsatisfactory in that the standard errors were much larger due to increased multi-collinearity.

The income measure TPI was the only one to provide credible results for the Sumptuary Tax Group. The dummy variable D1 was generally significant. Thus adequate results were obtained from two equations. Equation 5.47 had the higher \( R^2 \) and F values of the two.

\[ TR_{sum} = A \cdot TPI^{bt} \cdot 10^cD1 \] (5.47)

Equation 5.49

\[ TR_{sum} = A \cdot TPI^{a(k-t)} \cdot 10^bD1 \] (5.49)

although it had a lower \( R^2 \) and lower t-values, was also chosen. This latter explicitly modelled a declining income elasticity, which the analysis of Chapter 4 indicated was the preferred form of elasticity movement.
OTHER TAXES MODEL SELECTION

Two models of the relationship between income and this residual tax group were presented in Chapter 4, equations 4.29 and 4.30. The first model

\[ \text{T}_{\text{oth}} = A \cdot \text{TPI} \alpha + \beta t \quad (4.29) \]

generated the regression

\[ \text{LOTH} = 4.05818 - 8.51953 \text{LTPI} + .00438 \text{YT1} \]
\[ \quad (3.57217) \quad (.00162) \]
\[ R^2 = .9780 \quad (5.51) \]

The standard error and the coefficient of LTPI both seem much too large. Since income elasticity of this model was increasing, the following model was tested:

\[ \text{T}_{\text{oth}} = A \cdot \text{TPI} \beta t \quad (5.52) \]

\[ \text{LOTH} = -2.19238 + .00051 \text{YT1} \]
\[ \quad (.00002) \]
\[ R^2 = .9725 \quad (5.53) \]

Income elasticity of this model would be, in 1975

\[ \epsilon_y = .00051 \cdot 1975 \]
\[ = 1.007 \]

A variation of equation 5.52, using the independent variables PCI—POP, was tested:

\[ \text{TR}_{\text{oth}} = A \cdot \text{PCI} \alpha \cdot \text{POP} \beta t \quad (5.54) \]

\[ \text{LOTH} = 5.79987 + .00023 \text{YT2} + .00129 \text{PT1} \]
\[ \quad (.00007) \quad (.00021) \]
\[ R^2 = .9831 \quad (5.55) \]

The regression results for equation 4.30 exhibited very large standard errors, and were discarded. A slightly
simpler equation related to that model was then tested:

\[ TR_{\text{oth}} = A \cdot PCI_a \cdot POP^b \]  
(5.56)

\[ LOTH = -7.54313 + 0.58734 \cdot LPCI + 2.9050 \cdot LPOP \]  
\[ (.13681) \ 
\[ (.45033) \]

\[ R^2 = 0.9829 \]  
(5.57)

This equation had an \( R^2 \) no higher, and standard errors considerably larger, than those of equation 5.55.

The additive form (\( a + bt \)) of time-dependent elasticity did not behave well; neither did equations utilizing the independent variable set \( RPY--CPI--POP \). Of the remaining equations, the most reasonable results were obtained from 5.52 and its related form 5.54. Of these, equation 5.52 had the higher \( t \)-values.

\[ TR_{\text{oth}} = A \cdot TPI^b \]  
(5.52)

\[ TR_{\text{oth}} = A \cdot PCI^a \cdot POP^b \]  
(5.54)

The equations outlined above are used in the following chapter to formulate estimates of future revenues of each of the taxes and tax groups. These estimates are aggregated to obtain an estimate of total tax revenues. The selected regression equations and their resulting estimates, are used to analyze the time trend in the income elasticity of the tax structure of the State of Louisiana.

SUMMARY

A large number of alternative models have been examined for each of the five taxes and tax groups. The following paragraphs present the equations, chosen to
model the revenue generating processes of the nonseverance taxes.

Sales tax revenues were best modelled by equation 5.4, which displayed an increasing income elasticity. Modelling income tax revenues proved more troublesome. The best fit, equation 5.20, displayed a constant income elasticity. Equation 5.22 was slightly lower in quality of fit, but displayed a declining, and hence preferred, income elasticity. Equation 5.33 was chosen to model automotive tax group revenues. The sumptuary tax group modelling process posed a problem similar to that noted in choosing an income tax model. The best fit was found in equation 5.47, but a slightly lower quality fit was found in a preferred formulation, equation 5.49. Finally, the best model of the residual group Other Taxes was equation 5.52.

Thus the equations chosen to model nonseverance tax revenues were

1. \[ TR_{sal} = r_s a \cdot TPI^b t + cD6 \cdot 10^{dD6} \] (5.4)
2(a). \[ TR_{inc} = A \cdot TPI^a + bD4 + cD5 \] (5.20)
2(b). \[ TR_{inc} = A \cdot TPI^{a(k-t)} \cdot 10^{bD4} \cdot 10^{cD5} \] (5.22)
3. \[ TR_{aut} = r_s a \cdot r_g b \cdot TPI^{ct + dD3} \cdot 10^{eD3} \] (5.33)
4(a). \[ TR_{sum} = A \cdot TPI^b t \cdot 10^{cD1} \] (5.47)
4(b). \[ TR_{sum} = A \cdot TPI^{a(k-t)} \cdot 10^{bD1} \] (5.49)
5. \[ TR_{oth} = A \cdot TPI^b t \] (5.52)
Chapter 6

FORECASTS AND SUMMARY

In Chapter 4, various models of tax revenue generation were hypothesized. In Chapter 5, those models and many variations of them were tested. The summary of the previous chapter presented several equations, at least one for each tax and tax group, selected as best fits for the various models of tax revenue generation.

One purpose of this chapter is to utilize those regression equations to forecast future levels of revenues generated by each of those models. This is done in two stages. First, the values of the independent variables are projected. Several time series of future levels of the independent variables are prepared. Each series explicitly makes a different set of assumptions regarding the time trend of real per capita income growth, population growth, and inflation. These projections are substituted into the regression equations to project future tax revenues. For those models in which a tax rate or tax base variable was present, forecasts are presented to illustrate the impact of a policy decision to alter that tax rate or base.

The coefficients of the equations recommended in Chapter 5 do more than enable the forecasting mechanism. They provide empirical measures of the income elasticities
of the various taxes and tax groups. The form of these elasticities and their values are used to predict the time path of the income elasticity of the Louisiana tax structure.

This chapter concludes by summarizing the major contributions of the dissertation, which are four in number.

1. The development of an improved methodology for long-range forecasting of state tax revenues.

2. The development of the Upward-Bound Elasticity Theorem.

3. The use of that methodology and theorem to produce estimates of individual tax revenues and total tax revenues.

4. The suggestion that the income elasticity of the tax structure of the State of Louisiana is increasing slowly, to exceed unity in approximately ten years.

PROJECTING THE INDEPENDENT VARIABLES

Forecasts of tax revenues rely in turn on forecasts of the values of the variables which determine those revenues: total personal income (TPI), per capita income (PCI), real per capita income (RPY), consumer price index (CPI), and population (POP). The first need is to generate some hypothetical future values for the basic variables RPY, CPI, and POP. Since this dissertation rests largely on functions which grow according to power formulae (growth in the manner of compounding interest) these hypothetical values in turn must be derived from estimates of future growth rates of these variables.
That is, given the present values of RPY, CPI, and POP, and assuming a set of future growth rates for each variable, future values of all variables TPI, PCI, RPY, CPI POP, are obtained. These values, mapped through the regression functions selected for forecasts, generate revenue estimates for the various taxes under consideration.

On the following pages are found, first, alternate time series for each of the three variables RPY, CPI, and POP, reflecting different future growth rates for those variables; second, different combinations of growth patterns of these three variables, producing different scenarios of growth in TPI.

Tables 6.1 through 6.3 contain the extrapolations of the values of the independent variables RPY, CPI, and POP. Table 6.4 contains selected sets of extrapolations for the independent variable TPI. Table 6.1 contains seven possible growth paths for real per capita income; entries are in 1967 dollars. Each series represents a different long term growth rate for the independent variable. For each series, it is assumed that RPY falls 1 percent in 1974, 4 percent in 1975; that income rises 2 percent in 1976, 4.5 percent in 1977; and that the growth rate declines over three years time to the limiting value indicated in the column subhead.

Table 6.2 contains four possible sequences for the consumer price index, 1967 base; each series assumes a different long term rate of inflation. Each sequence assumes
inflation to 1977 at rates forecast by the Federal Budget Team.\(^1\) Inflation is then assumed to decline steadily until the limiting value indicated by the column subhead is reached. Table 6.3 provides seven possible time paths for the state's population. Each series is based on a different assumption regarding long-term population growth. Series 1 and 2 each assume a long-term annual growth rate of 0.6 percent. That limiting value is reached in five years time in Series 1, three years time in Series 2. Similar statements hold for Series 3 and 4.

Table 6.4 contains five representative time paths of total personal income, which is the product of RPY, CPI, and POP. Thus different combinations of the three latter variables generate different paths for total personal income. The three-digit descriptor for each series indicates (1) which RPY series was chosen, (2) which CPI series was chosen, and (3) which POP series was chosen. Thus income path 3-3-5 is built from the third series of RPY extrapolations, the third series of CPI extrapolations, and the fifth population growth pattern. Of all possible combinations of the RPY, CPI, and POP series, income path 1-1-1 represents the most conservative foreseeable growth in TPI. Income path 6-1-7 approximates the same average growth rates

---

as pertained over the time period studied, 1948-1974. Income path 3-3-5 assumes the same average growth rates as obtained during the period 1969-1974. Income path 5-4-3 assumes moderate real growth, substantial inflation, and slow population growth; these values are thought to be reasonable estimates of future growth rates in Louisiana. Income path 7-4-7 represents the largest foreseeable growth rates in the variables RPY, CPI, and POP.

Table 6.1
Actual\(^a\) and Projected Values of Real Per Capita Income (RPY) 1971-1985

<table>
<thead>
<tr>
<th>Year</th>
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<th>1.5%</th>
<th>2.0%</th>
<th>2.3%</th>
<th>2.5%</th>
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\(^a\)Actual values for 1971-73 are calculated from per capita income values in Statistics of the Developing South, Federal Reserve Bank of Atlanta, p. 4.
Table 6.2

Actual and Projected Values of Consumer Price Index
1971-1985

<table>
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<tr>
<th>Year</th>
<th>(1) Inflation rate, in percent per year</th>
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Table 6.3

Actual\textsuperscript{a} and Projected Values of Population
of State of Louisiana
1971-1985
(population in thousands)

<table>
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<th>Year</th>
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<th>(4)</th>
<th>(5)</th>
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<td>4142</td>
<td>4154</td>
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</table>


\textsuperscript{b}Limiting value reached in 1978, declining from 1.1 percent.

\textsuperscript{c}Limiting value reached in 1976, declining from 1.1 percent.
### Table 6.4

Selected Projections of Total Personal Income  
(in millions of current dollars)

<table>
<thead>
<tr>
<th>Year</th>
<th>TPI\textsubscript{111} \textsuperscript{a}</th>
<th>TPI\textsubscript{617}</th>
<th>TPI\textsubscript{335}</th>
<th>TPI\textsubscript{747}</th>
<th>TPI\textsubscript{543}</th>
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</thead>
<tbody>
<tr>
<td>1974</td>
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<td>$16,491.9</td>
<td>$16,319.2</td>
<td>$16,491.9</td>
<td>$16,379.9</td>
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<td>1975</td>
<td>17,701.9</td>
<td>17,895.8</td>
<td>17,683.6</td>
<td>17,895.8</td>
<td>17,646.6</td>
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<tr>
<td>1976</td>
<td>19,629.1</td>
<td>19,979.7</td>
<td>19,629.1</td>
<td>19,979.7</td>
<td>19,568.2</td>
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<tr>
<td>1977</td>
<td>22,012.5</td>
<td>22,584.0</td>
<td>22,063.8</td>
<td>22,344.5</td>
<td>21,967.5</td>
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<tr>
<td>1978</td>
<td>23,991.6</td>
<td>25,079.0</td>
<td>24,355.1</td>
<td>25,316.9</td>
<td>24,361.3</td>
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<td>1979</td>
<td>25,466.0</td>
<td>27,421.4</td>
<td>26,311.2</td>
<td>28,303.5</td>
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<tr>
<td>1980</td>
<td>26,847.9</td>
<td>29,705.0</td>
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<td>30,725.6</td>
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<td>29,395.4</td>
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<td>30,770.9</td>
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<td>35,878.1</td>
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<td>1984</td>
<td>32,201.8</td>
<td>39,940.2</td>
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<td>33,693.8</td>
<td>42,997.2</td>
<td>41,894.8</td>
<td>52,076.3</td>
<td>44,184.5</td>
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</table>

Source: Tables 6.1-6.3

\[ TPI_{1ijk} = RPY(1) \cdot CPI(j) \cdot POP(k) \]
FORECASTING THE DEPENDENT VARIABLES

The hypothetical future values of the income variables, which were set forth in the previous section, are now applied to the relevant regression equations, in order to forecast revenues of the six taxes and tax groups. Two distinct models of tax revenue generation are studied.

First, those equations pointed out at the close of Chapter 5, as the best fits for each of the taxes, are compiled into Model I. Revenues for the individual taxes, and for their sum, total taxes, under existing tax rates and under selected tax rate changes, are produced. The revenue forecasts are then used to analyze the future time path of the income elasticity of the entire Louisiana tax structure. Second, a set of equations, not necessarily the best fits, but preferable a priori and according to the analysis of Chapter 4, are compiled into Model II. As will be seen, some individual tax equations are common to both models. The procedures described above for Model I are duplicated in Model II.

Model I

Both first and second forecasting models contain an equation for forecasting each of the six taxes and tax groups. The first model contains the equations judged best fits of the various revenue generators described in Chapter 5. None of these equations displays decreasing income elasticity.
Sales tax. Sales tax revenue forecasts are made using the model

\[ \text{TR}_{\text{sal}} = r_s \cdot \text{TPI}_{111} + cD6 \cdot 10D6 \]  

estimated by

\[ \text{LSAL} = 0.61456 \cdot \text{LSR} + 0.00045 \cdot \text{YT1} - 2.42303 \cdot D6 + 0.34399 \cdot \text{SD16} \]

(5.3)

Table 6.5
Sales Tax Revenue Forecasts, Model I
(in millions)

<table>
<thead>
<tr>
<th>Fiscal Year</th>
<th>TPI$_{111}$</th>
<th>TPI$_{617}$</th>
<th>TPI$_{335}$</th>
<th>TPI$_{747}$</th>
<th>TPI$_{543}$</th>
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<td>$375.2</td>
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<tr>
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<td>702.4</td>
<td>799.5</td>
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<td>1,217.5</td>
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</table>

If the sales tax rate were raised to 4 percent, with no tax base changes, the resulting sales tax revenues would be as shown in Table 6.6.

Table 6.6
Sales Tax Revenue Forecasts, Model I, Four Percent Sales Tax Rate
(in millions)

<table>
<thead>
<tr>
<th>Fiscal Year</th>
<th>TPI$_{111}$</th>
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<th>TPI$_{335}$</th>
<th>TPI$_{747}$</th>
<th>TPI$_{543}$</th>
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</thead>
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<td>$455.6</td>
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<td>525.9</td>
<td>514.5</td>
<td>525.9</td>
<td>512.5</td>
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<tr>
<td>1980</td>
<td>780.7</td>
<td>884.5</td>
<td>838.2</td>
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</table>
The income elasticity of this sales tax model rises slowly over time, from 1.2327 in 1975 to 1.2372 in 1985.

**Severance taxes.** Future levels of severance tax revenues are primarily dependent on two factors: the speed of the decline in physical production of crude oil, condensate and natural gas, and the rate of price changes for crude oil and condensate. Professors Beard and Scott provide two sets of projections.² The more pessimistic set assumes that crude oil and condensate production decline ten percent per year through 1979-80, while natural gas production declines nine percent annually. Crude oil and condensate prices are projected to rise in line with the overall price index: nine percent in 1975-76, six percent annually thereafter. The less pessimistic forecasts assume the rate of decline in oil production to fall slowly from ten percent in 1975-1976 to six percent annually in 1979-80. Gas production was forecast to decline at a declining rate, from eight percent in 1975-76 to five percent in 1979-80. Changing technology in exploration and production, and pressures of demand and price, seem to make the latter projections the more reasonable set. Projections beyond the horizon of the Beard-Scott work were made by continuing into the future the smallest of the rates of production decline: six percent for crude oil, five percent for natural gas.

²Beard and Scott, *op. cit.*, p. 4.
The less pessimistic forecasts by Beard and Scott, as derived from information in Tables 5 and 6 of "Revenue Projections for Louisiana State Government, Fiscal Years 1974/75-1979/80" are as follows.

Table 6.7

<table>
<thead>
<tr>
<th>Fiscal Year</th>
<th>Tax Revenue</th>
</tr>
</thead>
<tbody>
<tr>
<td>1974/75</td>
<td>$552.0</td>
</tr>
<tr>
<td>1975/76</td>
<td>$537.0</td>
</tr>
<tr>
<td>1976/77</td>
<td>$515.0</td>
</tr>
<tr>
<td>1977/78</td>
<td>$499.0</td>
</tr>
<tr>
<td>1978/79</td>
<td>$489.0</td>
</tr>
<tr>
<td>1979/80</td>
<td>$485.0</td>
</tr>
</tbody>
</table>

Source: Beard and Scott, op. cit., Tables 5 and 6, p. 12.

Applying the smallest rates of production decline further into the future, revenues would be

<table>
<thead>
<tr>
<th></th>
<th>Oil</th>
<th>Gas</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1980/81</td>
<td>$311.0</td>
<td>$168.0</td>
<td>$479.0</td>
</tr>
<tr>
<td>1985/86</td>
<td>327.0</td>
<td>126.0</td>
<td>453.0</td>
</tr>
</tbody>
</table>

These forecasts, plus those of the minor severance taxes, produce the following projections of total severance tax revenues. Implicit in these totals is the assumption of a steady decline ($.5 million per year) in the revenues of the minor severance taxes. Continuing this same assumption, the forecasts for 1980/81 and for 1985/86 would be $489 million and $461.5 million, respectively.
Table 6.8
Total Severance Tax Revenues
Forecast by Beard and Scott
(in millions)

<table>
<thead>
<tr>
<th>Fiscal Year</th>
<th>Tax Revenue</th>
</tr>
</thead>
<tbody>
<tr>
<td>1974/75</td>
<td>$566.0</td>
</tr>
<tr>
<td>1975/76</td>
<td>550.5</td>
</tr>
<tr>
<td>1976/77</td>
<td>528.0</td>
</tr>
<tr>
<td>1977/78</td>
<td>511.5</td>
</tr>
<tr>
<td>1978/79</td>
<td>501.0</td>
</tr>
<tr>
<td>1979/80</td>
<td>496.5</td>
</tr>
</tbody>
</table>

Source: Beard and Scott, op. cit., Table 2, p. 4.

Income tax. The income tax model assuming constant income elasticity subject to shifts is used for Model I. This model is represented by the equation

$$ TR_{inc} = A \cdot TPI + bD4 + cD5 $$  \hspace{1cm} (5.20)

The regression fit of this equation is

$$ LINC = -3.30053 + 1.16263 \cdot TPI + 0.02947 \cdot SD14 + 0.01034 \cdot SD15 $$  \hspace{1cm} (5.21)

The dummy variable D4 is zero, and D5 is unity, for all years of the forecasts. Thus the estimated income elasticity of the Louisiana income tax is $1.16263 + 0.01034 = 1.17297$.

The estimates of future income tax revenues are found in Table 6.9.
Table 6.9
Income Tax Revenue Forecasts, Model I
(in millions)

<table>
<thead>
<tr>
<th>Fiscal Year</th>
<th>TPI111</th>
<th>TPI617</th>
<th>TPI335</th>
<th>TPI747</th>
<th>TPI543</th>
</tr>
</thead>
<tbody>
<tr>
<td>1975</td>
<td>$158.9</td>
<td>$161.0</td>
<td>$158.7</td>
<td>$161.0</td>
<td>$158.3</td>
</tr>
<tr>
<td>1976</td>
<td>179.4</td>
<td>183.2</td>
<td>179.4</td>
<td>183.2</td>
<td>178.7</td>
</tr>
<tr>
<td>1980</td>
<td>259.0</td>
<td>291.7</td>
<td>277.1</td>
<td>313.4</td>
<td>288.1</td>
</tr>
<tr>
<td>1985</td>
<td>338.1</td>
<td>450.1</td>
<td>436.6</td>
<td>563.5</td>
<td>464.7</td>
</tr>
</tbody>
</table>

Automotive tax group. Forecasts for the taxes combined into this group are made from the model

$$\text{TR}_{\text{aut}} = r_s a \cdot r_{gb} \cdot \text{TPI} + e + D_3 \cdot 10 f D_3 \quad (5.33)$$

and its regression equation

$$\text{LAUT} = -0.10817 \cdot \text{LSR} + 0.44533 \cdot \text{LGR} + 0.00039 \cdot \text{YT1} - 0.60929 \cdot D_3 + 0.08323 \cdot SD_13 \quad (5.34)$$

There are initially five sets of forecasts, corresponding to the five different time paths of total personal income previously chosen. The forecasts presented in Table 6.10 assume unchanged tax rates and bases.

Table 6.10
Automotive Tax Group Revenue Forecasts, Model I
(in millions)

<table>
<thead>
<tr>
<th>Fiscal Year</th>
<th>TPI111</th>
<th>TPI617</th>
<th>TPI335</th>
<th>TPI747</th>
<th>TPI543</th>
</tr>
</thead>
<tbody>
<tr>
<td>1975</td>
<td>$181.7</td>
<td>$183.2</td>
<td>$181.4</td>
<td>$183.1</td>
<td>$181.1</td>
</tr>
<tr>
<td>1976</td>
<td>197.0</td>
<td>200.0</td>
<td>196.9</td>
<td>199.9</td>
<td>196.3</td>
</tr>
<tr>
<td>1980</td>
<td>264.4</td>
<td>288.3</td>
<td>277.5</td>
<td>303.5</td>
<td>285.4</td>
</tr>
<tr>
<td>1985</td>
<td>319.2</td>
<td>385.5</td>
<td>377.5</td>
<td>446.8</td>
<td>393.4</td>
</tr>
</tbody>
</table>

The estimated coefficients of the model imply that an
increase in the sales tax rate would decrease automotive tax group revenues slightly. The cross-elasticity is \(-0.10817\).

An increase in the gasoline tax rate would significantly, but less than proportionately, increase revenues for the group.

Table 6.11 contains illustrations of both sales tax and gasoline tax rate increases, as applied to the time path of total personal income 5-4-3.

**Table 6.11**

<table>
<thead>
<tr>
<th>Gasoline tax (8¢)</th>
<th>8¢</th>
<th>10¢</th>
<th>10¢</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sales tax (3¢)</td>
<td>4¢</td>
<td>3¢</td>
<td>4¢</td>
</tr>
<tr>
<td>1975</td>
<td>$181.1</td>
<td>$175.6</td>
<td>$200.1</td>
</tr>
<tr>
<td>1976</td>
<td>196.3</td>
<td>190.3</td>
<td>216.8</td>
</tr>
<tr>
<td>1980</td>
<td>285.4</td>
<td>276.7</td>
<td>315.3</td>
</tr>
<tr>
<td>1985</td>
<td>393.4</td>
<td>381.3</td>
<td>434.5</td>
</tr>
</tbody>
</table>

Thus an increase in the sales tax rate would increase sales tax revenues, but decrease automotive tax group revenues. Since the sales tax revenue function has less than unit rate elasticity, the increased revenues of a higher sales tax rate are further dampened.

**Sumptuary tax group.** Forecasts are made using the model

\[ TR_{sum} = A \cdot TP_{ibt} \cdot 10cD, \]  

(5.47)
its regression fit

\[ LSUM = 0.90209 + 0.00029 \, YT1 + 0.02037 \, D1, \]  

(5.48)

and the five time series for movements of total personal income as described earlier.

Table 6.12
Sumptuary Tax Group Revenue Forecasts, Model I
(in millions)

<table>
<thead>
<tr>
<th>Fiscal Year</th>
<th>TPI_{111}</th>
<th>TPI_{617}</th>
<th>TPI_{335}</th>
<th>TPI_{747}</th>
<th>TPI_{543}</th>
</tr>
</thead>
<tbody>
<tr>
<td>1975</td>
<td>$118.5</td>
<td>$119.3</td>
<td>$118.4</td>
<td>$119.3</td>
<td>$118.3</td>
</tr>
<tr>
<td>1976</td>
<td>126.4</td>
<td>127.6</td>
<td>126.4</td>
<td>127.6</td>
<td>126.1</td>
</tr>
<tr>
<td>1980</td>
<td>154.2</td>
<td>163.4</td>
<td>159.4</td>
<td>169.3</td>
<td>162.5</td>
</tr>
<tr>
<td>1985</td>
<td>180.2</td>
<td>207.3</td>
<td>204.2</td>
<td>231.5</td>
<td>210.6</td>
</tr>
</tbody>
</table>

The revenues forecast here display an income elasticity which grows slowly over time, from .57275 in 1975, to .57565 in 1985. The rate of growth in sumptuary tax group revenues reflects both this income elasticity and the rate of growth in total personal income.

Other taxes. The forecasts of revenues from this tax group are made according to the revenue-generation model

\[ TR_{oth} = A \cdot TPI_{bt} \]  

(5.52)

and the resulting regression fit of that equation,

\[ LOTH = -2.19238 + 0.00051 \, YT1 \]  

(5.53)

This tax group is modelled with an income elasticity which increases over time. The range of estimated values of that income elasticity is 1.0073 for 1975, 1.0124 for 1985. Table 6.13 provides five sets of other taxes revenue
estimates, based on five possible income paths.

Table 6.13
Other Taxes Revenue Estimates, Model I
(in millions)

<table>
<thead>
<tr>
<th>Fiscal Year</th>
<th>TPI 111</th>
<th>TPI 617</th>
<th>TPI 335</th>
<th>TPI 747</th>
<th>TPI 543</th>
</tr>
</thead>
<tbody>
<tr>
<td>1975</td>
<td>$128.3</td>
<td>$129.7</td>
<td>$138.2</td>
<td>$129.7</td>
<td>$127.9</td>
</tr>
<tr>
<td>1976</td>
<td>143.6</td>
<td>146.2</td>
<td>143.6</td>
<td>146.2</td>
<td>143.1</td>
</tr>
<tr>
<td>1980</td>
<td>203.9</td>
<td>225.8</td>
<td>216.1</td>
<td>240.2</td>
<td>223.4</td>
</tr>
<tr>
<td>1985</td>
<td>268.0</td>
<td>343.0</td>
<td>334.1</td>
<td>416.4</td>
<td>352.6</td>
</tr>
</tbody>
</table>

Total tax revenues. The forecasts which follow are based on future movements in total personal income represented by time path 5-4-3. Real per capita income is thus assumed to grow at 2.5 percent per year. This rate exceeds the 2.0 percent average annual gain from 1969 to 1974, but falls short of the 3.0 percent average annual gain from 1948 to 1969. Thus the 2.5 percent growth rate falls between that of the post-World War II economic expansion and that of a relatively slow-growing economy. Such an intermediate value is a reasonable estimate of future real per capita income growth; this estimate assumes that the national economy is managed so that no severe recessions or economic disruptions occur. Inflation is assumed to occur at an annual rate of 6 percent. This assumption is based largely on two observations. First, inflation has been more severe, nationwide, in the past decade than in the two decades preceding it. Second, at least part of that inflation can be traced to deliberate federal policy aimed
at reduction in the rate of unemployment. It is assumed that such policy will be continued in future years, so that future rates of inflation will approximate those of the past several years. The population growth rate is assumed to decline to 0.8 percent per year. This value is lower than annual growth rates prevailing in the past decade and quarter-century, and is in keeping with both state and national long-term trends toward lower birth rates. Additionally, it is assumed that there are no administrative/legislative tax rate or tax base changes. The income time

Table 6.14
Total Tax Revenue Forecasts, Model I, Income Path TPI543

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Sales(^a)</td>
<td>$ 375.2</td>
<td>$ 429.5</td>
<td>$ 731.6</td>
<td>$1,259.2</td>
</tr>
<tr>
<td>Severance(^b)</td>
<td>550.5</td>
<td>528.0</td>
<td>489.0</td>
<td>461.5</td>
</tr>
<tr>
<td>Income(^c)</td>
<td>158.7</td>
<td>179.4</td>
<td>277.1</td>
<td>436.6</td>
</tr>
<tr>
<td>Automotive(^d)</td>
<td>181.1</td>
<td>196.3</td>
<td>285.1</td>
<td>393.4</td>
</tr>
<tr>
<td>Sumptuary(^e)</td>
<td>118.3</td>
<td>126.1</td>
<td>162.1</td>
<td>210.6</td>
</tr>
<tr>
<td>Other(^f)</td>
<td>127.9</td>
<td>143.1</td>
<td>223.4</td>
<td>352.6</td>
</tr>
<tr>
<td>Total</td>
<td>$1,511.8</td>
<td>$1,602.5</td>
<td>$2,169.1</td>
<td>$3,113.9</td>
</tr>
</tbody>
</table>

\(^a\)Source: Table 6.5
\(^b\)Source: Table 6.8
\(^c\)Source: Table 6.9
\(^d\)Source: Table 6.10
\(^e\)Source: Table 6.12
\(^f\)Source: Table 6.13

path 5-4-3 represents a 9.6 percent average annual growth rate in total personal income. This is a rate of increase
comparable to that used by other researchers. Before concluding the analysis of this model, forecasts of total tax revenues will be calculated for income time paths 1-1-1 and 7-4-7, to provide pessimistic and optimistic projections in addition to the expected values generated by path 5-4-3.

In Table 6.15 are found the ratios of the individual tax and tax group revenue estimates to the estimate of total tax revenues. The more elastic taxes show increasing proportions of total tax revenues. This trend is reinforced by the absolute decline of severance revenues, and would be further reinforced by use of the more pessimistic set of Beard/Scott estimates of severance revenues.

Also as predicted in Chapter 4, those taxes whose elasticity falls below the tax structure average elasticity

<table>
<thead>
<tr>
<th>Table 6.15</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ratio of Tax Revenue Estimates to Total Tax Revenue Estimates</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Sales</td>
<td>.2482</td>
<td>.2680</td>
<td>.3373</td>
<td>.4044</td>
</tr>
<tr>
<td>Severance</td>
<td>.3641</td>
<td>.3295</td>
<td>.2254</td>
<td>.1482</td>
</tr>
<tr>
<td>Income</td>
<td>.1050</td>
<td>.1120</td>
<td>.1278</td>
<td>.1402</td>
</tr>
<tr>
<td>Automotive</td>
<td>.1198</td>
<td>.1225</td>
<td>.1316</td>
<td>.1263</td>
</tr>
<tr>
<td>Sumptuary</td>
<td>.0783</td>
<td>.0787</td>
<td>.0749</td>
<td>.0676</td>
</tr>
<tr>
<td>Other</td>
<td>.0846</td>
<td>.0893</td>
<td>.1030</td>
<td>.1132</td>
</tr>
<tr>
<td>Total</td>
<td>1.0000</td>
<td>1.0000</td>
<td>1.0000</td>
<td>1.0000</td>
</tr>
</tbody>
</table>

Source: Table 6.14

3Beard and Scott, op. cit., p. 4; and Legler and Papke, op. cit., p. 176.
will decline in share. In the forecasts shown, the automotive and sumptuary groups show declining shares of total taxes in 1985 and 1980, respectively. This happens as the system average elasticity grows to exceed the elasticity of the tax groups.

The next step will be to measure the income elasticity at each of the four forecast years. The income elasticities of the various taxes are given in the table below.

Table 6.16
Income Elasticities, Model I

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Sales</td>
<td>1.2327</td>
<td>1.2332</td>
<td>1.2350</td>
<td>1.2372</td>
</tr>
<tr>
<td>Severance</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Income</td>
<td>1.1730</td>
<td>1.1730</td>
<td>1.1730</td>
<td>1.1730</td>
</tr>
<tr>
<td>Automotive</td>
<td>0.7703</td>
<td>0.8539</td>
<td>0.8554</td>
<td>0.7742</td>
</tr>
<tr>
<td>Sumptuary</td>
<td>0.5931</td>
<td>0.5934</td>
<td>0.5946</td>
<td>0.5960</td>
</tr>
<tr>
<td>Other</td>
<td>1.0073</td>
<td>1.0078</td>
<td>1.0098</td>
<td>1.0124</td>
</tr>
</tbody>
</table>

The weighted average income elasticity of the Louisiana tax structure thus varies over time as the individual elasticities and their weights vary.

Forecasts of total tax revenues and of income elasticity time paths were calculated using two additional income patterns. Income time paths TPI111 and TPI747 were selected to provide lower and upper bounds for future values of nominal tax revenues. Forecasts for these two income
Table 6.17

Time Path of Income Elasticity, Model I, Income Path TPI_{543}

<table>
<thead>
<tr>
<th>Year</th>
<th>TPI_{111}</th>
<th>TPI_{543}</th>
<th>TPI_{747}</th>
</tr>
</thead>
<tbody>
<tr>
<td>1975/76</td>
<td>1,514.5</td>
<td>1,511.8</td>
<td>1,525.3</td>
</tr>
<tr>
<td>1976/77</td>
<td>1,605.5</td>
<td>1,602.5</td>
<td>1,625.5</td>
</tr>
<tr>
<td>1980/81</td>
<td>2,024.7</td>
<td>2,169.1</td>
<td>2,314.9</td>
</tr>
<tr>
<td>1985/86</td>
<td>2,467.4</td>
<td>3,113.9</td>
<td>3,662.8</td>
</tr>
</tbody>
</table>

Source: Table 6.15 and 6.16

patterns, and for the expected income path TPI_{543}, are summarized in two tables below. Table 6.18 compares the total tax revenue forecasts of the three patterns. Table 6.19 compares the projected time path of income elasticity for the selected income time paths.

Table 6.18

Alternative Forecasts of Total Tax Revenues, Model I (in millions)

<table>
<thead>
<tr>
<th>Year</th>
<th>TPI_{111}</th>
<th>TPI_{543}</th>
<th>TPI_{747}</th>
</tr>
</thead>
<tbody>
<tr>
<td>1975/76</td>
<td>$1,514.5</td>
<td>$1,511.8</td>
<td>$1,525.3</td>
</tr>
<tr>
<td>1976/77</td>
<td>1,605.5</td>
<td>1,602.5</td>
<td>1,625.5</td>
</tr>
<tr>
<td>1980/81</td>
<td>2,024.7</td>
<td>2,169.1</td>
<td>2,314.9</td>
</tr>
<tr>
<td>1985/86</td>
<td>2,467.4</td>
<td>3,113.9</td>
<td>3,662.8</td>
</tr>
</tbody>
</table>

The projections differ most markedly in the 1980/81 and 1985/86 forecasts. Thus must be true, since the different income series were identical prior to 1974-75. The differing assumptions concerning growth rates become more apparent with the passage of time. Income path TPI_{111}
generates forecasts which exceed those from TPI\textsubscript{543} due to the differing population growth rate assumptions.

Table 6.19 summarizes the movement in income elasticity projected by each of the three selected income paths. The different time paths occur only because the levels of income are different; the income elasticities of the individual taxes are the same throughout Model I.

Table 6.19
Alternative Time Paths of Income Elasticity, Model I

<table>
<thead>
<tr>
<th>Year</th>
<th>TPI\textsubscript{111}</th>
<th>TPI\textsubscript{543}</th>
<th>TPI\textsubscript{747}</th>
</tr>
</thead>
<tbody>
<tr>
<td>1975/76</td>
<td>.6537</td>
<td>.6531</td>
<td>.6567</td>
</tr>
<tr>
<td>1976/77</td>
<td>.7037</td>
<td>.7032</td>
<td>.7087</td>
</tr>
<tr>
<td>1980/81</td>
<td>.8078</td>
<td>.8276</td>
<td>.8458</td>
</tr>
<tr>
<td>1985/86</td>
<td>.8685</td>
<td>.9175</td>
<td>.9489</td>
</tr>
</tbody>
</table>

Model II

The techniques illustrated in the previous section will now be applied to a variation of the first forecasting model. This variation contains two taxes which have declining income elasticities. The income tax estimating equation is

$$TR_{\text{inc}} = A \cdot TPI(a(k-t)) \cdot 10bD4 \cdot 10cD5$$  \hspace{1cm} (5.22)

The sumptuary tax group equation is

$$TR_{\text{sum}} = A \cdot TPI(a(k-t)) \cdot 10bD1,$$  \hspace{1cm} (5.49)

and all other equations are unchanged from Model I.

The specific equation for estimating income tax
revenues is

\[ LINC = -5.47984 + .00143 \times T1 + .20755 \times D4 + .08303 \times D5 \]  
(5.23)

This equation models two sources of revenue shifts, but does not allow those shifts to affect the income elasticity. The income elasticity depends on the time variable alone, and declines slowly:

\[ \epsilon_{1975} = .00143 \times (3000-1975) = 1.46575 \]
\[ \epsilon_{1985} = .00143 \times (3000-1985) = 1.45145 \]

The tax revenue estimates which follow are based on equation 5.23 and on the five hypothetical time paths of total personal income.

Table 6.20

Income Tax Revenue Estimates, Model II  
(in millions)

<table>
<thead>
<tr>
<th>Fiscal Year</th>
<th>Income Path 111</th>
<th>Income Path 617</th>
<th>Income Path 335</th>
<th>Income Path 747</th>
<th>Income Path 543</th>
</tr>
</thead>
<tbody>
<tr>
<td>1975</td>
<td>$168.6</td>
<td>$171.4</td>
<td>$168.4</td>
<td>$171.4</td>
<td>$167.9</td>
</tr>
<tr>
<td>1976</td>
<td>191.6</td>
<td>196.6</td>
<td>191.6</td>
<td>196.6</td>
<td>190.7</td>
</tr>
<tr>
<td>1980</td>
<td>274.8</td>
<td>318.5</td>
<td>298.9</td>
<td>348.2</td>
<td>313.6</td>
</tr>
<tr>
<td>1985</td>
<td>338.1</td>
<td>481.7</td>
<td>463.8</td>
<td>636.1</td>
<td>501.1</td>
</tr>
</tbody>
</table>

The best fit for this variation of the sumptuary tax group revenue generator is

\[ LSUM = -.83081 + .00079 \times T1 + .01752 \times D1 \]  
(5.50)

The income elasticity of this tax group falls slowly with time:

\[ \epsilon_{1975} = .00079 \times (3000-1975) = .80975 \]
\[ \epsilon_{1985} = .00079 \times (3000-1985) = .80185 \]
The table below contains estimates of future sumptuary tax group revenues, based on the equation above and on five hypothetical income paths.

Table 6.21

<table>
<thead>
<tr>
<th>Fiscal Year</th>
<th>Income Path 111</th>
<th>Income Path 617</th>
<th>Income Path 335</th>
<th>Income Path 747</th>
<th>Income Path 543</th>
</tr>
</thead>
<tbody>
<tr>
<td>1975</td>
<td>$113.7</td>
<td>$114.7</td>
<td>$113.6</td>
<td>$114.7</td>
<td>$113.4</td>
</tr>
<tr>
<td>1976</td>
<td>122.0</td>
<td>123.8</td>
<td>122.0</td>
<td>123.8</td>
<td>121.7</td>
</tr>
<tr>
<td>1980</td>
<td>148.9</td>
<td>161.6</td>
<td>156.0</td>
<td>169.7</td>
<td>160.2</td>
</tr>
<tr>
<td>1985</td>
<td>167.0</td>
<td>202.7</td>
<td>198.9</td>
<td>236.8</td>
<td>207.5</td>
</tr>
</tbody>
</table>

Total tax revenues of this model are forecast as shown in Table 6.22.

Table 6.22

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Sales</td>
<td>$375.2</td>
<td>$429.5</td>
<td>$731.6</td>
<td>$1,259.2</td>
</tr>
<tr>
<td>Severance</td>
<td>550.5</td>
<td>528.0</td>
<td>489.0</td>
<td>461.5</td>
</tr>
<tr>
<td>Income</td>
<td>167.9</td>
<td>190.7</td>
<td>313.6</td>
<td>501.1</td>
</tr>
<tr>
<td>Automotive</td>
<td>181.1</td>
<td>196.3</td>
<td>285.4</td>
<td>393.4</td>
</tr>
<tr>
<td>Sumptuary</td>
<td>113.4</td>
<td>121.7</td>
<td>160.2</td>
<td>207.5</td>
</tr>
<tr>
<td>Other</td>
<td>127.9</td>
<td>143.1</td>
<td>223.4</td>
<td>352.6</td>
</tr>
<tr>
<td>Total</td>
<td>$1,516.1</td>
<td>$1,609.3</td>
<td>$1,203.3</td>
<td>$3,175.4</td>
</tr>
</tbody>
</table>

a Source: Table 6.5  
b Source: Table 6.8  
c Source: Table 6.20  
d Source: Table 6.10  
e Source: Table 6.21  
f Source: Table 6.13
The ratios of the individual tax and tax group forecasts to the total tax revenue forecasts are given in Table 6.23. The elasticity estimates of Table 6.24, combined with the relative shares of total taxes in Table 6.23, yield the weighted average income elasticity of the entire tax structure. These values are shown in Table 6.25.

The income elasticities of Table 6.25 are higher than those of Table 6.17 primarily because of the larger estimate of the income elasticity of the income tax. To a lesser degree, the changed forecasts for income tax revenues and sumptuary tax group revenues, and their declining elasticities, contribute to the change.

Table 6.23

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Sales</td>
<td>.2475</td>
<td>.2669</td>
<td>.3321</td>
<td>.3966</td>
</tr>
<tr>
<td>Severance</td>
<td>.3631</td>
<td>.3281</td>
<td>.2219</td>
<td>.1453</td>
</tr>
<tr>
<td>Income</td>
<td>.1107</td>
<td>.1185</td>
<td>.1423</td>
<td>.1578</td>
</tr>
<tr>
<td>Automotive</td>
<td>.1195</td>
<td>.1220</td>
<td>.1296</td>
<td>.1239</td>
</tr>
<tr>
<td>Sumptuary</td>
<td>.0748</td>
<td>.0756</td>
<td>.0727</td>
<td>.0654</td>
</tr>
<tr>
<td>Other</td>
<td>.0844</td>
<td>.0889</td>
<td>.1014</td>
<td>.1110</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>1.0000</td>
<td>1.0000</td>
<td>1.0000</td>
<td>1.0000</td>
</tr>
</tbody>
</table>

Source: Table 6.22
Table 6.25

Income Elasticities, Model II

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Sales</td>
<td>1.2327</td>
<td>1.2332</td>
<td>1.2350</td>
<td>1.2372</td>
</tr>
<tr>
<td>Severance</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Income</td>
<td>1.4658</td>
<td>1.4643</td>
<td>1.4586</td>
<td>1.4515</td>
</tr>
<tr>
<td>Automotive</td>
<td>0.7703</td>
<td>0.8539</td>
<td>0.8554</td>
<td>0.7742</td>
</tr>
<tr>
<td>Sumptuary</td>
<td>0.8098</td>
<td>0.8090</td>
<td>0.8058</td>
<td>0.8019</td>
</tr>
<tr>
<td>Other</td>
<td>1.0073</td>
<td>1.0078</td>
<td>1.0098</td>
<td>1.0124</td>
</tr>
</tbody>
</table>

Table 6.25

Time Path of Income Elasticity, Model II, Income Path $TPI_{543}$

<table>
<thead>
<tr>
<th>Year</th>
<th>$\delta y$</th>
</tr>
</thead>
<tbody>
<tr>
<td>1975/76</td>
<td>.7050</td>
</tr>
<tr>
<td>1976/77</td>
<td>.7576</td>
</tr>
<tr>
<td>1980/81</td>
<td>.8905</td>
</tr>
<tr>
<td>1985/86</td>
<td>.9805</td>
</tr>
</tbody>
</table>

Accuracy of Forecasts

The reliability of the forecasting techniques was tested by comparing actual tax revenues for fiscal years 1974/75 and 1975/76 to forecasts of those years' tax revenue by the estimating equations of Models I and II. These forecasts were prepared from the income patterns previously used and from the actual values of personal income. This additional measure was introduced to display the accuracy of the estimating equations in the absence of error in projecting the independent variables.

Three significant phenomena were apparent. First, all estimates of total non-severance tax revenues were below...
the actual tax revenues. Second, the forecasting error was compounded by errors in the forecast of personal income. Third, the estimates obtained from Model II were clearly superior to those of Model I. Such estimates lend more support to the hypothesis of declining income elasticities of some individual taxes. Table 6.26 compares the forecasts obtained from Model II, using both projected and actual income levels, to actual tax revenues.

Table 6.26
Comparison of Actual Tax Revenues, 1974/75 and 1975/76, to Forecast Values, Model II

<table>
<thead>
<tr>
<th>Fiscal Year 1974/75</th>
<th>Fiscal Year 1975/76</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tax</td>
<td>Actual Tax Revenue</td>
</tr>
<tr>
<td>Sales</td>
<td>$365.1</td>
</tr>
<tr>
<td>Income</td>
<td>187.5</td>
</tr>
<tr>
<td>Automotive</td>
<td>174.6</td>
</tr>
<tr>
<td>Sumptuary</td>
<td>100.4</td>
</tr>
<tr>
<td>Other</td>
<td>110.7</td>
</tr>
<tr>
<td>Total Non-Severance</td>
<td>$938.3</td>
</tr>
<tr>
<td>Sales</td>
<td>$421.3</td>
</tr>
<tr>
<td>Income</td>
<td>205.4</td>
</tr>
<tr>
<td>Automotive</td>
<td>183.6</td>
</tr>
<tr>
<td>Sumptuary</td>
<td>106.5</td>
</tr>
<tr>
<td>Other</td>
<td>118.9</td>
</tr>
<tr>
<td>Total Non-Severance</td>
<td>$1035.7</td>
</tr>
</tbody>
</table>
The largest forecast errors occurred in the income tax revenue function. The estimate was $33.1 million low in 1974/75, $37.5 million low in 1975/76. The simplest rationalization is that the model understated the increase in income elasticity and/or revenue due to increased enforcement levels in the 1970's. The non-severance tax revenue forecast was 0.918 of actual in 1974/75, 0.933 in 1975/76.

Actual personal income in 1974 was $16,766 million, compared to the projected value of $16,380 million. Similarly, 1975 personal income was $18,591 million, which exceeded the forecast of $17,647 million. Forecasts based on actual income levels were 0.970 and 0.988 of actual non-severance revenues in 1974/75 and 1975/76. These ratios suggest that considerable accuracy was gained by the use of more precise values of the independent variables.

POLICY IMPLICATIONS

The paragraphs which follow outline the effects on total tax revenues and on the income elasticity of the tax structure of an increase in the state sales tax rate to 4 percent. The effects are measured using forecasting Model II and income path TPI_{543}. The moderate real growth, substantial inflation, and slow population growth which characterize TPI_{543} represent the time path of income with the highest likelihood of occurring, according to the author. The forecasts of tax revenues which would result from this policy action are found in Table 6.27.
Of course, any of the five time paths, or any other time path not so far presented, can be used for the forecasting process. Estimates can be revised by shifting from one income pattern to another that appears more likely.

Table 6.27

Total Tax Revenue Forecasts, Model II, 4 Percent Sales Tax Rate, Income Path TPI

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Salesa</td>
<td>$447.8</td>
<td>$512.5</td>
<td>$873.1</td>
<td>$1,502.7</td>
</tr>
<tr>
<td>Severanceb</td>
<td>550.5</td>
<td>528.0</td>
<td>489.0</td>
<td>461.5</td>
</tr>
<tr>
<td>Incomec</td>
<td>167.9</td>
<td>190.7</td>
<td>313.6</td>
<td>501.1</td>
</tr>
<tr>
<td>Automotived</td>
<td>175.6</td>
<td>190.3</td>
<td>276.7</td>
<td>381.3</td>
</tr>
<tr>
<td>Sumptuarye</td>
<td>113.4</td>
<td>121.7</td>
<td>160.2</td>
<td>207.5</td>
</tr>
<tr>
<td>Otherf</td>
<td>127.9</td>
<td>143.1</td>
<td>223.4</td>
<td>352.6</td>
</tr>
<tr>
<td>Total</td>
<td>$1,583.1</td>
<td>$1,686.4</td>
<td>$2,336.0</td>
<td>$3,406.8</td>
</tr>
</tbody>
</table>

a Source: Table 6.6  
b Source: Table 6.8  
c Source: Table 6.20  
d Source: Table 6.10  
e Source: Table 6.21  
f Source: Table 6.13

Table 6.28 transforms the entries in Table 6.27 into ratio form. Each new entry shows the ratio of total tax revenues generated by each tax and tax group for each year forecast.

The time trend in each of the individual taxes and tax groups behaves very much as indicated in Chapter 4. The most significant difference between the hypothetical results of Chapter 4 and the estimates of elasticities provided here is that the absolute decline in severance
Table 6.28

Ratio of Tax Revenue Estimates to Total
Tax Revenue Estimates, Model II, 4 Percent Sales Tax Rate
Income Path TPI

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Sales</td>
<td>.2829</td>
<td>.3039</td>
<td>.3738</td>
<td>.4411</td>
</tr>
<tr>
<td>Severance</td>
<td>.3477</td>
<td>.3131</td>
<td>.2093</td>
<td>.1355</td>
</tr>
<tr>
<td>Income</td>
<td>.1060</td>
<td>.1131</td>
<td>.1343</td>
<td>.1471</td>
</tr>
<tr>
<td>Automotive</td>
<td>.1109</td>
<td>.1129</td>
<td>.1184</td>
<td>.1119</td>
</tr>
<tr>
<td>Sumptuary</td>
<td>.0716</td>
<td>.0722</td>
<td>.0686</td>
<td>.0609</td>
</tr>
<tr>
<td>Other</td>
<td>.0808</td>
<td>.0849</td>
<td>.0956</td>
<td>.1035</td>
</tr>
<tr>
<td>Total</td>
<td>1.0000</td>
<td>1.0000</td>
<td>1.0000</td>
<td>1.0000</td>
</tr>
</tbody>
</table>

Source: Table 6.27

tax revenues results in more rapid change in income elasticities than does the constant value assumed in Chapter 4.

The automotive tax group and the sumptuary tax group display declining shares of total tax revenues in 1985/86 and 1980/81, respectively. These tax groups have become less elastic than the average for the entire tax structure. This is almost precisely as indicated in Chapter 4.

As explained earlier, total tax revenues rise less than the increase in sales tax revenues, as a small decline in automotive tax group revenues accompanies the increased sales tax rate. The individual tax and tax group income elasticities are unchanged; they are found in Table 6.22. Table 6.29 displays the time path of the income elasticity of the tax structure under this policy change.
Table 6.29
Time Path of Income Elasticity, Model II

Percent Sales Tax Rate

<table>
<thead>
<tr>
<th>Year</th>
<th>$\epsilon_y$</th>
</tr>
</thead>
<tbody>
<tr>
<td>1975/76</td>
<td>.7289</td>
</tr>
<tr>
<td>1976/77</td>
<td>.7808</td>
</tr>
<tr>
<td>1980/81</td>
<td>.9106</td>
</tr>
<tr>
<td>1985/86</td>
<td>.9995</td>
</tr>
</tbody>
</table>

With an increased sales tax rate (and with no other administrative or legislative changes in tax rates, tax bases, or enforcement) the tax structure of the State of Louisiana is projected to become practically unit elastic in approximately ten years. The increase in the rate of a slightly income-elastic tax thus hastens the increase in the income elasticity of the tax structure. Had the same first-year increase in revenues been the result of an increased gasoline tax (or other income-inelastic source), the increase in income elasticity over time would have been slowed.

This serves to explain why the tax structure has not already become unit elastic. In view of the Upward-Bound Elasticity Theorem, and of the hypothetical examples and empirical evidence, the tax structure could have become unit income-elastic years ago. The reason that it did not is in large measure due to the fact that many of the recent (and not so recent) tax increases have been on income-inelastic sources: gasoline, liquor and tobacco, oil and
natural gas. By increasing the share of total tax revenues produced by these sources, the income-elasticity of the tax structure falls.

The State of Louisiana levies taxes which display a wide range of income elasticities. Thus it is theoretically possible for the state to deliberately manipulate the income elasticity of its tax structure by raising or lowering rates on selected taxes. The potential growth in tax revenues can then be matched to the potential growth in expenditures.

SUMMARY OF FINDINGS

This final section of the dissertation is devoted to a summary of its contributions. These contributions are divided into two broad areas: advances in methodology, and empirical results.

Advances in Methodology

From a very extensive literature on the subject of state tax revenue forecasting, this dissertation has borrowed many relevant techniques. The contribution of this research is not the originality of the individual techniques, but their combination into a unified model. Several researchers, beginning with Groves and Kahn, utilized log-linear models. Singer initiated the use of dummy variables (in linear models) to model revenue shifts. Dockel modelled elasticity shifts perhaps without realizing
it. Wilford and others treated total personal income as the product of per capita income and population. Several researchers, learning from the omission of Groves and Kahn, included rate variables in their models. Several researchers have built (or attempted to build) models with interdependence of taxes. This dissertation utilizes all of the above features in its models of tax revenue generation. To the author's knowledge, this combination of features is unique. The equation used to model the revenue generation process of the automotive tax group illustrates many of these features. The sales tax rate appears explicitly, which indicates interdependence. The exponent of TPI, which is the income elasticity of the tax group, is time-dependent and subject to shifts. The dummy variable D3 shifts the revenue function as well as its income elasticity.

In addition to properly adapting a number of extant techniques in the building of state tax revenue generation models, this dissertation has added features which are, for the most part, original. Several authors had commented that, while their models assumed constant income elasticities, variable elasticities might in fact be more realistic. However, no researcher explicitly and knowingly utilized income elasticities which varied with time or with income. Wilford noted that the income elasticity which he estimated was an average for the time series.

Thus this dissertation, in building exponents of the income variable(s) in forms incorporating a time variable,
has explicitly modelled variable income elasticities. These forms of income elasticities are necessary to a properly specified model of the revenue generating process of many of the state's taxes.

Several researchers, among them Dockel, Wilford, and Richardson, have observed that the income elasticity of the tax structure rose over time. Dockel ascribed the rise to exogenous change; Wilford gave no explanation. The forecasts by Beard and Scott imply a rising income elasticity, but they do not comment on that feature. Richardson alone, in an article written at about the same time as parts of this dissertation, notes that the rise in income elasticity is due to endogenous factors. His writings imply that the more elastic taxes contribute greater portions of total tax revenues over time, and hence alter the weights used to compute income elasticity.

This dissertation has formalized that concept, with an analysis of the Upward-Bound Elasticity Theorem. This theorem states that the income elasticity of a tax structure tends, over time, to approach the income elasticity of the most elastic component of that structure. This effect was precisely demonstrated for a structure of constant-elasticity taxes, and was simulated for a more realistic structure which contained some variable-elasticity taxes.

**Significance of Forecasts**

In addition to developing an improved methodology
for the use of an elasticities approach to state tax revenue forecasting, this dissertation has applied that methodology to the problem of forecasting tax revenues for the State of Louisiana. However, this methodology can be useful in developing models of tax revenue generation for the tax structures of other states.

These forecasts serve three purposes. First, the forecasts provide to various legislators and administrative officials reliable estimates of the nominal amount of money generated by the state's taxes, as currently levied, in the intermediate and long run. As stated before, an elasticities approach is most effective over a relatively long time horizon. The estimates can be revised to reflect varying patterns of future income growth.

Second, policy-makers are given information concerning the impact, on individual tax revenues and on the aggregate total tax revenues, of various tax policy changes. This is accomplished through manipulation of the tax rate variables and the dummy variables which reflect shifts in tax rates, tax bases, or tax administration. The previous section provided estimates of the impact on total tax revenues of an increase in the sales tax rate, for a specific pattern of income growth. The same techniques can be employed to determine the impact of even higher tax rates, or increases in other tax rates, such as the gasoline tax rate. These impacts can be measured at the supposed time path of income or at any other income growth pattern.
Finally, the forecasts of tax revenues enable the estimation of the time path taken by the income elasticity of the tax structure. All of the estimates published in this dissertation indicate an income elasticity currently significantly below unity, but growing at a moderate rate. None of the estimates how income elasticity growing to exceed unity by fiscal 1985, but the shortfall is very slight in all cases. The estimates suggest that the income elasticity of the tax structure will rise more rapidly as income grows more rapidly, and that income elasticity will be increased if policy changes increase rates on the relatively elastic taxes. Specifically, income elasticity is estimated to become practically unitary by 1985 if income grows approximately 9.6 percent annually, and if the sales tax rate is increased to 4 percent.
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U. S. Bureau of the Census. Compendium of State Government


VITA

Lloyd Wayne Shell was born October 31, 1944. He was raised in Beaumont, Texas, and in 1962 was graduated from French High School of that city. He received his baccalaureate degree from Rice University in 1966, and earned a Master of Arts in Economics from Louisiana State University in 1969. His graduate study continued at Louisiana State University in the Department of Economics; his minor field of study was Quantitative Methods. It was during this period that he developed interest in the field of study that led to this dissertation.

Three years' service as a teaching assistant in the Department of Economics at L. S. U. confirmed his desire to pursue a career in instruction in higher education. He has taught economics and quantitative methods at Nicholls State University in Thibodaux, Louisiana, since 1971, and served as head of the Department of Economics and Finance for two years.

He married the former Janelle Louise Bergeron in 1968; they have an infant daughter, Nancy Claire. The family currently resides in Thibodaux, Louisiana.
EXAMINATION AND THESIS REPORT

Candidate:  Lloyd Wayne Shell

Major Field:  Economics

Title of Thesis:  "Revenue Growth and a State's Tax Structure: The Case of Louisiana"

Approved:

[Signatures]

Major Professor and Chairman

Dean of the Graduate School

EXAMINING COMMITTEE:

[Signatures]

Date of Examination:  March 4, 1977