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EFFICIENT FORECASTING AND PHILIPPINE RICE IMPORT/EXPORT POLICY

By

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1. INTRODUCTION

The Philippines and nearly every rice - producing country in the less-developed world has set "self-sufficiency" as a national objective.[1] One might have presumed that by this time a reasonable definition of the degree of sufficiency or insufficiency would have been well established. It happens that this is not so, at least not in the case of the Philippines. It can safely be asserted that, given the traditional estimation procedure, one cannot really state with reasonable accuracy, before the fact or even after the fact, just how large the shortage or surplus is expected to be, or even has been all these years.

The common view is that the Philippines was less than self-sufficient in rice over much of the postwar period, then became self-sufficient in 1968. The evidence commonly cited

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[1] Cf. Food and Agriculture Organization (UN), National Rice Policies 1966, Rome 1966.

is the rice import/export record: imports at positive levels (though occasionally zero) up to 1967; exports of significant size in 1968, but zero in 1969 only on account of the 1968 drought. However, for all practical purposes this import/export record is the result not of market forces but of government decisions solely, i.e., to accept this record as an indicator of self-sufficiency is likewise to accept that the government has had a generally accurate notion of the size of the shortage or surplus as the case may be. How accurate has this notion actually been? My view is that, given the method by which the shortage or surplus has traditionally been estimated by official and non-official quarters alike, one cannot really tell.

The procedure traditionally used to determine the extent of shortage or surplus is investigated in the next section. Section 3 discusses criteria for desirable forecasting models, and offers a specific alternative.

2. THE N.E.C. METHOD OF FORECASTING THE SIZE OF THE RICE SHORTAGE OR SURPLUS

2.1 The basic model

The Inter-Agency Committee on Rice and Corn Production and Consumption[2], situated at the National Economic Council, has been forecasting annually the size of the rice shortage or surplus on the basis of the residual after deducting an estimate of "Requirements" from an estimate of "Supply". The recommended size of imports[3] is then set as the difference between the above residual and a desired buffer stock level.

The model may be written

$$(1) \quad B_1 = Q^* + K_1 - R^*$$

where Q^* is forecast domestic output, K_1 is the stock at the beginning of the period, R^* is forecast "Requirements", and

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[2]The Inter-Agency Committee on Rice and Corn Production and Consumption was created on 13 March 1956 by the Office of Statistical Coordination and Standards (OSCAS), NEC. Its member-agencies are the Bureau of Agricultural Economics, the Rice and Corn Administration, the Rice and Corn Board, the Food and Nutrition Research CEnter, the Presidential Economic Staff, the Office of National Planning (NEC) and OSCAS. Its reports are submitted to the Director of OSCAS. See B.G. Bantegui, "The System of Evaluating the Rice Situation and Formulating Government Rice Policy in the Philippines," in Papers and Reviews of the Seminar on Rice and Related Statistics, 1965, The U.P. Statistical Center, 1965.

[3]Exports were of significant size only in 1968.

B_1 is the projected stock at the end of the period on the assumption that no exports or imports are made. (In this paper, asterisks are used to denote forecast or ex ante values.) Then required imports are given by

(2) $I^* = B - B_1$,

where B is the recommended buffer stock level.

This gives us enough of the model to make a very important criticism: although comparison of "Supply" (output plus beginning stock) with "Requirements" may seem very natural, it is sadly inefficient on account of a basic numerical feature which even renders as of minor importance the question of accuracy in the estimation of "Supply" and "Requirements" individually. In order that the criticism be clearly understood, let us for the moment suppose that "Requirements" includes an allowance for maintenance of the desired buffer stock; since both "Supply" and "Requirements" are numbers which currently range nationally from 100 to 120 million cavans of palay a year, the following may be considered a realistic example:

	True Sizes	Estimates A	B	C
"Supply"	110	105	115	115
"Requirements"	110	115	105	115
Difference	0	-10	10	0

In this example, we have exact self-sufficiency in the sense of the traditional estimation procedure. There are sets of estimates A, B, and C, all of which are reasonably accurate, since the errors of estimate of the individual components, "Supply" and "Requirements", in all cases are less than 5% of the true sizes. Although the individual errors in sets A and B are equally slight, one set indicates a shortage of 10 million cavans, while the other indicates the opposite, a surplus of 10 million cavans. These are not mean figures from the viewpoint of our international trade in rice: 10 million cavans of palay equals 440,000 metric tons of palay, or 286,000 metric tons of rice, at a 65% weight conversion rate. In comparison, the two highest importation levels since the last war (and the few years of instability following) have been 560,000 (1965), and 299,000 metric tons of rice (1963). But, in our example, a "true" condition of self-sufficiency can easily be mistaken for a condition of severe shortage (estimate A), or a condition of great surplus (estimate B). The primary source of error is neither in the estimate of "Supply" nor in the estimate fo "Requirements"; rather it is in the residual method of estimating the shortage or surplus which almost all quarters have taken for granted.

Included in the example is a set of estimates (C), in which the individual errors happen to cancel each

other out. Such a situation can only be fortuitous. T
is no reason to expect that individual errors will be in
the same direction. In particular, an error of forecast
of palay production on account of unforeseen good or bad
weather can have no effect on the error of estimate of
"Requirements", since the underlying bases of the latter
estimate are basically the current population, the propor-
tion of this population which is "rice-eating", and the per
capita consumption level of 1959. We shall go into these
estimation details later on.

The size of the relative forecast error can be indicated more precisely. Let x be an estimate of X , and let U(x) be the relative error of estimate, defined by

(3) $U(x) = (X - x)/x$

Then it can easily be shown[4] that the relative error in the forecast of required imports is given by[5]

$$U(I^*) = \frac{B_1}{I^*} U(Q^* + K_1 - R^*)$$

$$= \frac{B_1}{I^*} \{ \frac{Q^*}{B_1} U(Q^*) + \frac{K_1}{B_1} U(K_1) - \frac{R^*}{B_1} U(R^*) \}$$

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[4] See Appendix I for the manner of decomposition of estimation error within arithmetic identities.

[5] We assume that the error of forecast of the buffer stock is zero, i.e., that we are certain about the buffer level we desire.

$$(4) \quad U(I^*) = \frac{Q^*}{I^*}U(Q^*) + \frac{K_1}{I^*}U(K_1) - \frac{R^*}{I^*}U(R^*) .$$

The critical sources of error are Q^*/I^* and R^*/I^*, which in the case of Philippines are very large numbers indeed--in the 1960's they were usually greater than 20 and never less than 7. So even if the errors of estimate in Q^* and R^* are relatively small, say 5% at most, there can be no guarantee that the error of estimate in I^* will be less than say 100%. Indeed, there can be no guarantee that we shall not commit the error of exporting when we should be importing, or vice-versa.

2.2 Human Consumption Requirements

Total requirements are forecast by

$$(5) \quad R^* = C^* + F^* + S^* + W^*$$

where C' is human consumption requirements, F' is animal feed requirements, S is seed requirements and W is an allowance for waste.

In 1959, human consumption requirements were estimated by

$$(6a) \quad C^* = anN^* = (109.2 \text{ kg.})(.768)N = (1.95 \text{ sacks})(.768)N,$$

where N^* is the national population projection and n is that proportion of it which is "rice-eating." Each rice-eater was assumed to require 109.2 kg. of milled rice. A Philippine Statistical Survey of Households of May 1958 is cited as the source of the per capita consumption and rice-eating population coefficients.[6]

Since 1960, a more detailed formula has been used:

(6b) $C^* = a_1 n N_1^* + a_2 n N_2^* + a_3 n N_3^*$,

where N_1^*, N_2^* and N_3^* are the national population forecasts for males, females and children below ten years of age, respectively. It was again assumed that rice-eaters were 76.8% of the total (n = .768), with the males-females-children distribution the same for rice-eaters as for non-rice-eaters. The per capita (rice-eaters only) consumption coefficients used are:

Males	a_1 =	128.8 kg.	= 2.299	sacks
Females	a_2 =	117.9 kg.	= 2.105	sacks
Children	a_3 =	63.7 kg.	= 1.138	sacks.

The source cited for these parameters is a May 1959 PSSH survey.[7]

[6] Report of 7 December 1959. The survey was nationwide, with a sample of about 6,500 households.

[7] Report of 25 October 1960.

Since males, females and children are currently distributed in the proportions 13:11:6 (see Table 1), the average consumption requirement per capita of rice-eaters over the three classes reduces to 111.8 kg. The implied requirement per capita of the entire population is obtained by multiplying by .768, arriving at 85.86 kg.[8]

The possible relative error in C^* is a weighted average of the relative errors in the components:

$$(7) \quad U(C^*) = \frac{a_1 nN_1^*}{C^*} U(a_1 nN_1^*) + \frac{a_2 nN_2^*}{C^*} U(a_2 nN_2^*) + \frac{a_3 nN_3^*}{C^*} U(a_3 nN_3^*).$$

The possible relative error in each component is approximately[9] an ordinary <u>sum</u> of the relative errors in the three factors involved:

$$(8) \quad U(a_j nN_j^*) = U(a_j) + U(n) + U(N_j^*) \ , \ j = 1,2,3 \ .$$

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[8]Cf. Food Balance Sheets published in <u>the Statistical Reporter</u>. Rice availability per person for calendar year 1967 was estimated at ~~85.8 kg~~. (<u>The Statistical Reporter</u>, October-December 1968); also B.T. Oñate and E. S. Quiogue, "Variability Studies of Data from Household Food Consumption Surveys," <u>The Philippine Agriculturist</u>, September 1966, pp. 364-89. Cf. also the per capita recommended allowance of the Food and Nutrition Research Center, recently cited at 102.9 kg. in B.G. Bantegui and J.O. Sumagui, "The Food Supply Situation in the Philippines," <u>The Statistical Reporter</u>, October-December 1968.

[9]"Interaction" terms are omitted in (8). See Appendix 1.

Table 1
N.E.C. and Lorimer Population Projections
In Thousands

		Total	Males	Females	Children Below 10
A. NEC Population Projections					
High	1969	37,369	12,370	12,231	13,268
	1970	39,353	12,812	12,665	13,878
	1975	48,058	15,478	15,306	17,274
Medium	1969	37,158	12,256	12,105	12,803
	1970	38,493	12,667	12,512	13,314
	1975	46,157	15,099	14,922	16,136
Low	1969	37,008	12,250	12,105	12,653
	1970	38,286	12,667	12,512	13,107
	1975	45,496	15,095	14,919	15,482
B. Lorimer Population Projections					
High	1970	37,672	12,602	12,433	12,637
	1975	44,776	14,916	14,704	15,156
	1980	53,415	17,744	17,476	18,195
Medium	1970	37,402	12,601	12,433	12,368
	1975	43,872	14,916	14,704	14,252
	1980	51,407	17,613	17,350	16,444
Low	1970	37,134	12,601	12,432	12,100
	1975	43,023	14,916	14,704	13,403
	1980	48,978	17,482	17,222	14,274

NEC data are from the Inter-Agency Committee on Demography. Lorimer data are from F.W. Lorimer, "Analysis and Projections of the Population of the Philippines," in U.P. Population Institute, _First Conference on Population, 1965_, University of the Philippines Press, 1966, pp. 200-314.

Table 2

Human Rice Consumption Requirements
Forecast by the N.E.C. Method
(in thousand MT milled rice)

		Total	Males	Females	Children Below 10
A. NEC Population Projections					
High	1969	2,980	1,224	1,107	649
	1970	3,095	1,267	1,147	688
	1975	3,762	1,531	1,385	846
Medium	1969	2,934	1,212	1,096	626
	1970	3,037	1,253	1,133	651
	1975	3,634	1,493	1,351	790
Low	1969	2,927	1,212	1,096	619
	1970	3,027	1,253	1,133	641
	1975	3,602	1,493	1,351	757
B. Lorimer Population Projections					
High	1970	2,990	1,246	1,126	618
	1975	3,548	1,475	1,331	741
	1980	4,233	1,761	1,582	890
Medium	1970	2,977	1,246	1,126	605
	1975	3,504	1,475	1,331	697
	1980	4,118	1,742	1,571	804
Low	1970	2,964	1,246	1,126	592
	1975	3,462	1,475	1,331	656
	1980	3,987	1,729	1,559	698

Based on population projections in Table 1. The NEC method assumes that 76.8% each of males, females, and children are rice-eaters. Male rice-eaters are assumed to consume 128.8 kg. per capita, female rice-eaters 117.9 kg. per capita, and children rice-eaters 63.7 kg. per capita.

The possible population short-run forecast errors, given the state of demographic knowledge, appear to be less than 3%. We find in Table 1 that, for calendar year 1970, the NEC medium population estimate differs from the NEC high and low estimates by roughly 1%. A similar observation can be separately made for the Lorimer estimates. Taking the highest estimate (NEC) and the lowest estimate (Lorimer) together, we find that the mid-point differs from the extreme points by slightly less than 3%.

The sizes of $U(n)$ and the $U(a_j)$ which need to be considered depend on the purpose of the NEC forecasting model. If the policy is to provide the population with about the same standard of per capita consumption as obtained in the base years 1958-1959, then n and the a_j are benchmarks used for comparative purposes, and their U's consist solely of original sampling error. Such a policy had never been explicitly stated. If the policy is to provide the population with the standard of per capita consumption which it currently demands, then, since demands are never perfectly inelastic to prices and incomes, some changes in n and the a_j must have occurred in the decade since the original surveys. In this case, which is how current policy is ordinarily understood, the U's consist of more than original sampling error. If a_j and n may each have errors of say 3%, it is clear from equation (8) that the policy maker needs to be prepared for an error of 6% from these sources alone. All things considered, it does not seem unduly pessimistic to assume that the possible forecast may be as large as 10%.

In Table 2 the population projections of the NEC and of Lorimer are separately put through the NEC estimation procedure to arrive at alternative human consumption requirement forecasts. It should be clear that the variation in the forecasts stems solely from variation in the population forecasts. Possible errors in n and the a_j are not reflected here.

2.3 Non-human rice requirements

The non-human rice requirements are of quite minor importance, since they constitute a mere 5% of total requirements. Their possible contribution to total requirements forecast error is indicated by

$$(9) \quad U(R^*) = \frac{C^*}{R^*}U(C^*) + \frac{F^* + S^* + W^*}{R^*} U(F^* + S^* + W^*) \ .$$

In 1959 and 1960, the seed requirement was set at one 44 kg. cavan of palay (or .51 sack of milled rice) per hectare planted to rice. Thereafter, the requirement was set at .9 of a cavan of palay (or .459 sack of milled rice) per hectare. The committee reports[10] state that these coefficients are from surveys of the Bureau of Agricultural Economics[11] (Department of Agriculture and Natural Resources) undertaken in 1954, 1955, 1959 and 1960. We may state for reference that current estimation makes use of

$$(10) \quad S = sH = .459\ H$$

where H is current palay hectarage. The requirement for animal feed and commercial use, etc. is estimated at 6% of total requirements net of the seed requirement, i.e.,

$$(11) \quad F = f(R - S) = .06(R - S)$$

$$= .06(C + F + W)$$

$$= .0638(C + W)$$

The assumption that a fixed proportion of requirements net of the seed allowance are needed for feed thus implies that feed needs are estimated as proportional to the sum of human consumption needs plus the waste allowance. The estimate of F is almost totally dependent on the estimate of C and hence on the human population estimates (rather than

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[10]Dated 25 October 1960, 25 January 1961, and 25 May 1961.

[11]Formerly Agricultural Economics Division.

on estimates of the animal population).

An allowance was made for waste beginning in 1960, although W was not estimated separately for F until the report of 25 May 1961. The allowance is placed at 1.45% of rice production, or

(12) $W = wQ = .0145\ Q$

where Q is current output in sacks of milled rice.

Tables 3a and 3b contain NEC forecasts and final estimates of rice requirements over the last decade. But the term "final estimates" is a misnomer. No independent ex post estimates of rice requirements really exist, since there are no annual surveys which estimate the volume of human consumption.[12] Neither are there annual surveys of rice stocks with which to estimate consumption by the disappearance method.[13] The only bases by which "final

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[12]The annual surveys of the Food and Nutrition Research Center do not qualify for this purpose, since regions surveyed varied from year to year. As of 1966 the surveys which FNRC had done were in Bicol (1957), Central Luzon (1957), Metropolitan Manila (1958, 1959), Ilocos-Mt. Province (1960), Cagayan Valley-Batanes (1961), Southern Tagalog (1962), Western Visayas (1964) and Eastern Visayas (1965); cited in Oñate and Quiogue, op. cit. (1966) .

[13]Rice stocks have been measured with uneven coverage and at sporadic intervals, at times when politically necessary. The Rice and Corn Administration has records of its own stocks and some field reports of stocks in "large" warehouses.

estimates may be different from original forecasts are revisions in the population estimates or in the cases of the waste and seed allowances, in the estimates of output and hectarage. Often no revisions are made at all; see the data on human consumption from 1960/61 to 1967/68.

2.4 Supply[14] and the Buffer Stock

Supply is obtained as the sum of annual output and the stock at the beginning of the period. The Bureau of Agricultural Economics makes both forecasts and ex post estimates of output and hectarage. (Recall that these in turn determine the NEC estimates of waste and seed requirements.) The ex post estimates of output and hectarage are from the annual Crop and Livestock Survey, involving a sample size of about 6,000 and a sampling fraction of about 1:350. The forecasts, which are usually made quarterly, are based primarily on judgemental estimates of BAEcon field personnel. Since the forecasting procedure and the final estimation procedure are independent, the latter produce ex post estimates with which the forecasts may validly be checked. Such a check is available in Table 6. Hectarage

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[14] See J.V. Castillo, Improvement of forms for future crop and livestock surveys, The Statistical Reporter, 2:1 (January 1958), 1-5; I.P. David, A historical study of the development of the Philippine crop and livestock survey design, mimeo, U.P. College of Agriculture, 18 August 1964; B.G. Bantegui, op. cit. (1965).

forecasts were usually in error by 1-3%, with no tendency for bias in either direction. Output forecasts were even more accurate, with errors usually 1% or less.[15]

The stock at the end of the period is computed as the difference between production, importation and initial stock on one side and Requirements on the other. So if "Requirements" cannot be confirmed, neither can ending stock be confirmed. Since ending stock becomes beginning stock for the next crop year, a definite bias in the succeeding forecast is introduced: if the ending stock is underestimated because it was felt that there had been a shortage in the past year, then the forecast for the succeeding year will be biased towards another "shortage".

A buffer stock is customarily included in the calculations, measured in terms of requirements for a given number of days. It appears that the determination of the size of a desirable buffer has been left to judgement, probably unsystematized. When explicitly stated, the desired number of day' supply has been either 2 months or three weeks.[16] Based on NEC "final estimates", the actual number

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[15] Cf. Bantegui, op. cit. (1966), Table A. Mr. P.D. Evangelista of the Rice and Corn Board has pointed out that another source of error in the NEC procedure is neglect of improvement in the milling recovery ratio.

[16] Reports dated 9 January 1964, 26 August 1964, 13 January 1967, and 6 March 1967. Also see NEC Resolution Nos. 44(63) of 21 November 1963, 55(64) of 1 April 1964 and 70(64) of 27 August 1964.

of days' supply in the buffer has ranged from 18 to 85 over the last decade.

2.5 Conclusions

It was shown at the beginning of this section that the most serious defect in the traditional procedure of estimating shortage or surplus is the use of the Supply-Requirements residual, a number which is so sensitive to revisions in Supply and Requirements estimates as to be almost useless. The estimation of Requirements was discussed in detail, and it was hazarded that the possible forecast error could be as large as 10%. Errors of estimate in seed, feed and waste are of hardly any consequence. The reason that the possible error in forecasts of Requirements can only be guessed at is that there have been no attempts to substantiate the forecasts by means of surveys.[17]

A direct result of an unverified Requirements forecast is that the ending balance cannot be verified either. Since succeeding forecasts make use of beginning-of-the-period stocks, errors are compounded indefinitely onwards. An earlier statement bears repeating: for all the attention which is paid to the rice shortage or surplus, we do not

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[17] The costs of surveys are of course not to be sniffed at. Probably it would be more efficient to survey stocks regularly and then obtain consumption by disappearance method.

even have a fair idea of how large or small the shortage or surplus has been all these years past. We may even have had surpluses where shortages were claimed, and vice-versa.

In contrast, the production forecasts have a valid check in the Crop and Livestock Survey, and the forecasting record has been reasonably accurate. It is quite surprising to find that when from time to time the rice surplus or shortage question heats up politically, a substantial amount of suspicion is focused on the production data. The CLS is undoubtedly not error-free, but it does give some degree of verification to the annual output projections. On the other hand, the Requirements projections essentially stay as projections.

Finally, economists have readily noted that the consumption forecasts employ no price or income adjustments. It goes against the grain of persons accustomed to partial elasticities from every angle. Yet this lack of economic realism is a minor fault in the traditional procedure in comparison to those discussed above.

3. TOWARDS A MORE EFFICIENT FORECASTING MODEL

3.1 Criteria

It is useful to consider two types of criteria in connection with the efficiency of a forecasting model. One type is concerned with forecasting capabilities per se ; the other is concerned with fulfillment of national objectives which employ the model as a tool.

With regard to the first type, it is obviously desirable that (a) the forecasts should be of high quality, at least ex ante: this should automatically preclude the residual method when the two numbers to be differenced are close (say within 20%) to each other; (b) it should be feasible to estimate the needed parameters and to update them regularly; (c) it should be feasible to test the forecasts against realized levels: this is the ultimate test of the quality of the forecasts.

The traditional forecasting procedure is clearly focused on the so-called consumption "needs" of the population. Price stabilization policy in particular is neglected at least in so far as the NEC model is formally stated. The quantitative effect of recommended imports or the buffer stock on the domestic price level has essentially been left to personal judgement.

Fortunately the government has not always relied on the residual estimate in formulating its rice import/export decisions. A highly useful indicator of well-being among rice consumers has been, and will continue to be, the price of rice. This is a variable on which data is gathered accurately enough on a day-to-day basis. It is feasible to set a target price level, make suitable decisions if the forecast price level is too distant from the target, and then check the price level later on to see how effective the decisions were. There can in fact be no doubt that day-to-day decision-making takes this process.

Yet the concept of an annual number called shortage or surplus continues to survive as a major distraction to policy, especially in view of the political nature of the commodity. The concept would be much more useful, I feel, if expressed in the following terms: the expected shortage (or surplus) in the coming year is that quantity of rice which it is necessary for government to add to (or subtract from) the supply in the market in order that a certain target average real price level for the year be attained. It is possible to operationalize this concept from analysis of the effect on the price level, in the past, of supply and demand factors.

3.2. The Recommended Model and Initial Estimates

If, at a given price level, the total quantity of rice demanded increases in proportion to the population and also on account of real income growth, and if the price level then remains unchanged (on account of a simultaneous growth in supply), then per capita consumption of rice cannot have decreased. Thus, maintenance of the consumption standard -- the focus of the traditional model -- may safely be indicated by a secularly stable price.

Cet. par., a price increase benefits producers vis-a-vis consumers; vice-versa for a price decrease. Obviously the issue of whether a given condition of a crop indicates "surplus" or "shortage" depends on whether the current policy is to give preference to producers or to consumers. Over time the policy may shift, and has shifted, from one group to the other. The point here is not to question policy emphasis but rather to stress that the price variable is a generally adequate index against which to gauge the effectiveness of the measures used to attain the objective.

The best definition of the price of rice to use under such a scheme has to be determined.

(1) If surplus or shortage is an annual concept, so too should the target price of rice be an annual average.

(2) The actual price during the year will fluctuate around the average. From an analysis of past seasonal fluctuations, a target seasonal path may be established, around the target annual average, such that price movements within seasonal expectations need not be sources of concern to decision-makers.

(3) The observed price level is a consequence both of the rice-market situation and the general level of inflation. Since the latter force is beyond the jurisdiction of the rice agency, comparison of target with actual prices should be made only after deflation by a general price index.[18]

(4) The question of the most appropriate market level -- farm, wholesale, or retail -- would, I feel, be relatively unimportant since the correlation between prices at different market levels[19] through time is quite high. The national consensus seems to be that failure to maintain a price ceiling for consumers is more serious than failure to maintain a price floor for farmers, and hence my own preference is for the retail level.

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[18]Preferably an index excluding rice, since rice is such a large component of Philippine price indices.

[19]The price correlations referred to here are considered in M. Mangahas, The Response of Philippine Rice Farmers to Price, M.A. Thesis, University of the Philippines, 1965.

(5) The reference variety and grade (or set of these) of rice is also of somewhat minor concern because of the high correlation of prices across varieties through time. It is sufficient that the reference grade chosen be widespread and likely to remain in the market over an indefinite period. Ordinario or macan second class, the common reference, are probably satisfactory.

ordinaria

(6) The correlation of prices across locations is not as strong as it is across varieties or across market levels. Manila is a natural first choice if the retail price is to be used; other locations may be added as available analysis warrants.

What is needed next is an empirical model of price determination in which domestic supply, domestic demand, and our foreign trade in rice play a part. An equation which has been suggested[20] is

$$(13) \qquad P_t = a_0 + a_1 Q_t + a_2 I_t + a_3 t + v_t \quad ,$$

in which P is the price of rice, Q is domestic output available to the market (net of government additions to its stocks), I is importation, t is time trend, a proxy for

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[20] M. Mangahas, "The Effect of Importation on the Price of Rice," The Philippine Review of Business and Economics, 5:2 (December 1968); also "Estimates of the Task of Rice Price Stabilization in the Philippines, 1960-1974" The Statistical Reporter, October-December 1969 (forthcoming).

both population and real income, and v is a random error term. This equation may be viewed as the reduced form of the system

(14) $M_t = b_0 + b_1 P_t + b_2 t + U_{1t}$ Demand

(15) $M_t = c_0 + c_1 P_t + c_2 I_t + c_3 Q_t + U_{2t}$ Supply

where M is the quantity which is marketed (substantially less than output since production is partly for direct subsistence).

Let us turn to one possible application of equation (13). Suppose that the period involved is a year, and suppose that the objective is to maintain the 1970 price level at the same level as the 1969 price, without resorting to imports. Then the necessary increase in 1970 domestic output over 1969 is given by $-a_3/a_1$ (positive, since a_1 is negative a priori). If the necessary increase is equal to the forecast increase in domestic output, then it may be concluded that a condition of "self-sufficiency" is forecast, in the special sense that the forecast price in the absence of government intervention is the same as the target price.

At this point, it might be stressed that the precise specification of equation (13) is relatively less fundamental than the matter of deliberately employing an empirical price-determination system for policy purposes. Questions regarding the proper definitions of variables, which variables to choose, which functional form or lag structure to use are important in the context of improving the forecasting ability of the model.

A recent estimate[21] of (13) considers the following definitions:

t -- A.D. minus 1965

P_t -- Deflated retail price of Macan 2nd class in Manila, average for calendar year t weighted by the 1956 Central Luzon harvest distribution; original price data from the Central Bank and the Bureau of Agricultural Economics; deflator is the Central Bank Consumer Price Index, adjusted to exclude rice; harvest distribution is in D.A. Maulit "Palay Harvest and the Supply of Rice," The Philippine Statistician, 6:2 (June 1957).

Q_t -- National output for crop year t; Crop and Livestock Survey data, BAEcon.

[21]Mangahas, (1969).

I_t -- Total Rice imports for calendar year t ; data for 1956-1963 as adopted by an Inter-Agency committee on 31 March 1965; data for 1964-1966 from the Bureau of the Census and Statistics, Foreign Trade Statistics of the Philippines; data for 1967-1968 from the Rice and Corn Administration.

The regression over the period 1956-1968 gives

$$(16) \quad P_t = 250.4 - \underset{(1.369)}{1.688} I_t - \underset{(2.516)}{8.254} Q_t + \underset{(1.633)}{7.013} t$$

$$R^2 = .794 \qquad DW = 2.131$$

where P is in centavo/ganta at 1955 prices. I_t and Q_t are in units of 100,000 metric tons milled rice, and $t = 1$ stands for 1956.[22]

Equation (16) has several implications. The effect of population and real income growth, unless countered by either increased importation or increased domestic production, is to increase the price level by about 7 real centavos per year (about 12 centavos in current 1969 terms). In order to keep prices unchanged over a year without resorting

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[22] Note that the price level is much less sensitive to importations than to domestic output. A rationale for this is presented in Mangahas (1968).

to imports, the necessary increase in domestic output is estimated at

$$\frac{7.013}{8.254} \times 100{,}000 = 85{,}000 \text{ metric tons.}$$

The size of the buffer stock depends on the amount of potential influence which government wishes to have over the price level. Suppose it wishes to be able to decrease the price level if necessary by 40 centavos in current terms, or approx. 25 centavos in base year terms. Then the buffer stock necessary is estimated at

$$\frac{25}{8.254} \times 100{,}000 = 304{,}000 \text{ metric tons}$$

or about 5.43 million sacks of rice.[23]

The price relationship is quite relevant to two of the guidelines which Drilon cites as having been used by most if not all of the managing heads of NARIC and later RCA:[24]

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[23]Note that here price is defined as a calendar year average. The equation does not justify the conclusion that government will be able to decrease price immediately if it has such-and-such a buffer stock. If price changes over short time periods are of more interest, then the empirical research should be based on short-period changes.

[24]J. D. Drilon, Jr., "Rice Price Stabilization and the Rice and Corn Administration," Philippine Journal of Public administration, 11:3 (July 1967), p. 238.

"(1) The government does not need to handle a major portion of the rice trade in order to stabilize the price of rice." The estimate in the preceding paragraph is roughly 10% of total domestic output, and somewhat less than 20% of the total amount marketed, the national marketed surplus ratio being somewhat above 50%.

"(4) The government cannot have a major price stabilization program that would call for the purchase of a major portion of all of the marketable surplus of farmers because such a program would obviously require a tremendous outlay which the government cannot afford." Drilon then estimated that a virtual monopoly of the rice trade by government would call for working funds of as much as ₱ 400 million. This guideline is obviously concerned with producer-oriented price support. If we assume that the price support problem involves raising the average annual retail price by 40 centavos in current terms, then the model implies that 5.43 million sacks of rice have to be diverted away from the private sector and into indefinite government storage; the cost of purchasing 10 million sacks of palay at the current support price would be ₱ 160 million pesos. Although below Drilon's estimate of the cost if government monopolized the trade, this amount is still rather staggering. Of course these are not absolute estimates. They depend on the price change which government seeks to induce, or on the difference between the market price and the government's target.

Given the year of application, and assuming zero imports, equation (16) gives a simple linear relationship between the price level and the available domestic output. Considering 1970 (t = 15), we have

$$P_{15} = 250.4 - 8.254\ Q_{15} + 7.018\ (15)$$
$$= 355.6 - 8.254\ Q_{15}$$

To account for some expected inflation, let us assume that our deflator will be 165 in 1970 (it was about 160 in 1969). The equation in current terms is then

$$P_{15} = 586.74 - 13.619\ Q_{15}$$

and is charted in Figure 1. The diagram gives forecasts the price level <u>conditional</u> on the available domestic supply. For instance, an available supply of 3.0 million MT (about 105 million cavans of palay) implies a price level of about ₱ 1.78 ; an available supply of 3.4 million MT (nearly 119 million cavans of palay) implies a price level of about ₱ 1.23.[25]

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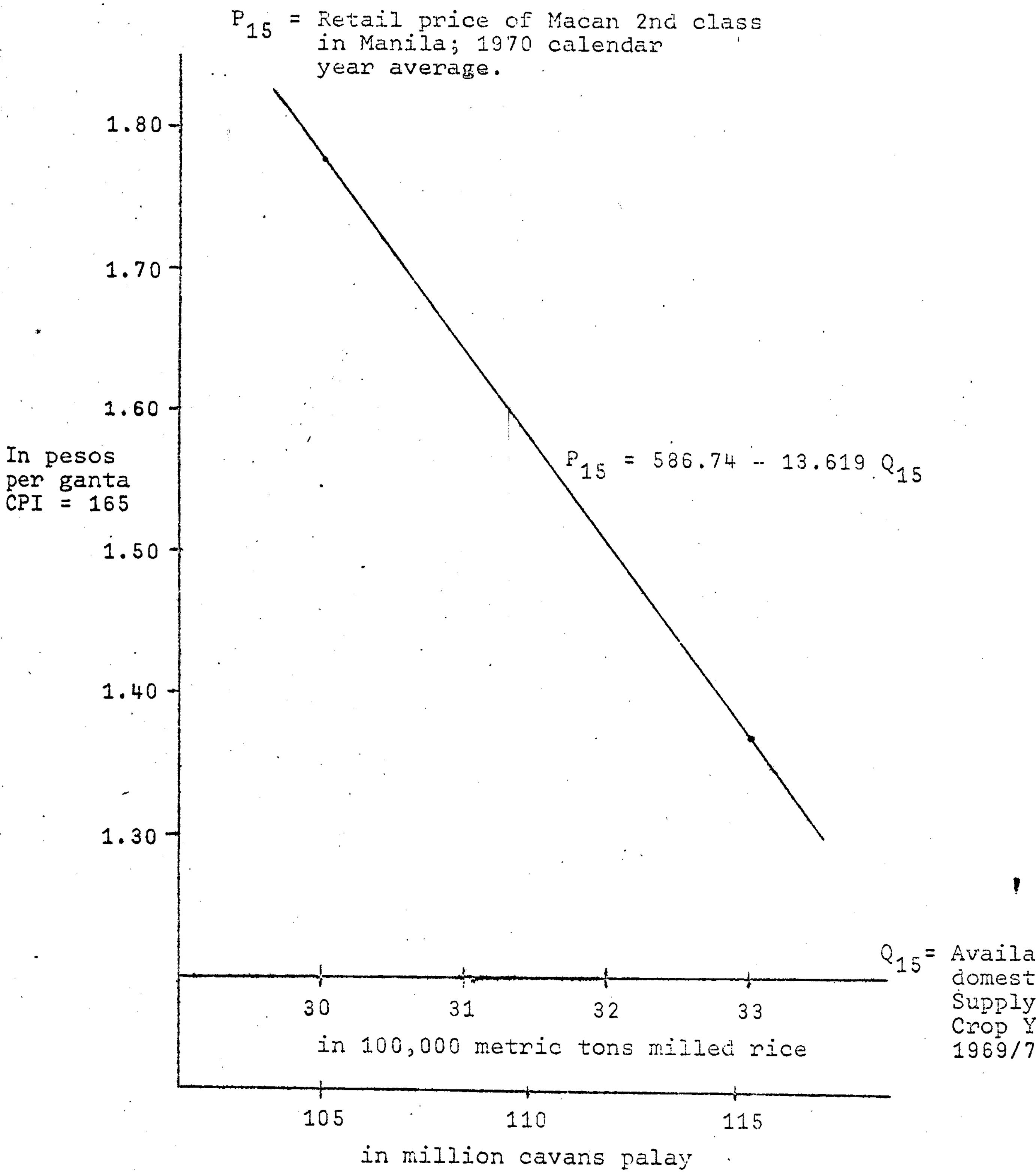
[25] Note that the production data originally used are from the CLS. These figures are somewhat less than those reported by RCPCC, from independent field observations. This is not the place to discourse on the relative accuracy of CLS versus RCPCC data. From the price forecasting viewpoint, the important matter is to consistently use some production <u>index</u>, in forecasting as well as in estimation. If the CLS figures and the RCPCC figures are highly correlated, then it makes little difference which is used as the production index

Fig. 1



P15 = Retail price of Macan 2nd class in Manila; 1970 calendar year average.
1.80
1.70
1.60
1.50
1.40
1.30
In pesos per ganta CPI = 165
P15 = 586.74 - 13.619 Q15
Q15 = Availa domest Supply Crop Y 1969/7
30
31
32
33
in 100,000 metric tons milled rice
105
110
115
in million cavans palay

Interval estimates of P_{15} can be made, also conditional on Q_{15}, to the degree of confidence desired. As is well known, the boundaries of the resulting confidence bank will be concave away from the regression line, since the forecast error will increase as Q_{15} departs in size from the Q-values in the original sample.[26]

For future periods, e.g., t = 16, 17 etc., the reduced function makes parallel shifts to the right to indicate the necessary increases in output if a given price level is to be maintained. Forecast errors will tend to be greater for periods farther off. The regression equation should be reestimated each year to maintain the quality of the shorter-run forecasts.

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[26] In equation (16) the standard error of estimate is about 6 centavos. Confidence bands were not computed since equation (16) is quite tentative in nature. In another computation, the importation figure for 1965 was adjusted from 560,000 MT to 410,000 MT when an RCA technician pointed out that about 150,000 MT of that importation were blocked on account of certain legal and administrative problems, and the result was

$$P_t = 271.4 - 2.633\, I_t - 9.232\, Q_t + 7.623\, t$$
$$(1.739) \qquad (2.706) \qquad (1.745)$$

$R^2 = .808$ DW = 2.348

S = 5.535

3.3. Measuring the Gain from Within-Year Price Stabilization

In the preceding section a relationship was introduced which determined the retail price average over a given period, specifically a calendar year. Given desired price changes, certain conclusions were made about the necessary size of the buffer stock and domestic palay procurement. These conclusions refer, strictly speaking, to changes in expected or mean price values, ignoring the possible variation about the mean. This variation has two sources, (a) the random error term v of equation (13) and (b) random variation of the independent variables about their own means.[27]

A recent article by Massell[28] gives a rationale for selecting the expected or mean price value as the within-year stabilization point, and offers a measure for the gain to stabilization. The measure is based on the assumption that consumer and producer surpluses adequately measure gain or utility, and that these surpluses may be added.

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[27] For the classical least squares which resulted in equation (16) to remain valid we must assume that the determining variables are distributed independently of the random error term.

[28] B. F. Massell, "Price Stabilization and Welfare," Quarterly Journal of Economics, 83:2 (May 1969), pp. 284-98.

Consider a simplified version of our reduced equation,

(17) $$P = a + bQ + v \quad .$$

where we assume a stochastic error term $\underline{v}$ which has mean zero and variance σ_{vv} and is uncorrelated with Q, i.e., $E(vQ) = 0$. Let Q also be random with mean μ_Q and variance σ_{QQ}. Then P is also a random variable with its own mean

(18) $$\mu_p = a + b\mu_Q$$

and variance

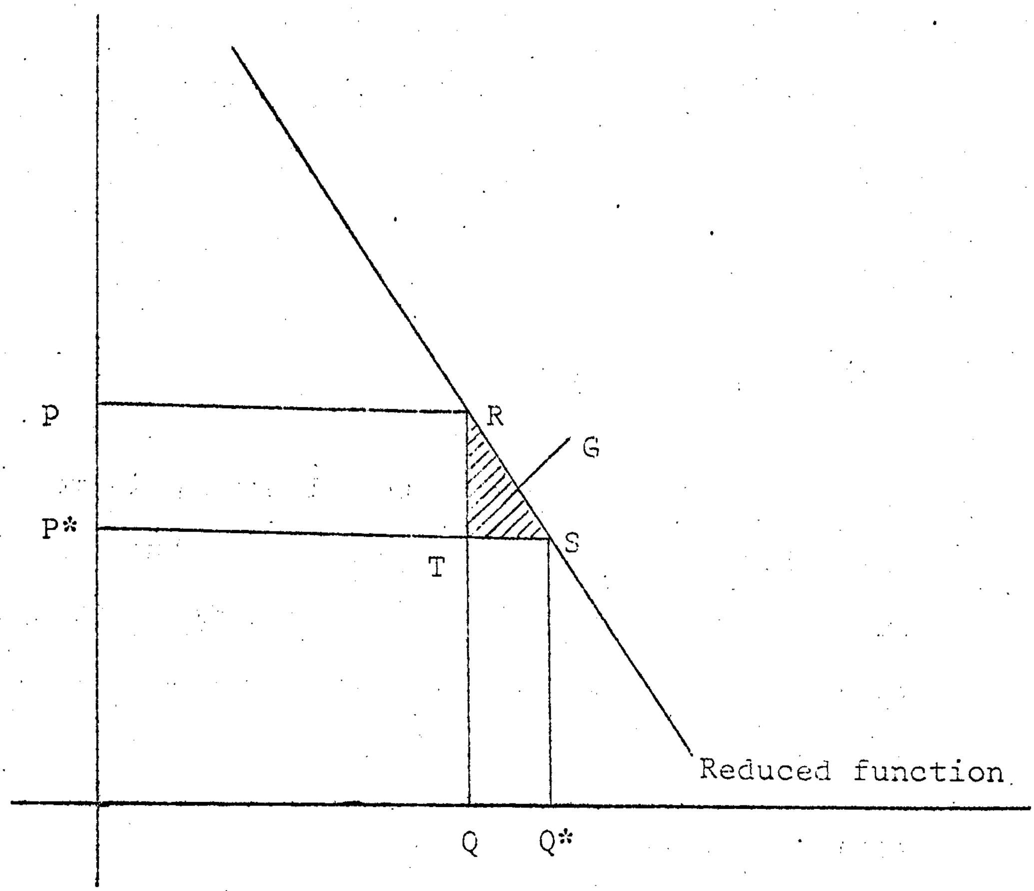
(19) $$\sigma_{pp} = b^2\sigma_{QQ} + \sigma_{vv} \quad .$$

Now assume that the objective is to stabilize the price level at price P^*, by means of buffer stock and procurement operations, i.e., the government must stand ready to add to or reduce the available stock of rice to the level Q^* given by

(20) $$Q^* = \frac{P^* - a}{b} - \frac{v}{b} \quad .$$

In Figure 2 we have the situation where output is at Q and therefore price at P , whereas the targets are Q^* and P^* respectively. Increasing the available supply to Q^* from government sources will raise consumer surplus by the

Fig. 2



area indicated by PRSP*, and will reduce producer surplus by the area indicated by PRTP*. Price units are now in pesos per unit of output. The gain from this operation is the shaded area marked "G". (This gain should also be compared to the cost of the government operation.)

Note that the reduced equation is treated as though it were a demand function for the total output; this seems plausible since it after all indicates alternative prices at which various output levels will clear the market. This is not to imply that the output levels will be sold in the market, for that would not be consistent with the original subsistence sector model, given by equations (14) and (15). Rather, the output levels will induce market supply functions which will clear with the market demand functions at the prices indicated in Figure 2.

In general, the gain in consumer surplus G_D, is measured by the difference between the areas of a rectangle and a triangle:

$$(21) \quad G_D = (P - P^*)Q^* - \frac{1}{2}(P - P^*)(Q^* - Q)$$

$$= \frac{1}{2}(P - P^*)(Q^* + Q)$$

On the other hand, the gain in producer surplus, G_S, is measured by the area of a rectangle:

$$(22) \quad G_S = -(P - P^*)Q \quad .$$

This gain is positive when the stabilization price P^* is greater than the market price P. The sum of the two surpluses is

(23) $$G = G_D + G_S = \frac{1}{2}(P - P^*)(Q^* - Q)$$
$$= -\frac{1}{2b}(a - P^* + bQ + v)^2 \ .$$

Taking the expected value,

(24) $$E(G) = -\frac{1}{2b}\left[(a - P^*)^2 + 2(a - P^*)b\mu_Q + \right.$$
$$\left. + b^2(\sigma_{QQ} + \mu_Q^2) + \sigma_{vv}\right] ,$$

after making use of $E(v) = 0$, and $E(Q^2) = \sigma_{QQ} + \mu_Q^2$.

The size of the expected gain thus depends on the price level P^* which is chosen as the stabilization point.

A natural criterion for selection of P^* is the maximization of $E(G)$:

(25) $$\frac{dE(G)}{dP^*} = -\frac{1}{2b}\left[-2b\mu_Q - 2(a - P^*)\right] ,$$

and setting this to zero gives

(26) $$P^* = a + b\mu_Q = \mu_P \ .$$

Thus we arrive at a rationale for stabilizing about the <u>expected price level</u>.

In the absence of a government price support or control policy, this implies stabilization about market equilibrium.[29] If the policy is to support a certain mean price level above or below market equilibrium, then this mean is treated as the expected price level under government intervention, and stabilization should focus on this (artificial) mean.[30]

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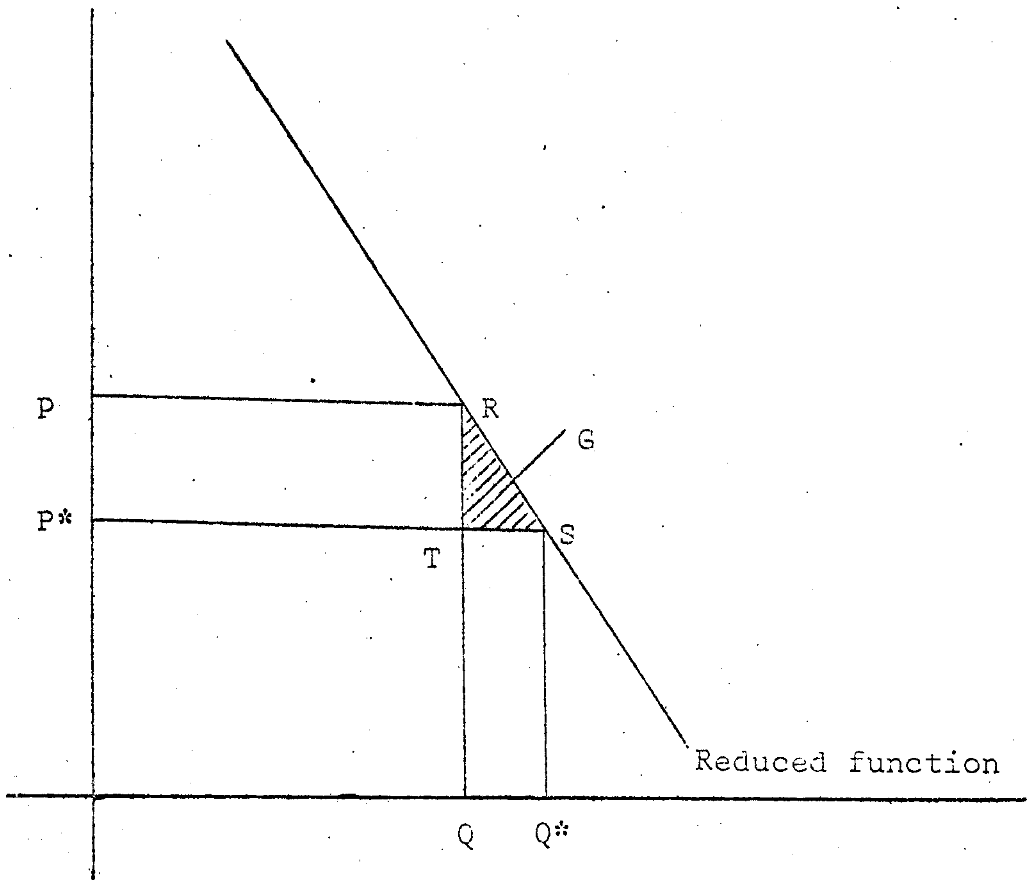
[29] It is interesting to note that at one time a market equilibrium price was recommended to be the target government price. In 1954 President Magsaysay appointed a committee, chaired by Salvador Araneta, then Secretary of Agriculture and Natural Resources, to determine the stabilization price the government should adopt for Macan No. 2, commercial grade. Drilon reports (1967, pp. 232-3):

"The recommended price was based on the theory that in a free market, or a situation approximating a free market, where a near balance between available supply and effective demand exists, the consumer price of a commodity would tend to seek a level that would cover the cost of production of the commodity and reasonable margins of profit for the producer and those handling the commodity between the producer and the consumer.

"Following this theory, the Committee reviewed rice prices in the past four years and found that prices in 1953 stabilized more or less at ₱ 0.85 per ganta, that during this particular year there was virtually no government regulation of the prices, and that statistical estimates set production at almost the same level as consumption requirements in that year."

[30] Recall that if P is distributed as $N(\mu_p, \sigma_{pp})$ then $P + C$ where C is a constant is distributed as $N(\mu_p + C, \sigma_{pp})$; interpret $P + C$ as the government's target price level.

Fig. 2



Substituting (26) into (23) and taking note of (20) gives

(27) $G = \frac{1}{2}(P - \mu_p)(\mu_Q - Q)$.

The expected gain from stabilization then reduces to

$$E(G) = \frac{1}{2}E\left[P(\mu_Q - Q)\right]$$

$$= \frac{1}{2}E\left[(a + bQ + v)(\mu_Q - Q)\right]$$

$$= \frac{b}{2}\left[\mu_Q^2 - E(Q^2)\right]$$

(28) $E(G) = -\frac{b\sigma_{QQ}}{2}$.

The expected gain from stabilization will therefore be greater (a) the greater is the variance of production and (b) the greater is the slope of the reduced equation. In other words, the expected gain from stabilization will be greater (a) the more sensitive is production to such vagaries as weather, and (b) the more sensitive is the price level to changes in the level of production. These results are of course also intuitively derivable. But there are two other counts from which we benefit by the formal analysis: (1) the expected gain from stabilization does not depend on the error allowed for in the reduced equation, if P* is chosen to maximize expected gain, i.e., σ_{vv} is found in equation (24) but not in equation (28); (2) equation (28) provides us with a measurable expression for the expected expected gain from within-year stabilization.

Let us now try to roughly evaluate this gain. Recall from Section 2 that the relative errors of forecast of output were on the average about 1% and not greater than 5%. Let us associate the forecast with the mean level of output and the forecast errors as the result of a roughly normal distribution of output about this mean; then the maximum deviation from the mean would be about twice the standard deviation. If $.05\ Q = 2\sigma_Q$, then $\sigma_{QQ} = (.025\ Q)^2$; for $Q = 30$ units of 100,000 MT each, $\sigma_{QQ} = .562$ units of 100,000 MT each. The estimate of b from equation (16) states that an additional unit of Q will reduce price by about 8.25 centavos per ganta, i.e., will reduce the price of 100,000 MT by ₱ 3.46 million.[31] Then the expected gain from within-year stabilization, for Q = 30, is (3.46 x .562/2) million pesos = ₱972,000, or roughly one million pesos.

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[31]Assuming 23.5 gantas per 56 kg.

3.4. Monthly Price Equations and the Research Agenda

Use of the annual-price model which has been presented must be restricted to problems in which the focus is variation in annual prices. As far as annual models go, the specification suggested is the best of those which have been tested. But since important policy decisions are made several times within a year there is a great need for shorter period models. This reveals serious data problems, since price is the only variable which is collected often (daily). Thus far output is collected on an annual basis, though the BAEcon has plans for quarterly surveys. The distribution of the annual output over the months of the year is known only for 1956 and 1963.

It is surprising to find that records are rather incomplete even for those variables which are government instruments. It would be a colossal task now to obtain monthly data more than a few years old on sales of government imported rice, for example. Monthly data on rice stocks would probably be a good substitute for monthly output data; these are available for a few years for RCA stocks and for "large" private warehouses that RCA observes.

In spite of the shortness of the series, a first attempt was made to estimate monthly price equations for each region, in a fashion similar to that described in Section 3.2. The data used are described in detail in Appendix II. In the main computations the retail price of rice, after deflation by a consumer price index of non-rice prices, was regressed on a time trend variable and on a number of alternative definitions of production or rice stocks in the region. The price taken was the mean of monthly average prices in main trading centers of the region. In the case of monthly Manila prices, national production or rice stocks were used as determining variables.

Specifically, the equation took two forms,

(29) $P = a + bQ + ct$, or

(30) $P = a + bS_p + cS_g + dt$

where Q refers to production, S_p to private rice stocks in key large warehouses which are observed by RCA, and S_g to government rice stocks. Two forms were used since it was felt that stock variables ought not to be mixed with (production) flows in the same equation. Monthly production figures were derived from annual BAEcon figures by applying estimates of the harvest distribution by month (see Appendix II for procedure.) Increased production had the expected negative effect on the retail price only if lagged at least one month.[32]

[32] See M. Mangahas, The Response of Philippine Rice Farmers to Price, M.A. Thesis, U.P., 1965, respecting the one-month lag of rice retail prices behind farm prices.

Production of the previous month, of the previous 2 months, and of the previous 3 months were used as alternative specifications of Q, and it was found that most often the best variable, in the statistical sense, was production of the previous 3 months.

In the equations of type (29), statistically significant coefficients for Q and t were readily obtained, but the overall explanatory power (R^2) of the estimated equations was not too high, at .5 or .6 at best. Meaningful results could not be obtained for the two Mindanao regions. Hence their implications regarding the required production increases for price stability should be regarded as quite tentative, and experimentation with further specifications should be made. Serial correlation was invariably a problem, indicating that first differences of the variables might be a starting point for future analysis. Table 7 nevertheless gives the tentative estimates of monthly supply increases (using BAEcon or Crop and Livestock figures as base) required for month-to-month price stability on the retail level; annual figures may be derived by multiplication by twelve.

The equations of type (30) encountered a problem in that the coefficient of S_g was usually negative, i.e., indicating that an increase in government stocks would lower the price of rice rather than vice-versa. This would of course be opposite to the intention of government. That this type of relationship was statistically obtained is not however too surprising since government purchasing activities and stocks are correlated directly with the extent of the harvest and therefore negatively with prices. What seems to be needed is further experimentation with the regression specification, incorporating perhaps stock changes instead of absolute levels of stocks. All these problems of specification would be matters of importance in the rice price research agenda.

3.5 Conclusions and Recommendations

This study pointed out the serious defects in the supply-requirements residual method being employed to indicate the level of rice shortage or surplus, and thence the required imports or exports level. Since the residual is so minute in comparison to both supply and requirements, it is so subject to error that, even granting the underlying theory, it would be very easy to find imports being recommended even when exports are appropriate. (This was probably the situation in the case of the rice imports of 1967.) The residual method can hardly be salvaged by attempting greater accuracy in the estimation of either supply or requirements, for what use is it to reduce error in these estimates from 5% to 2% when the expected reduction in error in the residual is (extravagantly) perhaps from 100% to 50%? Considering further that there is no way of verifying forecasts of the residual even after the passage of time, the appropriate recommendation is to discard the residual method altogether.

It was argued that government objectives of safeguarding the population's consumption level can be sufficiently represented in terms of the rice price level after basic adjustments for seasonality and for inflation. In particular, a maintained year-to-year average price level ensures that per capita consumption of rice does not decrease. A vital consideration is the fact that rice price targets and forecasts can be verified in fact. If errors are made in procurement, sales or international trade policy, at the very least it is possible to learn from them and adjust the procedure for arriving at decisions. The current residual method does not allow even this possibility.

The basic analytical work necessary of those concerned with rice policy then becomes a study of the effect of changes in production circumstances, population (a time variable being one possible proxy), and government rice market transactions on the price of rice, with the view that government will attempt to supplement deficient production from its stocks or draw off surplus production, with the price level as guide. There is no denying that the price level is in fact the guide for the short-run decisions made by the RCA; this is basically because in the short-run the only information available consists of prices, government stocks and the private stocks of certain large warehouses. But the price level may be used for longer run policy, such as import or export certification, as well. Since such policy requires anticipation of future needs, a forecasting method is required. A method was suggested, involving forecasting of the real price level, and estimates and implications drawn therefrom. Finally, even when the production-price relationship is clearly known, sources of price instability will exist due to unexpected production gains or losses on account of weather and other factors, and due to a degree of randomness in the behavior of rice suppliers and demanders. There will be a substantial gain from the reduction of instabilities from these sources by means of a government buffer stock, the measurement of which was analysed in Section 3.3.

It is not claimed that the estimates here are the final work; better equation-specifications and better variable-definitions, as well as improvements in quality of original data, ought to bring about more accurate forecasting in the future. The results on the annual level and for the Philippines as a whole seem to be fairly well established. Much more analysis is required to improve the analysis of prices on a regional and monthly basis. The capacity for verification and improvement is what may be claimed as a definite advantage over the traditional forecasting procedure.

Table 3a

NEC FORECASTS OF RICE REQUIREMENTS, 1959-1968
(in thousand cavans milled rice)

Date of Report	Year of Application	Midyear Population (000) N*	Human Consumption C*	Feed F*	Waste W*	Seed S*	Requirements R* Thousand cavans	Requirements R* Thousand MT
2 Jan. 1959	1959	24,718	37,018	1,770[b]	593[b]	1,413	40,793	2,284
7 Dec. 1959	1959	24,718	37,018	1,814[b]	619[b]	1,551	40,793	2,284
7 Dec. 1959	1960	25,448	38,111	1,793[b]	640[b]	1,551	42,094	2,357
22 Apr. 1960	1960	25,448	38,111	2,433[b]	613[b]	1,513	42,670	2,390
25 Oct. 1960	1960	27,796	39,403	2,515[b]	630[b]	1,529	44,078	2,468
25 Jan. 1961	1960/61	28,220	39,984	2,537[b]	645[b]	1,545	44,712	2,504
25 May 1961	1960/61		39,984	2,552[b]	643[b]	1,556	44,736	2,505
25 Oct. 1960	1961	28,673	40,627	2,594[b]	637[b]	1,699	45,557	2,551
15 Jan. 1962	1961/62	29,214[a]	41,384	2,542	662	1,500	46,187	2,586
22 Jan. 1963	1962/63	29,733	41,851	2,671	667	1,467	46,656	2,613
5 Apr. 1963	1962/63	29,733	42,259	2,697	674	1,474	47,105	2,638
9 Jan. 1964	1963/64	30,756	43,510	2,777	643	1,443	48,373	2,709
26 Aug. 1965	1964/65	31,807	44,986	2,872	670	1,454	49,981	2,799
14 Oct. 1965	1965/66	32,911	46,513	2,969	685	1,471	51,638	2,892
13 Jan. 1967	1966/67	34,067	48,112	3,133	690	1,407	53,340	2,987
6 Mar. 1967	1966/67	34,067	48,112	3,133	697	1,407	53,348	2,988
19 Dec. 1967	1967/68		49,800	2,998[b]	730[b]	1,588[b]	55,106	3,086

[a]Mean of October 1, 1961 and April 1962 population estimates.

N = total population
R = C + F + W + S (last figure may not add up because of rounding off)
Where C = total human rice requirement per year. See table 4a.
F = feed at 6% of total consumption requirements excluding seeds.
W = waste at 1.45% of production.
S = seeds at one cavan of palay seeds per hectare converted to cavans of 56 kilos clean rice -- up to October 25, 1960.
= seeds at 0.9 sacks of 44 kilos per hectare converted to sacks of 56 kilos clean rice starting from January 25, 1961.

[b]F*, W*, S* as individual components were derived from sum quantities.

Table 3b

NEC FINAL ESTIMATES OF RICE REQUIREMENTS, 1957-1968
(in thousand cavans milled rice)

Date of Report[1]	Year of Application	Human Consumption C	Feed[2] F	Waste[3] W	Seed S	Requirements R*	
						Thousand cavans	Thousand MT
2 Jan. 1959	1957	34,927	1,669	560	1,412	38,568	2,160
2 Jan. 1959	1958	35,957	2,232	528	1,516	40,233	2,253
7 Dec. 1959	1958	35,957	2,232	528	1,516	40,233	2,253
25 Oct. 1960	1958	37,074	2,303	602	1,516	41,495	2,334
25 Jan. 1961	1958/59	37,611	2,401	619	1,528	42,159	2,361
22 Apr. 1960	1959	37,018	2,350	619	1,413	41,400	2,318
25 Oct. 1960	1959	38,204	2,439	619	1,516	42,777	2,395
25 Jan. 1961	1959/60	38,776	2,481	623	1,518	43,397	2,430
	1960/61	39,984				44,627	2,499
	1961/62	41,384				46,198	2,587
	1962/63	42,259				47,105	2,638
	1963/64	43,510				48,373	2,709
	1964/65	44,986				50,002	2,800
	1965/66	46,513				51,627	2,891
	1966/67	48,112				53,348	2,987
	1967/68	49,800					

[1] Data without dated reports were obtained from RCPCC; original source: OSCAS, NEC.

[2 & 3] Feed, waste as individual components were derived from sum quantities (feed and waste combined) where waste was computed as 1.45% of production and feed as the residual.

Source: OSCAS, NEC and the Inter-Agency Committee on Rice and Corn Production and Consumption Reports, 1959-1969.

Table 4a

NEC FORECASTS OF HUMAN CONSUMPTION REQUIREMENTS, 1959-1968
(in thousand cavans milled rice)

Date of Report	Year of Application	Total C*	Males A_1*	Females A_2*	Children A_3
2 Jan. 1959	1959	37,018			
7 Dec. 1959	1960	38,111			
25 Oct. 1960	1960	39,403	16,415	14,847	8,141
25 Jan. 1961	1960/61	39,984	16,647	15,051	8,287
25 Oct. 1960	1961	40,627	16,915	15,293	8,419
15 Jan. 1962	1961/62	41,384	17,223	15,574	8,588
22 Jan. 1963	1962/63	41,851	17,424	15,753	8,674
5 Apr. 1963	1962/63	42,259	17,550	16,132	8,578
9 Jan. 1964	1963/64	43,510	18,034	16,374	9,102
26 Aug. 1964	1964/65	44,986	18,645	16,918	9,424
14 Oct. 1965	1965/66	46,513	19,263	17,462	9,788
13 Jan. 1967	1966/67	48,112	19,910	18,031	10,171
19 Dec. 1967	1967/68	49,800			

C = total consumption requirements = $A_1 + A_2 + A_3$

A_1 = rice requirement for males 10 years old

A_2 = rice requirement for females 10 years old

A_3 = rice requirement for children 10 years old

Source: OSCAS, NEC and the Inter-Agency Committee on Rice and Corn Production and Consumption Reports, 1959-1969.

Table 4b

NEC FINAL ESTIMATES OF HUMAN CONSUMPTION REQUIREMENTS, 1957-1968
(in thousand cavans milled rice)

Date of Report	Year of Application	Total C	Males A_1	Females A_2	Children A_3
2 Jan. 1959	1957	34,927			
2 Jan. 1959	1958	35,957			
7 Dec. 1959	1958	35,957			
25 Oct. 1960	1958	37,074	15,445	13,970	7,660
25 Jan. 1961	1958/59	37,611	15,681	14,185	7,745
22 Apr. 1960	1959	37,018			
25 Oct. 1960	1959	38,204	15,900	14,425	7,879
25 Jan. 1961	1959/60	38,776	16,155	14,610	8,011
	1960/61	39,984			
	1961/62	41,384			
	1962/63	42,259			
	1963/64	43,510			
	1964/65	44,986			
	1965/66	46,513			
	1966/67	48,112			
	1967/68	49,800			

C = total consumption requirements = $A_1 + A_2 + A_3$

A_1 = rice requirement for males · 10 years old

A_2 = rice requirement for females 10 years old

A_3 = rice requirement for children 10 years old

Data without dated reports were obtained from RCPCC; original source: OSCAS, NEC.

Source: OSCAS, NEC and the Inter-Agency Committee on Rice and Corn Production and Consumption Reports, 1959-1969.

Table 7

TENTATIVE ESTIMATES OF MONTHLY SUPPLY INCREASES*
REQUIRED FOR MONTH-TO-MONTH RICE RETAIL PRICE
STABILITY, BY REGION

	In thousand MT milled rice
Ilocos	.76
Cagayan	2.25
Central Luzon	3.20
Southern Tagalog	1.73
Bicol	.20
Eastern Visayas	1.76
Western Visayas	2.07
Manila	8.45 (national level)

*With BAEcon production figures as base.

Appendix I

Decomposition of estimation error within arithmetic identities

Let us use a capital letter, such as A, to denote a number to be estimated, and a small letter, such as a, to denote the estimate. Suppose that A is defined $A = B + C$, and suppose that A is to be estimated from prior estimates of B and C, thus: $a = b + c$. What do possible extents of relative error in b and c imply for the error in a? Define the relative error of an estimate of A by U(a), where

$$U(a) = \frac{A - a}{a} .$$

The absolute error in a is

$$A - a = (B - b) + (C - c) ,$$

which gives

$$\frac{A - a}{a} = \frac{B - b}{a} + \frac{C - c}{a}$$

$$= \frac{B - b}{b}\frac{b}{a} + \frac{C - c}{c}\frac{c}{a}$$

(1) $$U(a) = U(b)\frac{b}{a} + U(c)\frac{c}{a} .$$ Addition

So the relative error in a is a weighted sum of the relative errors in b and c.

Running in similar fashion through the other arithmetic operations, we obtain:

If $a = b - c$, then

$$U(a) = U(b)\frac{b}{a} - U(c)\frac{c}{a} \quad . \tag{2}$$

Subtraction

It is clear that, whenever b/a and c/a are numbers much larger than one, the residual method of estimating A becomes rather suspect. For suppose that a were only about 5% the size of b or c . Then an error in b of +2% and an error in c of -2% will lead to an error in a of approximately

$$(.02)(20) - (-.02)(20) = .80$$

or 80%. Given possible errors of this size, the residual method will not even guarantee that the sign of A is correctly obtained.

If $a = bc$, then

$$U(a) = U(b) + U(c) + U(b)U(c) \quad . \tag{3}$$

Multiplication

And if $a = b/c$, then

$$U(a) = \frac{1 + U(b)}{1 + U(c)} - 1 \quad . \tag{4}$$

Division

Appendix II

Data used in estimating monthly price equations

The original data consist of nineteen of the 23 variables listed in the data format (Table A.1). (The first four variables are simply for identification.) Additional variables were generated as follows:

X_{24} , the price deflator for the month.

X_{24} is defined as the Central Bank Consumer Price Index, with 1957 base, adjusted to exclude the price of rice. If h is the weight of X_{24} , then

$$\text{(A.1)} \quad X_{24} = \frac{1}{1-h} \text{CPI} - \frac{h}{1-h} \frac{P}{P_B}$$

where P is the current price of rice, P_B is the base year price of rice, and therefore (P/P_B) is the rice price index level. In equation A.1, CPI and P are variables which vary with time, while h and P_B are constants. Table A.2 contains the values of h and P_B used for each region. CPI is located in the data as X_{20} , and P is located as X_{23} ; therefore X_{24} is computed by

$$X_{24} = \frac{1}{1-h} X_{20} - \frac{h}{P_B(1-h)} X_{23} \quad .$$

X_{20} is in units such that for the base year (not month), $X_{20} = 1.000$.

X_{25} , the deflated rice price level for the month.

Then the deflated rice level is

$$X_{25} = P/X_{24} = X_{23}/X_{24} , \quad (A.2)$$

in the same units as X_{23} . The Central Bank series is used instead of the RCA series since it has a longer time span. The list of trading centers used to obtain the regional price data is in Table A.3.

X_{26} , the proportion of the crop year's production which is harvested in the current month.

Since the production data comes only on an annual (crop year) basis, it is necessary to have an estimate of a given month's harvest ratio in order to obtain an estimate of that month's production. (Monthly harvest figures are introduced to account for the seasonality in movements of the price level.) However, monthly harvest ratios are available only for crop years 1968 -- X_{16} in the data -- and 1956 -- X_{17} in the data. (There is a significant difference between the two harvest distributions, the tendency being a smoothening out of the harvest during the year.) Monthly harvest ratios in intervening years are obtained by a straight-line interpolation formula. The annual change in the harvest ratio for the given month during the 12 years between 1956 and

1968 is estimated by $(X_{16} - X_{17})/12$; this is multiplied by the number of years which have elapsed since 1956, and then added to the 1956 harvest ratio for the given month:

$$X_{26} = (X_2 - 56)\,\frac{X_{16} - X_{17}}{12} + X_{17} \quad , \qquad \text{(A.3)}$$

where X_2 stands for the last two digits of the current year (see Table A.1). This formula satisfies the condition that the sum of the harvest ratios over 12 months of the year should equal one, since

$$\sum_{12}(X_2 - 56)\,\frac{X_{16} - X_{17}}{12} + \sum_{12} X_{17} =$$

$$= (\text{const.}) \sum_{12}(X_{16} - X_{17}) + \sum_{12} X_{17} =$$

$$= (\text{const.})(1 - 1) + 1 = 1 \quad .$$

X_{27} , production during the month.

This is estimated by multiplying the Bureau of Agricultural Economics' annual production figure, X_{18} , by the month's harvest ratio, and converted into MT rice:

$$X_{27} = X_{18}\, X_{26} (.044)(.65) \qquad \text{(A.3)}$$

In the case of region 10 (Manila), national output is used for X_{27}.

X_{28} , RCA sales of imported rice during the month;

X_{29} , Private Stock in large warehouses, end of month;

X_{30} , RCA stock, end of month.

(A.4) $X_{28} = X_{14}(23.5)(.056)$

This converts RCA sales in gantas (X_{14}) to MT rice.

(A.5) $X_{29} = X_{21}(.056)$

(A.6) $X_{30} = X_{22}(.056)$

This converts the private stock in large warehouses (over 5,000 cavans), or X_{21} , and the RCA stock, or X_{22}, into MT rice. The 'large warehouses' consist of a select group over which RCA keeps data. In some computations the RCA stock and the large private stocks are combined, and the new variables is

(A.7) $X_{32} = X_{29} + X_{30}$.

Again, in the case of Manila, national stock figures are used.

X_{31} , or time trend.

This variable starts at 1 for January 1957 and increases by 1 each month thereafter:

(A.8) $X_{31} = (X_2 - 57)\ 12 + X_3$

where X_3 is the month of the year (months numbered 1 to 12).

Table A.1

ORIGINAL DATA FOR MONTHLY PRICE EQUATIONS

Cols.	Variable Number	Description	Units
1 - 2	1	Region	
3 - 4	2	Year (last 2 digits)	
5 - 6	3	Month	
7	4	Card number	
		Card number 1	
10 - 13	5	Palay market price (RCA)	centavos/46 kg.
16 - 19	6	Palay market price (PRPF)	centavos/44 kg.
21 - 23	7	Rice market price (RCA)	centavos/ganta
25 - 31	8	RCA rice stock	56 kg.
33 - 39	9	Rice stock of large warehouses	56 kg.
41 - 46	10	RCA palay procurement quantity	46 kg.
49 - 52	11	RCA buying price	centavos/46 kg.
		<u>RCA rice sales</u>	
54 - 60	12	Domestic, quantity	gantas
62 - 68	13	Domestic, value	pesos
		Card number 2	
		<u>RCA rice sales</u>	
9 - 15	14	Imported, quantity	gantas
17 - 24	15	Imported, value	pesos
27 - 30	16	1968 harvest share	percentage x 10
33 - 36	17	1956 harvest share	percentage x 10
38 - 45	18	palay production, current crop year	44 kg.
47 - 52	19	palay area, current crop year	hectares
		Card number 3	
10 - 13	20	Consumer Price Index, 1957 Base	tenths of a poi
16 - 22	21	Private Warehouse Stock (Mears)	56 kg. rice
25 - 31	22	Government Warehouse Stock (Mears)	56 kg. rice
34 - 36	23	Rice market price (Central Bank)	centavos/ganta

Table A.2

COMPUTATION OF CONSUMER PRICE INDICES EXCLUDING RICE

CPI = Consumers' Price Index, Central Bank.

I_o = Price Index excluding rice.

I_r = Rice Price Index, same base year as CPI.

h = Weight of rice price in Consumer Price Index. Source: Table A.3 of M. Mangahas, The Response of Philippine Rice Farmers to Price M.A. thesis, University of the Philippines, 1965.

P_r = Rice Price.

CPI is computed by $hI_r + (1 - h)I_o$ = CPI.

Therefore $I_o = [1/(1 - h)]\,CPI - [h/(1 - h)]\,I_r$.

We compute $I_r = P_r/P_B$ where P_B is the simple mean of rice prices across months of the base year.

REGION	h	$\frac{1}{1-h}$	$\frac{h}{1-h}$	Macan 2nd cla[illegible] Pesos/ganta[illegible] P_B
I Ilocos Norte	.23496	1.3071	.30712	.97
II Cagayan Valley	.16602	1.1990	.19907	.91
III Central Luzon	.16737	1.2012	.20101	.94
IV Southern Tagalog	.17926	1.2184	.21841	.94
V Bicol Region	.19874	1.2480	.24803	1.14
VI Eastern Visayas	.10622	1.1188	.11884	.95
VII Western Visayas	.15626	1.1851	.18520	1.00
VIII Southwestern Mindanao	.18678	1.2296	.22968	.96
IX Northeastern Mindanao	.16603	1.1990	.19908	1.02
X Manila	.10959	1.1230	.12308	.93

Table A.3

LIST OF TRADING CENTERS USED IN DETERMINING AVERAGE RETAIL PRICE OF MACAN 2ND CLASS RICE

Region	1	Laoag, Ilocos Norte San Fernando, La Union
	2	Baguio City Ilagan, Isabela Tuguegarao, Cagayan
	3	Tarlac, Tarlac Dagupan City Cabanatuan City
	4	Batangas, Batangas San Pablo City
	5	Legaspi City
	6	Cebu City Tacloban City Tagbilaran, Bohol
	7	Iloilo City
	8	Zamboanga City
	9	Davao City Iligan City Butuan City
	10	Manila

Source: Central Bank