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# A PRODUCTION SUBMODEL OF THE PHILIPPINE ECONOMY, 1950-1969

by

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## 1. General Features.

The aim of this study is to construct a submodel determining the levels of value-added, employment and the price level for each of the seven sectors in the Philippine national accounts. The submodel is designed to extend in detail the portions which are relevant to production of a previously estimated basic model [2], and specifically to extend the basis for planning and forecasting which the basic model has initiated [7]. Three main types of equations were estimated, corresponding to the three core equations of the basic model: (1) production functions, (ii) labor absorption functions, and (iii) demand functions (in which the sectoral product price level is an explanatory variable) or price equations (in which the sectoral product price level is the dependent variable).

Estimation is by ordinary least squares. This does not raise serious econometric issues since the submodel is almost entirely recursive, with simultaneity present only

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within the agricultural sector. The length of the time period varies with each equation, the maximum length being 1950-1969. Employment in particular is available beginning 1956, and hence regressions involving this variable use a somewhat shorter series. The submodel involves no first differences or relative differences; these have been set aside for a later stage of the work.

As with the basic model, the production submodel does not introduce a population variable. This does not appear to be a serious deficiency from the standpoint of short-term forecasting. Study of the (long term) effects of population control will require a suitably modified model. Estimation of equations in difference form should also relieve the deficiency to a large extent. Almost all variables have strong trend elements, and multicollinearity is invariably a problem. High coefficients of determination can usually be obtained regardless of specification. Insofar as statistical criteria were used, final specifications were chosen with an eye, in order of priority, for t-values, $\bar{R}^2$ , and the Durbin-Watson statistic.

The national accounts data used are the same series from which the basic model was estimated, viz., the recently revised national accounts for 1968 and 1969, which use different sources and methods of estimation from the earlier 1950-1967 series, are not used for the sake of comparability within the estimation series. Employment and sectoral wage data are from the Bureau of Census and Statistics Labor Force Surveys, which Mijares and Tidalgo have comprehensively analyzed [4] . The basic source for agricultural capital stock and purchased input data is Paris [5] . Land data are from the Bureau of Agricultural Economics Crop and Livestock Surveys (now the Integrated Agricultural Survey). The manufacturing capital stock series is from the BCS Annual Survey of Manufactures.. Price series for copper concentrates, construction materials, and imported mineral fuels, crude materials and imported machinery and equipment are from the Central Bank Statistical Bulletins.

The submodel consists of 20 structural equations and three identities, which when joined to the price equation of the basic model[1] determine , the 24 listed endogenous variables. There are 13 exogenous variables and 6 lagged endogenous variables (counting the $SP_i$). Nine of the structural equations have $\bar{R}^2$'s of .99, and only three are below .90.

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[1]Here is equation (3) of the basic model [2] for reference:

$$P = 85.37 - .0043\ Y + .0423\ Z$$

where Z is the average of end-of-month money supply (currency plus demand deposits) from October of the previous year to September of the current year, in million pesos.

## The Production Submodel

| Sector | Time series.Regression Code s/$\bar{R}^2$/DW |
|---|---|
| **Agriculture, Fishing and Forestry** | |
| (1) $Y_a = -2505.8 + \underset{(1.868)}{0.2740}L + \underset{(4.661)}{0.6705}N_a$ | 1957/67.SEP5J.96<br>112.2/.942/1.82 |
| (2) $N_a = -508.6 + \underset{(14.06)}{1.028}(LF - \sum_{i \neq a} N_i) \underset{(-3.620)}{-0.8849}W_a +$ | |
| $+ \underset{(2.478)}{4.187}P_a$ | 1956/68.NOV79.6<br>53.9/.991/1.61 |
| (3) $Y_a = 103.0 + \underset{(17.5)}{0.2532}(Y-T) \underset{(-3.946}{-10.26}P_a + \underset{(4.749)}{1.235}W$ | 1952/68.SEP115.36<br>48.4/.995/1.66 |
| **Mining and Quarrying** | |
| (4) $Y_q = -12.7 + \underset{(12.44)}{4.628}\,INPUT_q$ | 1956/68.OCT40.4<br>12.1/.928/1.95 |
| (5) $N_q = 54.6 - \underset{(-2.131)}{0.0711}W + \underset{(2.813)}{0.4561}Y_q$ | 1956/68.SEP43A.53<br>52/.552/2.50 |
| **Manufacturing** | |
| (6) $Y_n = 1109.7 + \underset{(21.38)}{0.4973}K_n$ | 1956/69.NOV93.1<br>67.2/.972/0.62 |
| (7) $N_n = 514.4 + \underset{(11.54)}{0.3097}\,Y_n$ | 1956/68.SEP45C.53<br>34.5/.917/1.63 |
| (8) $Y_n = 198.2 + \underset{(3.349)}{0.0701}(Y-T) \underset{(-2.438)}{-3.092}P_3 +$ | |
| $+ \underset{(7.587)}{0.7285}\,Y_{n-1}$ | 1950/69.SEP117.15<br>38.0/.995/2.22 |

Construction

(9) $$Y_c = 320.7 \underset{(-\ 3.082)}{-\ 0.1414}\ SW \underset{(3.234)}{+\ 1.687}\ SP_c$$ 1950/69.NOV43.9
36.3/.742/1.26

(10) $$N_c = 8.09 \underset{(4.766)}{+\ 0.6016}\ Y_c$$ 1956/68.SEP44B.53
32.7/.644/1.26

Transport, Storage, Communications and Utilities

(11) $$Y_t = 260.6 \underset{(49.6)}{+\ 0.2196}\ SP_t$$ 1950/69.NOV44.5
12.8/.992/0.21

(12) $$N_t = 13.4 \underset{(1.836)}{-\ 0.03128}\ W_t \underset{(10.80)}{+\ 0.7324}\ Y_t$$ 1956/68.SEP47B.54
14.7/.943/1.59

Commerce

(13) $$Y_r = 714.5 \underset{(85.0)}{+\ 0.6534}\ SP_r$$ 1950/69.NOV44.8
24.3/.997/1.35

(14) $$N_r = 305.4 \underset{(-2.238)}{-\ 0.2840}\ W_r \underset{(7.110)}{+\ 0.7859}\ Y_r$$ 1956/68.SEP46B.54
47.4/.933/1.70

(15) $$Y_r = 200.5 \underset{(-\ 2.824)}{-\ 2.485}\ P_r \underset{(30.6)}{+\ 0.1540}\ (Y-T)$$ 1950/69.SEP189.2
35.3/.994/0.93

Services

(16) $$Y_s = 1205.4 \underset{(124.9)}{+\ 1.386}\ SP_s$$ 1950/69.NOV43.20
32.1/.999/1.40

(17) $$N_s = -95.6 \underset{(14.8)}{+\ 0.4245}\ Y_s$$ 1956/68.SEP48B.53
62.9/.948/0.89

(18) $$Y_s = 751.0 \underset{(4.953)}{+\ 0.1157}\ (Y-T) \underset{(-\ 4.291)}{-24.32}\ P_s\ +$$

$$\underset{(4.179)}{+\ 14.00}\ P \underset{(8.53)}{+\ 0.7086}\ Y_{s-1}$$ 1950/69.SEP121.3
22.7/.999/1.68

Identities

(19) $Y = \Sigma\ Y_i + D$

(20) $N = \Sigma\ N_i$

## Notation

The sectoral subscript $i$ takes the following letters:

- a for Agriculture, Fishing and Forestry
- q for Mining and Quarrying
- n for Manufacturing
- c for Construction
- t for Transport, Storage, Communications and Utilities
- r for Commerce, and
- s for Services

The endogenous variables are:

$Y_i$ = net value-added in the ith sector in million pesos at 1955 prices

$N_i$ = persons employed in the ith sector, in thousands; average of May and October surveys

$P_i$ = implicit price index of the ith sector (1955=100); $i$ = a, n, r, s only

$Y$ = GNP in million pesos at 1955 prices

$N$ = aggregate employment, in thousands

$P$ = implicit price index of GNP (1955=100)

The predetermined variables are:

$W$ = annual money wage rate, computed as equal to the daily wage rate of unskilled industrial workers in Manila multiplied by 250; in pesos

$W_i$ = undeflated annual peso earnings of wage earners (including skilled and unskilled workers and working foremen in production and non-production departments) in the ith sector, computed as equal to the monthly peso earnings multiplied by 12; **$i$ = a, t, r only.**

$L$ = harvested area, in thousands of hectares

$LF$ = aggregate labor force, in thousands

$T$ = direct and indirect taxes, deflated by the implicit GNP price index; in million pesos

$SP_i$ = moving sum of $P_i$ from 1950 to the year previous to the current year; for $i$ = c, t, r and s.

$SW$ = moving sum of $W$ from 1950 to the year previous to the current year

$K_n$ = deflated book value of fixed assets (including land) in manufacturing establishments of five or more workers, computed by assuming 1956 nominal book value equals 1956 real book value, and adding each year the deflated annual change in nominal book value (deflator=implicit price deflator for gross domestic investment, 1955=100); beginning of the year, in million pesos.

$Y_{n-1}$, $Y_{s-1}$ = one-year-lagged values of $Y_n$ and $Y_s$

$D$ =

Depreciation
+ Indirect Taxes
+ Net Factor Income from Abroad

} in million pesos at 1955 prices

$INPUT_q$ = value of intermediate inputs in the mining sector, in million pesos at 1955 prices.

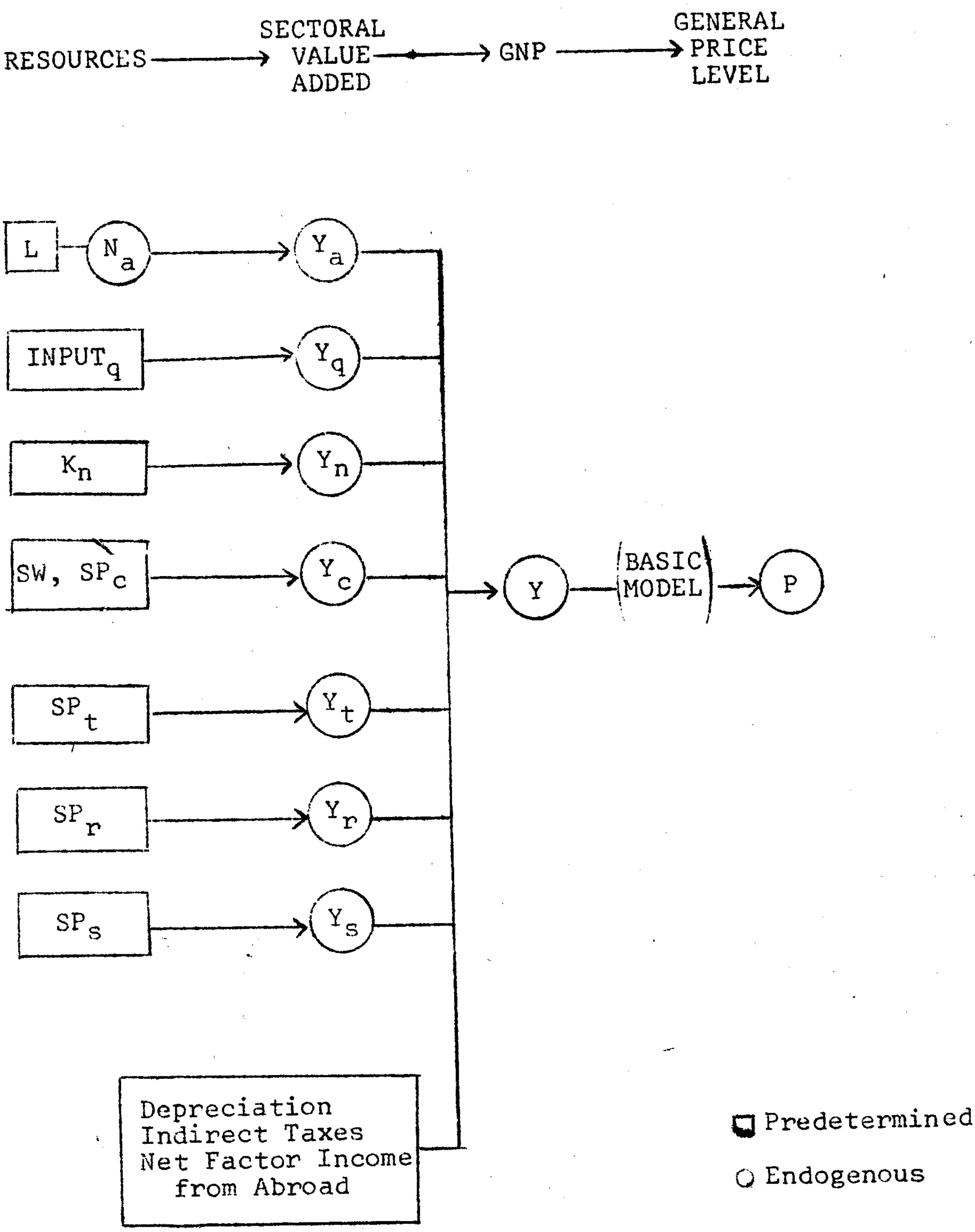
RESOURCES
SECTORAL VALUE ADDED
GNP
GENERAL PRICE LEVEL
L
N a
Y a
INPUT q
Y q
K n
Y n
SW, SP c
Y c
SP t
Y t
SP r
Y r
SP s
Y s
Y
BASIC MODEL
P
Depreciation
Indirect Taxes
Net Factor Income
from Abroad
Predetermined
Endogenous

Figure 1

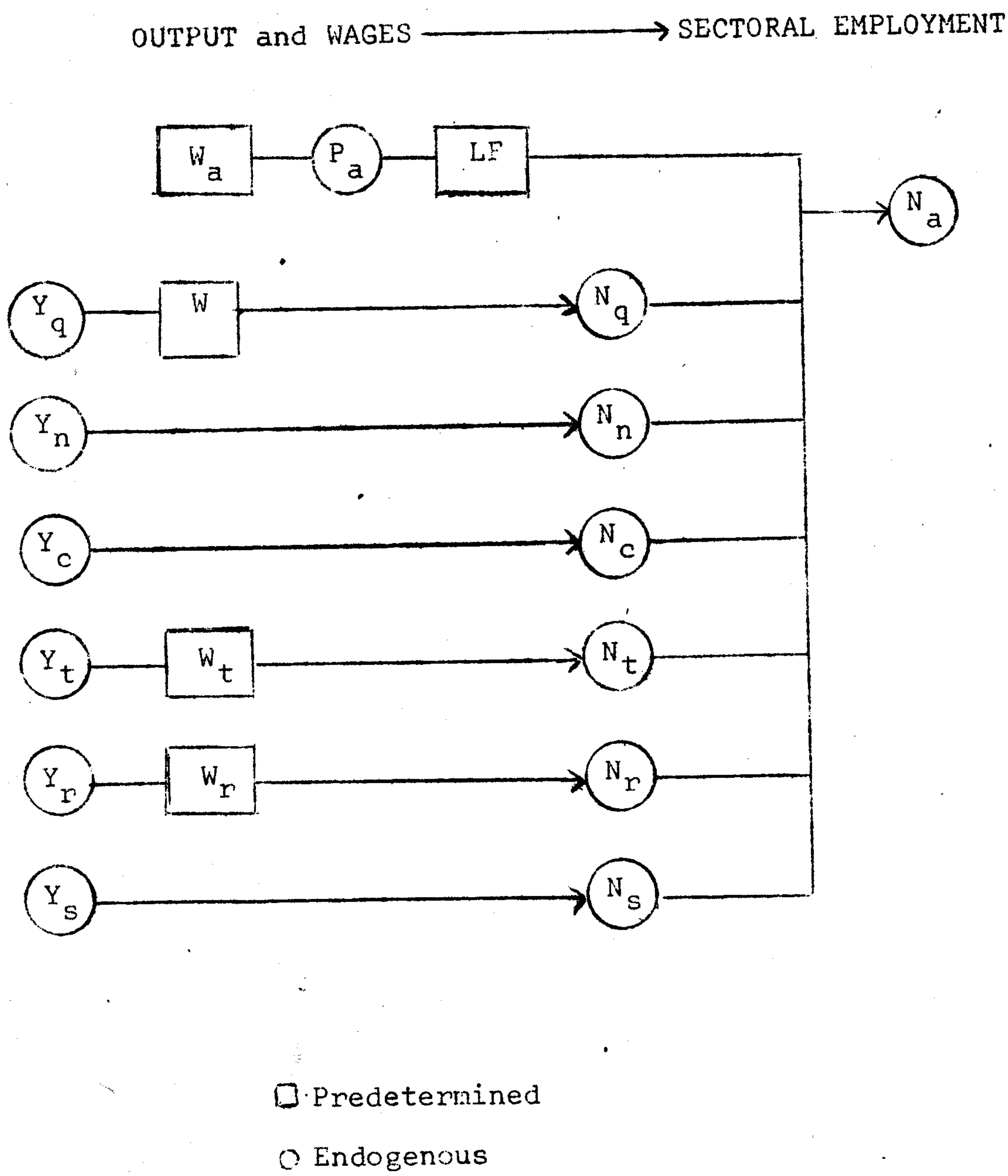
OUTPUT and WAGES → SECTORAL EMPLOYMENT
$W_a$
$P_a$
LF
$N_a$
$Y_q$
W
$N_q$
$Y_n$
$N_n$
$Y_c$
$N_c$
$Y_t$
$W_t$
$N_t$
$Y_r$
$W_r$
$N_r$
$Y_s$
$N_s$
□ Predetermined
○ Endogenous

Figure 2

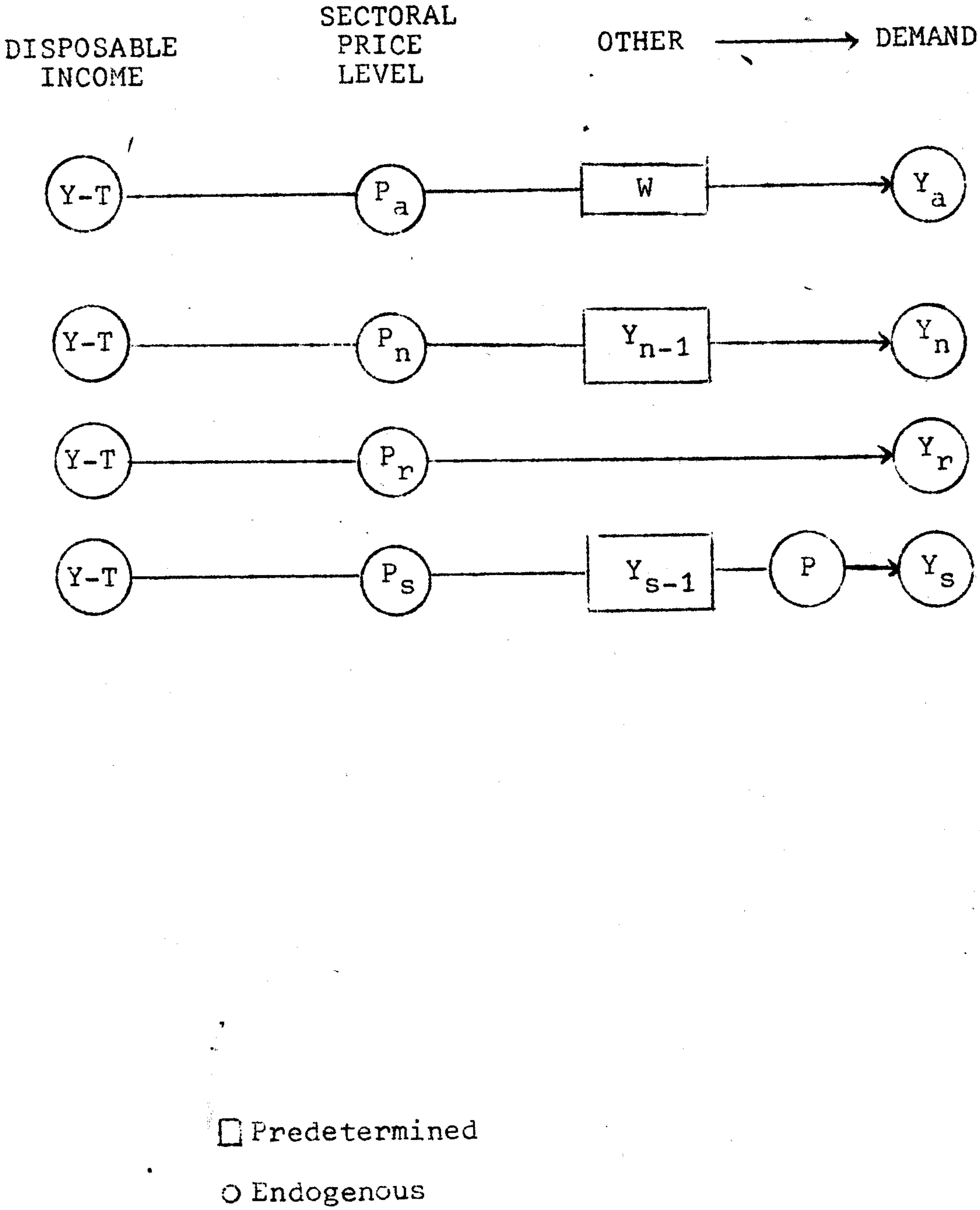
DISPOSABLE INCOME
SECTORAL PRICE LEVEL
OTHER
DEMAND
Y-T
Pa
W
Ya
Y-T
Pn
Yn-1
Yn
Y-T
Pr
Yr
Y-T
Ps
Ys-1
P
Ys
Predetermined
Endogenous

Figure 3

All but three of the 32 slope coefficients are significant at the 5% level or better. Though not much importance should be attached to the Durbin-Watson statistics, they are given for reference; it may be noted that they are within the (1.5, 2.5) range in ten of the structural equations. Figures 1-3 give an overview of the submodel.

Figure 1 outlines the determination of sectoral value-added, GNP and the general price level. Sectoral value-added is strictly resource-determined in all sectors except for agriculture, in which the demands for output and for labor join the production function in a simultaneous subsystem. The resources are sector-specific in only three sectors: agriculture, mining and manufacturing. In the other four sectors proxies for the sectoral capital stock, namely SW and $SP_i$ (i = c , t , r and s), are used. Underlying these proxies is the assumption that sectoral investment is a linear function of certain explanatory variables, say W and $P_i$ thus:

$$I_i = a_o + a_1 W + a_2 P_i$$

Then accumulated capital stock in the ith sector at the beginning of year H equals initial (beginning 1950) capital stock plus

$$\sum_{h=1950}^{H-1} I_{ih} = a_0(H - 1950) + a_1 \sum_{h=1950}^{H-1} W_h + a_2 \sum_{h=1950}^{H-1} P_{ih}$$

$$= \text{const.} + a_1 SW + a_2 SP_i + a_0 H$$

Assuming that sectoral capital stock $K_i$ is the critical variable determining $Y_i$, we have

$$Y_i = b_0 + b_1 K_i$$

$$= b_0 + b_1 \text{ (const.} + a_1 SW + a_2 SP_i + a_0 H$$

$$= \text{const.} + c_1 SW + c_2 SP_i + c_3 H$$

where $c_1 = a_1 b_1$, $c_2 = a_2 b_1$ and $c_3 = a_0 b_1$. Proxy variable coefficients can thus be interpreted as products of the capital coefficient and coefficients of an underlying investment function. The variables $SW_i$ and $SY_i$ were also tried as proxies, i.e., it was supposed that $W_i$ and $Y_i$ were investment determinants, but without interesting results. The time trend variable H does not represent any real information, and hence was also eliminated.

GNP is the simple aggregate of the $Y_i$ and depreciation, indirect taxes and net factor income from abroad. It determines P, with the assistance of the money supply, in the basic model.

The sectoral output levels, together with wage levels, then determine sectoral employment[2] (Figure 2). Agriculture is a special case in that employment is made a function of the labor force not already employed in other sectors, and of the real agricultural wage rate. This situation would be consistent with the usual migration pattern in a country experiencing economic development.

Sectoral price levels are then determined through demand functions in agriculture, manufacturing, commerce and services. In the mining and transport sectors, the best results obtained were merely price equations, which are not wholly satisfactory. There was even less success with the construction price index.

## 2. Agriculture, Fishing and Forestry.

Equation (1) in the production submodel is the agricultural production function, with value-added determined simply by harvested area and employment in the agricultural sector. In this form, the marginal product of a hectare of land is estimated at ₱274 and that of labor at ₱670 (per year

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[2]The employment variable is defined, as in the basic model, as the simple average of May and October survey observations, since (i) this series in principle incorporate more information than either the May or the October series alone, and (ii) it consistently performs better (higher t-ratios and $\bar{R}^2$'s) in production function and labor absorption regression trials, across all sectors, than the oftener-used October series.

at 1955 prices). Neither of these appear to be unreasonable. Trials were also made with other inputs: (a) LIR and LNIR, irrigated and unirrigated areas; (b) $K_a$ , the value of capital stock in agricultural machinery, equipment and work animals; (c) availabilities (domestic production plus imports) of inorganic fertilizer, agricultural chemicals, and animal feed, both as separate variables and combined in value terms. Alternative functions of interest are given in the Appendix as equations (1.1) to (1.7).

Separation of L into irrigated and unirrigated components did not give good fit, though regressions did show clearly that the marginal contribution of irrigated land is by far the higher (1.4).

The estimate of the marginal product of labor employed in agriculture was extremely sensitive to the specification chosen. It ranged from as low as ₱156 per person per year (1.4) to as high as ₱670 per person per year (1). In a fairly large number of specifications the t-values were below one, and even negative; this was often the case when $K_a$ was included in the specification. It does not seem that the issue of whether or not a near-zero marginal product of labor exists in agriculture can be resolved at this level of aggregation.

The capital stock variable invariably gave an exceptionally large coefficient, anywhere from 1.0 to 2.5 pesos of value-added per peso of the capital stock. It certainly does not appear, from casual observation, that capital in agriculture earns anywhere so large a rate of return. Close correspondence between estimated marginal products and factor prices was not set as a criterion for selection of production function specifications. Relatively large capital coefficients and relatively small labor coefficients such as were obtained in (1.1) and (1.2), would indeed be the expectation under the thesis that in the agricultural sector capital is an under-used input whereas labor is an over-used input. The absolute size of the estimated capital coefficients nevertheless did not seem plausible, and for this reason the specifications involving $K_a$ were excluded from consideration for the submodel.

The three components -- inorganic fertilizer, agricultural chemicals and animal feed -- of the purchased input variable were seperately introduced in the regressions. Fertilizer performed very poorly, almost always giving negative coefficients. This was traced to the poorness of the availability variable as a proxy for fertilizer applied. There were two years in which fertilizer availability rose by tremendous amounts, without noticeable effects on agricultural productivity.[3] Estimates of the separate contributions of agricultural chemicals and animal feeds may be seen in the appendix.

An obvious deficiency with any production function estimated from the data at hand, regardless of specification, would be the inability to capture the structural change implied by developments in the rice industry in particular in the last few years. The proportion of rice production from high yielding varieties was about 25% in crop year 1967/68 and nearly 50% in crop year 1968/69 [6] ; these would be reflected only in the last year of our 1956-1968 series. One would expect superior forecasts from separate analysis and projection by specific crop, incorporating expectations with respect to diffusion of technological improvements, etc. The main purpose at hand however is to develop a model which is internally consistent for all sectors for a recent historical period and which hopefully will be consistent and generally accurate as well in terms of short-term forecasts of sectoral production, employment and prices. Acknowledged problems with any one sector or variable should be viewed in this light.

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[3]In 1962, on account of exceptionally large imports (import arrivals contracted for in advance of full decontrol in 1962?); and in 1967, when Esso Fertilizer came into production.

Employment in the agricultural sector is taken as a linear function of the labor force less employment in all other sectors, the agricultural wage rate and the agricultural price level (2). Agriculture is thus treated as a residual sector which accomodates those not able to find work elsewhere, to an extent which is determined by the real cost of hiring labor in the agricultural sector. This assumption is consistent with the thesis that the agricultural sector is natural-resource-based whereas the other sectors are capital-based, that the direction of labor migration is from agriculture to the other sectors, and that the magnitude of the migration is limited by capital-determined employment opportunities in the other sectors [3] . The coefficient of the residual labor force in (2) is approximately one, i.e., given the real wage, the <u>marginal</u> entrant to the labor force is (approximately speaking) employed in agriculture if unemployed elsewhere, and if employed elsewhere represents a deduction by one in the agricultural employment level.

An alternative specification, with the real agricultural wage introduced as a ratio, is found in (2.1). The real industrial unskilled wage is also a significant variable (2.2). Its coefficient would measure the contemporaneous agricultural employment drawdown occurring per unit increase in the industrial wage, as migration takes place, reducing the size of the residual labor force which is really available for employment in agriculture. Equations (2) and (2.1) stress the role of employers (the demand side) in agricultural labor absorption, whereas (2.2) would stress the response of the labor force (the supply side) to perceived opportunities in the non-agricultural sectors. The two alternatives fit the data equally well. The elasticity at the means of agricultural employment with respect to the real agricultural wage in (2.1) is -0.12; the corresponding elasticity with respect to the real industrial unskilled wage is -0.22.

Some alternative labor absorption functions are given in (2.3 - 2.5). One finds the agricultural wage coefficient negative in (2.3) but significant at a low level, which would not be surprising, considering the prevalence of family labor in agriculture. The significance of the same coefficient in (2) does suggest that the latter specification is more appropriate.

The only variable in the demand function (3) which may need rationalizing is the unskilled wage rate (the regression is not statistically good without the wage variable). The positive wage coefficient can be interpreted as the effect of an improvement in income distribution on the demand for food -- other things equal, including disposable income, an increase in the wage rate will imply an increase in the share of disposable income going to low-income consumers, who are known to have a high income elasticity of demand. In the above specification, the demand elasticities at the means are 0.82 for disposable income and -0.39 for the agricultural price level. If the wage rate is not introduced the best statistical results with income and the agricultural price level as regressors are obtained with the equation in first-difference form, giving an $\bar{R}^2$ of only 0.77 (equation 3.1).

Equations (1) - (3) form a simultaneous system in $Y_a$, $N_a$ and $P_a$ in terms of $L$, $LF - \sum_{i \neq a} N_i$, $W_a$, $W$, $\sum_{i \neq a} Y_i - T + D$. Among the latter set of variables are the $N_i$ $(i \neq a)$ and the $Y_i$ $(i \neq a)$, which are endogenous to the submodel but predetermined with respect to $Y_a$, $N_a$ and $P_a$ on account of the recursive nature of the submodel. The reduced expressions for the three agricultural variables are given in Table 1. An increase in land area raises output and lowers the price level, and the effect on the price level tends to lower agricultural employment. An increase in the available supply of labor for agricultural raises employment and output, and hence lowers the price level. The agricultural wage figures as a labor absorption factor, so that a decrease in its level is required for an increase in employment and output, and for a fall in the price level. The industrial unskilled wage, for its part, enters as a demand factor for the product, and disposable GNP net of agricultural value-added comes in similarly. Both variables have positive effects on the levels of output, employment and the price level.

Table 1
The Agriculture, Fishing & Forestry
Sector: Reduced Form of Equations (1)-(3)

| Variables Predetermined With Respect to Endogenous Variables at the Right | Endogenous Variables | | |
|---|---|---|---|
| | $Y_a$ | $N_a$ | $P_a$ |
| L | 0.34437 | -0.10495 | -0.02506 |
| $LF - \sum_{i \neq a} N_i$ | 0.86629 | 0.76399 | -0.06305 |
| $W_a$ | -0.74570 | -0.65764 | 0.05428 |
| W | 0.42471 | 0.07679 | 0.01834 |
| $\sum_{i \neq a} Y_i - T + D$ | 0.08707 | 0.16200 | 0.03869 |
| Constant | -3.542.5 | 613.05 | 267.89 |

3. Mining and Quarrying

In the submodel, intermediate inputs ($INPUT_q$ equals gross output less value-added) are assumed to be the prime constraint affecting output. (In this sector, the NEC has estimates of the value of intermediate inputs which are independent of value-added.) The proxy capital variables do similarly well, but $INPUT_q$ is used because it is a more direct measurement of a resource used in mining.

A marginal ₱1 million worth of intermediate inputs appears to generate a value-added increment of about ₱4.6 million. Output and the unskilled wage in turn determine employment (5). In this function, the wage for mining workers, $W_q$ , did not produce a coefficient with the acceptable (negative) sign. Equation (5) is the poorest fitting-equation in the submodel. In this sector employment is reported to have fallen in absolute terms in certain years. It is suspected that errors due to sampling may explain a good deal of this employment volatility.

The mining sector's price level is not determined in the submodel. It may be assumed to be governed by conditions in world markets for the products of the mining industry. An equation which might be used for projections is (5.1), which links the sectoral price level to the mining wage and the export price for copper concentrates.

This section of the submodel is still in tentative shape. The question of how to project $INPUT_q$ is still opmn. The next step will be for time series of the value of fixed assets and employment in major mining corporations to be assembled, for continued trials with the production function.

4. Manufacturing.

The production function has output as a function solely of the capital stock (6). Both $N_n$ and the value of imports of raw materials did very poorly as regressors in conjunction with $K_n$. "Import-dependent import substitution", with reference to imported components of manufactured goods rather than to imported durable capital goods, is obvious in many manufacturing industries to the casual observer, but does not substantially turn up in analysis of an aggregate series. Capital is referred to as a constraint in manufacturing and succeeding sectors in the sense that output is relatively more limited by this factor than by labor in general (aggregated over all skills). There is no necessary implication that the rate of capital capacity utilization in any sector is very high [1].

Output is then the sole determinant of employment (7). This simple employment function represents the meager return to extensive regression analysis done in the case of the manufacturing sector. Neither $W$ or $W_n$ gave a negative coefficient in these regressions. There was no success with the Central Bank price indices for construction materials and imported machinery and equipment in labor absorption functions either in this sector or in others. Although the data in this sector are relatively good, being derived mainly from the Annual Survey of Manufactures, it may be that the aggregation over heterogeneous industries has concealed the relationships which we had expected to find.[4]

The manufacturing demand function contains the lagged endogenous variable, $Y_{n-1}$, which should be treated as a scale factor. At the means, the income elasticity is 0.42 and the price elasticity is -0.22.

5. Construction

The regressions for this sector have significant coefficients, but rather low $\bar{R}^2$'s. Real value-added in construction does not have a smooth trend. It fell in absolute terms in 1951, 1952, 1954, 1958, 1960, 1962, 1966 1968 and 1969, or nine times in a twenty-year series. There is a strong suspicion that this is due mostly to general data problems in the construction sector [8]. The production function (9) contains the proxy variables SW and $SP_c$, i.e., it is presupposed that investment in the construction industry is dependent on the construction price index level and on the unskilled wage rate. An increase in the wage decreases investment, which implies that the effect of wage increases on profits and hence

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[4] From a pool of cross-section and time series data mainly from the Survey of Manufactures, Williamson has found that:

"In the Philippine case, the source of that disappointing performance in labor absorption is the combination of a number of negative influences: (1) a shift in industry output structure in favor of capital intensive products; (2) a rise in real wages; (3) a decline in the user cost of capital services; (4) an extremely pronounced labor saving bias in technological change and (5) a very slow response of employment to capital intensity as firms adjust to optimal input mixes" [9, p.48].

financial capacity to invest is more than sufficient to counteract any tendency to substitute capital goods for labor.

A somewhat better-fitting relationship exists between value-added and the value of intermediate inputs (construction materials mainly), but this would beg the question of how consumption of construction materials is to be determined (9.1). Employment is barely significant as an explanatory variable for construction output (9.2).

Employment in construction is then directly determined by output, through (10), which fits rather poorly, $\bar{R}^2$ being only .64. A much superior relationship is the alternative (10.1), which brings in the general real wage, at an $\bar{R}^2$ of .76. Unfortunately (10.1) brings in a non-linearity as well and immensely complicates the solution to the submodel; hence the relegation of this equation to the appendix for reference.

There are only two structural equations specific to the construction sector, since the price variable did not produce good results in demand regressions. Simple dependence on the general rate of inflation produces a modest fit, but it is unsatisfactory to have a price level completely independent of the level of production. Aggregate investment (I in the basic model) did not perform well either as a demand determinant.

6. Transport, Storage, Communications and Utilities.

The production function (11) contains the proxy variable $SP_t$ , thus presupposing that investment in this sector is a function of the sectoral price index. The fit here is somewhat better than when $N_t$ alone is used (11.1) but about the same as when residual capital stock $K_0$ $(K_0 = K - K_a - K_n)$ is used (11.2 - 11.3). The chosen specification is preferred because (i) it maintains the principle that the capital stock of the sector is the chief constraint to output, and (ii) $SP_t$ is specific to the sector, whereas $K_0$ is not.

Employment is made a function of output and the sectoral wage rate (12). The wage variable is significant at the 10% level only; whereas it would be significant at the 5% level if $P_t$ were substituted for $Y_t$ as a regressor. The latter specification, however, cannot be used as yet since no satisfactory demand equation has been found with which to determine $P_t$ .

If projections of $P_t$ must nevertheless be made, the best alternatives would be a mixed demand and cost equation (12.1) and a cost-push equation (12.3).

7. Commerce and Services.

The production relationships for these two sectors (15 and 18) are similar to that in the transport sector, and were selected for the same reasons. It is thus presupposed that investment in the commerce sector depends on the commerce price index, while that in the services sector depends on the services price index. Alternatives are given in the appendix (15.1, 15.2, 18.1 and 18.2). Employment is then determined by output according to absorption equations (16) and (19). The commerce function has the wage $W_r$ as an additional determinant. Equation (16.1), which uses the real wage $W_r/P_r$ instead, incorporates more information and is statistically superior, but introduces a non-linearity problem. There is no services sector wage rate series; the industrial unskilled wage rate was used as a proxy without success. The model thus states that in the commerce sector the capital stock proxied by

$SP_r$) determines output (13); output then determines employment through absorption function (14), given the sectoral wage rate, and the price level through demand equation (15). The same process is followed in the services sector, through relationships (17) and (18). At the means, for the commerce and services sectors respectively, the income elasticities of demand are 1.07 and 0.46, while the price elasticities of demand are -0.21 and -1.08.

## 8. The Reduced Form

The reduced form, contained in Table 2, indicates in more detail the implications of the submodel. As explained earlier, the purpose of the submodel is to provide sectoral detail for the production, employment and price variables of the basic model. The effect of resource growth on production and employment can be obtained sectorally, and the aggregate unemployment rate can also be calculated as a result. We have well-fitting demand functions for four sectors, from which s sectoral prices can be derived.

However, not all of the analysis which can be done at the aggregate level can be disaggregated by sector by means of the production submodel. It may be noted that only one of the employment functions contains a price index as an explanatory variable. Although the basic model clearly pointed to the existence of a trade-off between aggregate employment and inflation, this trade-off cannot yet be describedat the sectoral level. Furthermore, since the aggregate price level figures as a determinant of only one sectoral price level ($P_s$), the effect of money supply expansion on <u>sectoral</u> inflation is not yet known. This would be an important piece of information, since the production submodel has sectoral prices determining sectoral investment and hence output. Further exploration is thus needed in order that the effect of an expanding money supply on each c... sector's employment and production can be determined.

Table 2

Reduced Form of the Production Submodel

| Predetermined Variables | Endogenous Variables $Y_a$ | $Y_q$ | $Y_n$ | $Y_c$ | $Y_t$ | $Y_r$ | $Y_s$ |
|---|---|---|---|---|---|---|---|
| Const. | -5477.4 | -12.7 | 1109.7 | 320.7 | 260.6 | 714.5 | 1205.4 |
| L | 0.34437 | 0 | 0 | 0 | 0 | 0 | 0 |
| LF | 0.86629 | 0 | 0 | 0 | 0 | 0 | 0 |
| $INPUT_q$ | -1.42561 | 4.628 | 0 | 0 | 0 | 0 | 0 |
| $K_n$ | -0.09011 | 0 | 0.4973 | 0 | 0 | 0 | 0 |
| $SP_c$ | -0.73223 | 0 | 0 | 1.687 | 0 | 0 | 0 |
| $SP_t$ | -0.12017 | 0 | 0 | 0 | 0.2196 | 0 | 0 |
| $SP_r$ | -0.38794 | 0 | 0 | 0 | 0 | 0.6534 | 0 |
| $SP_s$ | -0.38896 | 0 | 0 | 0 | 0 | 0 | 1.386 |
| SW | 0.06132 | 0 | 0 | -0.1414 | 0 | 0 | 0 |
| W | 0.48630 | 0 | 0 | 0 | 0 | 0 | 0 |
| $W_a$ | -0.74570 | 0 | 0 | 0 | 0 | 0 | 0 |
| $W_t$ | 0.02709 | 0 | 0 | 0 | 0 | 0 | 0 |
| $W_r$ | 0.24602 | 0 | 0 | 0 | 0 | 0 | 0 |
| T | 0.08707 | 0 | 0 | 0 | 0 | 0 | 0 |
| D | 0.08707 | 0 | 0 | 0 | 0 | 0 | 0 |
| $Y_{n-1}$ | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| $Y_{s-1}$ | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

Table 2 continuation

| Predetermined Variables | $N_a$ | $N_q$ | $N_n$ | $N_c$ | $N_t$ | $N_r$ | $N_s$ |
|---|---|---|---|---|---|---|---|
| Const. | -786.8 | 48.8 | 358.1 | 201.0 | 204.3 | 866.9 | 416.1 |
| L | -0.10495 | 0 | 0 | 0 | 0 | 0 | 0 |
| LF | 0.76399 | 0 | 0 | 0 | 0 | 0 | 0 |
| $INPUT_q$ | -0.86290 | 2.1108 | 0 | 0 | 0 | 0 | 0 |
| $K_n$ | -0.03709 | 0 | 0.1540 | 0 | 0 | 0 | 0 |
| $SP_c$ | -0.50200 | 0 | 0 | 1.10148 | 0 | 0 | 0 |
| $SP_t$ | -0.08727 | 0 | 0 | 0 | 0.1608 | 0 | 0 |
| $SP_r$ | -0.28645 | 0 | 0 | 0 | 0 | 0.5135 | 0 |
| $SP_s$ | -0.22492 | 0 | 0 | 0 | 0 | 0 | 0.5883 |
| SW | 0.04203 | 0 | 0 | -0.0850 | 0 | 0 | 0 |
| W | 0.13110 | -0.0711 | 0 | 0 | 0 | 0 | 0 |
| $W_a$ | -0.65764 | 0 | 0 | 0 | 0 | 0 | 0 |
| $W_t$ | 0.02389 | 0 | 0 | 0 | -0.03128 | 0 | 0 |
| $W_r$ | 0.21697 | 0 | 0 | 0 | 0 | -0.2840 | 0 |
| T | -0.16200 | 0 | 0 | 0 | 0 | 0 | 0 |
| D | 0.16200 | 0 | 0 | 0 | 0 | 0 | 0 |
| $Y_{n-1}$ | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| $Y_{s-1}$ | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

Table 2 continuation

| Predetermined Variables | $P_a$ | $P_n$ | $P_r$ | $P_s$ |
|---|---|---|---|---|
| Const. | 570.7 | 21.497 | -323.3 | 93.5 |
| L | -0.02506 | 0.00781 | -0.02134 | 0.00079 |
| LF | -0.06305 | 0.01964 | 0.05368 | 0.00198 |
| $INPUT_q$ | 0.31213 | 0.07260 | 0.19846 | 0.00731 |
| $K_n$ | 0.02894 | 0.00923 | 0.02523 | 0.00093 |
| $SP_c$ | 0.12925 | 0.02164 | -0.05917 | 0.00218 |
| $SP_t$ | 0.01862 | 0.00225 | 0.00616 | 0.00022 |
| $SP_r$ | 0.05765 | 0.00602 | -0.24649 | 0.00061 |
| $SP_s$ | 0.09071 | 0.02260 | 0.06179 | 0.00227 |
| SW | -0.01082 | -0.00182 | -0.00500 | -0.00018 |
| W | 0.00938 | -0.01102 | 0.03014 | 0.00111 |
| $W_a$ | 0.05428 | -0.01690 | -0.04621 | -0.00170 |
| $W_t$ | -0.00197 | 0.00061 | 0.00168 | 0.00006 |
| $W_r$ | -0.01790 | 0.00557 | 0.01525 | 0.00056 |
| T | -0.03869 | -0.02070 | -0.05658 | -0.00455 |
| D | 0.03869 | 0.02464 | 0.06737 | 0.00248 |
| $Y_{n-1}$ | 0 | 0.23561 | 0 | 0 |
| $Y_{s-1}$ | 0 | 0 | 0 | 0.02914 |

| Predetermined Variables | Y | M | P |
|---|---|---|---|
| Const. | - 1879.2 | 1808.4 | 93[illegible].4 |
| L | 0.34437 | - 0.10495 | - 0.00148 |
| LF | 0.86629 | 0.86629 | - 0.00372 |
| $INPUT_q$ | 3.20239 | 1.30790 | - 0.01377 |
| $K_n$ | 0.40719 | 0.11691 | - 0.00175 |
| $SP_c$ | 0.95477 | 0.51280 | - 0.00410 |
| $SP_t$ | 0.09943 | 0.07353 | - 0.00043 |
| $SP_r$ | 0.26541 | 0.22705 | - 0.00114 |
| $SP_s$ | 0.99704 | 0.36338 | - 0.00429 |
| SW | - 0.08008 | - 0.04297 | 0.00034 |
| W | 0.48630 | 0.06000 | - 0.00209 |
| $W_a$ | - 0.74570 | - 0.65764 | 0.00321 |
| $W_t$ | 0.02709 | - 0.00739 | - 0.00012 |
| $W_r$ | 0.24602 | 0.09377 | - 0.00106 |
| T | 0.08707 | - 0.16200 | - 0.00037 |
| D | 1.08707 | 0.16200 | - 0.00467 |
| $Y_{n-1}$ | 0 | 0 | 0 |
| $Y_{s-1}$ | 0 | 0 | 0 |

# APPENDIX

## Additional Equations

### Agriculture, Fishing & Forestry

Time series.Regression Cod $s/\bar{R}^2/DW$

(1.1) $$Y_a = -1060.8 + \underset{(2.560)}{0.2698}\, N_a + \underset{(2.148)}{1.300}\, K_a + \underset{(2.315)}{1.099}\, INPUT_a + \underset{(1.871)}{0.1678}\, L$$

1956/68.OCT39.1
61.8/.989/2.65

(1.2) $$Y_a = -1325.9 + \underset{(2.617)}{0.2555}\, L + \underset{(1.581)}{0.2408}\, N_a + \underset{(3.600)}{2.117}\, K_a$$

1956/67.SEP52.1
76.4/.976/2.98

(1.3) $$Y_a = -1236.9 + \underset{(4.549)}{2.258}\, INPUT_a + \underset{(3.062)}{0.3905}\, L$$

1956/68.OCT39.1
124.3/.954/1.69

(1.4) $$Y_a = -1122.2 + \underset{(2.860)}{4.722}\, LIR + \underset{(0.428)}{0.0869}\, LNIR + \underset{(0.690)}{0.1557}\, N_a$$

1956/68.OCT107.2
132.4/.948/0.91

(1.5) $$\frac{Y_a}{L} = .0187 + \underset{(4.420)}{2.245}\, \frac{K_a}{L} + \underset{(2.925)}{2.751} \left(\frac{100LIR}{L}\right)$$

1956/68.NOV39.2
.0103/.939/2.34

(1.6) $$\frac{Y_a}{L} = .1899 + \underset{(5.660)}{2.538}\, \frac{K_a}{L} + \underset{(2.512)}{1.415}\, \frac{Feed}{L}$$

1957/68.OCT108.11
.0105/.935/2.65

(1.7) $$\frac{Y_a}{L} = .1121 + \underset{(2.584)}{0.3406}\, \frac{N_a}{L} + \underset{(3.230)}{0.05161}\, \frac{Chem}{L} + \underset{(4.957)}{2.546}\, \frac{Feed}{L}$$

1957/68.OCT108.5
.0124/.910/3.02

(2.1)
$$N_a = 308.0 + \underset{(35.8)}{0.9961}\,(LF - \sum_{i \neq a} N_i) - \underset{(-4.529)}{1.286}\,(100W_a/P_a)$$

1956/68.NOV79.3
46.4/.993/1.66

(2.2)
$$N_a = 948.9 + \underset{(30.7)}{0.9876}\,(LF - \sum_{i \neq a} N_i) - \underset{(-3.858)}{1.095}\,(100W/P)$$

1956/68.NOV79.5
51.3/.992/2.05

(2.3)
$$N_a = 2494.9 - \underset{(-1.382)}{1.137}\,W_a + \underset{(6.270)}{1.141}\,Y_a$$

1956/68.SEP42B.54
180.9/.897/2.07

(2.4)
$$N_a = 2891.4 - \underset{(2.719)}{2.010}\,W + \underset{(5.939)}{1.650}\,Y_a$$

1956/68.SEP42A.53
149.7/.930/2.69

(2.5)
$$N_a = 3533.8 - \underset{(3.168)}{3.269}\,W + \underset{(4.275)}{1.351}\,Y_a + \underset{(1.631)}{3.301}\,K_a$$

1956/68.OCT28.2
138.6/.940/2.34

(3.1)
$$\Delta Y_a = -147.7 + \underset{(7.806)}{0.4661}\,\Delta Y - \underset{(-2.830)}{12.71}(100\Delta P_a/P)$$

1951/69.SEP53.2
58.8/.767/1.98

Mining

(4.1)
$$Y_q = 5.89 + \underset{(4.340)}{0.00334}\,K_q + \underset{(2.822)}{1.893}\,INPUT_q$$

1956/68.NOV73.3
7.4/.972/1.01

(4.2)
$$Y_q = 64.1 + \underset{(14.16)}{0.11519}\,SP_q$$

1950/69.NOV65.2
20.4/.913/0.46

(4.3)
$$Y_q = 76.5 + \underset{(14.61)}{0.07322}\,SY_q$$

1950/69.NOV65.3
19.8/.918/0.48

(5.1)
$$P_q = 43.7 + \underset{(6.656)}{0.2542}\,P_{cc} + \underset{(3.249)}{0.1538}\,W_q$$

1952/69.NOV88.16
6.39/.932/1.14

## Manufacturing

(6.1) $$Y_n = 1190.2 + \underset{(13.74)}{0.2993}\ INPUT_n$$
1956/68.OCT2.4
90.9/.940/0.57

(6.2) $$Y_n = -1383.4 + \underset{(11.54)}{2.983}\ N_n$$
1956/68.AUG46.34
107.0/.917/1.51

(8.1) $$Y_n = 127.4 - \underset{(-2.488)}{5.756}\ P_n + \underset{(14.14)}{0.1997}\ Y$$
1950/68.AUG39.16
72.2/.985/0.41

(8.2) $$Y_n = 404.1 + \underset{(29.04)}{0.2420}\ (Y-T) - \underset{(-8.384)}{0.8464}\ W$$
1950/69.SEP117.46
38.6/.995/1.68

(8.3) $$Y_n = 778.0 + \underset{(24.40)}{0.1705}\ (Y-T) - \underset{(-2.148)}{0.7062}\ (100\ W/P)$$
1950/69.SEP117.47
80.5/.979/0.40

(8.4) $$Y_n = 760.8 + \underset{(10.62)}{0.3106}\ (Y-T) - \underset{(-4.631)}{1.383}\ W_n$$
1950/69.SEP117.48
59.1/.989/1.64

(8.5) $$Y_n = 298.7 - \underset{(-3.331)}{4.354}\ P_n + \underset{(26.38)}{0.2183}\ Y - \underset{(-7.071)}{5.539}\ P_q$$
1950/69.SEP112.4
40.2/.996/1.64

## Construction

(9.1) $$Y_c = 187.1 + \underset{(7.156)}{0.3870}\ INPUT_c$$
1956/68.OCT41.4
32.8/.807/0.56

(9.2) $$Y_c = 52.8 + \underset{(2.321)}{0.5208}\ Y_{c-1} + \underset{(2.011)}{0.6013}\ N_c$$
1956/68.AUG45.25
37.7/.746/2.53

(10.1) $$N_c = 418.9 - \underset{(-2.487)}{0.3302}\ (100\ W/P) + \underset{(5.004)}{0.5368}\ Y_c$$
1956/68.NOV38D.3
26.9/.758/1.89

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## Transport, Storage, Communications and Utilities

(11.1) $$Y_t = 52.5 + \underset{(12.77)}{1.463}\, N_t$$ 1956/68.AUG48.34 24.6/.931/1.16

(11.2) $$Y_t = 143.7 + \underset{(60.5)}{0.01385}\, K_o$$ 1956/68.NOV70.3 5.35/.997/0.70

(11.3) $$Y_t = 128.9 + \underset{(2.472)}{0.1818}\, N_t + \underset{(18.15)}{0.01225}\, K_o$$ 1956/68.NOV70.1 4.42/.998/1.00

(12.1) $$N_t = 179.7 - \underset{(-2.391)}{0.1621}\, W + \underset{(6.307)}{0.01281}\, K_o$$ 1956/68.NOV69.8 15.2/.940/1.76

(12.2) $$P_t = 26.5 + \underset{(6.823)}{0.5321}\, Y + \underset{(2.466)}{0.01028}\, W_t$$ 1952/69.SEP39.58

(12.3) $$P_t = 55.3 + \underset{(23.8)}{0.00446}\, P + \underset{(2.26)}{0.00334}\, W_t$$ 1952/69.SEP39.52 1.32/.994/1.67

### Commerce

(13.1) $$Y_r = 76.9 + \underset{(10.99)}{1.641}\, N_r$$ 1956/68.AUG47.34 94.9/.909/1.24

(13.2) $$Y_r = 371.4 + \underset{(41.74)}{0.04646}\, K_o$$ 1956/68.NOV70.6 26.0/.993/0.95

(14.1) $$N_r = 9[illegible].2 - \underset{(-2.945)}{0.4473}\, (100 W_r/P_r) + \underset{(9.63)}{0.4715}\, Y_r$$ 1956/68.NOV38F.32 42.5/.946/1.96

(15.1) $$Y_r = 821.5 + \underset{(22.67)}{0.1528}\, (Y-T) - \underset{(-2.942)}{3.082}\, P_r -$$

$$- \underset{(-3.942)}{0.4496}\, (100\ W/P)$$ 1952/69.SEP120.33 25.5/.996/1.49

Services

$$(16.1)\quad Y_s = 356.3 + \underset{(14.79)}{2.243}\, N_s$$

1956/68.AUG49.34
144.6/.948/0.87

$$(16.2)\quad Y_s = 312.1 + \underset{(34.8)}{0.09335}\, K_o$$

1956/68.NOV70.9
62.7/.990/0.54

$$(18.1)\quad P_s = 34.7 + \underset{(4.195)}{0.00941}\, Z + \underset{(4.091)}{0.5438}\, P_{s-1}$$

1950/69.SEP104.59
1.39/.993/1.80

# APPENDIX

## Additional Notation

$K_a$ = capital stock in agricultural machinery and equipment plus value of agricultural work animals, beginning of the year, in million pesos at 1955 prices.

$K_0$ = $K - K_a - K_n$ where $K$ = aggregate capital stock beginning of the year, in million pesos at 1955 prices.

Chem = sum of imported and domestically produced agricultural chemicals, in thousand pesos at 1955 prices.

Feed = sum of imported and domestically produced animal feed, in metric tons

$INPUT_a$ = sum of Chem, value of Feed and value of sum of imported and domestically produced inorganic fertilizer, in million pesos at 1955 prices

LIR = portion irrigated of harvested area, in thousand hectares

LNIR = L - LIR

$INPUT_i$ = value of intermediate inputs used in the ith sector, computed as gross output less value-added, in million pesos at 1955 prices; for i = q, n and c.

$Z_t$ = average of end-of-month money supply (currency plus demand deposits) from October of the previous year to September of the current year, in million pesos.

## REFERENCES

[1] Bautista, R. M., "Capital Coefficients in Philippine Manufacturing: An Analysis," Philippine Economic Journal, 5:2 (Second Semester 1966) pp. 205-77.

[2] Encarnación, J., Mariano, R. S., and Bautista, R. M., "A Macroeconomic Model of the Philippines, 1950-1969," Philippine Economic Journal, forthcoming, Second Semester 1971.

[3] Hicks, G. L. and McNicoll, G., Trade and Growth in the Philippines: An Open Dual Economy, Cornell University, 1971.

[4] Mijares, T. A. and Tidalgo, R. L., "Labor Absorption in the Philippines," paper presented at the Conference on Manpower Problems in East and Southeast Asia, Singapore, May 1971 (mimeo).

[5] Paris, T. B., Jr., Output, Inputs and Productivity of Philippine Agriculture, 1948-1967. M. A. thesis, School of Economics, University of the Philippines, 1971.

[6] Paulino, L. A. and Trinidad, L. A., "The Shift to New Rice Varieties in the Philippines," in Seminar on Economics of Rice Production in the Philippines, papers presented at a Conference at the International Rice Research Institute, December 11-13, 1969.

[7] Republic of the Philippines, National Economic Council Four-Year Development Plan, FY1972-75, Manila 23 July 1971.

[8] Republic of the Philippines, National Economic Council Sources and Methods of Estimation for the National Accounts of the Philippines and Supporting Tables, Manila, June 1971.

[9] Williamson, J. G., "Capital Accumulation, Labor-Saving and Labor Absorption: A New Look at Some Contemporaneous Asian Experience," University of Wisconsin, SSRI Workshop Paper EDIE 6932.

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