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STATISTICAL FORECASTING MODELS OF LEADING FIRMS IN A SELECTED INDUSTRY

by

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Introduction

Sales forecasting plays a vital role in the management of any business activity irrespective of whether it involves top or middle sales management activities. Generally, it is the starting point of any planning activity. It is not only all encompassing in business operations but it also affects the efficiency of the overall planning and scheduling of all aspects of business activities. Notwithstanding its importance however, business practitioners here in the Philippines have felt that forecasting does not generally receive the attention it deserves.

Objectives

The objectives of this study are:

1) To develop sales forecasting models, using such latest techniques as the use of multiple regression.

The procedure will involve the development of straight company sales models as a function of independent variables. In addition, some sales models will be formulated by developing market share equations and industry demand equations. Here, company sales will be the product of market share and industry sales.

2) To determine the relative importance of the independent variables as determinants of sales.

This could assist the business practitioner in planning budget

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allocations to effect better sales.

Survey Findings

A survey was conducted among executives and marketing managers of a selected industry[1] in the Greater Manila Area. The interviewers were a marketing professor and senior business students of Pamantasan ng Lungsod ng Maynila [14]. The survey showed that forecasting tools in use were grossly inadequate, thus establishing the need for more accurate ones.

All the six companies, with the exception of the smallest in terms of sales, prepared yearly sales forecasts. The biggest firms prepared additional five-year forecasts and made adjustments on a yearly basis. The yearly forecasts were broken down into monthly sales to take care of the seasonality of sales. All the five companies with annual sales forecasts did it on a per product basis. Of these five, three used only the sales trend method. Two out of three firms did not even know the method they used.

In the three companies using the sales trend method, sales forecasting was done informally. The sales manager, oftentimes in consultation with the sales supervisors/salesmen, merely estimated the expected growth in sales for the coming year and used it in the sales forecasts.

The other two companies representing the top two companies in the industry followed a slightly different procedure. In the first company, sales forecasts would be transmitted by the different plant managers from all over the Philippines to the Head Office in Makati where they would be checked by the marketing staff. At the plant level the plant manager would prepare the sales forecast in consultation with the sales manager. The latter prepared his forecast in two ways: 1) through the trend method, and 2) by sales force composite method.

The two figures generally differed and the sales manager would then make the decision on the sales figure he would submit to the plant manager.

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[1] **The six company respondents were given assurances that all information would be kept confidential, thus neither their identities nor the industry they belong to would be disclosed in this paper.**

At the Makati Office the marketing staff would review the forecasts coming from different plants. Using also the trend method and the effects of some economic variables like gross national product and population, the company staff would come up with the final sales forecast at the plant level. Once the final decisions were reached the final individual plant sales forecasts would be returned to the respective plants.

In the case of the second company, all the decisions on sales forecasts were worked out in the main office where all statistical data on sales in various districts poured in. Estimates of sales in respective districts were asked from provincial sales offices and were considered in the analysis. According to this company, sales estimates emanating from the provinces were generally on the low side. This company did not elaborate on the specific method used in forecasting sales except that they used trend analysis and other methods.

All the six respondents had heard about the statistical method but made no comments regarding the use of the said method.

Of the five companies preparing annual sales forecasts, two prepared five-year forecasts subject to review and revision every year. In one particular company, deviations of actual sales from the forecasts varied from 10-20% although there was one year when there was severe economic fluctuation and price adjustments and its forecasts varied from the actual by as much as 40%. Due to limited knowhow they all felt that there would not be much change in their forecasting methods. Surprisingly, one of the companies had a fairly elaborate market research department which however it did not use for sales forecasting, but only for studies of advertising and sales promotion effectiveness.

Only two companies stated that the sales forecasts were circulated in their various departments for use in planning and budgeting. The five-year forecast was generally used as basis for capital budgeting. The time required between the decision to expand and the start of operation of the new plant generally varied from 18-24 months. Three other companies revealed that sales forecasts were used primarily by the sales department in the management and control of sales. The sixth company did not know how to make use of such information and consequently did not even prepare sales forecasts.

The two progressive companies more or less agreed that the following factors affected sales, although they did not venture information as to the relative importance of each. These are:

a) Product quality
b) Product availability and market penetration
c) Advertising
d) Sales promotion
e) Retail price
f) Reputation of the firm
g) Competition

The other four companies refused to comment.

Among the six respondents, only one appreciated the concept of market share and its significant role in the evaluation of the performance of the sales group. The other companies, while they concurred after due explanation was made on the important role market share could play in the management and control of the selling activities, still felt it was a variable difficult to measure and consequently hard to get and/or compute. Some others stated that it was a theoretical value one discussed only in business schools but which hardly played any role in practical sales forecasting.

The one company which responded and showed an active interest in the market share approach actually conducted studies to estimate the company's market share. The manager would assign a group of salesmen and/or supervisors in a given territory to watch the route trucks leaving competitor's plants and wait for the empty trucks to return. He would designate them to conduct the study continuously for a period of one week. In this manner he would have an estimate of the competitors' sales for that period, which when compared with his company's sales for the same period would give him the total industry sale in the territory. He would then be able to estimate his market share as well as that of the other firms.

All the companies surveyed generally followed the same procedure in the preparation of their advertising and sales promotion budget. The previous year's budget served as reference point and increases or decreases were made depending upon the decision made at the middle and top management levels.[18]

It appears that there is at present no rational approach being followed in the determination of advertising and sales promotion

expenditures. This is quite an eye opener since even the largest company spending millions of pesos annually on this item has come up with a better way of planning its budget allocation on sales promotion.

On the question of carry-over and lag effects of advertising and sales promotion, four out of the six interviewed were consistent in stating that the effect was rather shortlived and ranged from one to three months. Two of the respondents knew the meaning of carry-over but preferred not to express opinions on it.

All the respondents were unanimous in expressing the existence of interaction in advertising and sales promotion but gave no comments on the extent of such interaction. It was also shown that while there has been a lot of advances in the technological field of the industry, the forecasting methods in current use were the very ones used 10-20 years ago.

The firms included in the sample prepared direct sales forecasts and did not as a rule adopt market share as a sales target, thereby concealing certain useful sales trends which could prove essential in the proper analysis of sales operations. Thus, while direct sales could be observed to be increasing, the sales increase could be attributed only to the sales growth of the industry and not necessarily to an efficient sales operation. In contrast, a market share approach would provide a better measure of efficient sales performance. It was reported by a responsible manager in one of the surveyed firms that about eight (8) years ago, for five successive years, the sales management staff in one firm was given sales bonuses for a performance of increasing sales when in fact the market share of the company was on a down trend.

The gathered secondary data have not been included in this article due to its voluminous nature. They are available in the original manuscript.[2]

General Conceptual Model

A starting point in the design of sales forecasting models is the development of a general conceptual model which will consider the following factors:

[2] Cariño, Isidro D. 1975, Doctoral Dissertation under the same heading, University of the Philippines.

1. common consensus of opinions offered by marketing executives of the surveyed firms on the factors affecting the market share and industry demands;

2. published literature on similar types of models;

3. the writer's seven years of experience in this industry when he was connected with an international firm doing business in the Philippines;

4. data available from the surveyed companies; and

5. industry and demographic data.

A general conceptual model is given in the expression below:[3]

$$[1] \quad \text{Company Sale}_A = \text{Market Share}_A \times \text{Industry Sale} \times f(\text{Market Share})_B \times F(\text{Carry-over Effect})$$

where

$$\text{Market Share}_A = f(X_1, X_2, X_3, X_4)$$

$$\text{Industry Sale} = F(X_5, X_6, X_7, X_8)$$

$f(\text{Market Share})_B$ = a function representing the interaction effect of market share of Company B with respect to that of Company A.

$f(\text{Carry-over Effect})$ = a function representing the carry-over effect of the independent variables of the market share function of Company A.

X_1 = advertising ratio (A)
X_2 = sales promotion (A)
X_3 = market penetration (A)
X_4 = retail price (A)

[3] Only two terms will be defined since the others are assumed as self-explanatory. These are:
a. market share — the ratio of company sales to total industry sales:
b. market penetartion — a measure of product availability taken as the ratio of number of company outlets to total number of outlets

X_5 = area population
X_6 = household per capital income
X_7 = number of firms
X_3 = temperature

Solving the general conceptual model would be rather difficult and unwieldly, hence it was reduced to four simpler types.

I. The first is the multiplicative model. This expresses company sale as the product of two regression equations representing market share and industry sale. In this model an expression for market share was developed in view of the significance of the market share concept. In the measurement of the success or failure of the sales effort the market share of the company is the important consideration rather than the sales itself.

The multiplicative model [13] is given below.

$$[2] \quad \text{Company Sale}_A = \text{Market Share}_A \times \text{Industry Sale}$$

where

$$\text{Market Share} = f(X_1, X_2, X_3, X_4)$$
$$\text{Industry Sale} = F(X_5, X_6, X_7, X_8)$$

In equation [2], the last 2 functions represented in equation [1], the f(Market Share_B) and F(carry-over effect), have been excluded. Hence it must be shown that these last functions will not have significant effect in the accuracy of the predictor ability of equation [2] if it is to be a good predictor of sales. It will also be necessary to show that the residual value distribution of the regression in equation [2] is independent, and that the covariance between equations is small and negligible.

This brings us to the consideration of the carry-over effect which is taken up in the next type of model.

II. The second type of model is the direct sales model which was developed as a carry-over model with the use of monthly data. The company sales is expressed as a function of several independent variables as shown below.

$$\text{Company Sales} = f(Y_1, Y_2, Y_3, Y_4)$$

Y_1 = previous year's sale
Y_2 = current year and sales promotion expenditures
Y_3 = previous year's advertising and sales promotion expenditures
Y_4 = current year market penetration

To test the carry-over effect of advertising [30], a sub-model was developed and expressed as

$$\text{Company Sale} = f(Y_5, Y_6, Y_7, Y_8, Y_9)$$

where

Y_5 = current month's advertising expenditures
Y_6 = advertising expenditures a month ago
Y_7 = advertising expenditures two months ago
Y_8 = advertising expenditures three months ago
Y_9 = advertising expenditures four months ago

The purpose of this sub-model is to attempt to measure the lag effect of advertising [16]. In the research survey the executives interviewed concurred that there was a very small lag effect of advertising. This sub-model is an attempt to test the validity of such an output in the survey.

III. The third type of model is a direct sales model which expresses company sales as a function of previous sales. This is more commonly referred to as a time-series type. It is another form of a carry-over model since the independent variables are past company sales which are weighted in various ways. It is closely related to the second type since it is in effect a carry-over model.

IV. In the general conceptual model, the interaction effect has been represented by a function of the market share of the competing company. Since this interaction is present any model that does not consider it will not in a real sense be a close representation of reality. The fourth type model develops this interaction effect by setting up simultaneous equations for market shares of the two major competing companies in the industry.

The model is given below:

$$\text{Market Share (A)} = f(X_1, X_2, X_3, X_4)$$

Market Share (B) = $F(X_1, X_2, X_3, X_4)$

where the X_i's are the same variables represented in the general conceptual model for Companies A and B. It is necessary to know the relative value of interaction present among the variables in order to get an idea of the accuracy of the first type of model which eliminates from the general conceptual model the interaction effect represented by the function f(market $share_B$)

The fourteen models subsequently developed and shown in Table I were subsumed in the above four types of models.

Limitations of the Data

Most of the data used were those readily available from company records. The highly confidential nature of the operations in the industry made the gathering of information on company operations a major difficulty. For this reason the limited available data from operations will be used.

Most research studies start with the design of methods to be used in the gathering of needed data. In this particular study, the procedure followed attempted to find the available company records that could be used in the development of the forecasting tools. Hence the general sources of the data are the existing records of the companies and firms associated with them. In view of the multiplicity of data sources, it was necessary to cross-check the obtained data. The figures obtained checked fairly accurately with some published sources like Business Day's publication of April 18, 1974 [1].

One problem that appeared was the manner some of the data were gathered by the company. The methods used could stand much improvement. Even if cost and time were not considered as constraints, it would still be difficult to gather some information without the tacit approval of the companies concerned.

Some examples are the following:

a) In the computation of market penetration figures a sample is predetermined and selected outlets are checked one by one to find the availability of the product. Each outlet regardless of size is considered on an equal basis although strictly speaking, the size of the outlet should enter in the consideration.

b) The monthly advertising and sales promotion expenditures are recorded upon payment and may or may not coincide with actual appearance of the advertising ads or the sales promotion events.

c) Expenses not strictly sales promotion in nature are at times recorded as such. In the pre-martial law era particularly, according to some executives interviewed, contributions given by the company for political funds of local officials were classified under sales promotions.

d) Findings indicate that sometimes the decision to get market penetration data do leak out to salesmen and when they do, the salesmen exert more than extra effort to flood the outlets with their product and thus raise market penetration in their areas. Some salesmen even go to the extent of leaving the stock on consignment to retail outlets. This practice undoubtedly results in a biased market penetration data.

e) Advertising expenses for TV and print media for the Greater Manila Area are charged to the Manila-Rizal Area when in fact they really benefit a much greater area. Hence they spill over other neighboring areas. It is felt however that for as long as this is the general practice for both companies under study in this research work, the resulting inaccuracies are minimized. In the regression study, it is more the behavior and trend of these expenses that are important rather than the amounts themselves.

Tabulation of the Models

The models are tabulated in the accompanying chart. Various forms of relationships of the independent variables were tried out and the form with the best fit was used. Due to the behavior of the independent variables with respect to the dependent variables, it was expected that the linear relationship will fit best.

Basically there are four models. As listed in Table I they are grouped as follows:

1. The multiplicative models I, II, and III where company sales is obtained by the product of the regression equations, market share and industry sale.

2. The carry-over models IV, V, VI, VII and VIII which are direct sales models and which attempted to express company sale in terms

Tabulation of the Models

Model I	Philippines	Industry Sale = f(area population) Market Share = f(advertising and sales promotion ratio, market penetration price)
Model II First Regional Model	Manila-Rizal 1964-1973 (10 yrs)	Industry Sale = f(per capita income) Market Share = f(advertising and sales promotion ratio, market penetration price)
	Davao 1965-1973 (9 yrs)	Industry Sale = f(area population) Market Share = f(advertising and sales promotion ratio, market penetration price)
Model III Second Region Model	Manila-Rizal 1964-1973 (10 yrs)	Industry Sale = (same as First Regional Model for Manila-Rizal) Market Share = f(advertising ratio, sales promotion ratio, market penetration price)
	Davao 1965-1973 (9 yrs)	Industry Sale = (same as First Regional Model for Davao) Market Share = f(advertising ratio, sales promotion ratio, market penetration)
Model IV First Carry-over macro model	Philippines 1965-1973 (9 yrs)	Company Sale = f($Sale_{t-1}$, advertising and sales $promotion_t$, advertising and sales $promotion_{t-1}$, market $penetration_t$)
Model V	Philippines	Company Sale = f($Sale_{(t-1)}$, advertising and sales promotion

Table 1 (continued)

Second Carry-over macro model	1965-1973 (9 yrs)	$\text{ratio}_{(t)}$, advertising and sales promotion $\text{ratio}_{(t-1)}$, market penetration$_t$)
Model VI First Carry-over Regional Model	Manila-Rizal 1965-1973 (9 yrs) Davao 1966-1973 (8 yrs)	Company Sale = f(Sale$_{(t-1)}$, advertising and sales promotion$_{(t)}$, advertising and sales promotion$_{(t-1)}$, market penetration$_t$)
Model VII Second Carry-over Regional Model	Manila-Rizal 1965-1973 (9 yrs) Davao 1966-1973 (8 yrs)	Company Sale = f(Sale$_{(t-1)}$, advertising and sales promotion$_{(t)}$, advertising and sales promotion$_{(t-1)}$, market penetration$_t$)
Model VIII	Manila-Rizal 1969-1973 (5 yrs) Davao 1969-1973 (5 yrs) Monthly Observations	Company Sale = f(Adv_t, Adv_{t-1}, Adv_{t-2}, Adv_{t-3}, Adv_{t-})
Model IX Time-Series Predictor Models	Manila-Rizal 1969-1973 (5 yrs)	1) Naive Method: $S_{t+1} = \frac{x_t + x_{t-1}}{2}$

Davao
1969-1973 (5 yrs)
Monthly Data

2) Exponential Smoothing Method: $S_{t+1} = x_t + (1 - d)S_t$

3) Classical Time-Series Method: $S_t = T_t \times C_t \times I_t + u$

Seasonal Index (I): Compute a 12 month moving average for each month and take the ratio of the actual monthly value to the moving average value and use the average of these ratios to obtain a seasonal index for each of the 12 months.

Trend (T): Compute by regression analysis using the 12-month moving average data.

Cyclical (C): ratio of moving average value to trend.

Model	Place and Period	Regression Equation (Functional Relationships)

4) Forecasting with Adaptive Filtering: An iterative method of computing optimal weights so that the error can be reduced to a minimum level.

$$S_t + 1 = \sum_{t=1}^{\alpha} W_t X_t$$

$$e_{t+1} = (X_{t+1} - S_{t+1})$$

$$W_t^1 = W_t + 2\,ke\,X_t$$

S_t = forecast for t
X_t = monthly sale at t
α = constant
T_t = trend factor
C_t = cyclical factor
I_t = seasonal index factor
u = randomness
W_t^1 = new vector of 12 weights
W_t = old (initial) vector of 12 weights
k = learning constant
e = error
X_t = monthly observation at t

Model	Place and Period	Regression Equation (Functional Relationships)
Model X First Multi-Stage Least Square Macro-Model	Philippines (1964-1973) (10 yrs)	Market Share = f(Adv, SP ratio, Market Penetration)

Model XI Second Multi-Stage Least Square Macro-Model	Philippines 1964-1973 (10 yrs)	Market Share = f(Adv, SP, Market Penetration)
Model XII First Multi-Stage Least Square Regional Model	Manila-Rizal 1964-1973 (10 yrs)	Market Share = f(Adv, SP ratio, Market Penetration)
Model XIII Second Multi-Stage Least Square Regional Model	Manila-Rizal 1964-1973 (10 yrs)	Market Share = f(Adv, Sales Promotion, Market Penetration)
Model XIV Third Multi-Stage Least Square Regional Model	Manila-Rizal 1964-1973 (10 yrs)	Market Share = f(Adv Ratio, SP Ratio, Market Penetration)

of previous year's observations of the independent variables.

3. The time-series model [22][23] as represented by Model IX, which used four different methods: the naive method; the exponential smoothing method; the classical time-series method; and the method of forecasting with adaptive filtering.

4. The multi-stage [32] least squares models represented by Models X, XI, XII, XIII, and XIV, and which attempted to measure the interaction effects of advertising and sales promotion variables.

Design of the Models

The following formulations were made for the first macro-model.

$$\text{Market Share [35]} = f(X_1, X_2, X_3)$$

$$\text{Industry Sale} = F(X_4, X_5, X_6, X_7)$$

where

X_1 = advertising and sales prumotion ratio;
X_2 = market penetration;
X_3 = retail price per unit;
X_4 = area population;
X_5 = household per capita income;
X_6 = number of firms; and
X_7 = temperature.

The original scheme attempted to develop the usual regression analysis relating company sales with the aforementioned independent variables and coming up directly with values of company sales which could readily be used. This was the usual practice observed during the survey conducted. As a consequence of this practice, the marketing officials of the firm usually missed particularly important relevant information in the analysis of sales figures. Generally, when the yearly succeeding sales were higher than the previous year, the performance was considered satisfactory. Such a yardstick can be misleading and may result in a wrong assessment of the real situation. For instance, company A for the Philippine area registered an average increase in sales of 4.5% during the ten year period from 1964-1973. This would seem to be a fair achievement if one considered only the point of view of sales increase, but the fact remains that during this

same period, the rate of increase in this industry of the product referred to was 7%. Taken in this light, it simply meant that the increase in sales resulted from the growth of the industry, and since it was less than the industry growth rate, it could be interpreted to mean that its share of the market had even retrogressed notwithstanding the recorded increase in sales. On the basis of this analysis, the performance of company A during this period was rated not fair but unsatisfactory.

Consequently, it was decided that it would be more meaningful to compute sales by knowing two regression equations, namely the market share equations and the industry sale equations. In this manner the company would be more conscious of its real performance for it would be made aware of its market share in the industry. But of course it was realized that this approach may create some problems in the accuracy of the determination of company sales. Even if each of the resulting regression equation is an unbiased predictor of demand, the result may prove to be biased if the residuals [29] are not independent. Another way of expressing this relationship is to state the requirement of the minimization of the product of the residuals for the multiplicative model to be an unbiased predictor of demand. Based on this analysis, it was decided that the multiplicative type of model and the usual direct sales approach would have to be developed.

A study on sales predictor models would be incomplete if the lag effect is not considered, hence carry-over effect models were studied. Based on the research survey with marketing executives in this industry, there was very little lag effect on advertising and sales promotion and, according to them, the lag effect may at most extend to a maximum of three months. This observation was tested by developing two models using annual data and one model using monthly data.

This product exhibits seasonal sale characteristics, making it very suitable in time-series analysis. Since monthly records on sales and advertising are available, a model was developed to check the lag effect of advertising. Unfortunately, the historical sales data available was only for 5 years (1969-73), thus limiting the methods of forecasting that would be used. The more sophisticated tools of analysis available, such as the Box-Jenkins [3] and spectral analysis, could have been used if historical data were not limited. Through spectral analysis one can predict the cycles of sales, but the use of these methods will be left to future research.

It will be noted that where there exists interaction effect among the variables, the use of single regression equations will not produce accurate results. For instance, it will be rational to believe that there will be an expected interaction effect among the advertising activities of different companies. This is in fact the essence of competitive marketing strategy. The advertising of one company when not followed by competitive advertising, will bring about more effective results than when the advertising of one company is immediately followed by that of a competitor. A more realistic model will be one that will consider interaction effect. For this reason, multi-stage models were investigated.

In addition to the macro-models it was decided to study regional models. Two regions were chosen, namely the Manila-Rizal area and the Davao area. The guiding consideration in the choice of the two places were:

1) The Manila-Rizal area is an old and well-developed market, and is a rapidly growing market for Company B. Company A used to be the leader in this region.

2) The Davao area is a relatively young and developing market where Company A is the leader. There is very little competition from Company B.

Model Building Process

Initially in the macro-model, the industry demand was expressed as a function of the monthly per capital income, area population, number of firms, and temperature. The resulting low "t" values showed that the coefficients of the last two independent variables were insignificant. Hence they were dropped from the equation and industry sale was expressed in terms only of the first two variables.

The explanations offered for the behavior of these latter two variables are:

1) There was very little yearly variation in the number of firms. For the years under study (1964-1973) there had been only four changes. For the period 1964-66, there were no changes and the number of firms remained at six. For the next succeeding five years, it stayed at eight firms increasing to nine in 1972 and to eleven in 1973.

2) It is generally agreed that temperature plays a significant role in the demand of this consumer product in the Philippines. However, in this model, annual average temperatures were used and hence much of the variations had been averaged out. Consequently, it was not at all unexpected to get insignificant results in temperature coefficients.

At this stage the industry demand depended only on two independent variables, namely the per capita income and the area population. Both variables exhibited high individual correlations with industry demand and very high correlations between the two variables ranging from 0.98 to 0.99. It can be concluded that there exists a high degree of multi-collinearity. This indicates that either one of them will suffice for use in the succeeding models; industry sales was computed in terms of either the per capita income or the area population and the model with the higher correlation coefficient was chosen.

In the macro-model for market share of Company A and Company B, price was insignificant at the 5% level of significance as gathered from the low t-ratios. The same observations were made in the first regional model except for the market share regression for Company A where price had a t-ratio of -2.182. All others were less than 2 which rendered the price variable as insignificant at the 5% level. The possible explanation for this general behavior of the variable represented by price can be the fact that there is no price difference in the products of companies A and B. This is due to the normal practice of Company A and Company B to interchange as price leaders. When one company raises the price, the other immediately follows with the same price increase.

The stepwise regression of the first regional model for Company A in the market share equation indicates a near zero % contribution of price as a determinant of market share. This is further reinforced by the recorded F value which shows it to be not significant.

For these reasons, price as an independent variable was deleted in all the succeeding market share models.

To measure the stability of their coefficients, the models were developed using seven years, eight years, nine years and ten years data. The coefficients and various statistics were tabulated. In the process it was observed that the values of the Durbin-Watson statistics fluctuated as the number of years of observation used

varied from 7 years to 10 years. This indicated the presence of auto-correlation which may be attributed to missing explanatory variables or some inflationary effect which may have crept in during the years under observation or due to errors in measurement in some of the explanatory variables used.

The results in the multi-stage models showed that there was very little interaction as reckoned from the little changes in the coefficients in the equations for stage 1 to stage 2. This can be explained by the aggregative effect in the annual figures which tend to nullify the effect of interaction.

A test to prove this allegation makes it desirable to study the monthly data. However as already discussed, there appears to be some inaccuracies between the recording of the advertising expenditures and the appearance of the copy in the newspapers or bill boards. Consequently there are errors in the recording of monthly expenditures in the form of lags. Further research in this area will have to wait until more accurate monthly data are made available.

The Results

The results of the computations of the various models are shown in the accompanying tabulations in Table II. The figures enclosed in parentheses are t-ratios.

It will be observed that the values of the coefficients of determination (R_2) are fairly high and ranged from 0.746 to 0.991 except for the following values which are considered low:

(1) Model III, Market Share (A) for Manila-Rizal Area with R_2 = 0.54. The low value may be explained by the inaccuracies in the measurements of advertising and sales promotion due to the time lag in the recording of expenditures. This is reflected in the ratio.

(2) Model VIII, Advertising Lag Model for both Manila-Rizal and Davao Areas. The low values of R_2 (0.141 and 0.228) were expected, since the only independent variable considered was advertising and the other variables were intentionally deleted. This was resorted to in order to measure the effect of advertising and its carry-over effects.

(3) Model IX, Philippines. The low value of R_2 (0.33) was

Table II

The Results

Model	Place and Period	Dependent Variable	Intercept	Per Capita Income	Area Population	Adv SP Ratio	Adv Ratio	SP Ratio	Market Penetration	Price	M/C	R^2	F	D/W
Model I Macro Model	Philippines 1964-73 (10 yrs)	Industry Sale	-179.450		7.812 (19.657)						0.989	0.979	386.420	2.080
		Mkt Share (A)	0.485			1.920 (2.215)			-0.526* (-1.714)	0.148* (0.429)		0.922		1.926
		Mkt Share (B)	-0.111			1.293 (7.853)			0.384* (1.513)	-0.175* (-1.168)		0.914		2.582
Model II	Manila-Rizal	Industry Sale	839.387	5.026 (7.489)							0.935	0.875	56.098	6.623
First Regional Model	1964-73 (10 yrs)	Mkt Share (A)				0.351* (1.714)			0.000* (0.223)	-0.003 (-2.182)	0.863	0.746	5.887	1.869
		Mkt Share (B)				0.361 (2.233)			0.187 (2.478)	0.422* (1.215)	0.931	0.867	13.089	2.591
	Davao 1965-73	Industry Sale	-4095.906		8.095 (12.572)						0.978	0.957	158.072	2.315
		Mkt Share (A)	0.064		0.254* (1.921)				0.002* (0.587)	0.001* (1.140)	0.960	0.921	19.672	2.791

*Not significant

Adv — advertising SP — sales promotion Mkt — market

Table II

The Results

Model	Place and Period	Dependent Variable	Inter-cept	Per Capita Income	Area Popu-lation	Adv Sp Ratio	Sp Ratio	Market Penet-ration	M/C	R^2	F	D/W
Model III	Manila-Rizal	Industry Sale	(Same as First Regional Model, Manila-Rizal)									
Second Re-gional Model	1964-73 (10 yrs)	Mkt Share (A)	0.004			-0.194* (-0.884)	-0.252* (-1.189)	0.355 (2.096)	0.714	0.54	2.082	1.094
		Mkt Share (B)	-0.067			0.125* (1.023)	0.138* (1.942)	0.240* (1.529)	0.930	0.84	12.838	2.444
	Davao 1965-73 (9 yrs)	Industry Sale	(Same as First Regional Model, Davao)									
		Mkt Share (A)	-0.405			0.199* (1.849)	-0.057* (-0.665)	0.851 (2.531)	0.961	0.923	20.200	2.971

*not significant

Model	Place and Period	Dependent Variable	Inter-cept	Sale (t—1)	Ad SP t	Ad SP (t—1)	Market Penet-ration	Ad SP Ratio (t)	Ad SP Ratio (t—1)	M/C	R^2	F	D/W
Model IV	Philip-pines	Co (A) Sale	-8.277	0.940 (2.707)	-0.593* (-1.249)	0.177* (0.418)	18.205* (0.584)			0.989	0.978	45.695	2.643
First Carry-Over Macro Model	1965-73 (9 yrs)	Co (B) Sale	10.807	0.821 (3.470)	0.178* (0.356)	0.121* (0.302)	-17.700* (-0.485)			0.995	0.991	121.246	2.263
Model V	Philip-pines	Co (A) Sale	39.746	0.106* (0.239)			8.286* (0.160)	-110.072* (-0.740)	-186.273* (-0.889)	0.989	0.979	46.855	2.353
Second Carry-Over Macro Model	1965-73	Co (B) Sale	-12.405	0.872 (18.917)			27.046* (1.787)	29.130* (1.596)	-29.157 (-2.843)	0.998	0.997	384.978	2.783
Model VI	Manila-Rizal	Co (A) Sale	4.203	0.643 (2.289)	0.000* (0.081)	-0.004* (-1.288)	-1.131* (-0.332)			0.949	0.901	9.119	2.037
First Carry-Over	1965-73 (9 yrs)	Co (B) Sale	-2.300	0.053* (0.223)	-1.635 (-2.043)	2.731 (2.624)	9.913* (0.733)			0.983	0.966	28.664	2.570
Re-gional Model	Davao 1966-73 (8 yrs)	Co (A) Sale	-9.764	-0.105* (-0.396)	0.020 (2.745)	0.000* (0.771)	12.060* (1.143)			0.988	0.977	32.381	2.327

Model	Place and Period	Dependent Variable	Inter-cept	Sale (t—1)	Ad SP t	Ad SP (t—1)	Market Penet-ration	Ad SP Ratio (t)	Ad SP Ratio (t—1)	M/C	R^2	F	D/W
Model VII	Manila-Rizal	Co (A) Sale	0.573	0.669* (1.993)			2.577* (0.711)	0.968 (0.217)	-3.329* (-0.8153)	0.904	0.817	4.483	1.713
Second Carry-Over	1965-73 (9 yrs)	Co (B) Sale	-11.857	-0.290* (-1.291)			17.800 (3.584)	2.857 (0.619)	20.729 (3.552)	0.993	0.987	76.126	2.030
Re-gional Model	Davao 1966-73 (8 yrs)	Co (A) Sale	1.498	0.281* (0.541)			-10.694* (-0.247)	6.201* (0.446)	12.374* (0.692)	0.888	0.789	2.808	2.696

Model	Place and Period	Dependent Variable	Inter-cept	Adv t	Adv t—1	Adv t—2	Adv t—3	Adv t—4	AA/C	R^2	F	D/W
Model VIII Advtg. Lag Model	Manila-Rizal 1969-73 60 mo. obs.	Co (A) Sale	421.983	-0.757* (-1.795)	0.686* 1.300)	-0.077* -0.177	-0.358* -0.684	0.872 (2.004)	0.376	0.141	1.652	0.643
	Davao 1969-73 60 mo. obs.	Co (A) Sale	184.00	0.010* (1.689)	-0.011* (-1.214)	0.018* (1.079)	-0.010* (-1.168)	0.008* (1.379)	0.477	0.228	0.958	1.192

*Not Significant

Table III

Model	Place and Period	Regression Equation (Functional Relationships)	
Model IX Time-Series Predictor Models	Manila-Rizal Davao 1969-1973 60 monthly Data	1) Naive Method:	$S_{t+1} = 0.5\, X_t + 0.5\, X_{t-1}$
		2) Exponential Smoothing Method:	$S_{t+1} = 0.3\, X_t + 0.7 S_t$
		3) Classical Time-Series Method:	$S_t = T_t \times C_t \, X \, I_t + u$
		4) Forecasting with Adaptive Filtering	$S_{t+1} = \sum_{t=1}^{\alpha} W_t \, X_t$
			$e_{t+1} = X_{t+1} - S_{t+1}$
			$W_t^1 = W_t + 0.16\, eX_t$

Model	Place and Period	Dependent Variable	Intercept	Adv SP Ratio	Adv. Expense	SP Expense	Adv Ratio	SP Ratio	Market Penetration	R^2
Model X First Multi-Stage LS Macro-Model	Philippines 1964-73 (10 yrs)	Mkt Share (A) Stage 1	0.472	1.772 (3.256)					-0.455 (-2.070)	0.93
		Mkt Share (A) Stage 2	0.472	1.703 (3.260)					0.449 (-2.129)	
		Mkt Share (B) Stage 1	-0.009	1.340 (12.669)					0.169 (2.465)	0.94
		Mkt Share (B) Stage 2	0.012	1.263 (12.663)					0.153 (2.261)	
Model XI Second Multi-Stage LS Macro-Model	Philip- 1964-1973 (10 yrs)	Mkt Share (A) Stage 1	0.986		-0.015* (-1.321)	0.000* (0.015)			-0.903 (-4.444)	0.88
		Mkt Share (B) Stage 1	0.495		0.035* (1.079)	-0.015* (-0.572)			-0.338* (-1.106)	0.33
		Mkt Share (A) Stage 2	0.907		-0.017* (-1.614)	-0.001* (-0.144)			-0.792 (-4067)	
		Mkt Share (B) Stage 2	0.406		0.032* (1.096)	-0.014* (-0.595)			-0.196* (-0.670)	
Model XII First Multi-Stage LS Regional	Manila-Rizal 1964-1973 (10 yrs)	Mkt Share (A) Stage 1	-0.004	-0.468 (-2.507)					0.374 (2.980)	0.56
		Mkt Share (A) Stage 2	-0.064	-0.420 (-2.348)					0.438 (2.090)	
		Mkt Share (B) Stage 1	-0.064	0.276 (2.190)					0.229* (1.393)	0.83
		Mkt Share (B) Stage 2	-0.122	0.228*					0.323 2.080	

Model	Place and Period	Dependent Variable	Inter-cept	Adv SP Ratio	Adv. Expense	SP Expense	Adv Ratio	SP Ratio	Market Penet-ration	R^2
Model XIII Second Multi-Stage LS Regional Model	Manila-Rizal 1964-1973 (10 yrs)	Mkt Share (A) Stage 1	0.277		-0.034* (-1.930)	-0.047 (-2.016)			-0.020* (-0.187)	0.87
		Mkt Share (A) Stage 2	0.234		-0.014* (-0.984)	-0.066 (-3.271)			0.028* (0.296)	
		Mkt Share (B) Stage 1	0.019		0.002* (0.089)	0.031* (1.397)			0.186* (0.372)	
		Mkt Share (B) Stage 2	0.322		-0.000* (-0.016)	0.036* (1.828)			0.168* (0.404)	
Model XIV Third Multi-Stage LS Regional Model	Manila-Rizal 1964-1973 (10 yrs)	Mkt Share (A) Stage 1	0.004				-0.194* (-0.884)	-0.252* (-1.189)	0.355 (2.096)	0.54
		Mkt Share (A) Stage 2	-0.038				-0.023* (-0.121)	-0.373* (-1.862)	0.390 (2.499)	
		Mkt Share (B) Stage 1	-0.067				0.125* (1.023)	0.138* (1.942)	0.240* (1.529)	0.84
		Mkt Share (B) Stage 2	-0.143				0.035* (0.330)	0.133* (1.959)	0.378 (2.631)	

*Not Significant

expected since advertising and sales promotion expenditures are not good predictors of market share.

(4) Model XII, Market Share (A) for Manila-Rizal Area. As explained in (1) the low value of R_2 of 0.56 may be due to inaccuracies in measurements of advertising and sales promotion expenditures.

Significant Findings and Conclusions

1. The important consideration in the prediction of market share is the company's rate of growth. For a low or even retrogressive rate of growth, the advertising and sales promotion variables are the developing young market as well as a mature market. Market penetration is the important predictor of market share in a rapidly expanding market. Advertising and sales promotion, while important factors, play secondary roles to market penetration in this type of a market.

2. No definite conclusion can be given on the lag effect of advertising and sales promotion in this study. It may be inferred, however, that the lag effect of advertising and sales promotion is not significant as judged from the results of the carry-over and advertising lag models. This tends to confirm the opinions of the executives of this industry who were interviewed.

3. Based on this study, the multiplicative model is an unbiased predictor of sales. This has been shown by computing the correlation coefficients between the residuals of the market share and the corresponding industry sales regression equations. The computations show very small values of the correlation coefficients which indicate very low covariances of the residual values.

4. In the market share, macro-model price has come out to be insignificant at the 5% level, but only for the condition given by the data used in the study during which period the two main competitors practiced uniform pricing. There appears to be a collusion between the two companies as far as price changes are concerned since one acts as a price leader and the other inevitably follows shortly after. It is strongly felt that under different circumstances this variable may play a significant role should another competitor enter the industry and offer a lower price. Such a condition may change the existing situation and it may even be possible for the two existing companies to lower prices to maintain a steady market for their products. Under

this condition, price would become a significant predictor of market share.

5. In the carry-over model the previous year's sale has turned out to be an important sales predictor. This phenomenon may be attributed to the cumulative effects of past decisions carried over to the present. It may also include the effect of a series of carry-over distributions representing the effect of the variables with several lags which when taken together result in a significant contribution of the lag effect. On a short term, the results tend to show that the influence of advertising and sales promotion on sales exhibit very limited carry-over effects.

The advertising lag model appears to reinforce the limited carry-over effect by the significance of only the first term represented by the current month's advertising expenditure.

In view of the reported inaccuracies of the monthly expenditures in advertising this conclusion is not very definite. The results, however, indicate a limited lag effect of advertising. This tentative conclusion reinforces the opinions given by marketing executives of companies A and B interviewed during the research survey.

6. The results of the computation justified the simplified version of the multiplicative model which did not take into consideration the two functions in the general conceptual model represented by f(Market Share_B) and F(Carry-over Effect). The subsequent computations of the second and fourth types of models showed that the simplified assumptions were verified. The carry-over effect was shown to be small and tentative results point to the negligible contribution of the interaction effect.

7. The models developed in this research study are more accurate sales forecasting tools than those presently used in the industry.

8. The significance of the results of this study is not limited to providing a more accurate sales forecasting tool but have also given important insights on the relative importance contributed by the various independent variables. Thus the significant role taken by advertising and sales promotion ratio and market penetration in the growth of market share is found useful in the allocation of the marketing budget.

9. The changes in market shares will give valuable information in

market strategy formulation. For instance if a decreasing market share is indicated by the use of the models, the marketing manager can decide to increase or decrease the expenditures of the appropriate variable to bring about the desired result. Through marketing intelligence he can forecast his competitor's market share. Such information will be useful in the revision of his plans to meet or counteract the competitor's strategy. Thus, knowledge of changes in market share can contribute a significant role in the decision-making approaches in the marketing mix.

10. The results of this dissertation point to the importance of market share as information that will provide a good measure of the success or failure of the sales force. Thus a decreasing market share, notwithstanding the upward behavior of direct sales, is an indication of unsatisfactory performance. The recommended criterion for success of the sales force will be increasing market share rather than just increasing direct sales. Such a criterion will provide the motivation to improve sales performance and the results can be tied up to the bonuses and other incentive systems.

11. In product planning and plans for plant expansion, the behavior of market share changes will be an important factor to consider. A consistent increase in market share rather than mere increases in direct sales will give more accurate sales trend information.

12. In the time-series model, the more sophisticated forecasting method using adaptive filtering has resulted in the most accurate forecasts as compared with the three generally known methods such as the naive, exponential, and classical methods.

13. The multi-stage least squares models indicate very limited interaction effect in advertising and sales promotion. This is tentative and should be verified by future research using monthly data instead of annual figures. While monthly data in advertising expenditures are available, they appear to be subject to errors and inaccuracies both in measurement and recording.

Recommendations

The following recommendations are offered:

1. The models developed here are definite improvements of those in current use by the companies. It is recommended that the more

progressive companies with access to computers use these models in forecasting.

2. Should these companies desire to use these models, it is further recommended that data sample design, data gathering and recording be improved to remove built-in inaccuracies as cited in this research paper.

3. The use of the more sophisticated tools of analysis in time-series is recommended. In this paper the use of forecasting with adaptive filtering has given fairly satisfactory results. Unfortunately these tools require much longer historical data and such a study will have to be deferred until such data are made available.

4. Even in the present form the models will be useful for product planning, for motivation of the sales force, for strategy formulation in marketing, for expansion of plant capacity and for other planning activities where the concept of market share and changes in market shares will be of invaluable assistance.

Although the results can stand improvement, this research study hopes it has set a direction on the relative contribution of advertising and sales promotion ratio and market penetration to market share. The relative values of lag effect in advertising has been indicated in this paper. To be able to come up with more accurate results, it is recommended that further researches be made using more accurate data to confirm the results brought out in this research study.

Appendix 1

Results of Computed Data by the Model Vs. Actual Data, Model 1 (Test of the Model)

(A) Use of 7-year data 1964-1970 to forecast 1971, 1972, 1973, 1974

Market Share Product A

(1) Period Covered by Regression Equation, 1964-1970

Year	Estimated Market Share	Actual Market Share	% of Deviation Column 2-Column 3 Column 3
1971	0.241	0.230	7.7%
1972	0.233	0.230	1.6%
1973	0.228	0.220	3.9%
1974	0.221	0.230	3.7%

(2) Period Covered: 1964-1971, Product A

Year	Estimated Market Share	Actual Market Share	% of Deviation Column 2-Column 3 Column 3
1972	0.228	0.230	0.7%
1973	0.218	0.220	0.8%
1974	0.210	0.230	8.2%

(3) Period Covered: 1964-1972, Product A

Year	Estimated Market Share	Actual Market Share	% of Deviation Column 2-Column 3 Column 3
1973	0.218	0.220	0.8%
1974	0.211	0.230	8.2%

(4) Period Covered: 1964-1973, Product A

Year	Estimated Market Share	Actual Market Share	% of Deviation Column 2-Column 3 Column 3
1974	0.211	0.230	8.2%

Appendix I (continued)

(B) Market Share, Product B

(1) Period Covered by Regression Equation for 1964-1970

Year	Estimated Market Share	Actual Market Share	% of Deviation Column 2-Column 3 Column 3
1971	0.291	0.300	2.8%
1972	0.296	0.290	2.3%
1973	0.286	0.300	4.5%
1974	0.296	0.290	2.3%

(2) Period Covered: 1964-1971

Year	Estimated Market Share	Actual Market Share	% of Deviation Column 2-Column 3 Column 3
1972	0.295	0.300	1.4%
1973	0.284	0.290	1.8%
1974	0.295	0.290	1.8%

(3) Period Covered: 1964-1972

Year	Estimated Market Share	Actual Market Share	% of Deviation Column 2-Column 3 Column 3
1973	0.287	0.290	0.8%
1974	0.297	0.290	2.7%

(4) Period Covered: 1964-1973

Year	Estimated Market Share	Actual Market Share	% of Deviation Column 2-Column 3 Column 3
1974	0.299	0.290	3.1%

(C) Total Industry Sale

(1) Period Covered by Regression Equation for 1964-1970

Year	Estimated Sale	Actual Sale	% of Deviation Column 2-Column 3 Column 3
1971	118.693	120.00	1.1%
1972	124.492	123.00	1.2%
1973	127.547	137.00	6.9%
1974	140.086	141.00	

(2) Period Covered: 1964-1971

Year	Estimated Sale	Actual Sale	% of Deviation Column 2-Column 3 Column 3
1972	125.131	123.00	1.7%
1973	127.851	137.00	6.7%
1974	140.640	141.00	0.3%

(3) Period Covered: 1964-1972

Year	Estimated Sale	Actual Sale	% of Deviation Column 2-Column 3 Column 3
1973	125.137	137.00	8.6%
1974	138.137	141.00	2.0%

(4) Period Covered: 1964-1973

Year	Estimated Sale	Actual Sale	% of Deviation Column 2-Column 3 Column 3
1974	148.360	141.00	5.2%

(D) Company Sale Product A

(1) Period Covered by Model 1964-1970

Year	Estimated Sale	Actual Sale	% of Deviation Column 2-Column 3 Column 3
1971	28.6	27.7	3.2%

1972	29.4	28.3	3.9%
1973	29.1	30.2	3.7%
1974	31.0	32.7	5.2%

(2) Period Covered: 1964-1971

Year	Estimated Sale	Actual Sale	% of Deviation Column 2-Column 3 Column 3
1972	28.6	28.3	1.0%
1973	27.9	30.2	7.6%
1974	29.4	32.7	10.8%

(3) Period Covered: 1964-1972

Year	Estimated Sale	Actual Sale	% of Deviation Column 2-Column 3 Column 3
1973	27.4	30.2	9.2%
1974	29.2	32.7	10.6%

(4) Period Covered: 1964-1973

Year	Estimated Sale	Actual Sale	% of Deviation Column 2-Column 3 Column 3
1974	31.3	32.7	4.2%

(E) Company Sales Product B

(1) Period Covered by Model 1964-1970

Year	Estimated Sale	Actual Sale	% of Deviation Column 2-Column 3 Column 3
1971	34.40	35.20	2.3%
1972	36.95	37.10	0.4%
1973	36.60	39.20	6.6%
1974	40.40	41.10	1.7%

(2) Period Covered: 1964-1971

Year	Estimated Sale	Actual Sale	% of Deviation Column 2-Column 3 Column 3
1972	37.00	37.10	0.3%
1973	36.40	39.20	7.1%
1974	41.50	41.10	1.0%

(3) Period Covered: 1964-1972

Year	Estimated Sale	Actual Sale	% of Deviation Column 2-Column 3 Column 3
1973	36.10	39.20	7.7%
1974	41.20	41.10	1.0%

(4) Period Covered: 1964-1973

Year	Estimated Sale	Actual Sale	% of Deviation Column 2-Column 3 Column 3
1974	44.50	41.10	8.3%

Predictor tests were also made for Models II, III, IV and V and variations for the years 1971-1973 were as follows:

Model	Industry Sale	Market Share	Company Sale
II	0.96% - 8.5%	1.3% - 11.6%	2.8% - 13.7%
III	0.96% - 8.5%	1.5% - 20.6%	0.2% - 22.5%
IV	-	-	1.2% - 3.1%
V	-	-	0.2% - 18.2%

Appendix 2

Market Share and Total Industry Sale Regression Tabulations for Model 1. Philippines

Product A

Years	Constant	Adv SP Ratio	Mkt P	Price	R^2
N = 10	0.48530	1.92085 (2.21545)[1]	-0.52606 (-1.71375)	0.14846 (0.42959)	0.92291
N = 9	0.57555	1.75486 (1.93951)	-0.60906 (-1.52725)	0.07210 0.28176	0.89826
N = 8	0.58915	1.71117 (1.59563)	-0.62315 (-1.26318)	0.07774 (0.22920)	0.86565
N = 7	0.58960	1.72516 (1.54125)	-0.62776 (-0.95451)	0.08773 (0.39854)	0.79140

Product B

Years	Constant	Adv SP Ratio	Mkt P	Price	R^2
N = 10	-0.11193	1.293144 7.85396	0.38410 (1.51346)	-0.17576 (-1.16893)	0.91451
N = 9	-0.11364	1.30494 (7.03248)	0.38767 (1.39582)	-0.18953 (-1.02013)	0.90864
N = 8	-0.11231	1.28835 6.29300	0.38311 (1.28105)	-0.16579 (-0.98922)	0.90945
N = 7	-0.10907	1.28107 (4.40980)	0.37612 (1.08842)	-0.15230 (-0.59238)	0.89855

TOTAL INDUSTRY SALE

Years	Constant	Population	PC Income	No. of Firms	R^2
N = 10	-391.24829	19.97169 (3.46057)	-0.67218 (-2.53169)	-4.74219 (-1.69579)	0.99206
N = 9	-396.28467	20.19115 (1.81121)	-0.67294 (-0.78240)	-5.03492 (-3.35562)	0.99487
N = 8	-338.10449	17.14917 (1.82975)	-9.48218 (-0.94186)	-5.38044 (-2.80612)	0.99332
N = 7	-633.83276	32.92038 (1.63080)	-1.53346 (-0.84873)	-2.32713 (-2.21433)	0.97853

[1] Figures enclosed by parentheses are the t-ratios

Appendix 3
Industry Sale Regression Tabulations for Model 1, Philippines

PRODUCT A, f (i s) = f (population)

Years of Observation	Intercept	Population	M/C	R^2	F	D/W	S/E
1964-1973 (10 yrs)	-179.450	7.812 (19.657)	0.989	0.979	386.420	2.080	3.789
1964-1972 (9 yrs)	-172.678	7.609 (15.698)	0.986	0.972	246.451	2.037	3.888
1964-1971 (8 yrs)	-176.612	7.728 (12.349)	0.980	0.962	152.513	1.795	4.160
1964-1970 (7 yrs)	-159.084	7.193 (9.662)	0.974	0.949	93.361	2.275	3.999

INDUSTRY SALE REGRESSION TABULATIONS FOR MODEL 1, PHILIPPINES

PRODUCT A, f (i s) = f (Population, Dummy Variable)

Years of Observation	Intercept	Population	Dummy Variable	M/C	R^2	FF	D/W	S/E
1964-1973 (10 yrs)	-144.206	6.726 (9.657)	7.738 (1.805)	0.993	0.986	249.367	2.991	2.346
1964-1972 (9 yrs)	-132.216	6.365 (8.590)	8.432 (2.006)	0.991	0.983	178.474	3.160	2.249
1964-1971 (8 yrs)	-136.627	6.498 (7.862)	8.599 (1.916)	0.989	0.978	112.078	3.092	3.460
1964-1970 (7 yrs)	-133.214	6.395 (7.212)	7.231 (1.405)	0.982	0.965	56.762	3.083	3.650

NOTE: Regression equations for the industry sale were also developed for Model f where industry sale was expressed first as a function of household per capita income and second as a function of household per capital income and a dummy variable. The results are similar to the above table, an increase in the Burbin-Watson Statistic and R^2,

Appendix 4

Stepwise Regressions for Model 1, Philippines
No. of Years = 10

PRODUCT A MARKET SHARE

Source	SS	dF	MS	F
x_1 Adv SP R	0.007	1	0.007	6
x_2 Mkt P	0.000[2]	1	0.000	0
x_3 Price	0.000[2]	1	0.000	0
Sub-total (X_1, X_2, X_3)	0.007	3	0.007	0
Error	0.002	6		
Total SS	0.009	9		

In product A, X_1 contributes 87.6% of the variation in market share and X_2, X_3 make only insignificant contributions.

PRODUCT B MARKET SHARE

Source	SS	dF	MS	F
X_1 Adv SP R	0.004	1	0.004	6
X_2 Mkt P	0.000[2]	1	0.000	0
X_3 Price	0.000	1	0.000	0
Sub-total (X_1, X_2, X_3)	0.004	3	0.004	
Error	0.0005	6		
Total SS	0.0045			

[2] Rounding truncated figures

As in product A the biggest contributor is X_1 and is represented by 88%. X_2 and X_3 make only insignificant contributions.

For variable X_1, it is significant at the 5% level since computed F equals 6.00 and exceeds the tabular F value of 5.99.

Stepwise Regression, Model 1, Macro-Model
Total Industry Sale

Source	SS	dF	MS	F
X_4 Population	5549.508	1	5549.508	813.00
X_5 PC Income	50.782	1	50.782	7.445
X_6 Number of Firms	21.554	1	21.554	3.160
Sub-Total (X_4, X_5, X_6)	5621.844	3	1873.66	
Error	40.919	6	6.819	
Total SS	5662.73	9		
	For r = 0.05		Tabular F = 5.99	
	For r = 0.07		Tabular F = 13.74	

At the 5% level X_4 and X_5 are significant but X_6 is not significant.

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