Table 2.8 MEAN CUMULATIVE TAX ASSESSMENT, PROJECTED NUMBER AND TAX ASSESSMENT UNDER PIA PROPOSAL

B

| Proposed Bracket | Mean Taxable Income (in thousand ₱) | Marginal Rate | Mean Cumulative Tax (₱) | Projection — Number 1963 | Number 1964 | Tax Assessment 1963 | Tax Assessment 1964 |
|---|---|---|---|---|---|---|---|
| 0 - 2,000 | .697 | 5 | 34.042 | 96,042 | 107,555 | ₱3,347,064 | ₱3,748,292 |
| 01 - 4,000 | 2.969 | 8 | 177.52 | 23,293 | 26,086 | 4,134,973 | 4,630,787 |
| 01 - 6,000 | 5.633 | 12 | 455.96 | 10,430 | 11,680 | 4,755,663 | 5,325,613 |
| 01 - 8,000 | 7.464 | 16 | 734.24 | 5,686 | 6,367 | 4,174,889 | 4,674,906 |
| 01 - 10,000 | 9.699 | 18 | 1,125.82 | 3,610 | 4,043 | 4,064,210 | 4,551,690 |
| 001 - 12,000 | 10.859 | 20 | 1,351.80 | 2,524 | 2,827 | 3,411,943 | 3,821,539 |
| 001 - 14,000 | 12.960 | 22 | 1,791.20 | 1,346 | 1,508 | 2,410,955 | 2,701,130 |
| 001 - 16,000 | 15.034 | 24 | 2,268.16 | 1,346 | 1,508 | 3,052,943 | 3,420,385 |
| 001 - 18,000 | 17.498 | 26 | 2,889.48 | 505 | 565 | 1,459,187 | 1,632,556 |
| 001 - 20,000 | 19.053 | 28 | 3,314.84 | 842 | 942 | 2,791,095 | 3,122,579 |
| 001 - 24,000 | 21.838 | 31 | 4,149.78 | 982 | 1,099 | 4,075,084 | 4,560,608 |
| 001 - 28,000 | 25.802 | 33 | 5,414.66 | 982 | 1,099 | 5,317,196 | 5,950,711 |
| 001 - 32,000 | 30.093 | 34 | 6,872.55 | 701 | 786 | 4,817.658 | 5,401,824 |
| 001 - 36,000 | 34.062 | 37 | 8,302.94 | 475 | 531 | 3,943,897 | 4,408,861 |
| 001 - 40,000 | 38.131 | 39 | 9,851.09 | 325 | 365 | 3,201,604 | 3,595,648 |
| 001 - 46,000 | 43.283 | 42 | 11,958.86 | 386 | 433 | 4,616,120 | 5,178,186 |
| 001 - 52,000 | 48.507 | 44 | 14,203.08 | 366 | 411 | 5,198,327 | 5,837,466 |
| 001 - 58,000 | 54.677 | 46 | 16,971.42 | 199 | 222 | 3,377,313 | 3,767,655 |
| 001 - 64,000 | 60.641 | 48 | 19,767.68 | 188 | 210 | 3,716,324 | 4,151,213 |
| 001 - 70,000 | 67.253 | 50 | 23,006.50 | 112 | 127 | 2,576,728 | 2,921,826 |
| 001 - 78,000 | 73.823 | 52 | 26,367.96 | 115 | 129 | 3,032,315 | 3,401,467 |
| 001 - 86,000 | 81.004 | 54 | 30,162.16 | 79 | 90 | 2,382,811 | 2,714,594 |
| 001 - 94,000 | 89.742 | 56 | 34,955.52 | 76 | 84 | 2,656,620 | 2,936,264 |
| 001 -102,000 | 98.385 | 57 | 39,839.45 | 73 | 83 | 2,908,280 | 3,306,674 |
| ,001-110,000 | 106,010 | 58 | 44,225.80 | 50 | 56 | 2,211,290 | 2,476,645 |
| ,001-120,000 | 114.075 | 59 | 48,944.25 | 47 | 52 | 2,300,380 | 2,545,101 |
| ,001-130,000 | 125.946 | 60 | 56,007.60 | 47 | 53 | 2,632,357 | 2,968,403 |
| ,001-140,000 | 135.733 | 61 | 61,937.13 | 27 | 30 | 1,672,303 | 1,858,114 |
| ,001-150,000 | 143.795 | 62 | 66,892.90 | 33 | 37 | 2,207,466 | 2,475,037 |
| ,001-160,000 | 150.852 | 63 | 71,276.76 | 6 | 7 | 427,661 | 498,937 |
| -001-180,000 | 170.335 | 64 | 83,654.40 | 34 | 38 | 2,844,250 | 3,178,867 |
| ,001-200,000 | 191.975 | 65 | 97,623.75 | 20 | 23 | 1,952,475 | 2,245,346 |
| ,001-250,000 | 225.667 | 66 | 119,780.22 | 26 | 29 | 3,114,286 | 3,473,626 |
| ,001-300,000 | 268.949 | 67 | 148,535.83 | 18 | 20 | 2,673,645 | 2,970,717 |
| ,001-400,000 | 355.375 | 68 | 206,995.00 | 11 | 12 | 2,276,945 | 2,483,940 |
| ,001-500,000 | 448.863 | 69 | 271,055.47 | 9 | 10 | 2,439,499 | 2,710,555 |
| ,001 and over | 955.667 | 70 | 625,306.90 | 17 | 19 | 10,630,217 | 11,880,831 |
| | | | | | | ₱122,805,973 | |

repeated samples is approximately normally distributed with mean $\mu_h$ and variance $\sigma_h^2$, say, $a_h$ is also approximately normally distributed with mean given by (5) of section 2.3 after replacing $\bar{x}_h$ by $\mu_h$ and variance given by (6), where $V(\bar{x}_h) = \sigma_h^2$. Obviously, the tax assessment of the $h^{\underline{th}}$ bracket is approximately normally distributed with mean

$$(1) \qquad E\{R_t^{(h)} a_h\} = R_t^{(h)} \left[ \sum_{i=1}^{h-1} r_i (b_{i2} - b_{i1}) + r_h (\mu_h - b_{h-1,2}) \right]$$

and variance

$$(2) \qquad V(h^{\underline{th}} \text{ bracket tax assessment}) = (R_t^{(h)} r_h)^2 \sigma_h^2$$

A 95% confidence interval can now be computed from

$$(3) \qquad \underline{\text{middle estimate}} \pm 1.96 \sqrt{\sum_{h=1}^{23} (R_t^{(h)} r_h)^2 \hat{\sigma}_h^2}$$

Note that the second term of (3) is simply

$$(4) \qquad \sqrt{\sum (1.96 R_t^{(h)} r_h \hat{\sigma}_h)^2} = \sqrt{\sum [1/2 \text{ (difference of } \underline{\text{high}} \text{ and } \underline{\text{low}} \text{ estimates)}]^2}$$

where the high and low estimates are given in Table 2.6.

The result obtained using (3) is expected to be of shorter interval than that computed from Table 2.6. For instance, the interval from Table 2.6 gives, for 1963, 117,328,088 - 105,732,290 = 11,595,798; whereas, using (3), we obtain only so that

111,530,840 ± = , (high estimate)

, (low estimate)

provides the 95% approximate confidence limits of the total tax assessments in 1963.

## 2.7 Estimating Individual Tax Assessments Under Additional Exemptions

Information generally available at the BIR offices are on taxable returns. Except for the number, no information are usually available on non-taxable returns under the current scheme of individual exemptions. The dearth of such data renders it very difficult to make a study on the effect on the distribution of net income when exemptions are lowered than those presently in use. On the other hand, in case of increases in exemption levels, we can proceed to investigate net taxable assessments in one of two ways: (i) estimate the drop in taxable returns from past data, assume that the percentage distribution is undisturbed and proceed as in section 2.3 with reduced overall projected number of taxable returns, or (ii) assume a lognormal distribution for the taxable net income of married persons, estimate the proportion of married persons of each taxable bracket to the total married persons and their number. The number of taxable married persons in the bracket plus the original number of single persons in the same bracket gives the total number of taxable persons in that bracket. We may then proceed to estimate tax assessments by utilizing mean accumulated tax assessments $a_h$ of Table 2.5.

We discuss (i) first. During the years 1954 through 1957, exemption per dependent was ₱600 while for years 1958 through 1961 this exemption had been raised to ₱1,000 per dependent. The exemption level for the two sets of periods

was ₱3,000 for a married person who is the head of the family. The growth of taxable returns $R_t$ for the period is shown below:

| | First Period | | | | Second Period | | |
|---|---|---|---|---|---|---|---|
| t = | 0(1954) | 1 | 2 | 3 | 4(1958) | 5 | 6 | 7 |
| $R_t$ = | 72,334 | 82,069 | 88,735 | 99,670 | 90,364 | 103,337 | 118,844 | 137,935 |

Using transformation to common logarithm for $R_t$ and least squares, the regression equation for the first period (1954 through 1957) and the second period (1958 through 1961) are, respectively:

$$\log \hat{R}_t = 4.86231 + 0.04516t$$

$$\log \hat{R}_t' = 4.78576 + 0.04917t$$

The difference d (see graph) is obtained as

$$d = \text{antilog}\hat{R}_4 - \text{antilog}\hat{R}_4'$$

$$= 110,395 - 96,037 = 14,358$$

This represents an estimate of the number of married persons or heads of families which became non-taxable upon the institution of ₱1,000 exemption per dependent in the second period from the ₱600 exemption per dependent in the second period. A direct proportion would give us 35,892, representing an estimate of total number of married persons who would become non-taxable if current exemption level is increased by another ₱1,000 per dependent.

With an increase of exemption to ₱2,000 (from ₱1,000) per dependent, the 1963 total number of taxable returns is only 115,136 (151,028 - 35,982), whereas 1964 is estimated to be only 133,244. Both are about 3,500 short of the 1960 and 1961 taxable returns, respectively. From our assumptions of the same percentage distribution, tax assessments should come close to those of 1960 and 1961.

Low and high estimates for each bracket may be again obtained after estimates of standard deviations of the mean taxable income (for each proposed brackets) have been computed. Then, by (6) of section 2.3, the standard error of mean accumulated tax assessment for the $h^{\underline{th}}$ sub-bracket $s_{ah'} = r'_h \sqrt{v(\bar{x}'_h)}$, where $r_{h'}$ is the marginal rate of the $h'$ sub-bracket, and $v(\bar{x}_h)$ is the standard error of the $h'$ sub-bracket mean which can be computed by working back in the original sample of 1,073 returns.

Let us discuss (ii) next. Let the net taxable income of a married person be under an additional exemption per dependent of 1,000. If $t$, is the net income under current exemption level, the

$$x_2 = x_1 - 1000c$$

where $c$ is the number of dependents. Preliminary studies, however, have not indicated any relation between size of income and number of dependents. The average number of dependent per married taxable return is 1.708.

The probability that a married taxable person has net taxable income $x_2$ falling in interval $(b_{i1}, b_{i2})$ after

additional an exemption of ₱1,000 per dependent is

$$P_r(b_{i1} \leq x_2 < b_{i2}) = P_r(b_{i1} + 1000c \leq x_1 < b_{i2} + 1000c).$$

Let the average net additional exemption per married taxable returns be ₱1,708 (₱1,000 x 1.708). From our assumption, $x_1$ has a lognormal distribution with mean $\mu'$ and variance $\sigma'^2$. An estimate of $\mu'$ is 7.2177 and of $\sigma'^2$ is $(2.2035)^2$ obtained from the sub-sample of 638 married taxable returns among the 1,073 sub-sampled from the Manila list. Hence, the quantity $z = (x_1 - 7.2177)/2.2035$ follows approximately a unit normal distribution. Using 1,708 instead of 1,000c,

$$P_r(b_{i1} \leq x_2 < b_{i2}) = P_r\left[\frac{\ln(b_{i1} + 1708) - 7.2177}{2.2035} \leq z < \frac{\ln(b_{i2} + 1708) - 7.2177}{2.2035}\right]$$

For bracket i(=1, ..., 23) $\zeta_1 = [\ln(b_{i1} + 1708) - 7.2177]/2.2035$ and $\zeta_2 = [\ln(b_{i2} + 1708) - 7.2177]/2.2035$ can be computed and the probabilities obtained from the c.d.f's:

Thus, $P_r(b_{i1} \leq x_2 < b_{i2}) = F(\zeta_2) - F(\zeta_1)$

$$= \int_{-\infty}^{\zeta_2} \frac{e^{-z^2}}{\sqrt{2u}}\, dz - \int_{-\infty}^{\zeta_1} \frac{e^{-z^2}}{\sqrt{2u}}\, dz$$

These probabilities may be interpreted as proportions falling in interval $(b_{i1}, b_{i2})$. Tabulated below Table 2.9 are the proportions of married taxable returns falling in each bracket with deductions averaging ₱1,708 per return.

The proportion of married taxable return in the entire 1960 list is .6004 (section 2.2). Of the number married, only 44.39% are taxable after an additional deduction of ₱1,000 per dependent, leaving 55.61% of the currently married taxable return no longer taxable. Equivalently, 33.39% (.6004 x .5561) of the currently total 1960 taxable list will no longer be taxable or about 34.437. The previous estimate in (i) is greater by 1,455 married taxable return.

Knowing now the decrease in number of married taxable returns, corrections in the total projected number of taxable returns can be made and tax assessments may be computed using methods already discussed.

Table 2.9

ESTIMATED PERCENTAGES OF TAXABLE RETURNS OF MARRIED PERSONS, PROJECTED ON THE BASIS OF CURRENT TAX STRUCTURE, STILL TAXABLE AFTER RAISING THE EXEMPTION LEVEL PER CHILD BY P1,000.

| Tax Bracket | | Estimated Percentage |
|---|---|---|
| | | $\Pr\left[\frac{\ln(b_{i1} + 1708) - 7.2177}{2.2035} < z < \frac{\ln(b_{i2} + 1708) - 7.2177}{2.2035}\right]$ |
| $b_{i1}$ | $b_{i2}$ | |
| Zero | 2,000 | 18.90 |
| 2,001 | 4,000 | 8.61 |
| 4,001 | 6,000 | 4.75 |
| 6,001 | 8,000 | 2.76 |
| 8,001 | 10,000 | 1.99 |
| 10,001 | 20,000 | 4.21 |
| 20,001 | 30,000 | 1.44 |
| 30,001 | 40,000 | .67 |
| 40,001 | 50,000 | .36 |
| 50,001 | 60,000 | .20 |
| 60,001 | 70,000 | .13 |
| 70,001 | 80,000 | .09 |
| 80,001 | 90,000 | .06 |
| 90,001 | 100,000 | .05 |
| 100,001 | 120,000 | .06 |
| 120,001 | 140,000 | .035 |
| 140,001 | 160,000 | .023 |
| 160,001 | 200,000 | .027 |
| 200,001 | 250,000 | .006 |
| 250,001 | 300,000 | .008 |
| 300,001 | 400,000 | .007 |
| 400,001 | 500,000 | .003 |
| 500,001 | o | .003 |
| | | 44.392 Total |

## Part IV. Estimating Revenue from Taxes on Commodities, License, Business and Occupation

The National Internal Revenue Code (NIRC), otherwise known as Commonwealth Act No. 466 specifies the different types of licenses, business and occupation taxes with their corresponding rates. The NIRC, the Administrative Code and various Acts of Congress have indicated selected commodities which are exempt from taxes and others which are subject to specific taxes.

The Joint Legislative-Executive Tax Commission has data on most revenues from license, business and occupation taxes from 1950 through 1964. Collections from these types of taxes have fluctuated considerably through these years. They started from about ₱98 millions in 1950 and rose steadily to ₱158 million in 1952, followed by a dip to ₱134 in 1953 and a slow climb to ₱192 in 1957; then in 1958 and 1959 sudden drops were experienced from ₱166 millions to ₱158 million which were later offset by spectacular gains in 1960 to 1964 when revenue from these sources almost doubled from ₱195 million to ₱360.

The major contributions to these taxes had come roughly from the same sources. Advance sales tax ranked first, accounting for about 44% of collections in 1964. Sales taxes under section 186 (NIRC) on non-luxuries was a poor second with only about 20% for the same year followed by compensating tax which contributed only about 7%. Taxes on contractors, banks and bankers and amusement had contributed about 6%, 4%, and 3%, respectively.

In the case of specific taxes on cigars and cigarettes, collections for fiscal years 1950 to 1963 showed also steadily rising trends except for slight dips in 1955 and in 1962. Revenue realized from these commodities more than tripled from ₱50

millions in 1950 to ₱154 by 1962. Statistics also showed continuous declines in collections for imported items against continuously increasing trends for the domestic component. Domestic revenue of taxes on cigars and cigarettes started poorly with ₱9.5 million in 1950 to ₱153 million by 1962 whereas revenue from imports of the same commodity decreased from ₱40.5 millions to almost negligible amounts during the same period.

3.2 Projections of Collections on Tax Base

For studies on trends of various components of licenses, business and occupation taxes, separate projections for each component are necessary. More sophisticated analyses generally demand closer inquiries into the timing and application of various statutes affecting the specific tax component.

If no significant changes in the statutes occur over a reasonable period of time, historical analysis based on statistics is sufficient for forecasting levels of collection and/or tax base. Regression of collections or tax bases on time has been extensively utilized. Forecast values of the dependent variable based on the regression equations are directly considered as middle estimates and standard errors of these forecast values were computed for obtaining estimates of low and high values. In all cases, the 95%, fiducial limits were used for the two latter estimates.

Four different models have been employed in fitting the trends, depending on the "scatter" diagram. These are:

(i) Simple: $Y = a + bt$

(ii) Quadratic: $Y = a + bt + ct^2$

(iii) Cubic: $Y = a + bt + ct^2 + dt^3$

(iv) Exponential: $Y = ab^t$

In most licenses, business and occupation taxes the collections were considered as the predictands, whereas only taxes based on Section 185 and 186, taxes on brokers, taxes on banks and bankers, and taxes on manufacturers, etc., had tax bases as predictands. This was because either there had been so many changes experienced in tax rates during the period or that tax bases simply gave the better scatter and patterns of behaviour. In the case of specific commodities, tax bases were the predictands. Tax assessments were computed from tax bases by the simple application of tax rates.

Table 3.1

## REGRESSION EQUATIONS AND REVENUE PROJECTIONS OF TAXES ON LICENSE, BUSINESS AND OCCUPATION AND ON CERTAIN SPECIFIC COMMODITIES

| Type of Taxes | Regression Equations[1/] | | Fiscal Year 1965 (in ₱ million) | 1966 | 1967 |
|---|---|---|---|---|---|
| I. License, Business and Occupation | | | | | |
| 1. Luxury items (section 184) (50% rate) | $\log T = 3.30351 \quad 0.06155t$ (in ₱1,000); $t = 0$ (1958); t-unit $= \frac{1}{2}$ year | L | 2.3 | 2.6 | 2.9 |
| | | M | 5.4 | 6.3 | 7.2 |
| | | H | 12.4 | 14.9 | 17.9 |
| 2. Semi Luxury (section 185) (30% rate) | $\log B = 3.35033 \quad 0.02718t$ (in ₱1,000); $t = 1$ (1958); t-unit $= \frac{1}{2}$ year | L | 0.9 | 1.0 | 1.1 |
| | | M | 1.7 | 1.9 | 2.2 |
| | | H | 3.4 | 3.9 | 4.4 |
| 3. Non-Luxuries (section 186) (7% rate) | $B = 276.8 \quad 48.6t \quad 12.4t^2$ (in ₱ million); $t = 0$ (1957); t-unit = 1 year | L | 91.8 | 107.9 | 125.5 |
| | | M | 102.0 | 120.1 | 139.9 |
| | | H | 112.1 | 132.2 | 154.2 |
| 4. Advance Sales Tax | $T = 108,297.25 \quad 15317.05t$ (in ₱1,000); $t = 1$ (1962); t-unit $= \frac{1}{2}$ year | L | 145.8 | 162.8 | 179.0 |
| | | M | 215.5 | 246.2 | 276.8 |
| | | H | 285.2 | 329.5 | 374.6 |
| 5. Compensating Tax | $T = 13,708.14 \quad 820.56t$ (in ₱1,000); $t = 1$ (1957); t-unit $= \frac{1}{2}$ year | L | 17.9 | 19.3 | 20.6 |
| | | M | 27.7 | 29.3 | 30.9 |
| | | H | 37.4 | 39.3 | 41.3 |
| 6. Alcohol and Tobacco Products | $T = 2504.71 - 70.02t - 1.40t^2 \quad 0.47t^3$ $t = 1$ (1957); t-unit $= \frac{1}{2}$ year | L | 2.4 | 3.0 | 3.9 |
| | | M | 3.2 | 3.9 | 4.8 |
| | | H | 4.0 | 4.7 | 5.7 |
| 7. Minor Taxes | | | | | |
| Specific Taxes | | | | | |
| 1. Cigars and Cigarettes | $T = 112.9386 \quad 3.9566t$ (in ₱ million); $t = 1$ (1957); t-unit $= \frac{1}{2}$ year | L | 158.5 | 165.8 | 173.1 |
| | | M | 180.2 | 188.1 | 196.0 |
| | | H | 201.9 | 210.4 | 218.9 |

| | | Middle estimates (1965) | Proposed |
|---|---|---|---|
| | | (₱ million) | |
| 2. Fuels and Oil | | | |
| (i) | Bunker Fuel Oil | .93 | 50.23 |
| (ii) | Diesel Fuel Oil | 8.61 | 477.64 |
| (iii) | Lubricating Oil | 5.30 | 6.05 |
| (iv) | Kerosene or Petr... | 7.88 | 12.60 |
| (v) | Gasoline and Naftha | 83.15 | 124.72 |

1/ T refers to tax collections while B refers to tax base.

## Part V. Some Concluding Remarks

### 1. On Corporate Income Tax Assessments

Tax assessments of corporations can be estimated if tax rates change under the four net taxable brackets utilized in the Study or any combinations thereof. If tax brackets are changed using different end points then the results given in Part II cannot be utilized directly.

The brackets appear not very convenient for fitting separate log normal distributions on net taxable incomes for each net taxable bracket except for the first two brackets. Apparently, good fitting may be obtained using brackets (in thousand ₱) 0-50; 50-100; 100-200; 200-500; more than 500.

Since the percentage distribution is based on 1962, later analysis should include more recent data on this type of distribution in order to have better estimates of percentage distribution.

If more data are available in punched cards, finer analyses on tax liabilities by type of organization, nature of business, kinds of business deductions, etc. can be incorporated in the future.

If tax rates and brackets do not change in the future, faster computational work can be accomplished by programming the processing of raw data for electronic computers. Mr. R. Mariano has written a FORTRAN program for the IBM-1620 for estimating means, variances, number of returns, mean of total net taxable income in low, middle and high values and estimated revenue for each of the current brackets.

### 2. On Individual Income Tax Assessments

During the period of study, data at the three offices of the BIR were available in different formats; although recently, there have been work done in these offices to

have uniformity in reporting and in punching information in data cards.

3. In General

Other types of studies can be more readily extended to include built-in flexibilities,[1/] the impact of taxation on national income and employment, and other fiscal-policy matters. Compensatory fiscal policy requires decreases in expenditures and/or increases in tax revenue during a period of inflation, (conversely, increases in expenditures and/or decreases in tax revenue during deflation). The magnitude of adjustment can be formalized from studies of changes in tax revenue associated with given changes in national income, so that, in effect, the formulation of models are usually built around (estimates of) "marginal tax rates" or "average tax rates". The above statistical studies can be utilized to improve estimates of average tax rates.

Provisions have also been made for situations when the average tax rate could increase or decrease depending upon other policies set by fiscal planners. Three estimates, therefore, are given in order to guide them in their policy decisions. The statistical analysis can be further extended to take account of decisions which eventually decrease or increase the number of taxable returns (e.g. changes in the level of personal exemptions). By making provisions for low, middle and high estimates of the number of taxable returns, together with average taxable assessments, it is possible to make eight more alternative estimates on total revenue aside from the traditional practices in projections.

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1/ Mr. M. Mangahas has done such a study.