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AN ECONOMETRIC MODEL FOR FORECASTING
INTERNAL TAXES:
A NATIONAL LEVEL APPROACH

By

ROSARIO G. MANASAN*

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The views expressed in this paper are those of the authors and not necessarily those of PIDS.

* With the technical assistance of Mr. Dennis S. Deveza and Misses Florie Lejano, Ma. Theresa Jaramillo, Mariquit Soriano and Ruth Fontamillas.

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ABSTRACT

The ability to project and forecast future tax collections is an important element in the identification of future budgetary gaps and the planning of new tax measures that may be needed to meet these needs. Aside from projecting future tax collections, a good tax forecasting model may also be used as a gauge against which to measure the government's tax collection efforts.

The purpose of this paper is to develop, specify and estimate a forecasting model for internal taxes which has a higher level of disaggregation, includes determinants in the specification other than tax bases, and considers various proxy variables for the tax bases.

Total tax collections fall into four general categories, namely: (1) income taxes, (2) license and business taxes, (3) specific taxes, and (4) other taxes. Some seventy sub-categories are divided into these four main groupings.

Structural single equation forecasting models were specified and estimated for a selected number of these sub-categories for the period 1961-1978. The rest were estimated through the use of identities.

The determinants used to explain and forecast the movements of the tax variables may be classified into two groupings: (1) variables that reflect the tax bases; and (2) variables that reflect the changes in the tax structure and tax rates over time.

In specifying the functional relationship between the tax and explanatory variables, both the linear and logarithmic forms were considered. For each of the forecasting equations estimated, the t-statistics, coefficient of determination, R^2 , and the percentage root mean square error (RMSE%) were computed to aid in evaluating the

relative merits of alternative forecasting equations. The equation harnessing the highest number of merits relative to a set of criteria is used to compute the forward projections of the tax variable specified.

Having built an econometric model for forecasting future taxes which exhibited lower forecasting errors, were now challenged to test our next modeling work towards the spatial or regional direction.

The full documentation of this project required the inclusion of the data base of the tax variables and their determinants for the estimating (1961-1978) and forecasting (1979-1982) period. Since the data series for these highly disaggregated variables were not readily available, this was an initial problem. The result of the effort, though, should eliminate re-gathering of data already established and make the model implementable by Bureau personnel.

AN ECONOMETRIC MODEL FOR FORECASTING INTERNAL TAXES: A NATIONAL LEVEL APPROACH

1. INTRODUCTION

Tax revenue forecasting is an essential input in the budgetary process. The ability to project and forecast future tax collections is an important element in the identification of future budgetary gaps and in the planning of new tax measures that may be needed to meet these needs. In addition, taxes are considered to play a major part in the financing of the country's economic and social development. Hence, the government's tax collection agencies assume a pivotal role in this respect. A good tax forecasting model may therefore be used as a gauge against which to measure the government's tax collection efforts .

An earlier paper reviewed the existing tax forecasting models in the Philippines.¹ The findings of the said paper indicate that: (1) a high degree of disaggregation in tax forecasting model yields low performance in statistical tests reflecting the greater difficulty involved in capturing the volatile movements inherent in each tax category; (2) the use of tax bases and other variables expected, a priori, to be more reflective of the tax structure than simpler variables like time in explaining the level of tax receipts, is not a guarantee in obtaining more accurate forecasts; and (3) the elasticities approach in tax forecasting resulted in the lowest average root mean square percentage forecasting error, indicating in turn that the functional relationship between the different tax categories and their respective bases is better described by the power function and the simpler linear one.

It is in this context that the present study is undertaken. The purpose of this paper is to develop, specify and estimate a forecasting model for internal taxes (i.e., taxes collected by the Bureau of Internal Revenue) taking into consideration the implications stated in the earlier study. In particular, this paper will attempt to estimate a tax forecasting model that has a higher level of

¹ Bureau of Internal Revenue, "Survey and Review of Forecasting Models on Internal Government Revenues," unpublished Philippine Institute for Development Studies Paper, March 1981.

disaggregation, includes determinants in the specification other than tax bases, and considers various proxy variables for the tax bases.

Total tax collections fall into four general categories namely: (1) income taxes, (2) license and business taxes, (3) specific taxes and (4) other taxes. Some seventy sub-categories are divided into these four main groupings. In making this study, structural single equation forecasting model were specified and estimated for a selected number of these sub-categories for the period 1961-1978. The rest were estimated through the use of identities. The choice of the tax variables that were actually forecasted with the regression equations is discussed in the next section.

Using the estimated forecasting equations, the values of the different tax variables were then forecasted for the period 1979-1982. The 1979-1980 forecasts were compared with actual values, when such values are available, while the 1981-1982 forecasts are interpreted as the tax revenue implication of the 1978-1982 Five Year Development Plan, i.e. the amount of taxes that may be collected by the government if the macroeconomic targets of the Plan were attained. A fuller explanation is contained in Section Three.

Section Three also outlines the methodology used in this paper. Section Four provides a discussion of the data and their sources. Section Five, on the other hand, contains the analysis and Section Six summarizes the results obtained in the previous section.

2. THE VARIABLES

As earlier indicated, time-series data covering 1961-1978 for more than seventy tax sub-categories are available from the Bureau of Internal (BIR). However, forecasting of some of these tax variables was not done with the use of regression equations.

The criteria used in selecting the tax sub-groupings investigated in this study are: (1) share of the tax sub-category in the total revenue take of the major classification where it belongs to i.e., if a sub-grouping accounts for more than 10 per cent of the total receipts of the major tax groupings it belong to, it was included in the list of tax variables to be studied in greater detail;

(2) growth rate of the tax-sub-category, i.e., if the growth rate of the tax sub-classification is greater than average growth rate of total collections, it was considered worthy of more detailed analysis; (3) tax sub-categories that are of special interest from the economic view point, e.g. taxes from the sale of luxury and semi-luxury items, transfer taxes, etc.; and (4) tax sub-categories that exhibited highly erratic movements through time; these were lumped into the “others” category and analyzed as a separate sub-grouping.

On the basis of this selection scheme, the following list of tax variables was considered for more intensive study:

1. income taxes
 - 1.1. individual income tax
 - 1.2. corporate income tax
2. license and business taxes
 - 2.1. percentage taxes
 - 2.1.1 contractor’s tax
 - 2.1.2 sales tax
 - 2.1.2.1 sales tax on luxury items
 - 2.1.2.2 sales tax on semi-luxury items
 - 2.1.2.3 sales tax on non-luxury items
 - 2.1.3. bank’s and banker’s tax
 - 2.1.4. other per centage taxes
 - 2.2 fixed taxes
 - 2.2.1 fixed taxes on manufacturers and importers, on merchants, on dealers of alcohol and tobacco, on owner’s and operators of mills and factories and on registered dealers of prohibited drugs.
 - 2.2.2 Other fixed taxes
3. specific tax
 - 3.1. specific tax on tobacco products
 - 3.2. specific tax on petroleum products
 - 3.3. specific tax on-alcoholic beverages and distilled spirits
 - 3.4. specific tax on other products

4. other taxes
 - 4.1 documentary stamp tax
 - 4.2 revenue from public forest
 - 4.3 franchise tax
 - 4.4 transfer taxes
 - 4.5 other other taxes

The definition of these tax classifications is found in their respective subsections in Section Five (The Analysis).

The determinants used to explain and forecast the movements of the tax variables may be classified into two groupings: (1) variables that reflect the tax bases; and (2) variables that reflect the changes in the tax structure and tax rates over time. The tax base variables are defined on the basis of their legal definition as stated in the National Internal Revenue Code. Changes in the tax structure variables are defined on the basis of the historical legal record of the tax variables as featured in the BIR Tax Numeric Code. Definitions of these determinant variables are found in their respective subsection in Section Five.

The symbols used for both tax and non-tax variables are given in Appendix A.

3. METHODOLOGY

Forecast for each of the tax variables enumerated in Section Two were obtained from structural single equation regression models. The general estimation procedure used was the method of ordinary least squares. The estimation period covered 1961-1978.

In specifying the functional relationship between the tax and explanatory variables, both the linear and logarithmic forms were considered. For the purposes of this paper, however, the linear form is preferred, a priori, over the latter because it allows greater ease in the use of dummy variables.

For each of the forecasting equations estimated, the following statistics were computed to aid in evaluating the relative merits of alternative forecasting equations:

(1) t-statistic-indicates the statistical significance of the regression coefficients associated with the various explanatory variables; with 18 observations, as in the present case, and two independent variables, which is true for most of the equations estimated, a computed t-statistic greater than 2.1 in absolute value implies that corresponding regression coefficient is statistically different from zero at the 5 per cent level of significance;

(2) coefficient of determination, R^2 is a descriptive statistic that provides a useful measure of the extent to which the estimated regression line fits the actual observation points; R^2 measures the proportion of the total variation in the dependent variable explained by the variations in the independent or explanatory variable; a high value of R^2 is associated with a good fit of the regression line while a low R^2 is associated with a poor fit; as a rule of thumb, an R^2 greater than .7 is considered satisfactory.

(3) The per centage root mean square error (RMSE%) measures how closely the simulated values from historical simulation of the independent variable move in relation to the actual data series; it is defined as:

$$\text{RMSE\%} = \sqrt{\frac{1}{N} \sum_{i=1}^N \left(\frac{Y_i - Y_i}{Y_i} \right)^2}$$

Where

- Y_i = simulated value of the independent variable.
- Y_i = actual value of the independent variable
- N = number of observations in the simulations;

For the purpose of this paper, an RMSE% less that 20 per cent is deemed acceptable.

In the final analysis, since the purpose of this study is to develop a forecasting model the RMSE% is considered to be more important criterion relative to the R^2 and the t-statistic in the evaluation of competing/alternative forecasting equations. Note that if the main interest of the

study were to test a specific hypothesis regarding the coefficients, then the t-statistics would have been given greater weight.²

It should be pointed out at this stage that the tax forecasts or forward simulations of the tax variables obtainable from the model developed in this paper are conditional forecasts in the sense that the explanatory variables have to be predicted/forecasted into the future before the single-equation regression model can be used to forecast the tax variables made by the National Economic Development Authority (NEDA) and published in the Plan are used to forecast the tax variables. On the other hand, when the explanatory variables are not Plan variables, e.g. gross sales of a certain group of products, said variables are first regressed on a relevant national income variable (which is a Plan variable), e.g. gross value added for this group of products. Then the target value of this national income account variable is used to forecast the given explanatory variable on the basis of the regression equation thus estimated. Finally, the corresponding tax variable is then forecasted based on the forecast of the explanatory variable. These tax forecast values should then be interpreted as the amount of tax revenue forthcoming if the plan targets for the aggregate economic variables are attained.

4. THE DATA

Data for the tax receipts for the various tax categories for 1961-1978 were obtained from the Statistical Division, the Accounting Division and Various Sectors of the BIR. It should be noted that tax data emanating from the different divisions of the BIR are not necessarily consistent with each other. A major part of the work done in this study is the reconciliation of the data coming from the different divisions of the Bureau.

BIR tax data for the different tax categories were available in fiscal year series from 1961-1974 and in calendar year series from 1974-1978. The 1961-1974 fiscal year series is converted into a calendar year series to obtain a time-series data base in calendar years from 1961-1978 via the following scheme:

² Pindyck, Robert and Daniel Rubinfeld, Econometric Models and Econometric Forecasts, Mc.Graw-Hill: New York, 1975, p. 316.

From : date for fiscal year 2 = cumulative data from July Year 1 to June Year 2

Subtract : cumulative data from July to December Year 1

Add : cumulative data from July to December Year 2

Equals : cumulative data from January to December Year 2 = Calendar Year 2 data.

Data for the tax bases for the years 1961-1978 were obtained from the National Income Accounts Statistics for national income account variables, from Annual Survey of Manufacturers by the National Census and Statistics Office (NCSO) for the sales data, from the Foreign Trade Statistics of the NCSO for the exports and imports data and from the Central Bank Statistical Bulletin for the price and other information. Data for changes in tax structure were obtained from the BIR Tax Numeric Code. These are discussed in greater detail in the various subsections of Section Five.

The data series for both tax variables and explanatory variables are presented in Appendix B.

5. ANALYSIS

5.1 The Income Tax

The income tax is a tax on all yearly profits or income arising from property, profession, office, trade or business. It is classified into: (1) the individual income tax and (2) the corporate income tax.

The individual income tax is imposed on the taxable net income received during the taxable year by every individual, whether the said individual is a Philippine citizen residing in the country or abroad or an alien residing in the Philippines. Resident citizens are taxed at steeply progressive rates based on their taxable net income obtained from sources within the Philippines and abroad. Non-residents citizens are taxed at the same rates as resident citizens on their taxable net income from Philippine sources and at a different (simpler and lower)

rate structure on adjusted gross income from abroad. Resident aliens are taxed on the basis of their taxable net income derived from both local and foreign sources at the same rate structure applicable to resident citizens. Non-resident aliens who are engaged in trade or business in the Philippines are taxed based on their Philippine-source net income at the same rates applicable to resident citizens and resident aliens. Non-resident aliens who are not engaged in trade or business in the Philippines are taxed at a flat rate of 30 per cent of gross income derived locally.

The present rate structure for resident citizens and resident aliens starts with a 3 per cent tax on taxable net income less than P2,000 and goes through a total of 37 steps to a maximum of 70 per cent of taxable income over P500,000. This rate structure has been in effect since 1968. Before 1968, there were 23 graduated rates ranging from 3 to 60 per cent of taxable net income.

The corporate income tax is imposed on all corporations, domestic or foreign at the dual rate system of 25 per cent on the first P100,000 of net income and 35 per cent on the excess over this amount. Domestic corporations are taxed on the basis of net income from domestic as well as from foreign sources. Resident foreign corporations are taxed at the same rate as domestic corporations on net income obtained from within the Philippines only. Non-resident foreign corporations are taxed at a flat rate of 35 per cent of gross income derived from within the Philippines. This rate structure has been in effect since 1968.

Data for income taxes were obtained from the Statistics Division and the Accounting Division of the Bureau of Internal Revenue.

At first, structural single equation forecasting models were specified and estimated for (1) individual income tax, (2) corporate income tax and (3) total income taxes for the period 1961-1978. Both linear and logarithmic functions were tried. The estimation procedure utilized is that of the ordinary least squares method.

In general, two explanatory variables were included in the specifications: the tax base variable and the change in the tax rate/structure variable. The taxable base variable considered for the individual income tax were: (1) personal income, (2) index of employed persons and index of average monthly earnings of salaried employees. For the corporate income tax, the tax base variables studied included: (1) corporate income, (2) gross sales or receipts of establishments, (3) non-agricultural gross value added at current prices. The tax base of total income tax was measured by the gross national product at current prices. For all types of income taxes, a dummy variable to reflect the tax rate change in 1968 was included as an explanatory variable.

The specification of the relationships estimated for the various categories of income taxes may be presented as follows:

$$(1) \quad \text{IIT} = f \left[\left(\begin{array}{c} \text{PI} \\ \text{IEP, IAME} \end{array} \right) \left(\begin{array}{c} \text{DI} \end{array} \right) \right]$$

$$(2) \quad \text{CT} = f \left[\left(\begin{array}{c} \text{CI} \\ \text{GS} \\ \text{GVACNA} \end{array} \right) \left(\begin{array}{c} \text{DI} \end{array} \right) \right]$$

$$(3) \quad \text{TIT} = f \left[\left(\begin{array}{c} \text{GNPC} \end{array} \right) \right]$$

where:

- IIT : individual income tax collections in million pesos,
- CIT : corporate income tax collections in million pesos
- TIT : total income tax collections in million pesos
- PI : personal income at current prices in million pesos
- CI : corporate income at current prices in million pesos
- GNPC : gross national product at current prices
in million pesos

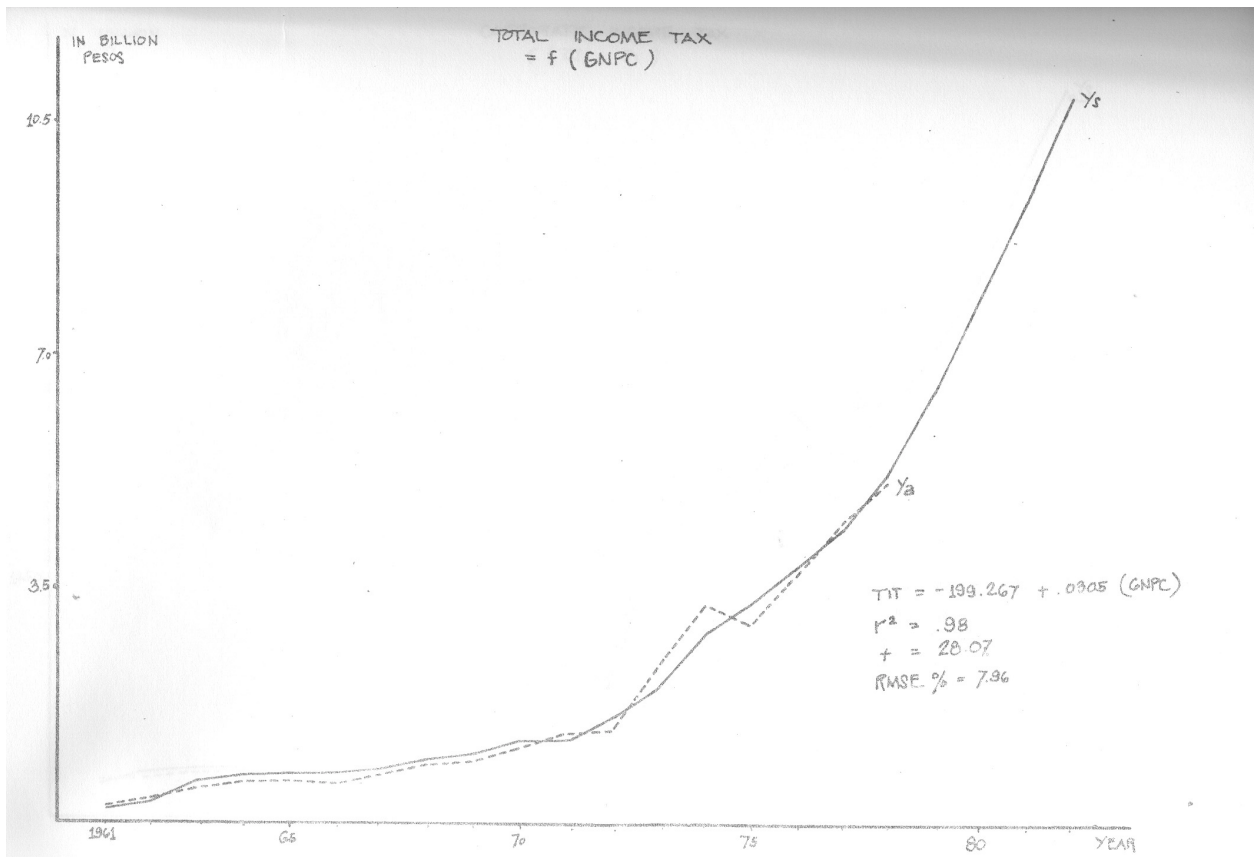
GVACNA	:	gross value added at current prices in non-agricultural sector in million pesos
IEP	:	index of employed persons, 1972-100
IAME	:	index of average monthly earnings of salaried employees, 1972 – 100
GS	:	gross sales/receipts of establishments
and DI	:	0 for 1961-1967, 1 for 1968-1978.

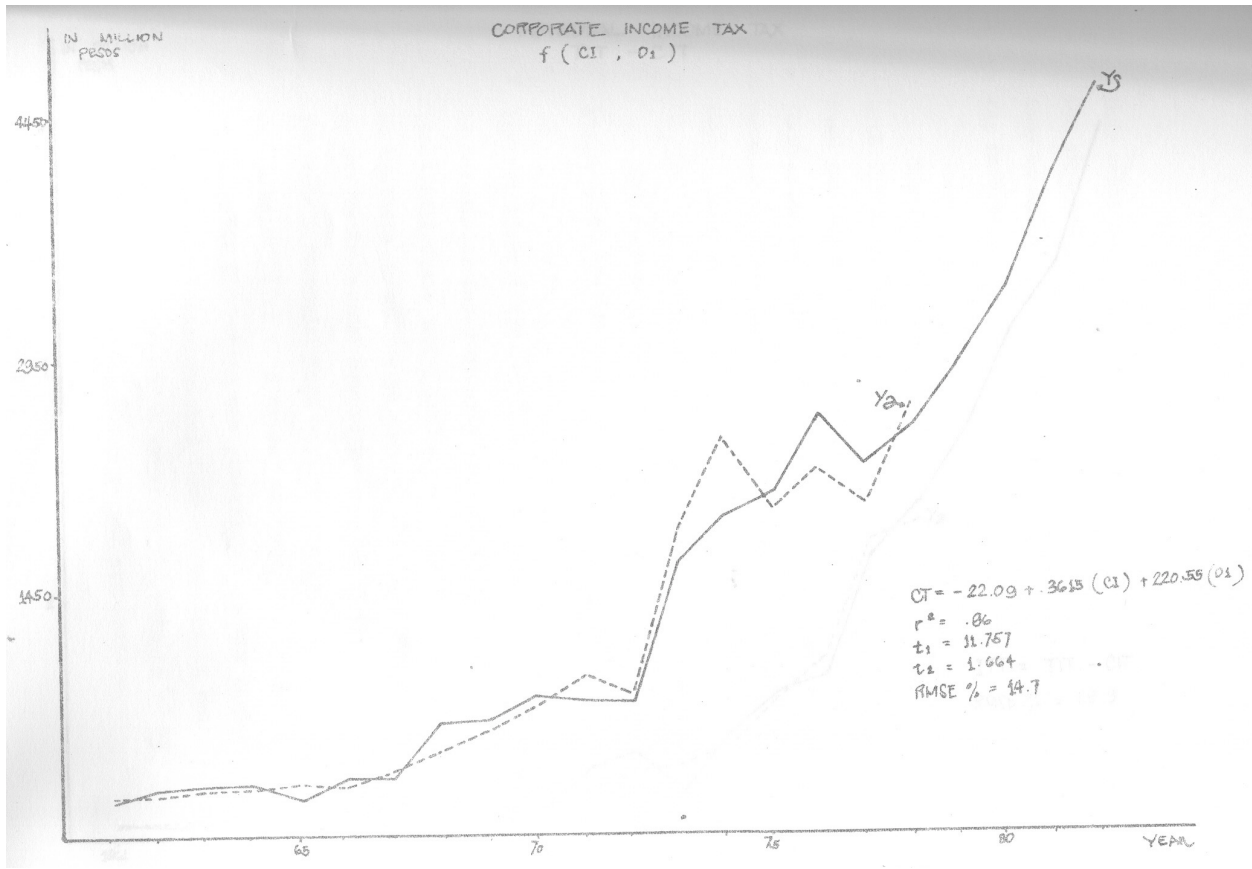
The variables in parenthesis are proxy for the same explanatory variable. Thus, in any given regression equation only one of these alternative measures is included.

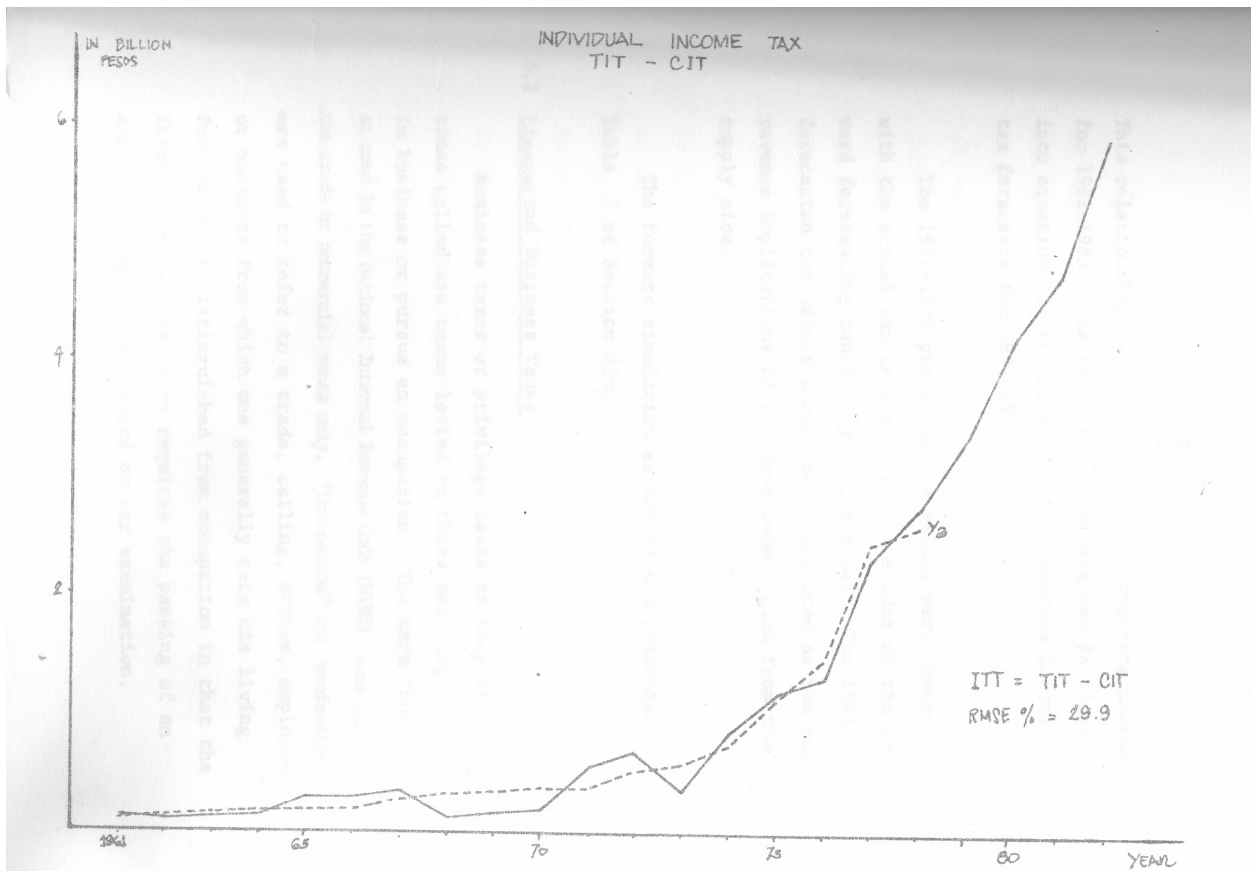
Personal income, corporate income, gross value added and gross national product data were taken from the national income accounts of the NEDA. The two indices mentioned and the gross sales/receipts figures were obtained from the Central Bank Statistical Bulletin.

The “best” estimated forecasting equations obtained are presented below. “Best” here is judged in the context of Section Three. Note that the individual income tax is taken as a residual of total income tax and corporate income tax to maintain consistency. The alternative specifications estimated are given in Appendix C.1.

(4)	TIT	=	-199.267 + .03	GNPC
			(28.07)	
	R ²	=	.980	RMSE% = 7.96%
(5)	CIT	=	-22.09 + .3616 CI + 220.550 DI	
			(11.757)	(1.664)
	R ²	=	.960	RMSE% = 14.70%
(6)	IIT	=	TIT - CIT	
	RMSE%	=	29.5%	







The numbers in parenthesis are the t-values of the corresponding regression coefficients. The percentage root mean square error based on the historical simulations from 1961-1978 are also given.

Equations (4), (5) and (6) were used to arrive at forward forecasts for 1979-1982. The 1979-1980 projections were based on the actual values of the explanatory variables while the 1981-1982 forecasts were computed by using the target values for the national income account variables as presented in the NEDA Five Year Development Plan of 1978-1982. There are no target values for corporate income from the Development Plan. Thus, corporate income is regressed on gross national product at current prices. This yields:

$$(7) \quad CI = -1052.9189 + .0662 \text{ GNPC}, R^2 = .95$$

This relationship is used to forecast corporate income for 1981-1982. The forecasts thus obtained is plugged into equation (5) to arrive at the corporate income tax forecasts for 1981-1982.

The 1979-1980 projected tax values were compared with the actual tax levels to get some idea of the forward forecasting capability of the model. The 1981-1982 forecasted tax values should be interpreted as the tax revenue implications of the development plan from the supply side.

The forward simulation estimates are presented in Table 2 of Section Six.

5.2 License and Business Taxes

Business taxes or privilege taxes as they are sometimes called are taxes levied on those desiring to engage in business or pursue an occupation. The term “business” as used in the National Internal Revenue Code (NIRC) means business in the trade or commercial sense only. “Occupation” and “profession” are used to refer to a trade, calling, office, employment or business from which one generally gets his living. Profession is distinguished from occupation in that the former is a calling which requires the passing of an appropriate government board or bar examination.

In general, there are two broad classifications of privilege taxes: (1) fixed taxes on business, and (2) percentage taxes on business. Fixed taxes on business are legally fixed in the form of an absolute amount per unit of transaction or business operation, while percentage taxes are legally fixed in the form of a rate or percentage based principally on receipt, selling price or compensation.

For purposes of this paper, fixed taxes on business are categorized into two sub-groups: (1) fixed taxes on manufacturers, producers and importers, on merchants, on dealers of alcohol and tobacco products, on owners and operators of mills and factories and on registered dealers of prohibited drugs; and (2) other fixed taxes. The latter category includes fixed taxes on occupation, firearms license fees, hunting permit fees, and rental on land containing petroleum.

Similarly, on the basis of the selection criteria for tax variables warranting closer study, percentage taxes are divided into: (1) contractor's tax, (2) sales tax, (3) bank's and banker's tax and (4) other percentage taxes.

The contractor's tax is imposed on the gross receipts of one who undertakes to do a price of job for others like proprietors/operators of dockyards, smelting plants, establishments for upholstering, washing and greasing of motor vehicles, cutting lumber, drycleaning, repair of bicycles; operators of tailoring and dress shops, arrastre and stevedoring and warehousing; master plumbers; printers and publishers; business agents; lessors of personal property; proprietors/operators of restaurants, day and night club.

The sales tax is levied on every original sales, barter or exchange of both locally produced and imported articles based on the gross value of the articles sold. The rate of the sales tax varies with the degree of essentiality and at times with the origin of the article on which it is imposed. The sales tax on imported articles is based on tariff inclusive value of the product plus a mark-up that distinguishes again the degree of essentiality of the product. The sales tax is divided into three sub-headings: (1) sales tax on non-essential articles, (2) sales tax on semi-essential articles, and (3) sales tax on essential articles. The bank's and banker's tax is imposed on the gross receipts derived by all banks doing business in the Philippines from interests, discounts, dividends, commissions, profits from exchange, royalties, rentals of property, and all

other items treated as gross income. This tax shall also be collected from other financial intermediaries, based on their gross receipts derived from quasi-banking activities.

“Bank” indicates every person, association or company having a place of business where credits are opened by the deposit or collection of money or where money is advanced or loaned on stocks, bonds, boullion, bills or exchange or where promissory notes are received for discount or for sale.

The other percentage tax category includes the carrier’s tax, percentage tax on stocks, real estate, commercial and customs brokers and dealers and on cinematographic film owners, lessors or distributors, compensating tax, percentage tax on proprietors and operators of mills and factories, percentage tax on sale of soft drinks, percentage tax on insurance companies, on mines and on amusement.

The compensating tax is a tax imposed on imported goods which are used directly by the importer himself for production of another product.

Data for the various categories of license and business taxes were obtained from the collection reports of the Statistics Division and the Accounting Division of the BIR.

Structural single equation regression models were specified and estimated for the two general classification of license and business tax as well as for the sub-categories falling under each of said major groupings for the period 1961-1978. The estimation procedure used is the method of ordinary least squares. Both the linear and the double logarithmic functional forms were tried.

The explanatory variables included are the tax base variables and tax rate change variables. For the contractor’s tax, the alternative proxies considered for the tax base variables are gross value added in current prices in construction, communication, hotel and other services,

publishing and printing and net domestic product in current prices in construction. For the various sub-headings under the sales tax, the tax bases were represented by either the gross sales less exports plus imports of the group of commodities corresponding to given sales tax sub-category or the manufacturing index for the same group of commodities. The taxable base of the bank's and banker's tax was measured in one of the following ways: net domestic product in current prices of commerce, gross value added in current prices of banks, and gross value added in current prices of banks and non-banks. The various proxy variables used for the tax base of other percentage taxes were gross value added at current prices in non-agricultural sectors. For the fixed taxes on manufacturers, producers, importers and merchants, etc., the taxable base was measured by the gross value added at current prices in manufacturing and commerce. The tax base of total fixed taxes was represented by either the non-agriculture gross value added at current prices or the number of manufacturing establishments.

To take account of major changes in the rates and structure of the sales tax, two dummy variables were introduced: one for each of the changes that occurred in 1969 and 1977. Similarly, dummy variables for tax rate/structure changes were used in the specification of total fixed taxes.

To summarize, the general specification of equations estimated for the different categories of the license and business tax are as follows:

$$(8) \quad CT = f \left[\begin{array}{c} \left(\begin{array}{c} GVACCCHSM \\ GVACCCHSPP \\ NDPCC \end{array} \right) \end{array} \right]$$

$$(9) \quad STNE = f \left[\begin{array}{c} \left(\begin{array}{c} SLXPMNE \\ SLXNE, IMPNE \\ MINE \end{array} \right) \left(\begin{array}{c} DS1 \\ DS2 \end{array} \right) \end{array} \right]$$

$$(10) \quad \text{STSE} = f \left[\left(\begin{array}{c} \text{SLXPMSE} \\ \text{SLXSE, IMPSE} \\ \text{M I E} \end{array} \right) \left(\text{DS1} \right) \left(\text{DS2} \right) \right]$$

$$(11) \quad \text{STE} = f \left[\left(\begin{array}{c} \text{SLXPME} \\ \text{SLXE, IMPE} \\ \text{M I E} \end{array} \right) \left(\text{DS1} \right) \left(\text{DS2} \right) \right]$$

$$(12) \quad \text{TSAT} = f \left[\left(\begin{array}{c} \text{SLXPMTOT} \\ \text{SLXTOT, IMPTOT} \\ \text{M I E} \end{array} \right) \left(\text{DS1} \right) \left(\text{DS2} \right) \right]$$

$$(13) \quad \text{BT} = f \left[\left(\begin{array}{c} \text{NDPCOM} \\ \text{GVAB} \\ \text{GVABNB} \end{array} \right) \right]$$

$$(14) \quad \text{OPT} = f \left[\left(\begin{array}{c} \text{GVACM} \\ \text{GVACNA} \end{array} \right) \right]$$

$$(15) \quad \text{OPTB} = f \left[\left(\begin{array}{c} \text{GVACM} \\ \text{GVACNA} \end{array} \right) \right]$$

$$(16) \quad \text{FTI} = f \left[\left(\text{GVACMCOM} \right) \left(\text{DS1} \right) \left(\text{DS2} \right) \right]$$

$$(17) \quad \text{TFT} = f \left[\left(\begin{array}{c} \text{GVACNA} \\ \text{EST} \end{array} \right) \left(\text{DS1} \right) \left(\text{DS2} \right) \right]$$

Where:

CT	:	contractor's tax collections in million pesos
STNE	:	sales tax collections on non-essential articles in million pesos
STSE	:	sales tax collections on semi-essential articles in million pesos
STE	:	sales tax collections on essential articles in million pesos
TSAT	:	total sales tax collections in million pesos
BT	:	bank's and banker's tax collections in million pesos
OPT	:	other percentage tax including bank's and banker's tax in million pesos
TPT	:	total percentage taxes in million pesos
FTI	:	fixed taxes on manufacturers, producers, and importers, on merchants, on dealers of alcohol and tobacco products, on owners and operators of mills and factories and on registered dealers of prohibited drugs in million pesos
OFT	:	other fixed taxes in million pesos
TFT	:	total fixed taxes in million pesos
LBT	:	license and business tax at million pesos
GVACCCHSM:		gross value added at current prices in construction, communication, hotel and other services and manufacturing in million pesos

GVACCCHSPP	:	gross value added at current prices in construction, communication, hotel and other services and printing and in publishing in million pesos
NDPCC	:	net domestic product in construction at current prices in million pesos
NDPCCOM	:	net domestic product in commerce at current prices in million pesos
GVAB	:	gross value added in banks at current prices in million pesos
GVABBNB	:	gross value added in banks and non-banks at current prices in million pesos
GVACM	:	gross value added in manufacturing at current prices in million pesos
GVACNA	:	gross value added in non-agricultural sector at current prices in million pesos
GVACMCOM	:	gross value added in manufacturing and commerce at current prices in million pesos
SLXPMNE	:	gross sales less exports plus imports of non-essential articles in million pesos
SLXPMSE	:	gross sales less exports plus imports of semi-essential articles in million pesos
SLXPME	:	gross sales less exports plus imports of essential Articles in million pesos
SLXPMTOT	:	gross sales less exports plus imports of all products in million pesos
SLXNE	:	gross sales less exports of non-essential articles in million pesos
SLXSE	:	gross sales less exports of semi-essential articles in million pesos
SLXE	:	gross sales less exports of essential articles in million pesos

SLXTOT	:	gross sales less exports of all products in million pesos
IMPNE	:	imports of non-essential articles in million pesos
IMPSE	:	imports of semi-essential articles in million pesos
IMPE	:	imports of essential articles in million pesos
IMPTOT	:	imports of all products in million pesos
MINE	:	manufacturing index of non-essential articles in million pesos
MISE	:	manufacturing index of semi-essential articles in million pesos
MIE	:	manufacturing index of essential articles in million pesos
DS1	:	0 for 1961-1968, 1 for 1969-1978
DS2	:	0 for 1961-1976, 1 for 1977-1978

Different proxy measures for the same explanatory variables are enclosed in parenthesis. In the estimation of a given regression equation only one of these alternative proxy measures is included.

Gross sales data were obtained from the Annual Survey of Manufacturers of the NCSO from 1960-1977. There were no sales data for the census years 1961, 1967, 1972, 1975 and 1976. To complete the time series data on sales, interpolation using average growth rates was employed. Thus, the average growth rate for 1962-1966 was applied to the 1960 figure to obtain the 1961 level of sales. The average growth rate for 1968-1971 was applied to the 1966 figure to get the 1967 level and to the 1971 figure to arrive at the 1972 level. Similarly, the compounded growth rate for the period 1973-1977 was used to obtain the 1975 and 1976 sales data.

Exports and imports data came from the Foreign Trade Statistics of the NCSO while the manufacturing index was from the CB Statistical Bulletin. The CB Statistical Bulletin publishes a per product manufacturing index. The manufacturing index used for the different categories of the sales tax in this study is a weighted average of the CB indices which are given per product/commodity. The weights used are percentage contribution of each product to the total

sale of the product type, i.e. non-essential, semi-essential or essential. The gross value added and the net domestic product information are from the national income accounts statistics of the NEDA.

The estimated regression equations were appraised on the basis of the consideration discussed in Section Three. The “beat” forecasting equations for the different classifications of the license and business taxes are given below. The equations for sales tax for non-essential articles and the sales tax for semi-essential articles did not perform well. Thus, these two sub-groupings were lumped together and estimated as a residual from total sales tax and sales tax from essential articles. Similarly, the estimated equations for the bank’s and banker’s tax were not found acceptable and this category was added to the other percentage tax category. The alternative forecasting equations are given in Appendix C.2.

$$(18) \quad CT = -6.5882 + .0206 \text{ GVACCCHSPP} \\ (13.74)$$

$$R^2 = .946 \quad \text{RMSE\%} = 11.79\%$$

$$(19) \quad \text{TSAT} = 43.0190 + .0045 \text{ SLXPMTOT} + 5.7337 \text{ DS1} \\ (3.46) \qquad (0.94) \\ + 502.4980 \text{ DS2} \\ (6.51)$$

$$R^2 = .899 \quad \text{RMSE\%} = 14.45\%$$

$$(20) \quad \text{STE} = 37.8406 + 1.7177 \text{ MIE} + 195.2970 \text{ DS2} \\ (1.360) \qquad (1.763)$$

$$R^2 = .877 \quad \text{RMSE\%} = 13.64\%$$

$$(21) \quad \text{STNE} + \text{STSE} = \text{TSAT} - \text{STE} \\ \text{RMSE\%} = 869.66\%$$

$$(22) \quad \text{OPTBT} = 62.704 + .0051 \text{ GVACNA} \\ (6.46)$$

$$R^2 = .784 \quad \text{RMSE\%} = 29.29\%$$

$$\begin{aligned}
(23) \quad TPT &= CT + TSAT + OPTBT \\
RMSE\% &= 11.40 \\
(24) \quad TFT &= -30.8785 + .0020 \text{ GVACNA} - 1.2418 \text{ DS1} \\
&\quad (3.363) \quad (-.033) \\
&\quad \quad \quad + 153.9654 \text{ DS2} \\
&\quad \quad \quad (3.010) \\
R^2 &= .928 \quad RMSE\% = 15.94\% \\
(25) \quad FTI &= 30.2273 + .0028 \text{ GVACMCOM} + .6577 \text{ DS1} + 100.156 \text{ DS2} \\
&\quad (21.304) \quad (.1207) \quad (13.829) \\
R^2 &= .997 \quad RMSE\% = 8.94\% \\
(26) \quad OFT &= TFT - FTI \\
RMSE\% &= 2693.95\% \\
(27) \quad LBT &= TFT + TFT \\
RMSE\% &= 10.84\%
\end{aligned}$$

The numbers in parenthesis are the t-values of the corresponding regression coefficient. The percentage root mean square ERROR presented was estimated on the basis of historical simulation for 1961-1978.

Forward simulations of the various classifications and sub-classifications of license and business taxes were computed for 1979-1982. The 1979-1980 projections were made on the basis of equations (17) to (26) and the actual values of the explanatory variables, whenever these were available or the forecasted values of said variables, otherwise. Gross sales, imports, exports and manufacturing index data were not available. These four explanatory variables were then forecasted by regressing said variables on relevant national income account variables. The same was done for gross value added in construction, communication, hotel and other services and printing and publishing. Thus, the following relationships were obtained:

$$\begin{aligned}
(28) \quad \text{GVACCCHSPP} &= -1381.6982 + .1539 \text{ GVACNA}, & R^2 &= .986 \\
(29) \quad \text{STOT} &= 17866.4974 + 1.5429 \text{ GVACM}, & R^2 &= .689 \\
(30) \quad \text{XTOT} &= -47.1725 + .7992 \text{ XC}, & R^2 &= .998 \\
(31) \quad \text{IMPTOT} &= -322.6942 + .8523 \text{ MC} & R^2 &= .999
\end{aligned}$$

$$(32) \quad \text{SLXPMTOT} = \text{STOT} - \text{XTOT} + \text{IMPTOT}$$

$$(33) \quad \text{MIE} = -1.0977 + .0080 \text{GVACM} \quad R^2 = .997$$

Where:

STOT	:	gross sales of all products in million pesos
XTOT	:	exports of all products in million pesos
IMPTOT	:	imports of all products in million pesos
XC	:	exports of goods and services in current terms in national accounts in million pesos
MC	:	imports of goods and services in current terms in national accounts in million pesos

To illustrate the procedure followed in estimating the 1979-1980 projections:

Step one: (28) – (33) (18) – (27) and the actual values of the explanatory variables in these equations were used to project the values of the dependent variables in these equations;

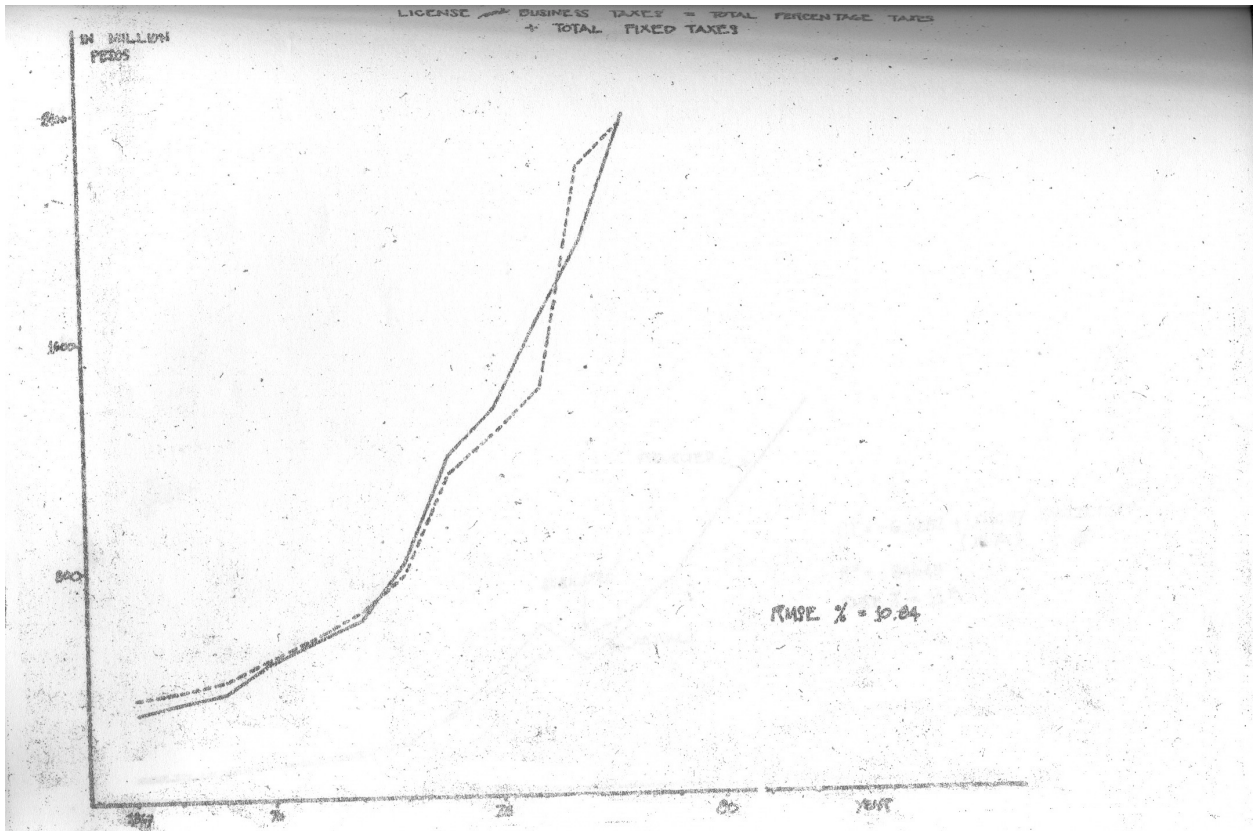
Step two: and the actual values of the determinant variables when these are available or the projected value of the same variables obtained from step one, were employed to arrive at the projected values of the tax variables.

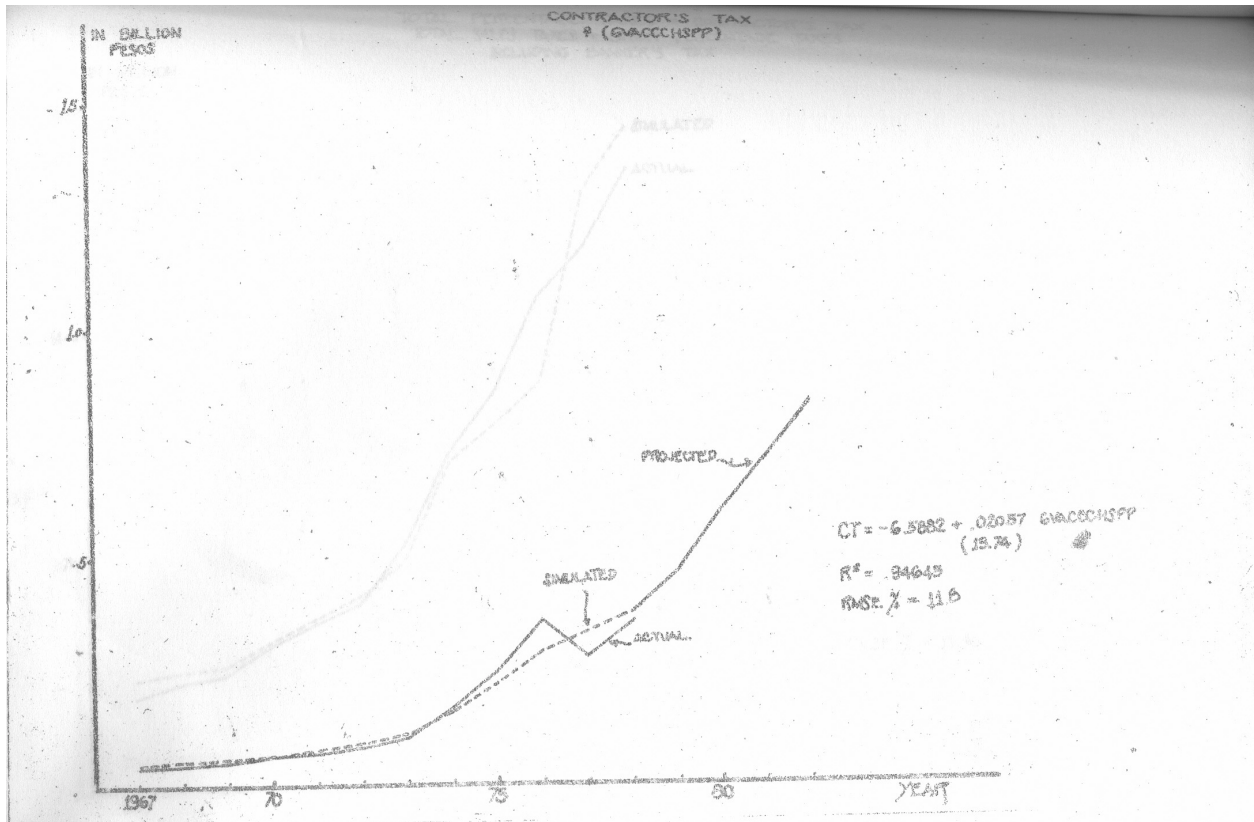
The 1981-1982 forecasts of the different divisions and subdivisions of the license and business tax were derived. An analogous procedure was utilized in conjunction with the target values of the national account variables given in the NEDA Five Year Development Plan, 1978-1982.

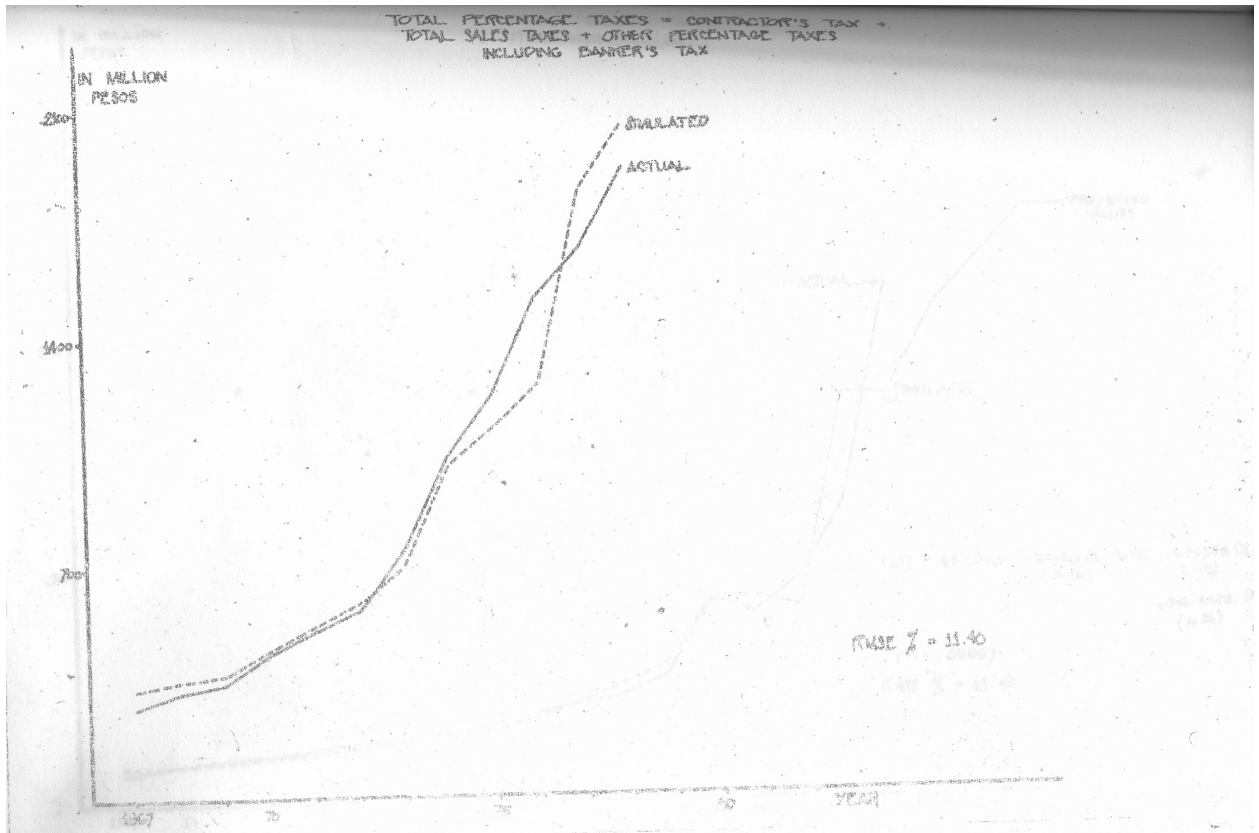
The forward simulations are presented in Table 2 of Section Six.

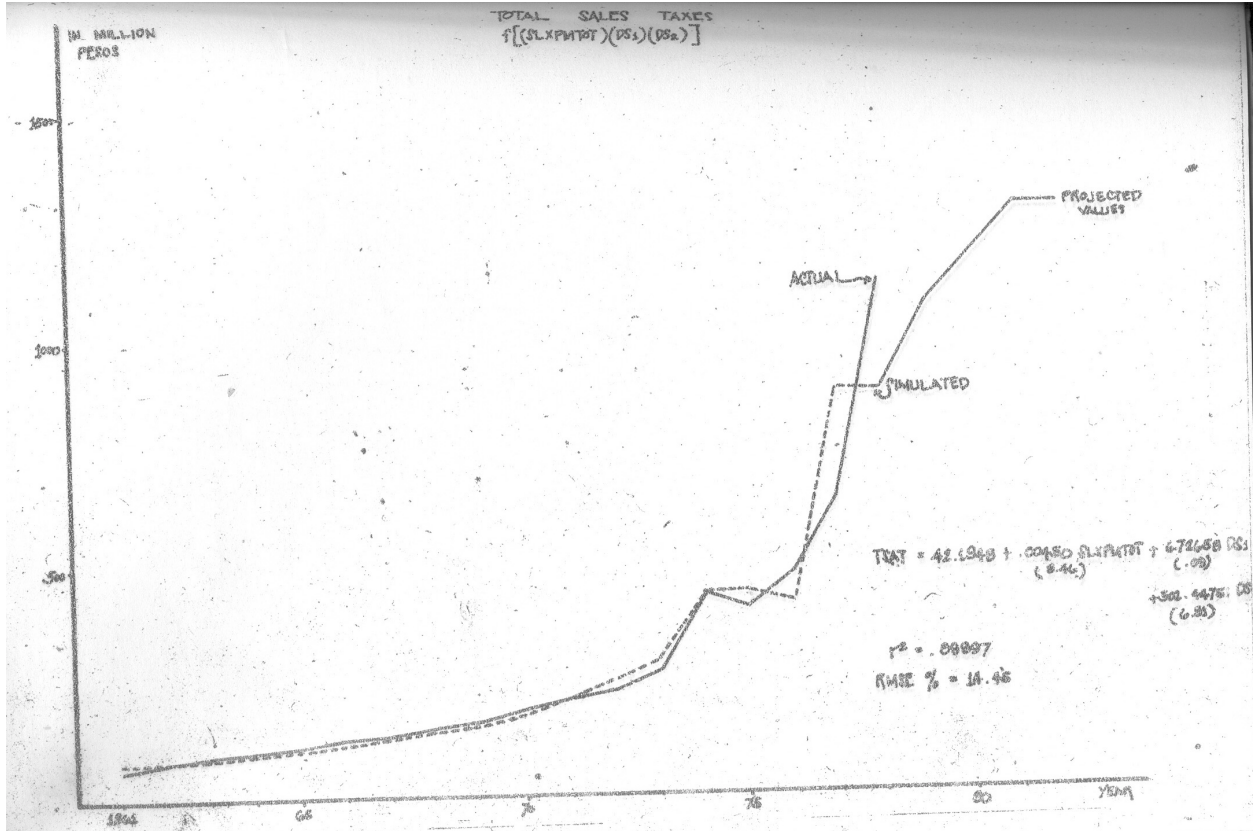
5.3 The Specific Tax

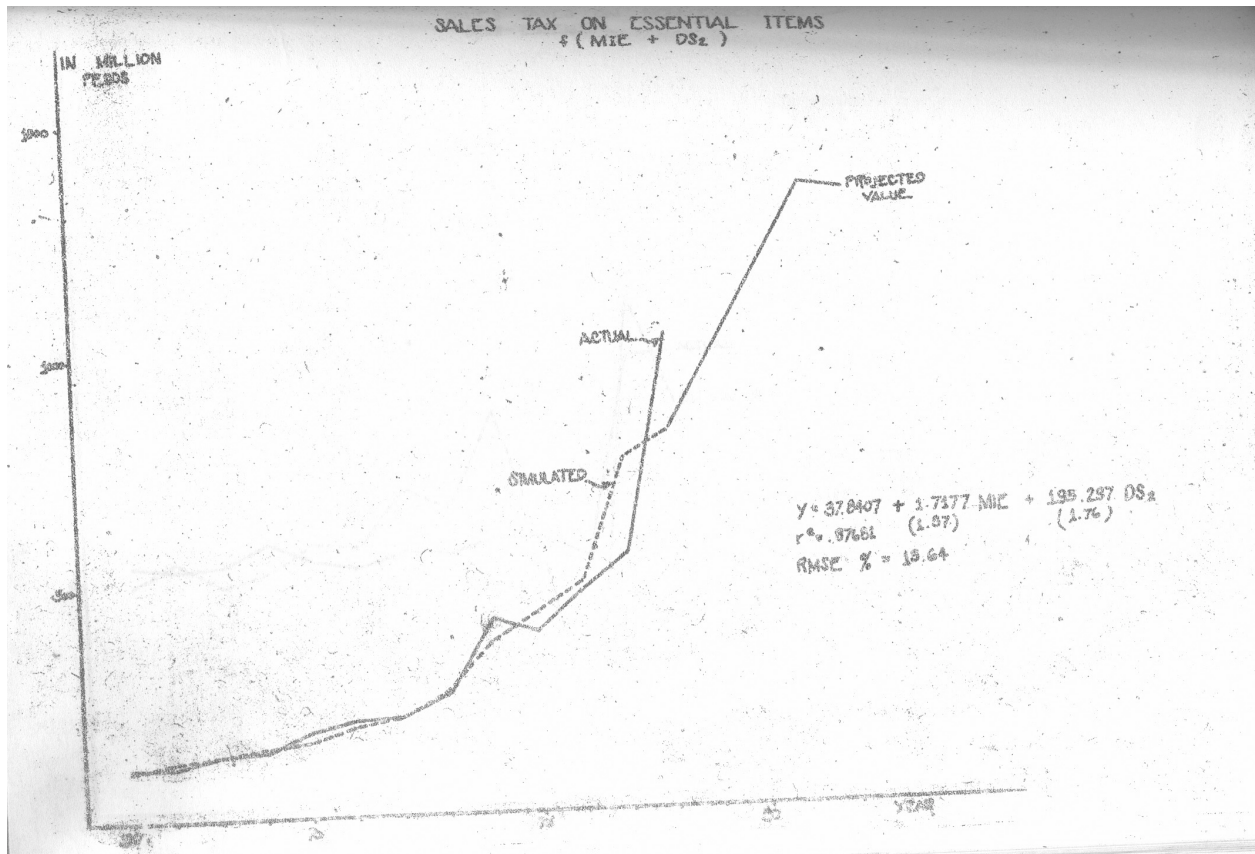
The specific tax is a tax that is applied on certain specific articles produced locally or imported from abroad for domestic sale or consumption. Exports are exempted from the specific tax. The specific tax imposes a fixed amount or sum on the number or on some standard unit of weight or measurement of the products or articles subject to the said tax.

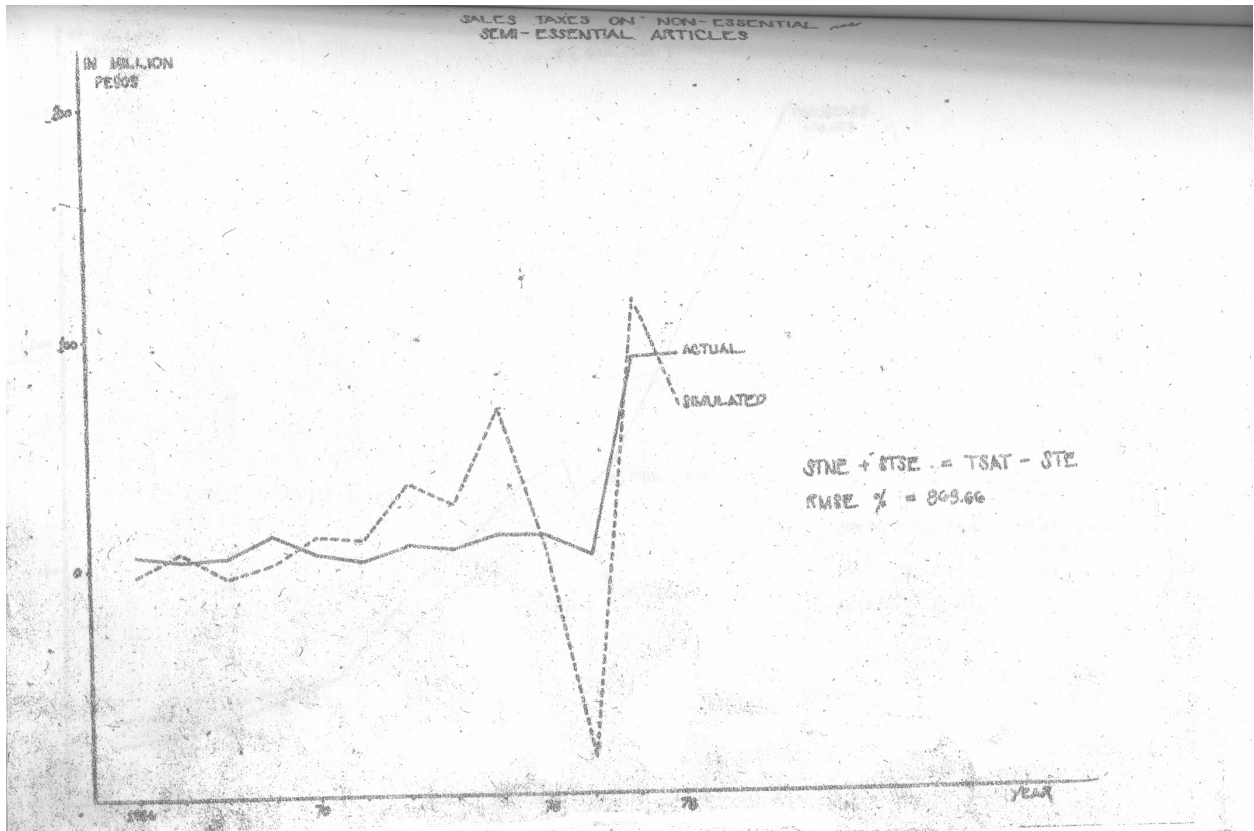


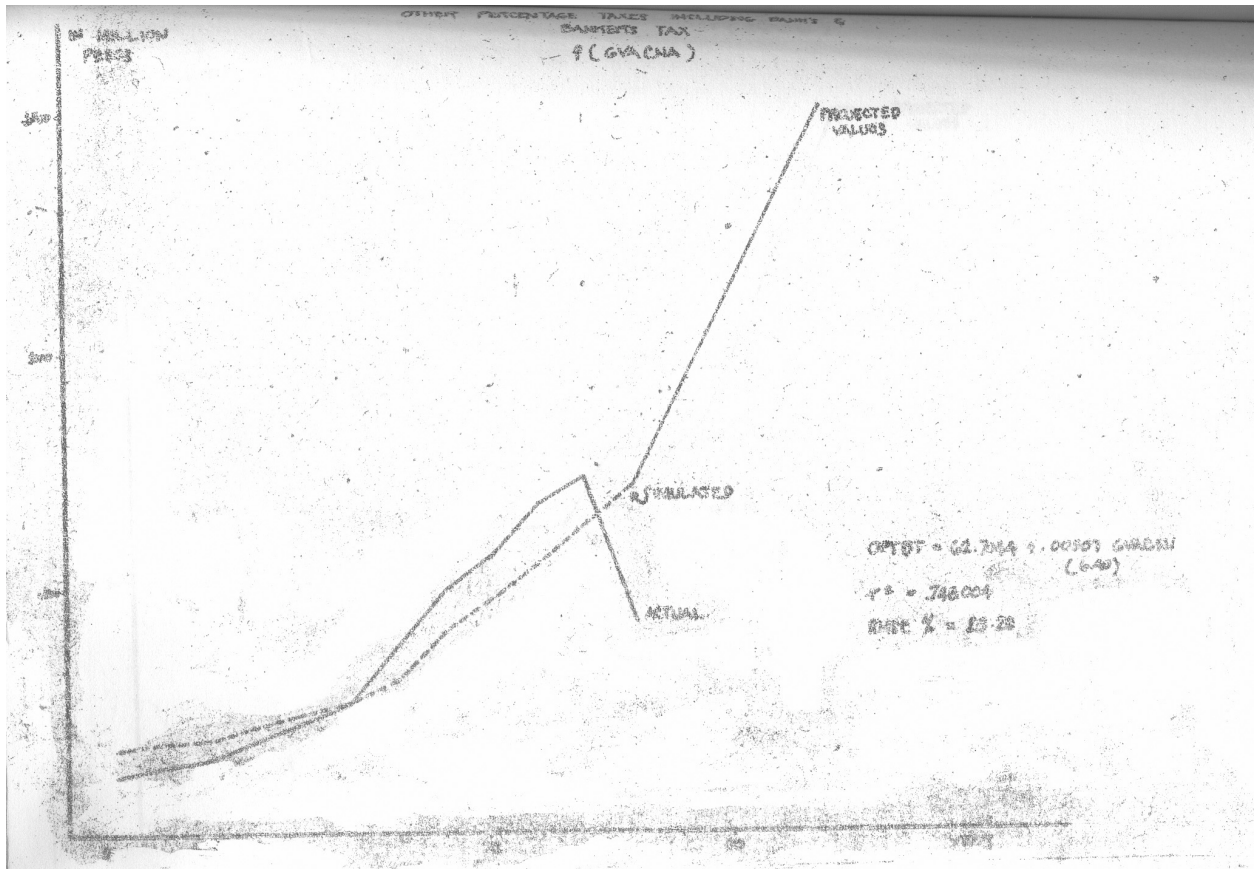


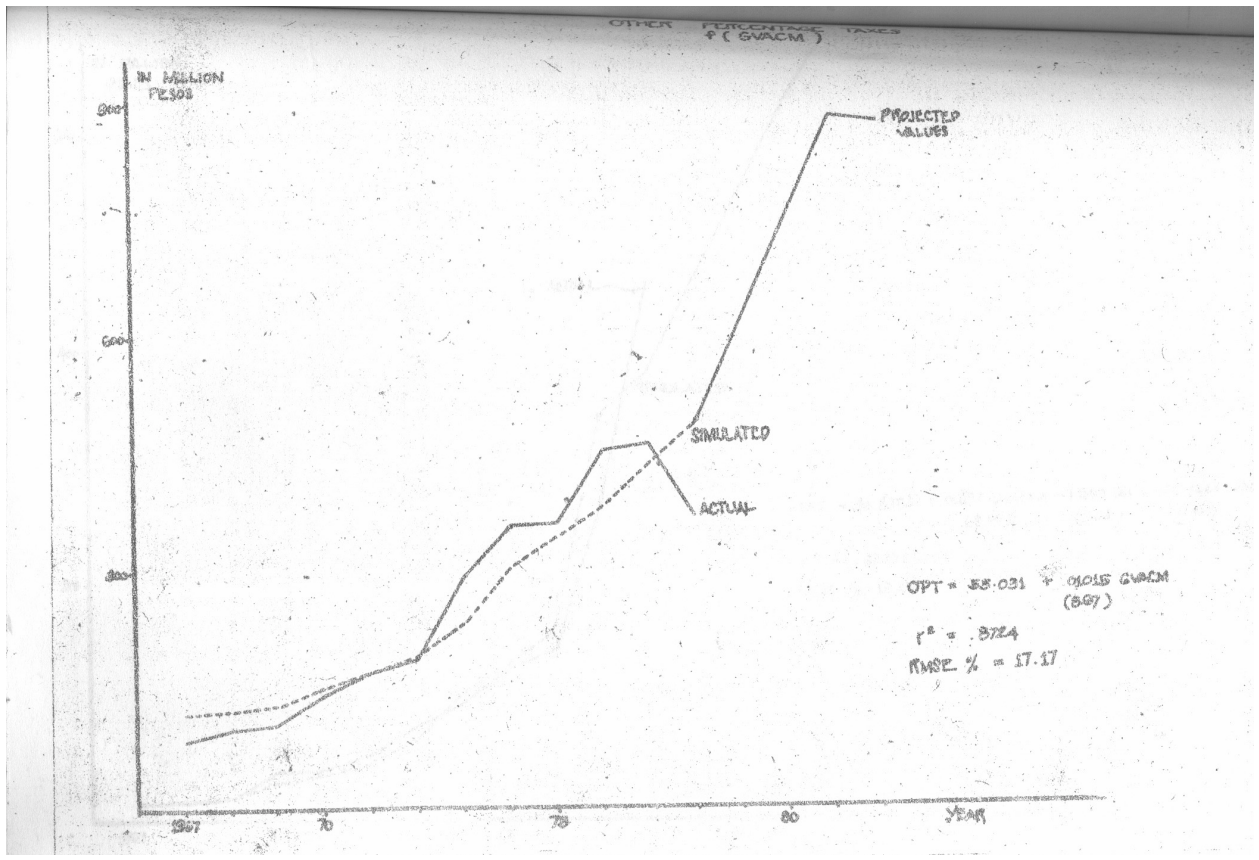


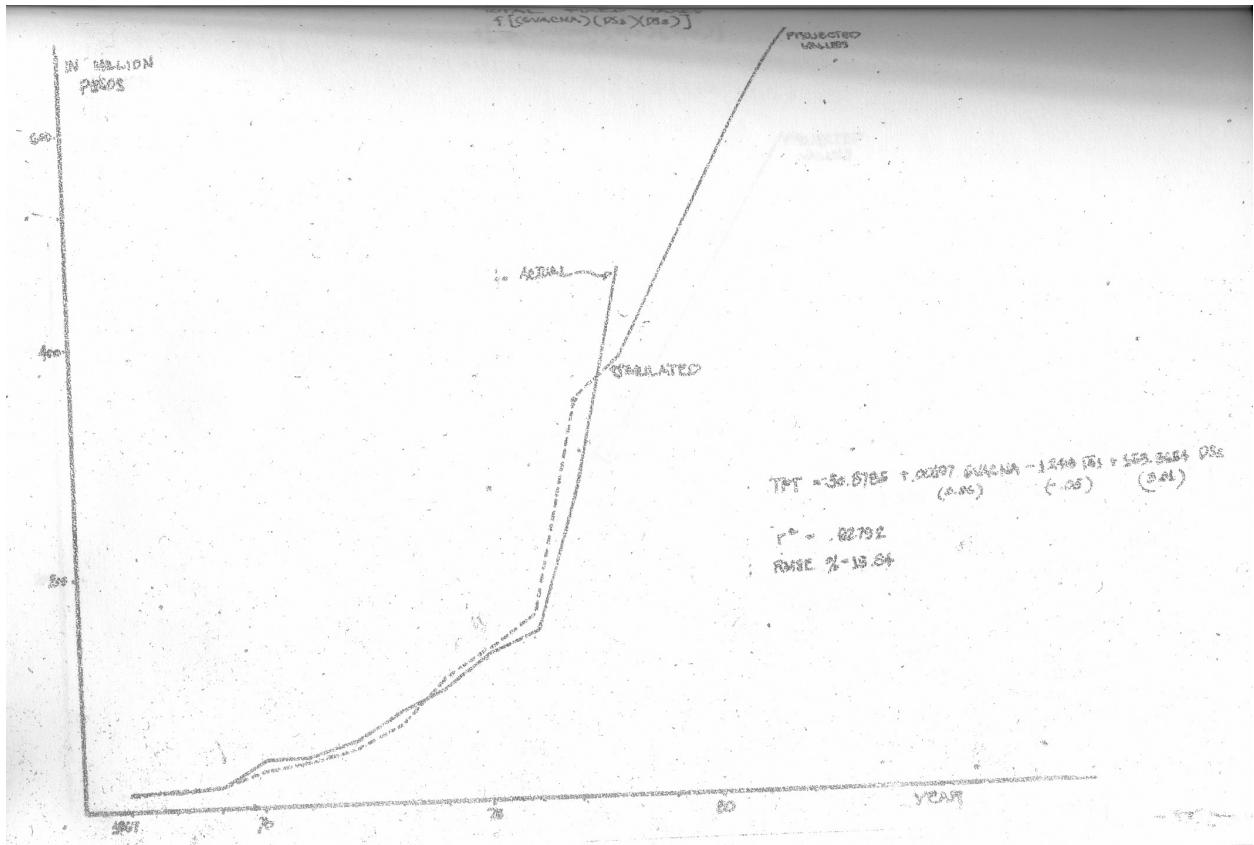


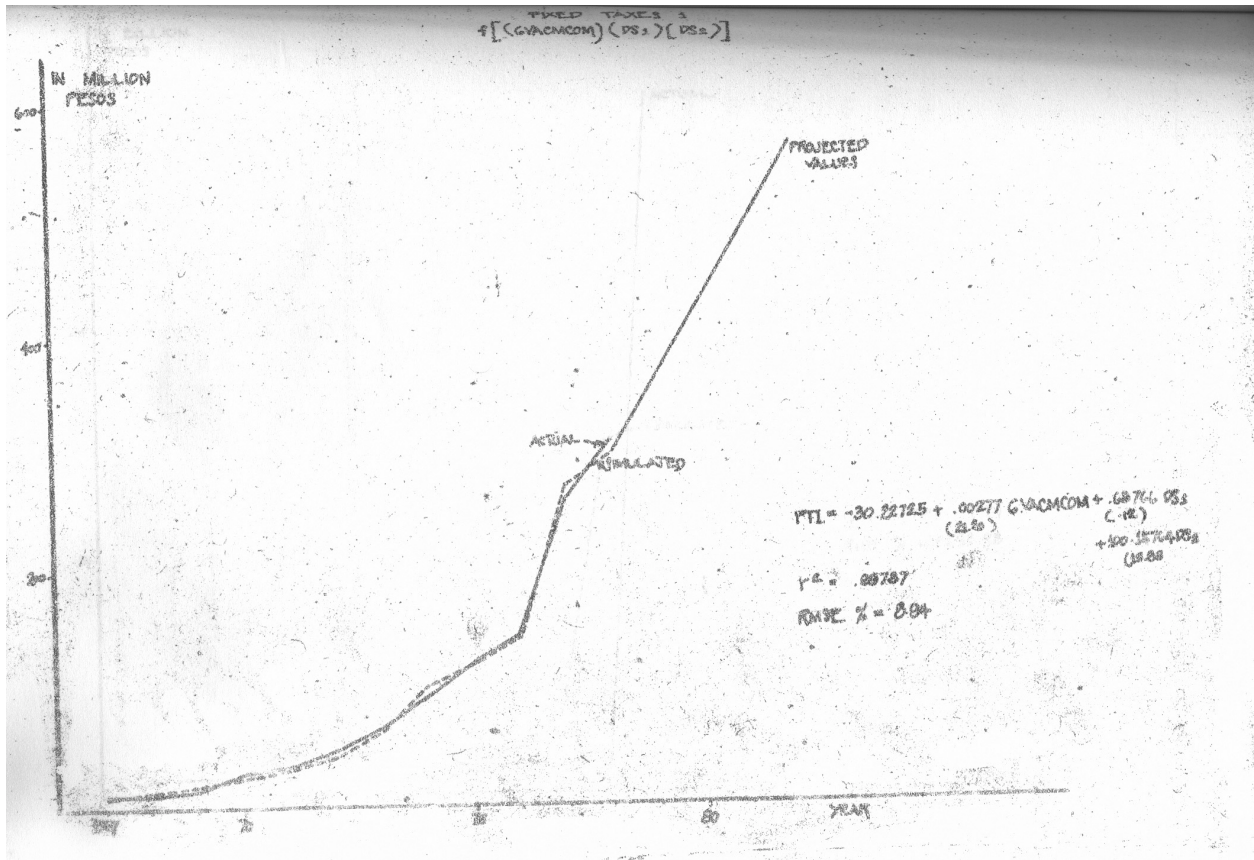




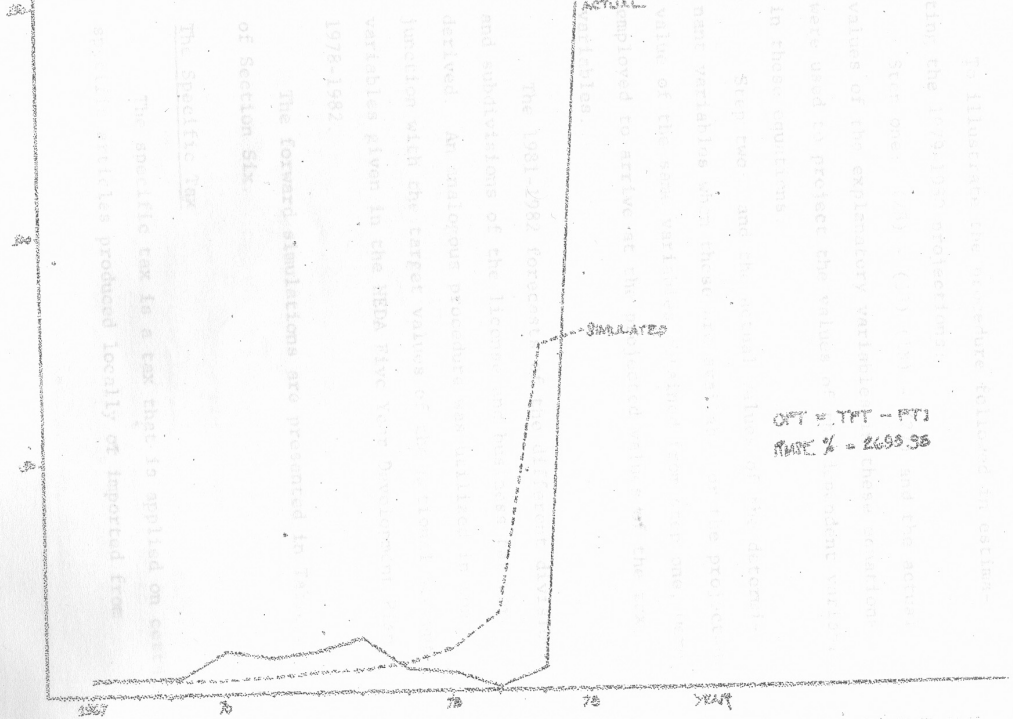








IN BILLION
PECSOS



5.1 The Specific Tax

The specific tax is a tax that is applied on certain articles produced locally or imported from

The forward simulations are presented in the

of Section Six.

The 1981-2082 forecast of the different divisions and subdivisions of the Bureau of Internal Revenue derived. An analogous procedure was utilized in conjunction with the target values of the different variables given in the HEDA Five Year Development

ACTUAL

1978-1982

Simulated

Step two and the actual value of the dependent variable variation from those of the actual value of the independent variable of the same year. The value of the dependent variable was then determined and employed to arrive at the projected value of the tax available.

To illustrate the procedure followed in estimating the 1978-1982 projections:

Step one: $OFF = TPT - FTI$ and the actual values of the explanatory variables (these projection were used to project the value of dependent variable in these equations).

Step two: and the actual value of the dependent variable variation from those of the actual value of the independent variable of the same year. The value of the dependent variable was then determined and employed to arrive at the projected value of the tax available.

OFF = TPT - FTI
RATE % = 2693.38

Articles subject to specific tax are distilled spirits, wines, fermented liquors, manufactured tobacco, cigars, cigarettes, matches, fireworks, manufactured oils and other fuels, coal and coke, bunker fuel oil, diesel fuel oil, cinematographic films and saccharine. “Distilled spirits” include ethyl alcohol, ethanol, spirits of wine, whisky, brandy, rum, gin, vodka, and other similar products or mixtures. “Wines” include all alcoholic beverages produced by fermentation without distillation from the juice of any fruit while “fermented liquors” include all alcoholic beverages produced by the same process from grains or malt like beer, lager beer, ale and porter. “Manufactured tobacco” includes smoking, chewing, snuff and all other forms of manufactured tobacco except cigars and cigarettes. “Fireworks” include firecrackers, sparkles, rockets, and similar devices. “Manufactured oils and other fuels” include kerosene, lubricating oils, naphtha, gasoline, and similar products of distillation, denatured alcohol used for motive power, processed gas, thinners and solvents, liquefied petroleum gas, asphalts, greases, waxes and petroleum and aviation turbo jet.

Data on specific tax collections were obtained from the Statistics Division and Accounting Division of the BIR. Specific tax collections as reported are of two years: (1) those falling under the general funds and (2) those falling under the special funds. The general fund data are classified by product or commodity while the special funds data are classified according to the use or purpose of said funds, i.e., Local Government Fund, Highway Special Fund, Bond Fund, Philippine Virginia Tobacco Administration Fund, Philippine Tobacco Industrial Promotion Fund, Education Special Fund, BIR Special Fund and Barangay Development Fund.

Funds allocated to the first three of the special fund categories are portions of specific taxes derived from petroleum products while the funds allocated to the remaining categories are derived from specific tax on cigarettes. These amounts were added to their counterparts in the general fund to arrive at the total level of specific tax receipts from the particular product under consideration.

Initially, structural single-equation regression models were specified and estimated for four general categories of specific tax collections, namely: (1) specific tax on tobacco products, (2) specific tax on petroleum products, (3) specific tax on alcoholic beverages and (4) specific

tax on all other products using both linear and logarithmic functional forms. The selection of these four tax groupings was the result of the selection scheme discussed in Section Two.

The explanatory variables considered for these tax groupings are of three types: the tax base variables, changes in tax structure variables and others. Alternative proxy variables for the tax bases were specified on the basis of the legal definition of the base. Gross value added at constant 1972 prices and sales less exports plus imports deflated by the wholesale price index (all defined with regards to the given tax grouping being studied) are the candidate tax base variables tried for specific tax on tobacco products, specific tax on petroleum products and specific tax on alcoholic beverages. The tax base variables used for the specific tax on the other products are gross value added in manufacturing at constant prices and gross value added in all sectors at constant prices. Note that the tax base variables are in real terms. This stems from the fact that the specific tax is a tax based on volume or quantity and not on value. Note also that exports are deducted from sales inasmuch as exports are not subject to specific tax.

For specific tax on tobacco products, a dummy variable was included as an explanatory variable to reflect the change in the structure of the said tax that occurred in 1973. Numerous changes in the structure of the specific tax on other products were legislated over the years. To take this factor into account, time was used to explain the specific tax on alcoholic products and the specific tax on other products. A dramatic rise in the price of oil and petroleum products was experienced in 1974. It was postulated that the significant increases in the price of oil and petroleum products affected the demand for said products and consequently, the specific tax collection from petroleum products. Thus a dummy variable representing this shift was employed to explain specific tax collection from petroleum products.

The general specifications may be summarized as follows:

$$(34) \quad TP = f \left[\begin{array}{c} \left(\begin{array}{c} GVARTP \\ SLXPMRTP \\ SLXRTP, IMPRTP \end{array} \right) \left(\begin{array}{c} DTP \end{array} \right) \end{array} \right]$$

$$(35) \quad PP = f \left[\begin{array}{c} \left(\begin{array}{c} GVARPP \\ SLXPMRPP \\ SLXRPP, IMPRPP \end{array} \right) \left(\begin{array}{c} DPP \end{array} \right) \end{array} \right]$$

$$(36) \quad AP = f \left[\begin{array}{c} \left(\begin{array}{c} GVARB \\ SLXPMRAP \\ SLXRAP, IMPRAP \end{array} \right) \left(\begin{array}{c} \text{time} \end{array} \right) \end{array} \right]$$

$$(36) \quad OP = f \left[\begin{array}{c} \left(\begin{array}{c} GVARTOT \\ GVARM \end{array} \right) \left(\begin{array}{c} \text{time} \end{array} \right) \end{array} \right]$$

$$(36) \quad AOP = f \left[\begin{array}{c} \left(\begin{array}{c} GVARTOT \\ GVARM \end{array} \right) \left(\begin{array}{c} \text{time} \end{array} \right) \end{array} \right]$$

where:

- TP : specific tax collections on tobacco products in million pesos
- PP : specific tax collections on petroleum products in million pesos
- AP : specific tax collections on alcoholic products in million pesos
- OP : specific tax collections on other products in million pesos
- AOP : specific tax collections on alcoholic and other products in million pesos
- TSPT : total specific tax collections in million pesos
- GVARTP : gross value added in tobacco products at 1972 prices in million pesos
- GVARPP : gross value added in petroleum products at 1972 prices in million pesos
- GVARB : gross value added in beverages at 1972 prices in million pesos
- GVARTOT : gross value added in all sectors or gross domestic product at 1972 prices in million pesos

GVARM	:	gross value added in manufacturing at 1972 prices in million pesos
SLXPMRTP	:	sales less exports plus imports of tobacco products deflated by wholesale price index in million pesos
SLXPMRPP	:	sales less exports plus imports of petroleum products deflated by wholesale price index in million pesos
SLXPMRAP	:	sales less exports plus imports of alcoholic beverages deflated by wholesale price index in million pesos
SLXRTP	:	sales less exports of tobacco products deflated by wholesale price index in million pesos
SLXRPP	:	sales less exports of petroleum products deflated by wholesale price index in million pesos
SLXRAP	:	sales less exports of alcoholic beverages deflated by wholesale price index in million pesos
IMPRTP	:	imports of tobacco products deflated by wholesale price index in million pesos
IMPRPP	:	imports of petroleum products deflated by wholesale price index in million pesos
IMPRAP	:	imports of alcoholic beverages deflated by wholesale price index in million pesos
DTP	:	0 for 1961-1972, 1 for 1973-1977, and
DPP	:	0 for 1961-1973, 1 for 1974-1977.

Different measures of the same explanatory variables are enclosed by parenthesis to denote that they are alternative proxy variables. Thus, only one of them is included in a given regression equation.

Sales figures were obtained from the Annual Survey of Manufactures of the NCSO from 1960-1977. Interpolation using average growth rates was done for the census years 1961, 1967, 1972, 1975 and 1976. To complete the time-series on sales, the average growth rate for 1962-1966 was applied to the 1960 figure to get the 1961 figure while the average growth rate for 1968-1971 was applied to the 1966 level to obtain the 1967 figure and to the 1971 level to arrive

at the 1972 figure. The compounded growth rate for the period 1973-1977 was used to get the 1975 and 1976 sales figures.

Exports and imports data came from the NCSO Foreign Trade Statistics. The wholesale price index was obtained from the CB Statistical Bulletin. The gross value added data came from the National Accounts Staff of the NEDA.

The alternative forecasting regression equations estimated were evaluated on the basis of the statistics discussed in Section Three. The “best” regression equations are given below. The rest are presented in Appendix C.3. Note that none of the forecasting equations estimated for the specific tax on alcoholic beverages were found acceptable. Thus, the specific tax on alcoholic beverages and the specific tax on other products were combined to form one category.

$$(39) \quad TP = 166.76 - 3.143 SLXRTP + 321.34 IMPRTP + 165.13 DTP$$

(-1.17)
(7.22)
(3.34)

$$R^2 = .95 \quad RMSE\% = 13.24\%$$

$$(40) \quad PP = 9.764 - 6.852 SLXRPP + 45.116 IMPRPP + 78.199 DPP$$

(-2.813)
(5.411)
(.42)

$$R^2 = .980 \quad RMSE\% = 19.67\%$$

$$(41) \quad AOP = -878.55 + .0303 GVARTOT - 54.34 TIME$$

(4.690)
(-2.96)

$$R^2 = .85 \quad RMSE\% = 24.00\%$$

$$(42) \quad TSPT = TP + PP + AOP$$

RMSE%
=
9.38%

The numbers in parenthesis are the t-values. The RMSE% were from historical simulations from 1961-1977.

Equation (39) regresses specific tax on tobacco products on gross sales less exports on imports and on the dummy variable for the change in the structure of said tax. In equation (40), sales less exports, imports and the dummy variable for the oil price stock are used to explain specific tax on petroleum products. Equation (41) regresses specif tax on alcoholic and other products on gross domestic product and time. Equation (42) is an accounting identity showing the sum of all specific taxes.

Forward simulations of these four specific tax categories were made for the period 1979-1982. For 1979-1980, the actual values of the explanatory variables whenever available were used to arrive at the forward simulated values of the tax variable. However, actual sales, exports and import figures for tobacco and petroleum products are not yet available. These three explanatory variables were forecasted by making use of regression equations, relating them with the corresponding national income account variables. Thus, the following relationships are utilized:

$$\begin{aligned}
 (43) \quad STP &= 8.339 + .011 \quad GVARTP, & R^2 &= .57 \\
 (44) \quad XTP &= .011 + .0001 \quad XR, & R^2 &= .43 \\
 (45) \quad IMPTP &= -1.329 + .0002 \quad IMPR, & R^2 &= .86 \\
 (46) \quad SPP &= -5.426 + .040 \quad GVARTP, & R^2 &= .57 \\
 (47) \quad XPP &= .4436 + .00002 \quad XR, & R^2 &= .0047 \\
 (48) \quad IMPPP &= -26.34 + .004 \quad IMPR, & R^2 &= .82
 \end{aligned}$$

where:

STP	:	sales of tobacco products in million pesos
SPP	:	sales of petroleum products in million pesos
XTP	:	exports of tobacco products in million pesos
XPP	:	exports of petroleum products in million pesos
IMPTP	:	imports of tobacco products in million pesos

IMPPP	:	imports of petroleum products in million pesos
GVARTP	:	gross value added in tobacco products at 1972 prices in million pesos
XR	:	total exports of goods and non-factor services at 1972 prices in million pesos
IMPMPR	:	total imports of goods and non-factor services at 1972 prices in million pesos

To illustrate the procedure for projecting the value of the specific tax on tobacco products for 1979:

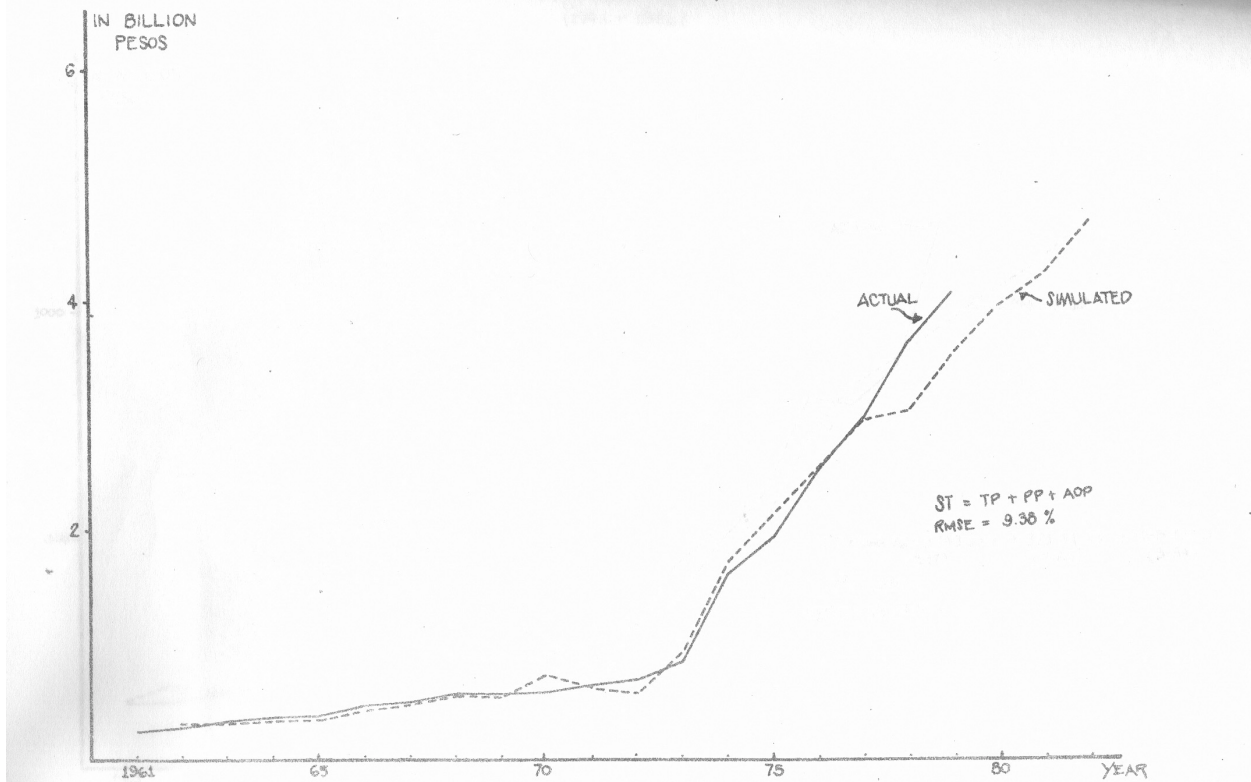
First, sales, exports and imports of tobacco products are forecasted using (43), (44), (45), respectively, and the actual values of their explanatory variables, i.e., gross value added, total exports and total imports;

Second, using (39), the forecasted level of sales, exports and imports obtained in the first step and the actual value of the wholesale price index, the specific tax on tobacco products is estimated.

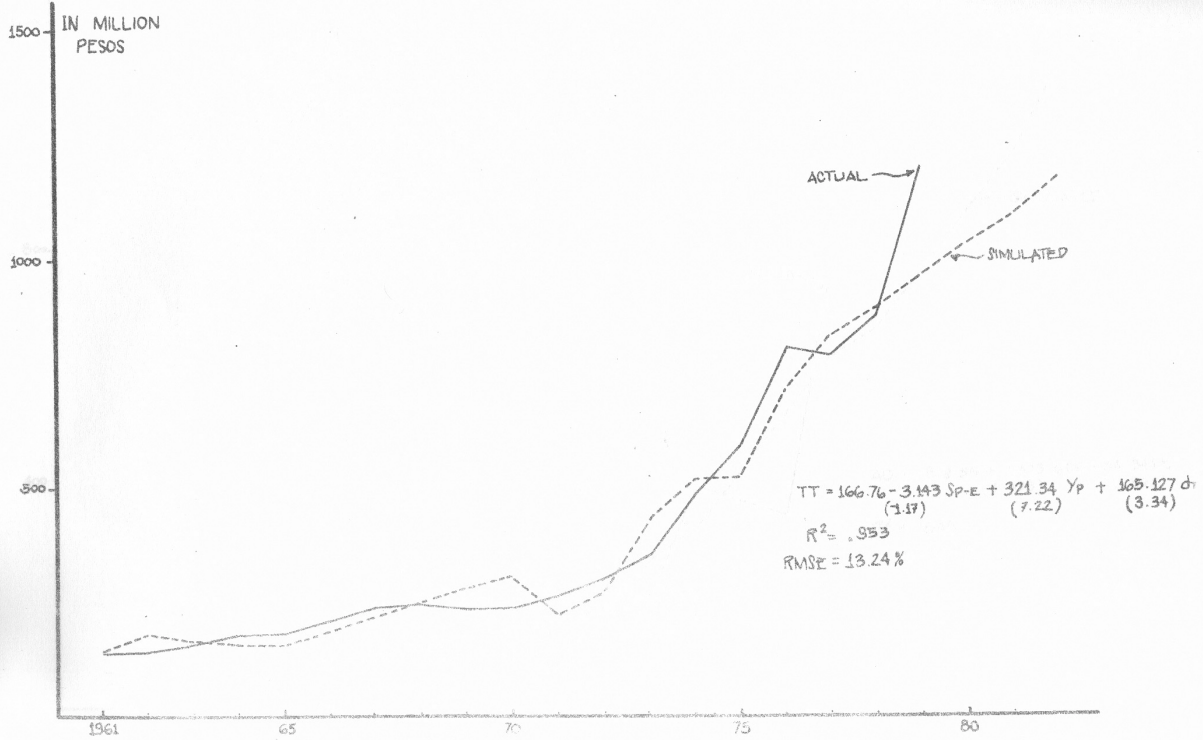
For the 1981-1982 simulations, the target of the national income account variables are used to forecast specific tax collections following the same basic procedure outlined above for the 1979-1980 simulations.

The forward simulations are presented in Table 2.

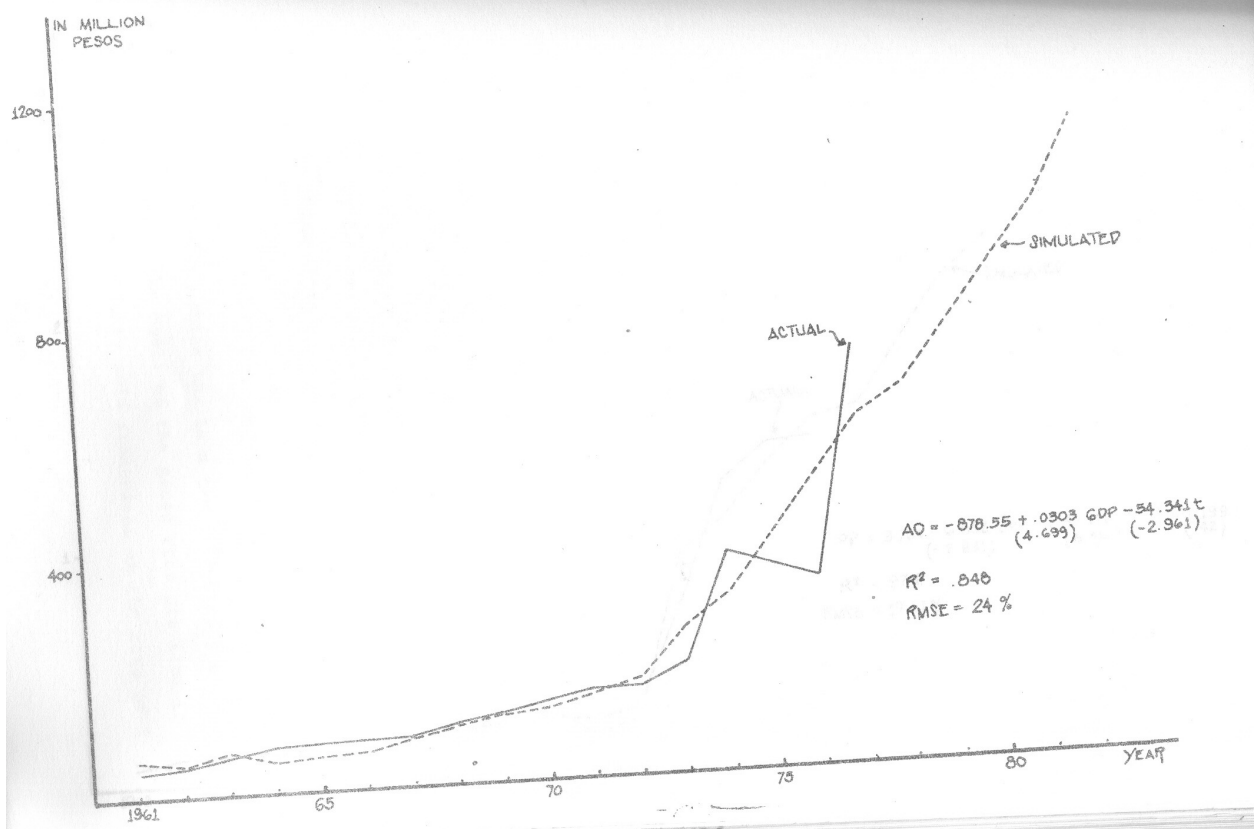
SPECIFIC TAX COLLECTION
(1961 - 1982)



TOBACCO PRODUCTS TAX
COLLECTION
(1961 - 1982)

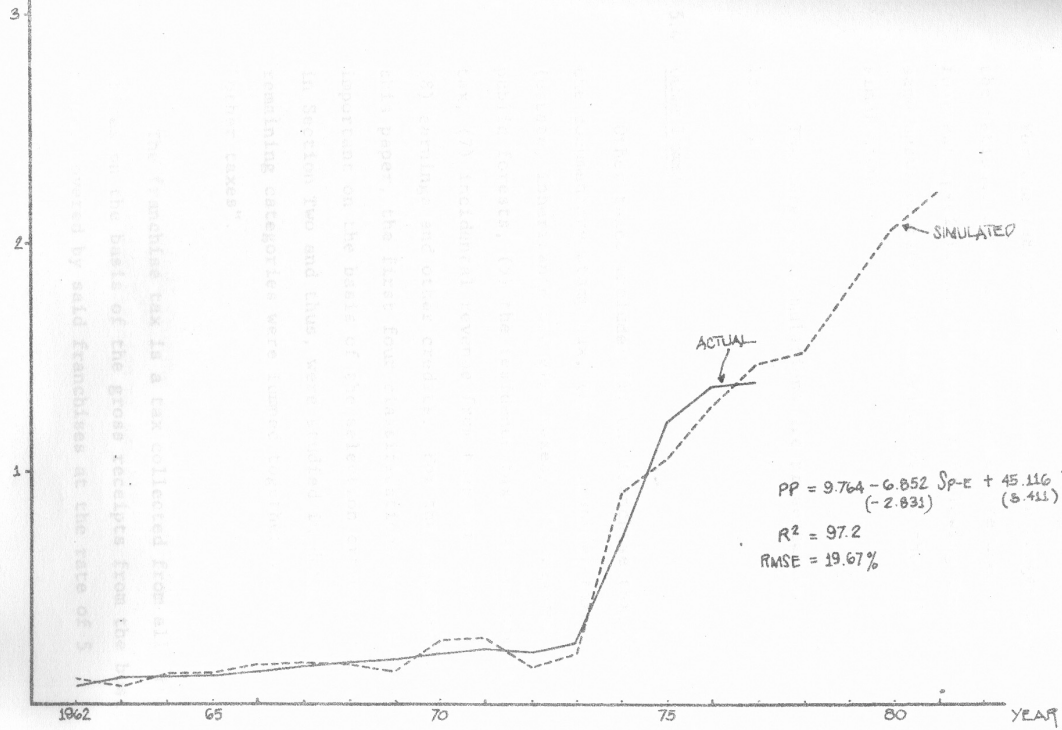


ALCOHOLIC & OTHER PRODUCT TAX COLLECTION
(1961 - 1982)



PETROLEUM PRODUCTS TAX COLLECTION
(1962 - 1982)

IN BILLION
PESOS



5.4 Other Taxes

Other taxes include: (1) the franchise tax, (2) the documentary stamp tax, (3) the transfer taxes (estate, inheritance and gift taxes), (4) revenue from public forests, (5) the residence tax, (6) war profits tax, (7) incidental revenue from taxation, and (8) earnings and other credits. For the purposes of this paper, the first four classifications were deemed important on the basis of the selection criteria discussed in Section Two and thus, were studied in detail. The remaining categories were lumped together and called “other taxes.”

The franchise tax is a tax collected from all franchises on the basis of the gross receipts from the businesses covered by said franchises at the rate of 5 per cent.

The documentary stamp tax are taxes affixed on documents, instruments, and papers evidencing the acceptance, assignment, sale or transfer of an obligation, right or property.

Transfer taxes are taxes imposed on the gratuitous disposition or transmission of private property. There are two types of transfer taxes: (1) estate tax which is a tax on the right of an individual (the decedent) to transfer property at death; and (2) the gift tax which is a tax imposed on the right to transfer property during the lifetime of the transferrer.

Revenue from public forests are derived from forest charges imposed on individuals granted the privilege of cutting or gathering forests products like timber, firewood, gums, resins, rattan and others from public forest and private lands registered with the Bureau of Forest Development.

The residence tax is levied on every resident of the Philippines over 18 years of age who is employed, engaged in business or owns real property.

Data for the different categories of “Other Taxes” were obtained from the Statistics Division and the Accounting Division of the BIR.

Structural single equation regression models were specified and estimated for the various categories of other taxes. Again, both linear and logarithmic functional forms were considered. The method of ordinary least squares was used to estimate the regression equations.

Total “other taxes” is regressed on gross national product at current prices as a proxy for tax base and a dummy variable to represent the tax amnesty granted in 1973. The franchise tax is regressed on gross value added in electricity, gas and water, transport and communications and storage and services sectors at current prices to take account of the tax base and time to take care of the numerous changes in tax rate and structure over time. The explanatory variables considered for the documentary stamp tax were gross national product at 1967 prices, population and gross domestic product at 1967 prices for the tax base and time. Revenue from public forests was regressed on gross value added in forestry at current prices and time.

The specifications for the different classifications of other taxes may be given as follows:

$$(49) \quad \text{TOT} = f \left[\left(\text{GNPC} \right) \left(\text{DO} \right) \right]$$

$$(50) \quad \text{FRT} = f \left[\left(\text{GVACEWTCSS} \right) \left(\text{TIME} \right) \right]$$

$$(51) \quad \text{TRT} = f \left[\left(\begin{array}{l} \text{GVACTOT} \\ \text{POPN} \\ \text{DEATHS} \end{array} \right) \left(\text{TIME} \right) \right]$$

$$(52) \quad \text{DST} = f \left[\left(\begin{array}{l} \text{GNPR} \\ \text{VARTOT} \\ \text{POPN} \end{array} \right) \left(\text{TIME} \right) \right]$$

$$(53) \quad \text{FRT} = f \left[\left(\text{GVACF} \right) \left(\text{TIME} \right) \right]$$

where:

TOT	:	total other taxes in million pesos
FRT	:	franchise tax collections in million pesos
DST	:	documentary stamp tax collections in million pesos
TRT	:	transfer taxes in million pesos
OOTFRTDST	:	other taxes including the franchise tax and documentary stamp tax in million pesos
GNPC	:	gross national product at current prices in million pesos
GNPR	:	gross national product at 1967 prices in million pesos
GVARTOT	:	gross domestic product or gross value added in all sectors at 1967 prices in million pesos
GVACTOT	:	gross domestic product or gross value added in all sectors at current prices in million pesos
GVACF	:	gross value added in forestry at current prices in million pesos
GVACEGWTCSS	:	gross value added in electricity, gas, water, transportation, communication, storage and services sectors current prices in million pesos
POP	:	population in millions
DEATHS	:	number of deaths in millions
DO	:	0 for 1961-1972, 1974-1978, 1 for 1973
TIME	:	time

Alternative proxy measures for the same explanatory variables are enclosed in parenthesis.

Gross value added data were from the national income accounts statistics of NEDA while the population figures were obtained from the NCSO.

The forecasting equations which passed the criteria set in Section Three are presented below.

In the absence of good forecasting equations for the franchise tax and the documentary stamp tax, these two categories were grouped with the other taxes category to form a fourth category which was estimated as a residual of total other taxes and transfer taxes and revenue from public forests. The rest of the estimated equation are given in Appendix C.4.

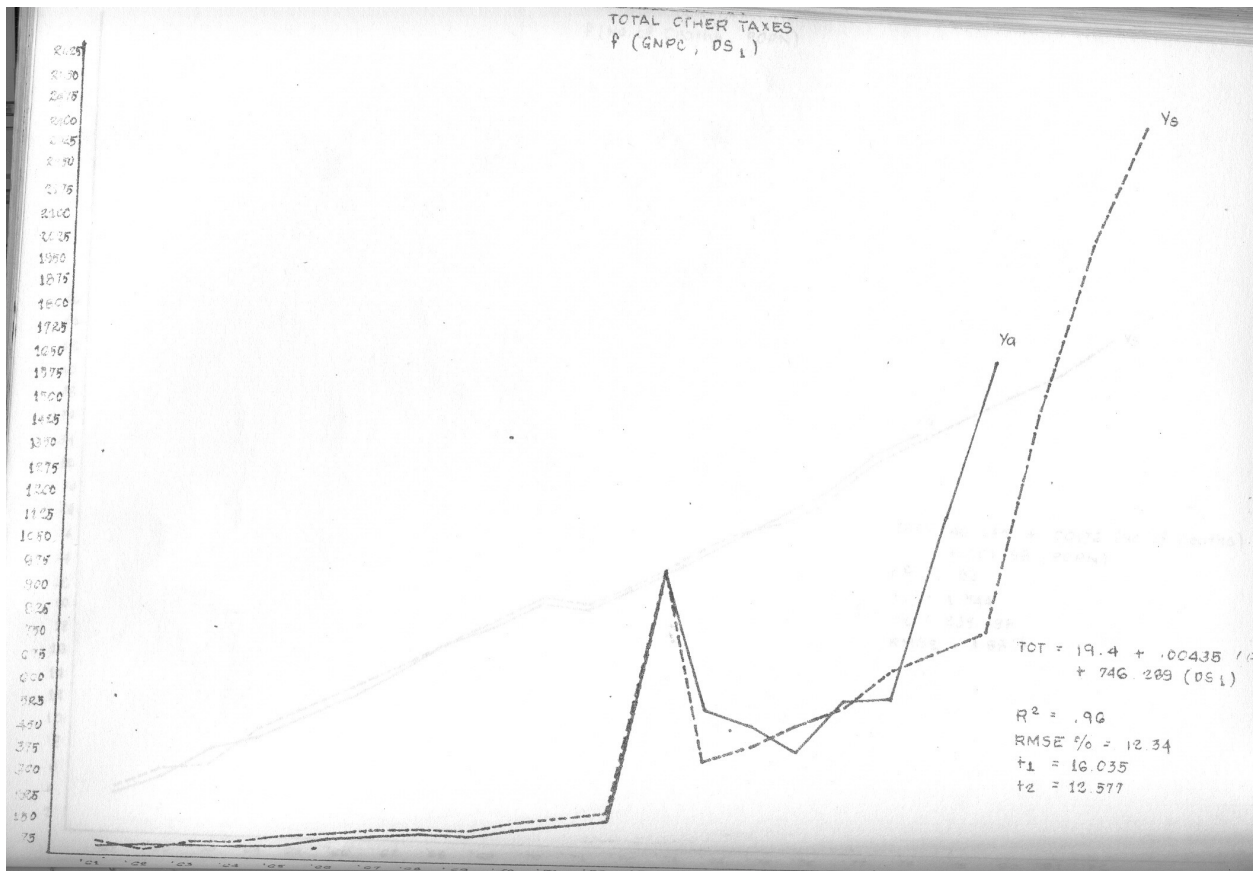
$$\begin{aligned}
 (54) \quad \text{TOT} &= -19.400 + .0044 \text{GNPC} + 746.2890 \text{DO} \\
 &\qquad\qquad\qquad (16.035) \qquad\qquad\qquad (12.577) \\
 R^2 &= .967 \qquad\qquad\qquad \text{RMSE\%} = 12.34\% \\
 \\
 (55) \quad \text{TRT} &= -46.145 + .0018 \text{DEATHS} + .0018 \text{POP} \\
 &\qquad\qquad\qquad (1.54) \qquad\qquad\qquad (235.398) \\
 R^2 &= .990 \qquad\qquad\qquad \text{RMSE\%} = 3.88\% \\
 \\
 (56) \quad \text{RFPP} &= 31.65 - .0089 \text{GVACF} + 3.234 \text{TIME} \\
 &\qquad\qquad\qquad (-4.546) \qquad\qquad\qquad (5.679) \\
 R^2 &= .27 \qquad\qquad\qquad \text{RMSE\%} = 18.05\% \\
 (57) \quad \text{OOTFRDST} &= \text{TOT} - \text{TRT} - \text{RFPP} \\
 \text{RMSE\%} &= 31.67
 \end{aligned}$$

The numbers in parenthesis are the t-values of the corresponding regression coefficients. The percentage root mean square error of the historical simulation for 1961-1978 are also presented.

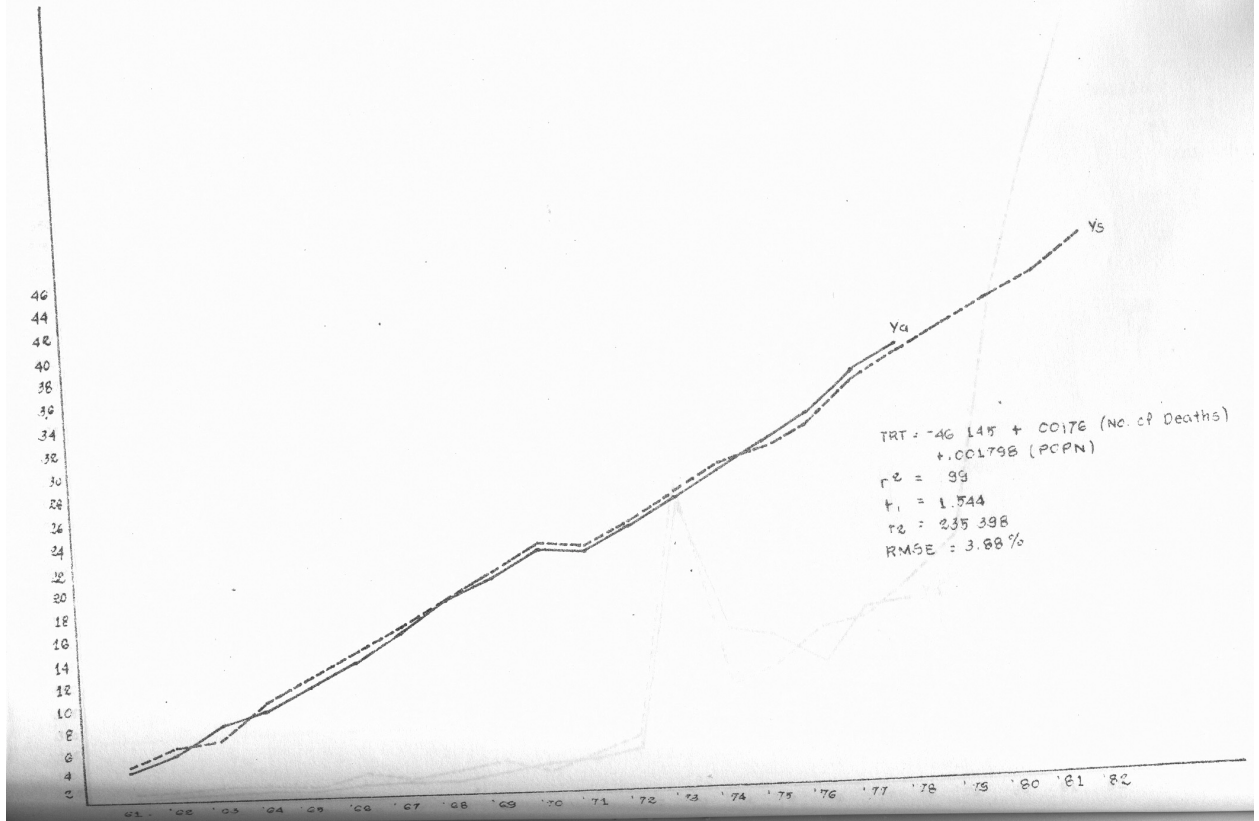
Forward simulations for 1979-1982 were computed. To arrive at the 1979-1980 projections, actual values of the explanatory variables were plugged into (54) – (57). The 1981-1982 forecasts were estimated on the basis of the target values of the national income and demographic variables in the NEDA Five Year Development Plan. No target value is set for gross value added in forestry. Thus, gross value added in forecasting is related with gross national product at current prices, like:

$$(58) \text{ GVACF} = 1083.27 + .017445 \text{ GNPC}$$

Target values for gross national product for 1981-1982 were injected into (58) to yield the forecasts for gross value added in forestry for the same years. The resulting figures were used with (56) to obtain the 1981-1982 forecasts for revenue from public forest.



TRANSFER TAX
 P (NO. OF DEATHS, POPN)



TOT-TAT-RFPD

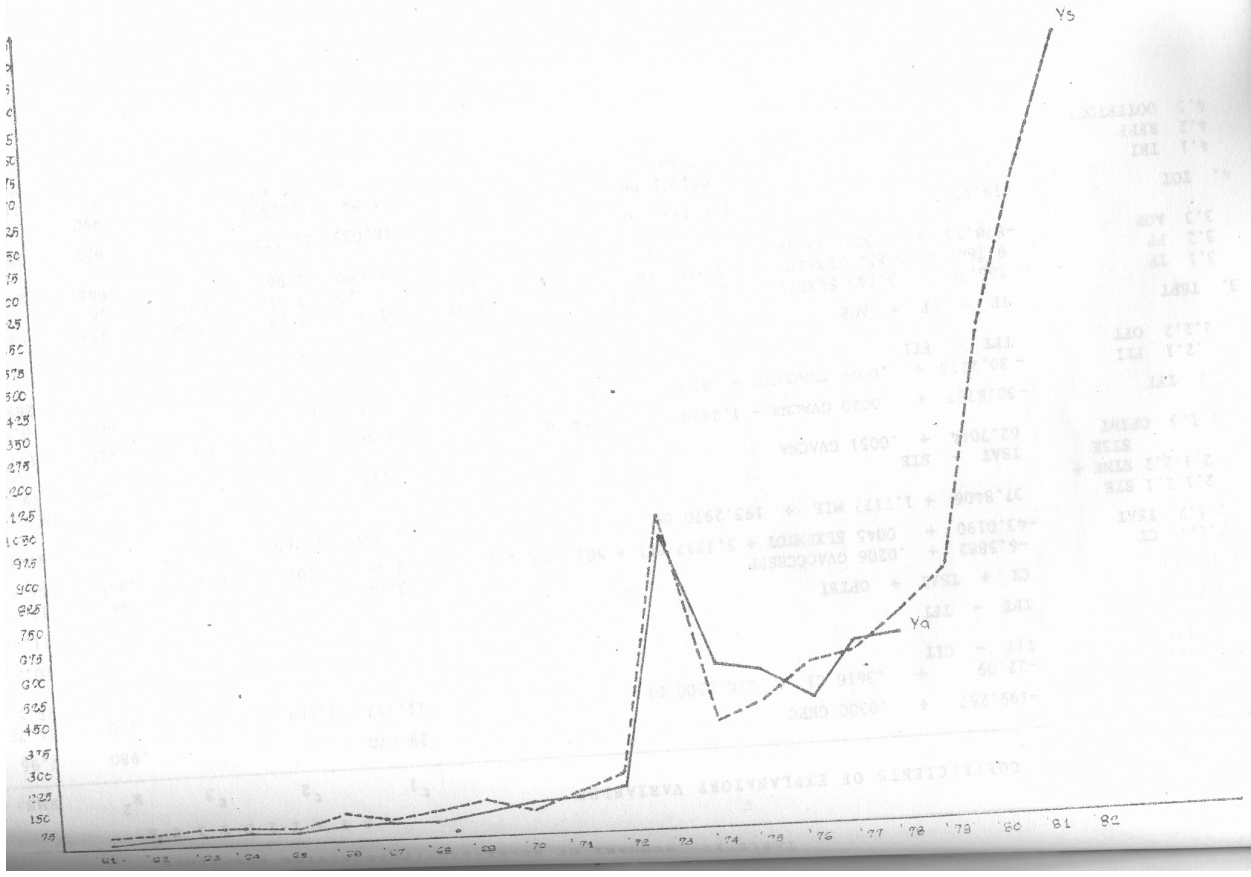


TABLE 1. SUMMARY OF REGRESSION / FORECASTING EQUATIONS

TAX VARIABLES	COEFFICIENTS OF EXPLANATORY VARIABLES			STATISTICS			R2	RMSPE %
				t1	t2	t3		
1 TIT			-199.267 + 0.03 GNPC	28.07			0.980	7.96
1.1 CIT			-22.09 + .3616 CI + 220.5500 DI	11.757	1.664		0.960	14.70
1.2 IIT			TIT - CIT					29.50
2 LBT			TPT - TFT					10.84
2.1 TPT			CT + TSAT + OPTBT					11.40
2.1.1 CT			-6.5882 + 0.0206 GVACCCHSPP	13.740			0.946	11.79
2.1.2 TSAT			-43.019 + 0.0045 SLXPMTOT + 5.7337 DSI + 502.4080 DS2	3.46	0.094	6.510	0.899	14.40
2.1.2.1 STE			37.8406 + 1.7177 MIE + 195.2970 DS2	1.369	1.763		0.877	13.64
2.1.2.2 STNE + STSE			TSAT - STE					869.66
2.1.2.3 OPTBT			62.7044 + 0.0051 GVACNA	6.46			0.748	29.29
2.2 TFT			-30.8787 + 0.002 GVACNA - 1.2418 +153.9654 DS2	3.363	-0.033	3.01	0.928	15.94
2.2.1 FTI			-30.2273 + 0.0028 GVACMCOM = .6577 DS1 + 100.1576 DS2	21.304	(0.121)	(13.829)	0.997	8.94
2.2.2 OFT			TFT - FTI					2693.95
3 TSPT			TP + PP + AOP					9.38
3.1 TP			166.76 - 3.143 SLXRTP + 321.34 IMPRTP + 165.13 DTP	-1.17	7.22	3.34	0.953	13.24
3.2 PP			9.764 - 6.852 SLXRPP + 45.116 IMPRPP + 78.199 DPP	-2.813	5.411	0.42	0.980	19.67
3.3 AOP			-878.55 + .0303 GVARTOT - 54.35 TIME	4.69	-2.96		0.848	24.00
4 TOT			-19.4007 + .0044 GNPC + 746.2890 DO	16.035	12.577		0.967	12.34
4.1 TRT			-46.145 + .0018 DEATHS + .0019 POPN					
4.2 RFPF			31.65 - .0089 GVACF + 3.234 Time	1.54	235.598		0.990	3.88
4.3 OOTFRTDST			TOT - TRT - RFPF	4.546	5.679		0.27	18.05
								31.67

SUMMARY OF RESULTS

The estimated forecasting equations exhibiting better performance in terms of the selection criteria set out in Section Three are summarized in Table 1.

In general, the explanatory variables included are of two types: the taxable base, and the changes in the tax rate/ structure over time. The problem of high forecasting errors as indicated by the RMSE% was a persistent problem in the trial runs. For this paper, 20 per cent at the outset is set at the cut-off value of the RMSE%. However, some regression equations with higher RMSE% than this were accepted in the absence of better alternative equations. At times, the use of accounting identities is done in a deliberate attempt to avoid high forecasting errors. This is true of the individual income tax and the total specific tax whose “best” RMSE% from the regression equations were 32 per cent and 38 per cent, respectively. Their RMSE%, when the identity equations were used, declined to 29 per cent for the individual income tax and to 9 per cent for the total specific taxes.

The statistics used to evaluate the forecasting capability of alternative regression equations, namely t-statistics, R², and RMSE% were found to be consistent with one another in general. Thus, regression equations with significant t-values for the coefficients also exhibit high R² and low RMSE%.

In practically all of the estimated regression equations, the linear form was found to be more acceptable than the logarithmic form in terms of the criteria set.

Note that the regression coefficients of the specific tax on tobacco products and on petroleum products are negative with respect to the sales less exports, contrary to a priori expectations. This may be due to the problem of multicollinearity, and warrants further study. However, this problem is set aside for the moment since the regression equations possess better than average forecasting capabilities.

The estimates of the forward simulations for the various categories and sub-categories are presented in Table 2. There are two uses for the projections obtained from this exercise: (1) to

test the accuracy of the forecasting equations established in this study in simulating forward the levels of the tax variables; (2) to forecast the 1981 and 1982 tax collections on the basis of the target values of economic aggregates in the NEDA Five Year Development Plan.

It should be noted that direct forward simulations tend to result in the cumulation of forecasting errors as one moves farther away from the estimation period. In order to avoid this, adjusted forward simulations were also estimated. The adjustments were done in the following manner: step one, the levels for 1979-1982 of tax variables were simulated directly through the use of the estimated forecasting equations presented in Table 1; the results in this step are given in Table 2; step two, the growth rates of the tax variables for 1978-1979 implied by the direct simulation obtained from step one were applied to the actual 1978 levels to get the projected 1979 levels; step three, in the same manner, the growth rate of the tax variables for 1979-1980 from the direct simulations were applied to the 1979 actual values to get the 1980 projected levels and so on for 1981 and 1982. The results of this exercise are presented in Table 3.

The forecast errors for total tax collection on the basis of direct simulation for 1979 is 5 per cent and for 1980, 7 per cent. However, the errors for the different categories of the tax collections vary from 1 per cent to as high as 25 per cent in 1979 and from 8 per cent to as high as 57 per cent in 1980. The specific tax collections consistently exhibited the largest error margins. Note that lower errors in the aggregate tax projection resulted from the negative and positive errors in the various categories canceling out.

Of course, the errors from the adjusted simulations are consistently lower. For 1979 and 1980, the errors are only 1.04 per cent and 1.09 per cent, respectively. The very high 33.7 per cent error computed for the 1979 forecasts of Other Taxes must have been largely the result of the change in the reclassification of some sub-category taxes into the miscellaneous tax. The adjusted simulation also proved advantageous for specific taxes because the computed forecast error registered at only 3.6 per cent in contrast to that of the direct simulation which was 13.1 per cent.

TABLE 2
PROJECTION OF TAX COLLECTIONS
By Direct Simulations

	1978	1979		1980		1981	1982
	Actual	Actual	Forecast	Actual	Forecast	Forecast	Forecast
A. Income Tax (TIT)	5190.49	6096.68	6465.10	7077.96	7869.71	9195.35	10978.38
0							
1. Individual (IIT)	2548.89	3224.34	3445.76	3746.07	4379.19	5139.46	6075.23
2. Corporate (CIT)	2641.60	2872.34	2902.86	3331.89	3349.49	4055.89	4707.81
B. License and Business (LBT)	2368.30	3068.32	2859.13	3862.30	3394.15	3877.51	4300.42
1 Total Percentage Tax (TPT)	1910.66		2414.97		2868.58	3276.43	3616.42
a) Contractors Tax (CT)	354.58	546.70	457.90		593.38	710.01	838.10
b) Total sales Tax (TSAT)	1115.017	1527.10	1064.86		1173.40	1270.33	1268.86
sale tax on essential (STE)	1023.828	1333.60	975.20		747.07	1339.36	1325.61
ii sales of non-essential plus semi-essential (STNE + STSE)	91.19	193.50	89.66		426.33	(69.03)	(56.75)
c) Other percentage tax with bank's tax (OPTB)	441.07		892.21		1101.78	1296.09	1509.46
2 Total Fixed Tax (TFT)	457.70	589.60	444.16		525.59	601.09	684.00
a) Fixed Tax 1 (FTI)	308.64		359.48		427.71	492.91	564.66
b) Other Fixed Taxes (OFT)	149.06		84.68		97.88	108.18	
C. Total Specific Tax (TSPT)	3614.21	4072.93	3538.57	4554.53	3943.07	4279.28	4692.84
a) Tobacco Products (TP)	874.56	1205.75	962.55		1033.73	1095.48	1171.93
b) Petroleum Products (PP)	1687.91	2238.78	1828.39		2063.09	2228.82	2432.87
c) Alcohol-Other Products (AOP)	1051.74	628.39	747.63		846.25	954.98	1088.04
D. Total Other Taxes (TOT)	663.79	1232.90	931.13	1744.05	1131.47	1344.38	1574.86
a) Transfer Tax (TRT)	42.23	50.90	38.12		40.39	42.65	45.29
b) Revenue from Public forest (RFPF)	28.40		31.64		31.59	21.47	15.43
c) Other Other Taxes (OOTFRDST)	593.16		861.37		1059.49	1280.26	1514.14
E. TOTAL TAX COLLECTION	11836.85	14470.83	13793.93	17238.84	16338.40	18863.62	21546.50

TABLE 3
PROJECTION OF TAX COLLECTIONS
By Adjusted Simulations (P M) 1/

	1978	1979		1980		1981	1982
	Actual	Actual	Forecast	Actual	Forecast	Forecast	Forecast
A. Income Tax (TIT)	5190.49	6096.68	6465.10	7077.96	7869.71	9195.35	10978.38
0							
1. Individual (IIT)	2548.89	3224.34	3445.76	3746.07	4379.19	5139.46	6075.23
2. Corporate (CIT)	2641.60	2872.34	2902.86	3331.89	3349.49	4055.89	4707.81
B. License and Business (LBT)	2368.30	3068.32	2859.13	3862.30	3394.15	3877.51	4300.42
1 Total Percentage Tax (TPT)	1910.66		2414.97		2868.58	3276.43	3616.42
a) Contractors Tax (CT)	354.58	546.70	457.90		593.38	710.01	838.10
b) Total sales Tax (TSAT)	1115.017	1527.10	1064.86		1173.40	1270.33	1268.86
sale tax on essential (STE)	1023.828	1333.60	975.20		747.07	1339.36	1325.61
ii sales of non-essential plus semi-essential (STNE + STSE)	91.19	193.50	89.66		426.33	(69.03)	(56.75)
c) Other percentage tax with bank's tax (OPTB)	441.07		892.21		1101.78	1296.09	1509.46
2 Total Fixed Tax (TFT)	457.70	589.60	444.16		525.59	601.09	684.00
a) Fixed Tax 1 (FTI)	308.64		359.48		427.71	492.91	564.66
b) Other Fixed Taxes (OFT)	149.06		84.68		97.88	108.18	
C. Total Specific Tax (TSPT)	3614.21	4072.93	3538.57	4554.53	3943.07	4279.28	4692.84
a) Tobacco Products (TP)	874.56	1205.75	962.55		1033.73	1095.48	1171.93
b) Petroleum Products (PP)	1687.91	2238.78	1828.39		2063.09	2228.82	2432.87
c) Alcohol-Other Products (AOP)	1051.74	628.39	747.63		846.25	954.98	1088.04
D. Total Other Taxes (TOT)	663.79	1232.90	931.13	1744.05	1131.47	1344.38	1574.86
a) Transfer Tax (TRT)	42.23	50.90	38.12		40.39	42.65	45.29
b) Revenue from Public forest (RFPF)	28.40		31.64		31.59	21.47	15.43
c) Other Other Taxes (OOTFRTDST)	593.16		861.37		1059.49	1280.26	1514.14
E. TOTAL TAX COLLECTION	11836.85	14470.83	13793.93	17238.84	16338.40	18863.62	21546.50

1/ Starting 1979, the levels of actual tax collections were classified so that some sub-categories under license and business tax and other taxes are now reported under miscellaneous tax. Without the 1979 and 1980 actual level of collections for most sub-categories, the 1980, 1981 and 1982 adjusted projections may not be computed. Nevertheless, we used the available tax levels for the general categories to get the total tax collections forecasts.

7. CONCLUSION

In an earlier effort³ to test various tax forecasting models, it was found out that the use of elasticities results in the lowest average root mean square percentage forecasting error. To test how the present forecasting effort compares with the previous undertaking, the forward tax projections resulting from the use of the elasticities approach (Phase I) and the use of the linear models (Phase II) are presented below.

Assumptions. - Taking the revised estimates of the national income accounts for calendar year 1978-1980 that were released by the NEDA in June 1981 as the base, GNP at 1972 prices is assumed to grow at 5.8 per cent for 1981 and at 6.3 per cent for 1982 respectively; the real growth of manufacturing domestic product is assumed to be 5.7 per cent for 1981 and 6.5 per cent for 1982; and real industrial and service domestic products growth at 6.0 per cent and 6.7 per cent for the respective years. These growth rates on the other hand, are the updated target rates from Development Plan officially released in December 1980.

The resulting adjusted projections are shown in Tables 5 and 6.

Observations:

1. The elasticity approach consistently overestimated total tax collections for 1979 and 1980 by 0.5 per cent and 3 per cent respectively, while the linear approach underestimated total collections for the same periods by 1.04 per cent and 1.09 per cent, respectively.
2. The very minimal forecasting error of 0.5 per cent in 1979 for the elasticities approach reflects the fact that this year is included in the estimation period (1961-1979) for this phase. Note that the estimation period for the linear models in the present phase covers 1961-1978 only because the breakdown of the various tax categories are not yet available for the later years.
3. The forward forecast error in the elasticities approach increased six-fold in 1980 (.5%-3%), indicating the tendency of power curves to overestimate the effect of the movement of the tax base on the actual level of tax collected.

³ See footnote one in the text

4. The use of the linear approach resulted in lower forward forecasting errors for the income taxes and its components while for license and business taxes, and other taxes, the logarithmic function resulted in lower errors. The approaches resulted in approximately equal forecast errors for the specific taxes. The greater applicability of a linear function to explain income tax movements indicates that our income tax structure is progressive while the greater applicability of a power function to explain the movements of our license and business tax and other taxes, indicates that our business and other taxes are regressive in nature. For policy considerations, if the BIR's expressed goal is to employ more of the ability to pay principle, then these regressive taxes should be looked into as possible sources of income.

Since the use of the linear model consistently resulted in lower forecasting errors, the use of the projections presented in Table 5 as the official BIR revised forecast for 1981 is recommended. Of course, the 1982 forecast should be adjusted, considering the effect of the implementation of the gross income taxation by 1982.

APPENDIX A.1
Definition of Symbols Used for Tax Variables

IIT	: individual income tax collections in million pesos
CIT	: corporate income tax collections in million pesos
TIT	: total income tax collections in million pesos
CT	: contractor's tax collections in million pesos
STNE	: sales tax collections on non-essential articles in million pesos
STSE	: sales tax collections on semi-essential articles in million pesos
STE	: sale tax collections on essential articles in million pesos
TSAT	: total sales tax collections in million pesos
BT	: bank's and banker's tax collections in million pesos
OPT	: other percentage tax collections in million pesos
OPTBT	: other percentage tax including bank's and banker's in million pesos
TPT	: total percentage taxes in million pesos
FTI	: fixed taxes on manufacturers, producers, and importers, on merchants, on dealers of alcohol and tobacco products, on owners and operators of mills and factories and on registered dealers of prohibited drugs in million pesos
OFT	: other fixed taxes in million pesos
TFT	: total fixed taxes in million pesos
LBT	: license and business tax in million pesos
TP	: specific tax collections on tobacco products in million pesos

APPENDIX A: 1

PP	: specific tax collections on petroleum products in million pesos
AP	: specific tax collections on alcoholic products in million pesos
OP	: specific tax collections on other products in million pesos
AOP	: specific tax collections on alcoholic and other products in million pesos
TSPT	: total specific tax collections in million pesos
TOT	: total other taxes in million pesos
FRT	: franchise tax collections in million pesos
DST	: documentary stamp tax collections in million pesos
RFPF	: revenue from public forests in million pesos
TRT	: transfer taxes in million pesos
OOTFRTDST	: other taxes including the franchise tax and documentary stamp tax in million pesos

APPENDIX A.2
Definition of Symbols Used for Non-Tax Variables

PI	: personal income at current prices in million pesos
CI	: corporate income at current prices in million pesos
GNPC	: gross national product at current prices in million pesos
IEP	: index of employed persons, 1972=200
IAME	: index of average monthly earnings of salaried employees; 1972=100
GS	: gross sales/receipts of establishments
DI	: 0 for 1961-1967, 1 for 1968-1978
GVACCCHSM:	gross value added at current prices in construction, communication, hotel and other services and manufacturing in million pesos
GVACCCHSPP:	gross value added at current prices in construction, communication, hotel and other services and printing and publishing in million pesos
NDPCC	: net domestic product in construction at current prices in million pesos
NDPCCOM	: net domestic product in commerce at current prices in million pesos
GVAB	: gross value added in banks at current prices in million pesos
GVABNB	: gross value added in banks and non-banks at current prices in million pesos
GVACM	: gross value added in manufacturing at current prices in million pesos
GVACNA	: gross value added in the non-agricultural sector at current prices in million pesos
GVACMCOM:	gross value added in manufacturing and commerce at current prices in million pesos
SLXPMNE	: gross sales less exports plus imports of non-essential articles in million pesos
SLXPMSE	: gross sales less exports plus imports of semi-essential articles in million pesos
SLXPME	: gross sales less exports plus imports of essential articles in million pesos
SLXPMTOT	: gross sales less exports plus imports of all products in million pesos

APPENDIX A.2

SLXNE	: gross sales less exports of non-essential articles in million pesos
SLXSE	: gross sales less exports of semi-essential articles in million pesos
SLXE	: gross sales less exports of essential articles in million pesos
SLXTOT	: gross sales less exports of all products in million pesos
IMPNE	: imports of non-essential articles in million pesos
IMPSE	: imports of semi-essential articles in million pesos
IMPE	: imports of all essential articles in million pesos
IMPTOT	: imports of all products in million pesos
MINE	: manufacturing index of non-essential articles in million pesos
MISE	: manufacturing index of semi-essential articles in million pesos
MIE	: manufacturing index of essential articles in million pesos
DSI	: 0 for 1961-1968, 1 for 1969-1978
DS2	: 0 for 1961-1976, 1 for 1977-1978
STOT	: gross sales of all products in million pesos
XTOT	: exports of all products in million pesos
XC	: exports of goods and services in national accounts in million pesos in current terms
MC terms	: imports of goods and services in national accounts in million pesos in current terms
GVARTP	: gross value added in tobacco products at 1972 prices in million pesos
GVARPP	: gross value added in petroleum products at 1972 prices in million pesos
GVARB	: gross value added in beverages at 1972 prices in million pesos
GVARTOT	: gross value added in all sectors or gross domestic product at 1972 prices in million pesos

APPENDIX A.2

GVARM	: gross value added in manufacturing at 1972 prices in million pesos
SLXPMRTP	: sales less exports plus imports of tobacco products deflated by wholesale price index in million pesos
SLXPMRPP	: sales less exports plus imports of petroleum products deflated by wholesale price index in million pesos.
SLXPMRAP	: sales less exports plus imports of alcoholic beverages deflated by wholesale price index in million pesos
SLXRTP	: sales less exports of tobacco products deflated by wholesale price index in million pesos
SLXRPP	: sales less exports of petroleum products deflated by wholesale price index in million pesos
SLXRAP	: sales less exports of alcoholic beverages deflated by wholesale price index in million pesos
IMPRTO	: imports of tobacco products deflated by wholesale price index in million pesos
IMPRPP	: imports of petroleum products deflated by wholesale price index in million pesos
IMPRAP	: imports of alcoholic beverages deflated by Price index in million pesos price index in million pesos
DTP	: 0 for 1961-1972, 1 for 1973-1977
DPP	: 0 for 1961-1973; 1 for 1974-1977
STP	: sales of tobacco products in million pesos
SPP	: sales of petroleum products in million pesos
XTP	: exports of tobacco products in million pesos
XPP	: exports of petroleum products in million pesos
IMPTP	: imports of tobacco products in million pesos
IMPP	: imports of petroleum products in million pesos
XR	: total exports of goods and non-factors services in million pesos in real terms

APPENDIX A.2

IMPR	: total imports of goods and non-factors services in million pesos in real terms
GNPR	: gross national product at 1967 prices in million pesos
GVARNA	: gross value added in real terms in non-agriculture sectors in million pesos
GVACTION	: gross domestic product or gross value added in all sectors at current prices in million pesos
GVACF	: gross value added in forestry at current prices in million pesos
GVACEGWTCSS	: gross value added in electricity, gas, water, transportation, communication, storage and services sectors at current prices in million pesos
POP	: population in millions
DEATHS	: number of deaths in millions
DO	: 0 FOR 1961-1972, 1974-1978, 1 FOR 1973
TIME	: time

**APPENDIX B.1
DATA SERIES FOR TAX VARIABLES**

	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978
1.0 Income Taxes	277.15	322.43	397.8	448.2	495.6	482.8	611.9	763.0	855.5	1050.5	1328.6	1375.397	2378.356	3180.2	3073.796	3705.22	4521.87	5190.5
1.1 Individual Income Tax	174.45	211.2	259.4	271.7	298.65	288.37	395.3	527.9	602.23	763.86	956.688	867.1	1857.7	2391.3	1954.06	2222.26	2048.57	2641.598
1.2 Corporate Income Tax	102.7	111.23	138.4	176.5	196.95	194.35	216.59	235.04	252.89	286.66	371.901	508.29	510.6	788.89	1119.736	1482.96	2473.3	2548.89
2.0 License and Business Taxes	134.9	169.788	190.162	220.215	227.487	268.661	290.956	336.62	364.276	481.244	541.801	618.654	830.44	1197.695	1340.347	1662.415	1921.56	2368.364
2.1 Percentage Taxes	124.939	161.509	178.383	309.041	210.563	257.936	276.805	323.856	346.495	442.448	501.335	563.55	753.534	1101.449	1216.116	1517.128	1658.681	1910.662
2.1.1 Contractor's Tax	17.413	21.838	23.281	26.484	30.257	33.361	38.607	44.185	49.039	65.223	68.391	78.4	99.182	167.015	248.909	357.18	279.772	354.577
2.1.2 Sales Taxes	57.162	75.31	87.263	96.219	97.133	120.349	122.021	143.91	156.058	189.012	208.855	223.68	264.999	432.186	400.346	475.513	639.936	1115.017
2.1.2.1 On Luxury Items	2.286	6.218	4.246	4.499	3.533	6.059	4.938	3.455	6.531	4.619	1.773	8.47	5.556	3.417	0.713	1.231	67.807	71.935
2.1.2.2 On Semi-Luxury	1.788	1.29	2.512	2.619	1.37	0.826	0.961	1.012	8.161	1.513	0.995	1.75	2.416	10.527	1.039	1.658	21.747	19.254
2.1.2.3 On Non-Luxury	53.088	67.802	80.51	89.101	92.23	113.464	116.122	139.443	141.366	182.88	206.087	213.44	257.027	418.242	388.594	472.524	550.382	1023.828
2.1.3 Bank's and Banker's Tax	7.552	11.288	15.882	18.142	17.938	23.324	29.172	36.6	35.077	46.79	55.114	73.9	101.068	144.033	205.961	233.426	274.066	74.493
2.1.4 Other Percentage Taxes	43.812	53.073	51.952	68.196	65.235	79.902	87.005	99.161	106.321	141.423	168.975	187.56	288.285	358.215	260.9	451.009	464.907	366.575
2.2 Fixed Taxes	9.961	8.279	11.779	11.174	16.924	10.725	13.501	12.766	17.058	38.489	40.496	54.9	76.906	96.246	124.230	143.436	263.880	457.701
2.2.1 On Manufacturers/Importers	1.765	(0.991)	2.13	0.774	4.396	(1.42)	2.005	0.971	1.774	7.914	8.453	8.34	12.571	22.943	33.927	55.788	122.21	34.722
2.2.2 On Merchants	3.125	3.477	3.559	3.99	5.836	4.823	4.494	4.794	7.597	13.09	13.366	15.37	24.001	30.914	38.468	46.353	48.729	57.736
2.2.3 On Dealers of alcohol/tobacco	2.074	2.421	2.483	3.22	3.49	4.01	3.237	3.43	3.897	7.848	10.043	21.15	27.358	35.925	46.123	38.675	81.342	212.412
2.2.4 On Millers/Owners of Factories	0.174	0.239	0.300	0.082	0.24	0.300	0.164	0.044	0.282	0.487	0.769	1.06	1.632	2.262	2.102	2.443	8.041	3.769
2.2.5 On dealers of drugs	0.066	0.086	0.072	0.085	0.081	0.148	0.109	0.1167	0.089	0.124	0.143	0.16	0.049	-	-	-	-	-
Total	7.204	5.232	8.544	8.121	14.043	7.32	10.009	9.406	13.639	29.463	32.774	46.1	65.611	92.044	120.620	143.259	260.322	308.639
2.2.2 Other Fixed Taxes	2.757	3.047	3.235	3.053	2.881	3.405	3.492	3.36	3.419	9.026	7.722	8.8	11.29	4.202	3.61	0.17	3.557	149.062
3.0 Specific Tax	259.81	281.57	329.31	363.07	378.28	437.98	480.58	540.65	553.65	580.50	645.78	663.43	823.33	1605.3	1934.65	2515.245	2945.05	3614.21
3.1 On Tobacco Products	144.48	147.48	160.38	183.45	184.13	220.56	242.31	248.10	243.995	244.17	269.57	301.92	362.78	496.57	591.18	810.34	788.33	874.556
3.2 On Petroleum Products	78.574	87.842	110.72	115.837	123.901	140.412	157.284	184.1862	195.425	212.3664	228.007	211.776	267.52	729.527	1233.212	1383.89	1399.755	1687.91
3.3 Alcoholic Beverages and Distilled Spirits	35.65	44.324	55.95	60.925	67.675	74.33	76.72	103.15	111.06	122.79	143.57	145.32	188.41	376.16	99.71	308.31	750	1031.135
3.4 On Other Products	1.123	1.986	2.253	2.856	2.5721	2.6811	4.267	5.22	3.187	3.129	4.443	4.431	4.522	5.135	8.23	12.66	6.59	20.605
4.0 Other Taxes	40.01	63.342	66.523	72.212	73.054	84.159	90.534	103.92	128.684	158.786	185.989	204.119	1038.854	554.155	329.723	454.365	646.52	663.786
4.1 Documentary Stamp Tax	11.63	13.94	17.01	18.3	20.33	20.91	24.02	30.53	53.844	61.76	74.738	79.293	123.355	188.44	209.22	241.48	307.04	350.602
4.2 Revenue from Public Forests	7.7	11.2	16.3	15.7	15.8	19.07	20.4	21.65	22.87	23.92	37.075	37.84	46.293	33.706	31.869	28.115	28.154	28.345
4.3 Franchise Tax	5.5	6.9	8.33	8.7	9.6	13.3	14.4	15.647	18.42	29.046	29.586	43.516	50.051	71.3	71.128	68.768	48.253	56.597
4.4 Transfer Tax	5	9.4	7.9	5.9	11.8	1.86	13.74	18.268	14.345	16.086	18.893	13.782	34.984	28.415	24.276	28.416	37.341	42.23
4.5 Other Taxes	10.19	26.902	16.983	23.612	15.524	19.019	17.974	19.825	19.205	19.974	25.697	29.688	784.171	232.294	202.45	87.586	225.732	186.012
TOTAL TAX COLLECTIONS	711.87	835.13	983.795	1103.69	1174.42	1273.6	1473.99	1745.74	1902.11	2271.06	2702.25	2861.60	5070.88	6537.35	5888.23	8337.19	10035.01	11836.85

**APPENDIX B.2
DATA SERIES FOR NON-TAX VARIABLES**

	PI	CI	GNPC	GVACNA	IEP	IAME	GS	DI
1961	13053	462	15161		66.1	64.1	4766.2	0
1962	14480	696	170301		67.9	66.2	5398.9	0
1963	16614	821	19793		69.7	68.4	6708.4	0
1964	17988	866	21383		71.4	69.8	7423.36	0
1965	19869	734	23382		81.2	70.6	7508.7	0
1966	21445	995	25145		87.4	74.2	8205.94	0
1967	24090	1106	28734	21484	92.1	75.5	12973.72	0
1968	26393	1427	31791	23148	95.3	79.2	11281.4	1
1969	29432	1328	35012	25207	100.4	83.0	11991.74	1
1970	33986	1907	41751	30730	94.6	86.9	15846.95	1
1971	40616	1600	49599	35213	97.7	93.4	19521.7	1
1972	45727	1708	55526	40035	100.0	100.0	21451.05	1
1973	56695	4049	71616	50712	108.4	110.1	31248.3	1
1974	78505	4925	99948	70252	118.3	121.0	47552.9	1
1975	88955	5243	114265	81607	111.0	135.7	51949.7	1
1976	103227	6382	131938	96587	120.8	151.6	67826.1	1
1977	121693	5706	154280	112746	126.2	158.8	71837.3	1
1978	140929	6225	178583	129565	129.0	189.2	54498.7	1
1979	157935	747.8	218263	163610				
1980	190728	8715.10	264265	204946				
1981								
1982								

	GVACCHSH	GVACCHSPP	NDPCC	NPPCCOM	GVAB	GVABNB	GVACM	GVACMCOM
1961			643	3483				
1962			640	3928				
1963			852	4427				
1964			942	4907				
1965			1083	5397				
1966			1086	5872				
1967	8489	2494	1248	6535	443	551	6155	13950
1968	9236	2676	1241	6874	517	668	6722	14887
1969	10218	3072	1398	7407	570	778	7325	16041
1970	12925	3351	1368	8750	701	954	9574	20091
1971	14955	3779	1561	9551	949	1231	11417	23048
1972	17620	4497	1934	10627	1093	1393	13388	26078
1973	22800	5440	2306	13067	1306	1774	17715	33498
1974	32194	8059	3730	18692	1865	2594	24608	47067
1975	39009	110222	5522	19832	2536	3633	28544	53854
1976	46341	14404	8030	24683	2843	4163	32545	61968
1977	53777	16560	9352	28943	3296	4853	37834	71818
1978	60386	18431	10429	31595	4070	5852	42607	82633
1979		22581					54689	104812
1980		29167					68181	129804
1981								
1982								

	LXPMNE	SLXPMSE	SLXPME	SLXPMTOT	SLXNE	SLXSE	SLXE	SLXTOT
1961	1332.26	2668.81	3727.2	7728	1006.12	2123.86	3453	6583
1962	1841.51	3018.72	4688.9	4688	1008.08	2140.46	4146	6180
1963	1980.82	3842.6	5589.2	9737	1013.47	2906.09	5006.1	7250
1964	2693.25	4197.64	6199.1	11216	1515.23	3057.19	5440.8	8140
1965	2674.95	4229.22	6483.0	11411	1535.43	3080.27	5364.6	8175
1966	2964.36	4734.76	6898.1	14597	1678.06	3451.66	6071.4	11201
1967	4301.04	5701.61	8725.4	18729	2714.75	4213.32	7660.1	14590
1968	4639.26	6446.64	9488.0	20835	2810.79	4609.26	8476.8	15896
1969	4406.69	6731.79	11016.3	21983	2635.67	4890.67	9833.3	17359
1970	5499.32	9034.4	13374.8	27910	3105.71	6166.93	11977	21250
1971	7893.14	10860.05	16747.4	35501	4812.32	7926.37	14703.8	27442
1972	335.24	12805.49	21237.3	43629	7043.26	9704.79	18821.8	35570
1973	8533.52	17582.57	27174.8	53283	4559.12	13706.02	24428.3	42694
1974	6698.26	22135.65	27174.8	87005	8829.34	15443.68	41443.7	65717
1975	6539.59	21811.37	46238.7	85915	8779.34	14035.61	38017	60904
1976	6170.52	20582.14	43698.7	80452	6177.94	12657.14	34017	52852
1977	4530.09	19827.97	38337.4	72694	3837.65	11465.18	28278	43580
1978	5890.92	20376.47	36061.9	72329	1824.91	9724.12	28278.7	37348
1979								
1980								
1981								
1982								

	IMPNE	IMPE	IMPTOT	MINE	MISE	MIE	DS1	DS2
1961	544.96	274.17	1145				0	0
1962	878.26	542.99	2254				0	0
1963	936.51	583.19	2487				0	0
1964	1140.45	758.24	3086				0	0
1965	1148.95	1118.37	3236				0	0
1966	1283.11	826.72	3396	45	53	42	0	0
1967	1488.29	1065.34	4139	55	59	48	0	0
1968	1837.39	1011.14	4939	69	66	59	0	0
1969	1841.12	1183.01	4624	69	73	64	1	0
1970	2967.47	1397.78	6660	93	119	72	1	0
1971	2933.68	2043.64	8059	105	127	93	1	0
1972	3100.70	2415.50	10121	100	100	100	1	0
1973	3876.56	2746.46	10595	155	151	131	1	0
1974	6691.97	6726.74	21288	202	185	195	1	0
1975	7775.76	8140.59	25011	223	212	229	1	0
1976	7925.00	9681.69	27600	254	258	267	1	0
1977	8362.79	10058.68	29114	262	277	309	1	1
1978	10652.35	10262.63	34981	315	248	336	1	1
1979						432		
1980						540		
1981								
1982								

	GVARTOT	GARM	SLXPMRTP	SLXPMRPP	SLXMRAP	SLXRTP	SLXRPP	SLXRAP
1961	32603		6.239		6.028	6.234		5.785
1962	34163		5.173	16.246	6.182	5.085	12.552	6.145
1963	36541		6.342	19.888	7.43	6.247	15.973	7.378
1964	37810		6.343	18.649	8.964	6.303	14.258	8.912
1965	39792		7.718	18.545	9.392	7.668	13.997	9.313
1966	41560		9.304	19.577	10.763	9.163	14.425	10.707
1967	44093	9846	10.772	21.903	12.014	10.547	15.348	11.858
1968	46544	10478	13.189	26.943	12.816	12.848	20.706	12.738
1969	48779	10897	15.777	33.236	13.824	15.295	26.943	13.753
1970	51014	11823	18.195	43.847	14.889	17.676	35.246	14.837
1971	53526	12611	19.291	45.88	16.932	18.924	35.900	16.864
1972	56075	13388	21.988	55.727	18.358	21.456	45.610	18.450
1973	60931	15252	23.608	50.198	16.955	23.105	39.721	16.899
1974	64139	15981	30.32	71.26	21.573	30.320	51.652	21.484
1975	63361	16537	26.11	65.418	15.357	25.765	43.363	15.186
1976	72962	17481	23.315	59.441	15.311	22.010	36.495	15.266
1977	77363	18794	22.389	57.945	15.332	20.875	33.504	15.045
1978	81995							
1979	87744							
1980	92792							

	IMPRTP	IMPRPP	IMPRAP	DTP	DPP	STP	SPP	XTP
1961	0.006		0.012	0		421.3		17.104
1962	0.096	3.913	0.04	0	0	374.75	745.45	42.861
1963	0.076	4.122	0.057	0	0	477.34	983.21	48.243
1964	0.044	4.629	0.056	0	0	505.33	880.33	67.974
1965	0.054	4.84	0.086	0	0	602.49	888.89	57.868
1966	0.167	5.632	0.066	0	0	707.23	946.79	45.379
1967	0.268	6.129	0.089	0	0	852.99	1015.15	51.498
1968	0.410	6.826	0.096	0	0	1070.41	1393.21	68.793
1969	0.520	6.965	0.076	0	0	1260.71	1821.84	64.652
1970	0.629	11.477	0.052	0	0	1633.9	2929.11	81.019
1971	0.367	11.647	0.068	0	0	1870.2	3412.17	98.865
1972	0.542	10.117	0.06	0	0	2255.65	4640.55	111.077
1973	0.561	10.365	0.072	1	0	2832.74	4919.69	182.557
1974	0.894	26.055	0.098	1	1	4138.65	11783.71	206.064
1975	0.860	28.186	0.205	1	1	4049.19	11254.81	250.289
1976	1.431	32.427	0.232	1	1	3961.66	10749.64	208.992
1977	1.773	35.798	0.402	1	1	3876.02	10267.15	210.332
1978						3792.24	9806.31	220.048

	XPP	IMPTP	IMPPP	XR	IMPR	GNPR	GVACTOT	GVACF
1961	0.019	0.324	99.426	5279	6366	32242	15268	
1962	2.255	5.749	218.752	6118	6417	34019	17083	
1963	4.515	4.656	239.851	7286	6115	36383	19856	
1964	5.744	2.813	269.377	7723	7375	37627	21467	
1965	14.659	3.485	284.115	8773	7818	39520	23496	
1966	11.625	10.184	334.052	9308	8193	41240	25882	
1967	18.123	17.091	363.818	9615	10069	43224	29024	1298
1968	48.121	26.111	405.168	8522	10829	45540	32129	1534
1969	51.474	37.694	413.502	8170	11027	47967	35296	1737
1970	109.439	45.591	688.065	8744	9990	50035	42448	1637
1971	152.427	34.282	906.16	8997	10015	59921	50120	1902
1972	79.575	54.246	1011.774	9877	10334	55526	56705	2012
1973	101.515	57.617	1270.847	11312	10800	60881	71786	2634
1974	115.486	104.563	4429.507	9980	12883	64739	99638	3258
1975	270.923	133.508	5586.477	9951	13505	68530	114603	2833
1976	166.033	222.639	6654.177	11931	13679	72718	133928	3305
1977	138.895	265.921	7388.685	14168	14557	77162	155434	3741
1978	70.939	238.847	7591.548	13980	16379	81995	176691	4737
1979				15359	18929		-	5606.71
1980							-	6611.44

	STOT	STOT	XC	MC	GVARTP	GVARPP	GVARB	SLXTOT
1961								
1962								
1963								
1964								
1965								
1966								
1967	18027	3439	4903	5438	683	744	442	14590
1968	19641	3745	4713	5754	717	772	473	15896
1969	21188	3828	4578	5807	751	829	535	17359
1970	27770	6520	8095	8236	784	858	609	21250
1971	34931	7489	9260	9648	818	939	662	27442
1972	43375	7805	9877	10334	950	1048	724	35570
1973	55095	12401	15932	13392	1291	1358	758	42694
1974	84204	18487	22266	25400	1457	1219	787	65717
1975	77507	16593	21276	29057	1542	1230	808	60904
1976	71682	18830	23248	31841	1556	1134	859	52852
1977	66624	23044	29200	34675	1567	1069	1020	43580
1978	62240	24892	31390	41321	1586	1108		37348
1979	76118	32892	41461	53120	1662	1733		
1980	91615	42998	54181	68924	1760	1640		

	GVACEG WTCSS	POPN	DEATHS	DO	TIME
1961		27410	139.15	0	1
1962		28313	112.96	0	2
1963		29257	145.06	0	3
1964		30241	154.09	0	4
1965		31270	162.49	0	5
1966		32345	164.99	0	6
1967	5752	33477	167.1	0	7
1968	6369	34656	185.27	0	8
1969	6906	35883	166.46	0	9
1970	7879	37158	163.51	0	10
1971	9324	36685	177.44	0	11
1972	10373	37969	206.47	0	12
1973	12052	39144	204.79	1	13
1974	15379	40380	207.03	0	14
1975	18693	41680	192.11	0	15
1976	22707	43048	210.2	0	16
1977	27084	55510	232.57	0	17
1978	30953	45840	276	0	18
1979		46580	291.3456	0	19
1980		47664	307.544	0	20

APPENDIX C.1

ALTERNATIVE REGRESSION EQUATIONS FOR INCOME TAXES

Linear Regression

1. CIT = 127.793 + .0358 (GS)
r² = .87 RMSE% = 143.178%
t = 10.38
2. CIT = 271.29 + 1259.04 (DI)
r² = .52 RMSE% = 385.11%
t = 4.16
3. CIT = -2044.24 + .078 (GVARNA)
r² = .764 RMSE% = 169.4
t = 5.68
4. CIT = 253.03 + .0198 (GVACNA)
r² = .82 RMSE% = 99.25%
t = 6.765
5. IIT = -291.0735 + .019 (PI)
r² = .92 RMSE% = 238.2
t = 13.627

Multiple Regression

1. CIT = 38.164 + .0308 (GS) + 358.1758 (DI)
r² = .895 RMSE% = 77.07
t₁ = 7.336
t₂ = 1.878
2. CIT = -2038.318 - 22.146 (DI) + .0784 (GVARNA)
r² = .7638 RMSE% = 168.97
t₁ = -.0426
t₂ = 4.8

APPENDIX C.1

3. CIT = $-11.583 + .0189$ (GVACNA)
r² = .8339 RMSE% = 81.4
t₁ = 6.0436
t₂ = 0.843
4. IIT = $-1301.956 - 1.79$ (IEP) + 22.935 (IAME) – 281.179 (DI)
r² = .93 RMSE% = 125.56
t₁ = -0.203
t₂ = 6.35
t₃ = -1.406

Logarithmic

1. TIT = $-18658.7 + 1897.17$ (GNPC)
r² = .922 RMSE% = 317.1
t = 14.39
2. CIT = $-6295.927 + 978.01$ (CI)
r² = .93 RMSE% = 296.38
t = 15.18
3. CIT = $-3.3 + 1.01$ (GS)
r² = .956 RMSE% = 11.58
t = 18.76
4. CIT = $-35646.28 + 3470.385$ (GVARNA)
r² = .766 RMSE% = 184.84
t = 6.688
5. CIT = $-11704.28 + 1215.3$ (GVACNA)
r² = .904 RMSE% = 52.7
t = 10.3
6. IIT = $-8617.71 + 7981.63$ (PI)
r² = .75 RMSE% = 527.3
t = 8.12
7. IIT = TIT - CIT
RMSE% = 526.9

APPENDIX C.2
ALTERNATIVE REGRESSION EQUATIONS
FOR LICENSE AND BUSINESS TAXES

Linear Regression

1.	CT	=	-21.988 + .0045 GVACCCHSM		
			(12.76)		
	R ²	=	.93787	RMSE%	= 14.75
2.	CT	=	4.542 + .03602 NDPCC		
			(17.3)		
	R ²	=	.94625	RMSE%	= 28.51
3.	BT	=	-12.0793 + .00756 NDPCCOM		
			(7.2)		
	R ²	=	.67851	RMSE%	= 59.97
4.	BT	=	26.9985 + .04883 GVAB		
			(4.56)		
	R ²	=	.4946	RMSE%	= 68.17
5.	BT	=	30.5038 + .00314 GVABNB		
			(3.16)		
	R ²	=	.50595	RMSE%	= 66.93
6.	OPT	=	33.6925 + .00382 GVACNA		
			(10.27)		
	R ²	=	.90332	RMSE%	= 20.13
7.	TFT	=	14.0797 + .00390 EST		
	R ²	=	.96794	RMSE%	= 94.96

APPENDIX C.2

Multiple Linear

1. STNE = 5.1714 - .00027 SLXPMNE + 1.8174 DS₁ + 67.05153 DS₂
 (-1.83) (1.15) (38.00)
 R² = .99227 RMSE% = 81.66
2. STNE = 5.1057 - .00019 SLXNE - .00034 IMPNE + 1.7176 DS₁ + 67.7543 DS₂
 (-.47) (-1.05) (1.01) (18.56)
 R² = .99231 RMSE% = 82.45
3. STNE = 6.1674 - .02396 MINE + 1.4696 DS₁ + 69.1475 DS₂
 (-2.01) (.78) (28.58)
 R² = .99389 RMSE% = 83.05
4. STSE = .4206 - .00026 SLXPMSE + .40737 DS₁ + 14.47207 DS₂
 (1.45) (.17) (5.82)
 R² = .83044 RMSE% = 113.8
5. STSE = .4521 - .00023 SLXSE + .00030 IMPSE + .44468 DS₁ + 14.2594 DS₂
 (.54) (.43) (.17) (3.42)
 R² = .83050 RMSE% = 114.04
6. STSE = .1297 + .017354 MISE + 2.5555 DS₁ + 14.2613 DS₂
 (.58) (.76) (3.62)
 R² = .79648 RMSE% = 138.84
7. STE = .473104 + .00814 SLXPME + 436.952 DS₂
 (6.07) (.60)
 R² = .87021 RMSE% = 19.26
8. STE = 63.4143 + .00337 SLXE + .02989 IMPE + 328.735 DS₂
 (.36) (1.35) (2.45)
 R² = .87858 RMSE% = 23.20

$$9. \quad STNE + STSE = 5.8233 + .00002 (SLXPMNE + SLXMPSE) + 2.4499 DS_1 + 81.389 DS_2$$

(.18)

(.89)

(28.12)

$$R^2 = .98681 \quad RMSE\% = 74.64$$

$$10. \quad STNE + STSE = 5.5769 + .00019 (SLXNE + SLXSE) - .00016 (IMPNE + IMPSE)$$

(.62)

(-.50)

$$+ 1.7797 DS_1 + 84.0876 DS_2$$

(.58)

(15.56)

$$R^2 = .98716 \quad RMSE\% = 70.01$$

$$11. \quad TSAT = 69.7231 - .00395 SLXTOT + .02254 IMPTOT + 62.7423 DS_1 + 182.2976 DS_2$$

(-1.32)

(3.71)

(1.04)

(1.48)

$$R^2 = .94013 \quad RMSE\% = 16.33$$

$$12. \quad TFT = -26.273 + .00365 EST + 30.0443 DS_1 + 6.1282 DS_2$$

(10.13)

(3.36)

(-.19)

$$R^2 = .98276 \quad RMSE\% = 56.2$$

Logarithmic

1.	CT	=	1469.829 + 162.544 GVACCCHSM (9.35)				
	R ²	=	.98276	RMSE%	=	45.72	
2.	CT	=	1248.545 + 161.0434GVACCHSPP (12.70)				
	R ²	=	.93.727	RMSE%	=	30.93	
3.	CT	=	-835.185 + 125.190 NDPCC (15.63)				
	R ²	=	.9340	RMSE%	=	65.95	
4.	STNE	=	75.933 + 10.1191 SLXPMNE (4.59)				
	R ²	=	.16127	RMSE%	=	854.45	
5.	STNE	=	24.6688 + 1.6553 SLXNE (4.25)				
	R ²	=	.003207	RMSE%	=	401.39	
6.	STNE	=	-74.0186 + 10.9052 IMPNE (4.92)				
	R ²	=	.28051	RMSE%	=	936.15	
7.	STNE	=	82.0996+ 19.9997 MINE (4.15)				
	R ²	=	.2778	RMSE%	=	1195.45	
8	STSE	=	-41.121 + 5.1044 SLXPMSE (5.14)				
	R ²	=	.3454	RMSE%	=	227.20	
9.	STSE	=	-36.4045 + 4.7755 SLXSE (4.84)				
	R ²	=	.25240	RMSE%	=	228.88	

19. TSAT = $-2055.561 + 227.898 \text{ SLXPMTOT}$
(6.1)
R² = .55177 RMSE% = 55.70
20. TSAT = $-1848.817 + 214.203 \text{ SLXTOT}$
(5.5)
R² = .4359 RMSE% = 48.64
21. TSAT = $-1647.929 + 216.836 \text{ IMPTOT}$
(3.67)
R² = .69479 RMSE% = 80.96
22. BT = $-827.4035 + 99.0185 \text{ NDPCCOM}$
(7.6)
R² = .71628 RMSE% = 116.52
23. BT = $-507.4169 + 86.031 \text{ GVAB}$
(5.25)
R² = .6089 RMSE% = 62.73
24. OPT = $-1618.193 + 193.633 \text{ GVACM}$
(12.47)
R² = .93490 RMSE% = 12.35
25. TFT = $-1352.9485 + 147.2414 \text{ EST}$
(14.23)
R² = .92022 RMSE% = 82.71

APPENDIX C.3

**ALTERNATIVE REGRESSION EQUATIONS
FOR SPECIFIC TAXES**

Linear Regression

1.	TP	=	123.252 + 407.642 IMPRPP (12.55)			
	R ²	=	.913	RMSE%	=	19.70
2.	TP	=	34.468 + 19.512 SLXRTP (4.03)			
	R ²	=	.52	RMSE%	=	28.9
3.	TP	=	25.656 + 19.553 SLXPMRTP (4.359)			
	R ²	=	.559	RMSE%	=	30.18
4.	PP	=	-133.72 + 42.659 IMPRPP (16.31)			
	R ²	=	.95	RMSE%	=	35.07
5.	PP	=	-131.366 + 19.49 SLXRPP (23.92)			
	R ²	=	.29	RMSE%	=	100.7
6.	PP	=	-293.188 + 18.363 SLXPMRPP (4.156)			
	R ²	=	.55	RMSE%	=	97.2
7.	AP	=	-68.109 + 54.66 time (4.31)			
	R ²	=	.65	RMSE%	=	57.7 time: 1961-1977 Excluding 1975
8.	AP	=	-444.832 + .986 GVARB (5.48)			
	R ²	=	.75	RMSE%	=	58.9 time: 1961-1977 Excluding 1975

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9.	AP	=	-108.365 + 20.738 SLXPMRAP (1.82)				
	R ²	=	.27	RMSE%	=	55.9	
10.	AP	=	-36.140 + 42.769 time (3.38)				
	R ²	=	.51	RMSE%	=	86.1	
11.	OP	=	-2.69 + .006 GVARM (2.65)				
	R ²	=	.439	RMSE%	=	29.29	
12.	AOP	=	-545.375 + .0573 GDP (5.2)				
	R ²	=	.7354	RMSE%	=	44.2	time:1961-1977 Excluding 1975
13.	TSTP	=	-2510.384 + .267 GVARM (7.488)				
	R ²	=	.836	RMSE%	=	44.6	
14.	TSTP	=	-241.313 + 241.965 time (6.79)				
	R ²	=	.8075	RMSE%	=	51.5	

Multiple Linear Regression

1. TP = 108.603 – 2.09 SLXRTP + 361.163 IMPRTP + 7.808 time
 (-.309) (4.03) (.49)
 R² = .914 RMSE% = 20.71
2. TP = 115.697 + .834 SLXRTP + 397.371 IMPRTP
 (2.64) (7.916)
 R² = .913 RMSE% = 19.78
3. PP = -5.483 – 7.144 SLXRPP + 48.415 IMPRPO
 (-3.16) (17.705)
 R² = .972 RMSE% = 20.48
4. PP = 228.74 – .022 GVARPP + 989.6 DPP
 (-.488) (49.45)
 R² = .899 RMSE% = 23.43
5. AP = -1045.16 + 2.861 GVARB – 102.493 time
 (8.96) (-5.752)
 R² = .81 RMSE% = 51.7 time: 1961-977
 Excluding 1975
6. AP = -132.35 + 11.050 SLXRAP + 1608.18 IMPRAP
 (3.016) (9.008)
 R² = 69.61 RMSE% = 90 time: 1961-1977
 Excluding 1975
7. AP = -1194.082 + 2.99 GVARB – 112.522 time
 (2.84) (-1.56)
 R² = .735 RMSE% = 68.5
8. OP = -1.1651 + .00029 GVARM + .28 time
 (.142) (.146)
 R² = .44 RMSE% = 30.07
9. AOP = -95.44 + .005 GVARM + 48.873 time
 (.056) (.523)
 R² = .66 RMSE% = 52 time: 1961-1977
 Excluding 1975

Logarithmic

1.	TP	=	$472.04 + 104.969 \ln \text{ IMPRTP}$ (4.03)			
	R ²	=	.52	RMSE%	=	51.79
2.	TP	=	$-332.742 + 257.833 \ln \text{ SLXRTP}$ (3.85)			
	R ²	=	.498	RMSE%	=	32.31
3.	TP	=	$-340.489 + 258.576 \text{ SLXPMRTP}$ (4.01)			
	R ²	=	.517	RMSE%	=	36.07
4.	PP	=	$-879.524 + 571.39 \ln \text{ IMPRPP}$ (8.07)			
	R ²	=	.82	RMSE%	=	95.91
5.	PP	=	$-1290.49 + 529.638 \ln \text{ SLXRPP}$ (2.5)			
	R ²	=	.31	RMSE%	=	111.75
6.	AP	=	$-3794.17 + 619.431 \ln \text{ GVARB}$ (3.82)			
	R ²	=	.646	RMSE%	=	66.2
						time: 1961-1977 Excluding 1975
7.	AP	=	$-428.757 + 235.83 \ln \text{ SLXPMRAP}$ (2.27)			
	R ²	=	.256	RMSE%	=	68.8
8.	AP	=	$-3385.63 + 553.227 \ln \text{ GVARB}$ (3.46)			
	R ²	=	.521	RMSE%	=	86.7
9.	TSTP	=	$-32593.81 + 3551.364 \ln \text{ GVARM}$ (6.79)			
	R ²	=	.78	RMSE%	=	51.5

APPENDIX C.4

ALTERNATIVE REGRESSION EQUATIONS FOR OTHER TAXES

Linear

1.	TRT	=	.9568 + 1.9 (Time)				
	r^2	=	.99	RMSE%	=	5.355	
	t	=	40.025				
2.	TRT	=	7.55 + .0018 (GVACTOT)				
	r^2	=	.866	RMSE%	=	63.55	
	t	=	71.018				
3.	TRT	=	46.86 + .001825 (POPN)				
	r^2	=	.838	RMSE%	=	26.6	
	t	=	9.097				
4.	RFPD	=	25.75 + .00167 (GVACF)				
	r^2	=	.0519	RMSE%	=	22.28	
	t	=	3.54				
5.	RFPD	=	10.8274 + 1.468 (Time)				
	r^2	=	.59	RMSE%	=	22.65	
	t	=	6.4				
6.	DST	=	-248.7 + .00667 (GNPR)				
	r^2	=	.9068	RMSE%	=	122.678	
	t	=	13.178				
7.	DST	=	-360.12 + .011356 (GVARNA)				
	r^2	=	.885	RMSE%	=	89.19	
	t	=	11.88				
8.	DST	=	-71.8 + 18.4 (Time)				
	r^2	=	.81	RMSE%	=	175.6	
	t	=	9.285				

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9. $FRT = 17.21 + .0018 (GVACEGWTCSS)$
- | | | | | | |
|-------|---|-------|-------|---|-------|
| r^2 | = | .51 | RMSE% | = | 47.87 |
| t | = | 4.733 | | | |
10. $FRT = -7.327 + 4.099 (Time)$
- | | | | | | |
|-------|---|-------|-------|---|-------|
| r^2 | = | .83 | RMSE% | = | 52.66 |
| t | = | 9.775 | | | |
11. $OOTFRTDST = -576.22 + .002 (GNPC) + .019 (POPN)$
- | | | | | | |
|-------|---|-------|-------|---|-------|
| r^2 | = | .601 | RMSE% | = | 79.97 |
| t | = | 6.527 | | | |
12. $OOTFRTDST = -6.52 + .004 (GNPC)$
- | | | | | | |
|-------|---|------|-------|---|-------|
| r^2 | = | .58 | RMSE% | = | 57.58 |
| t | = | 5.33 | | | |

Multiple Regression

1. $DST = -422.198 + .0137 (GNPR) - 20.94 (Time)$
- | | | | | | |
|-------|---|------|-------|---|------|
| r^2 | = | .94 | RMSE% | = | 33.2 |
| t_1 | = | 2.41 | | | |
| t_2 | = | 12.6 | | | |
2. $OOTFRTDST = -576.22 + .0021 (GNPC) + .019 (POPN)$
- | | | | | | |
|-------|---|------|-------|---|-------|
| r^2 | = | .606 | RMSE% | = | 79.97 |
| t_1 | = | 4.18 | | | |
| t_2 | = | 3.88 | | | |

Logarithmic

1. $TRT = -4.658 + 11.718 (Time)$
- | | | | | | |
|-------|---|-------|-------|---|--------|
| r^2 | = | .849 | RMSE% | = | 261.94 |
| t | = | 10.39 | | | |
2. $TRT = -116.8 + 12.658 (GVACTOT)$
- | | | | | | |
|-------|---|------|-------|---|-------|
| r^2 | = | .978 | RMSE% | = | 77.46 |
| t | = | 27.0 | | | |

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3.	TRT	=	-215.87 + 45.3369 (Deaths)			
	r^2	=	.84	RMSE%	=	220.27
	t	=	10.09			
4.	TRT	=	-657.055 + 64.5 (POPN)			
	r^2	=	.99	RMSE%	=	50.02
	t	=	40.025			
5.	RFPD	=	-20.199 + 6.46 (GVACF)			
	r^2	=	.115	RMSE%	=	71.97
	t	=	4.48			
6.	RFPD	=	4.089 + 10.23 (Time)			
	r^2	=	.66	RMSE%	=	86.678
	t	=	7.0			
7.	DST	=	-5704.814 + 491.41 (GVARNA)			
	r^2	=	.84	RMSE%	=	433.89
	t	=	8.03			
8.	DST	=	-95.43 + 98.15 (Time)			
	r^2	=	.52	RMSE%	=	1127.5
	t	=	1127.5			
9.	DST	=	-3653.74 + 338.5 (GNPR)			
	r^2	=	.83	RMSE%	=	685.7
	t	=	9.855			
10.	FRT	=	-245.9 + 30.66899 (GVACEGWTCSS)			
	r^2	=	.69	RMSE%	=	93.77
	t	=	7.32			
11.	FRT	=	-16.8 + 23.95 (Time)			
	r^2	=	.638	RMSE%	=	495.09
	t	=	6.757			

APPENDIX C.4

12. OOTFRTDST = -2631.2 + 268.43 (GNPC)

$$\begin{array}{lcl} r^2 & = & .645 \\ t & = & 6.86 \end{array} \qquad \begin{array}{lcl} \text{RMSE\%} & = & 406.25 \end{array}$$

13. OOTFRTDST = -13343.1 + 1296.245 (POPN)

$$\begin{array}{lcl} r^2 & = & .565 \\ t & = & 6.227 \end{array} \qquad \begin{array}{lcl} \text{RMSE\%} & = & 679.646 \end{array}$$

14. OT = -2874.3 + 294.725 (GNPC)

$$\begin{array}{lcl} r^2 & = & .66 \\ t & = & 7.004 \end{array} \qquad \begin{array}{lcl} \text{RMSE\%} & = & 288.8 \end{array}$$

15. OOTFRTDST = OT - TRT - RFPD

$$\begin{array}{lcl} \text{RMSE\%} & = & 394.19 \end{array}$$



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