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SECTORAL OUTPUT, INPUT, AND PRODUCTIVITY

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1. Introduction

This paper is concerned with productivity trends in Philippine agriculture and manufacturing. The analysis focuses on the rates of change in output and in tangible factor inputs to obtain productivity estimates which are considered rough measures of the impact of intangible factor inputs, such as human capital investments, on production.[1] One approach of deriving the total productivity index uses the Jorgenson-Griliches method (1967) which adjusts conventional inputs for qualitative improvements. However, Denison (1972) has shown that the Jorgenson-Griliches method is empirically untenable and theoretically unsound because it reclassifies growth sources from a component of productivity to a component of input. Thus, our partial and total productivity measures are derived from measures of tangible factor inputs unadjusted for quality changes. Kendrick (1973, p. 5) has pointed out that productivity measures of this type "remain a useful point of departure for analysis of growth and change in economic aggregates and structure." Besides, the present treatment of tangible factor inputs is analytically convenient and empirically appropriate for our purpose.

The analysis for agriculture, which covers the period 1956-1974, allows the utilization of consistent input and output time-series data. 1956 has been chosen as the initial period because two surveys were conducted in this year: one is the first labor survey of the Bureau of the Census and Statistics' *Survey of Household Bulletin* (1956) and the other is the Bureau of Agricultural Economics' (BAECON) capital formation survey in agriculture (1964) which

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[1] For further elaboration of this type of analysis, see Kendrick (1973), Paris (1971), Crisostomo (1972), and Crisostomo and Barker (1972).

provides the capital stock benchmark figure employed here. The year 1974 is chosen, it being the latest available period in which all required output and input data for productivity analysis are available at the time of the study.

Of course, the choice of a particular time frame may result in estimates different from those based on an alternative time period. Pragmatism has been the prime consideration in basing this study on the stated time period. Any attempt to estimate the average rates of change of productivity before 1956 would have to rely almost entirely on extrapolated output and input measures. The resulting productivity estimates would then be as shaky as the output and input figures on which they are built. In other words, if there is such a thing as a unique estimate of the secular rates of change in productivity in an economic time-series, then the 1956-74 period would roughly indicate its general order of magnitude when most of the required data are available from independent sources.

The analysis for manufacturing does not consider the years beyond 1970 since the main source of data, *Manufacturing Statistics of the Philippines: 1956-70* (1974) has compiled consistent output and input figures only up to 1970.

The discussion in the next sections proceeds by first analyzing partial and total productivity trends in each sector; then evaluating the variability in output, input, and productivity growth rates; and, finally, proposing an interpretation of the influence of human capital accumulation on productivity.

2. Partial and Total Productivity

An examination of productivity trends in Philippine agriculture and manufacturing necessitates a look at these sectors' partial and total productivity measures. These measures enable us to understand the recent performance of these dynamic sectors of the Philippine economy. This section will analyze the productivity trends in agriculture for the period 1956 -1974 and those in manufacturing for the period 1956-1970. The rallying point of the discussion throughout the paper is the Kendrick-type productivity indices which are painstakingly estimated.

2.1 Agriculture

The growth rates between 1956 and 1974 as well as for the

Table 1 — Agriculture: Average Annual Percentage Rates of Change in Output, Inputs, and Productivity Ratios, Philippines: 1956-74 (by subperiods)

	1956-64	1964-74	1956-70	1956-74
Output	2.28	3.80	5.19	3.12
Inputs				
Labor (man-hours)	1.57	— 2.79	0.86	— 0.85
Capital	4.10	6.52	5.12	5.44
Land	2.71	3.44	5.61	3.11
Total	2.23	1.07	3.13	1.59
Productivity Ratios				
Output per unit of				
Labor input	0.69	6.60	4.33	3.98
Capital input	— 1.82	— 2.72	0.06	— 2.32
Land input	— 0.43	— .36	— 0.42	0.01
Total Factor Input	0.05	2.73	2.06	1.54
Capital-labor input ratio	2.52	9.31	4.27	6.29

Source: Computed from Table A.1.

three subperiods are shown in Table 1. Output in agriculture increased at an average compound rate of 3.12 per cent a year between 1956 and 1974. Real total input rose at a rate of 1.59 per cent, employing man-hours and effective crop area as measures of labor and land inputs, respectively. Thus, the total factor productivity in agriculture rose by 1.54 per cent per year for the 1956-74 period.

Breaking the 1956-74 period into three subperiods — 1956-64, 1964-74, and 1956-70 (see Table 1) — note that output rose at an average annual rate of 2.28, 3.80, and 5.19 per cent in the first, second and third subperiods, respectively (see Figure 1). The high rate in the third subperiod is of immediate importance because its time frame coincides with the entire period under which the manufacturing sector is analyzed. While output rose continually in the three subperiods, total inputs declined in the second subperiod and somewhat accelerated in the third subperiod. Consequently, the increase in total factor productivity was 2.68 per cent higher in the second subperiod than the first. The third subperiod exhibited a

higher rate of total productivity growth than the first subperiod as well as over the entire period (1956-1974), though slightly lower than that of the second subperiod. Although total inputs in the third subperiod substantially rose relative to the previous two subperiods, the total factor productivity has not declined far below that of the second subperiod because its output accelerated faster than that of the second (see Figure 2).

Table 1 shows a progressive acceleration in the rate of increase in agricultural output per unit of the labor input from 0.70 per cent average annual rate for the 1956-64 subperiod to 6.60 per cent average annual rate for the 1964-74 subperiod. This could be explained by the rapid acceleration between the two subperiods of the rate of substitution of capital for labor — from 2.52 to 9.31 per cent, respectively, resulting in lower rates of change in real agricultural output per unit of capital over the same subperiods. Apparently, this has been confirmed by the evidence generated over the subperiods. While the capital-labor ratio of the second subperiod rose faster than that of the first subperiod, its real output per unit of capital input declined more than that of the first subperiod. "Land" as defined here refers to effective crop area which incorporates the effects of such factors as multiple cropping, growing availability of irrigation facilities, etc. In fact, a recent study (Crisostomo 1972) documented the increase in the multiple cropping index from 1948 to 1960. This could be expected since the land-complementing "non-farm current inputs" (such as seeds, fertilizers, chemicals, etc.) have been suggested to have grown rapidly over this period. In the long run, the abundant land frontiers in Philippine agriculture will be exhausted and the exploding Philippine population will contribute to a continuing decline of the land-labor ratio. This decline can be offset by raising the productivity of land via the employment of abundant labor and land-complementing modern inputs.

One variant of total factor productivity tried employed the concept of man-days equivalent labor instead of man-hour labor, and simultaneously defined the land input differently by disaggregating total effective crop area into irrigated and non-irrigated crop area and then applying its respective rental rate per hectare to arrive at an "adjusted land input." The resulting variant measures (shown in Table 2) exhibited the same pattern as those observed in the first measure (see Table 1). However, its estimate of total factor productivity was slightly higher than that of the first measure because man-days equivalent labor had grown less rapidly than man-hour labor.

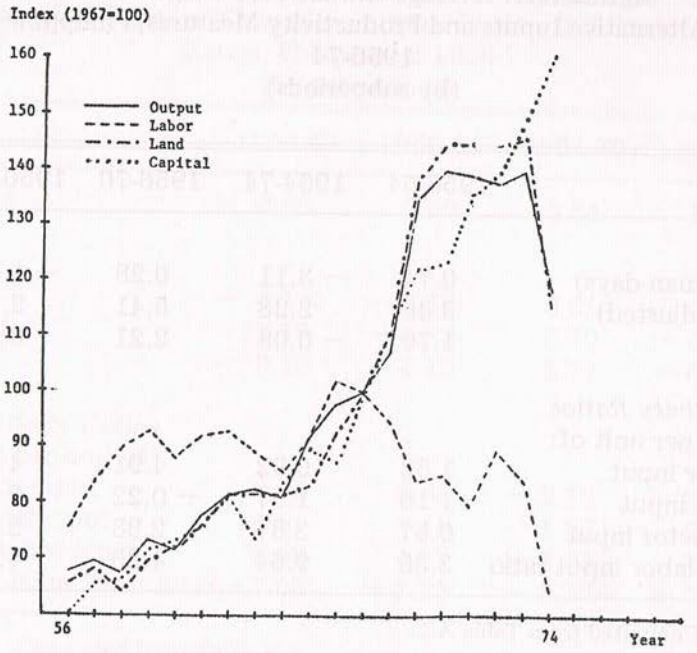

Figure 1 — Output and Inputs in Agriculture, 1956-1974

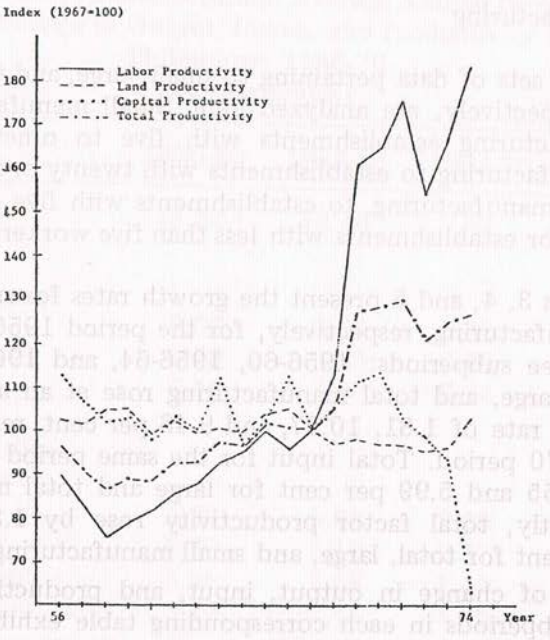

Figure 2 — Total and Partial Productivity in Agriculture, 1956-1974.

Table 2 — Agriculture: Average Annual Percentage Rates of Change of Alternative Inputs and Productivity Measures, Philippines: 1956-74
(by subperiods)

	1956-64	1964-74	1956-70	1956-74
Inputs				
Labor (man-days)	0.74	− 3.11	0.28	− 1.40
Land (adjusted)	3.46	2.23	5.41	2.78
Total	1.70	− 0.08	2.21	0.72
Productivity Ratios				
Output per unit of:				
Labor input	1.53	6.92	4.91	4.53
Land input	− 1.18	1.57	− 0.22	0.35
Total factor input	0.57	3.87	2.98	2.40
Capital-labor input ratio	3.35	9.64	4.85	4.85

Source: Computed from Table A.1.

2.2 Manufacturing

Three sets of data pertaining to small, large, and total manufacturing, respectively, are analyzed here. Small manufacturing refers to manufacturing establishments with five to nineteen workers; large manufacturing to establishments with twenty or more workers; and, total manufacturing, to establishments with five or more workers. Data for establishments with less than five workers are not available.

Tables 3, 4, and 5 present the growth rates for small, large and total manufacturing, respectively, for the period 1956-1970 as well as the three subperiods: 1956-60, 1956-64, and 1964-70. Output in small, large, and total manufacturing rose at an average annual compound rate of 1.81, 10.27, and 9.48 per cent, respectively, for the 1956-70 period. Total input for the same period increased at a rate of 6.55 and 5.99 per cent for large and total manufacturing. Consequently, total factor productivity rose by 1.89, 3.72, and 3.50 per cent for total, large, and small manufacturing, respectively. The rates of change in output, input, and productivity measures for the subperiods in each corresponding table exhibit similar patterns in all manufacturing concepts.

Table 3 — Small Manufacturing: Average Annual Percentages Rates of Change in Output, Inputs, and Productivity Ratios, Philippines: 1956-70 (by subperiods)

	1956-60	1956-64	1964-70	1956-70
Output	— 0.66	0.30	3.84	1.81
Inputs				
Labor	— 4.14	— 3.57	6.01	0.51
Capital	—11.19	— 4.82	5.70	— 0.31
Total	— 9.19	— 4.49	5.77	— 0.09
Productivity Ratios				
Output per unit of:				
Labor input	3.46	3.85	— 2.12	1.29
Capital input	10.5	5.10	— 1.87	2.11
Total factor input	8.52	4.77	— 1.94	1.89
Capital-labor input ratio	— 7.05	— 1.25	— 0.26	— 0.82

Source: Computed from Table A.2.

Table 4 — Large Manufacturing: Average Annual Percentage Rates of Change in Output, Inputs, and Productivity Ratios, Philippines: 1956-70 (by subperiods)

	1956-60	1956-64	1964-70	1956-70
Output	11.34	12.48	7.31	10.27
Inputs				
Labor	8.36	6.86	5.03	6.08
Capital	5.09	4.38	9.69	6.66
Total	5.75	4.90	8.74	6.55
Productivity Ratios				
Output per unit of:				
Labor input	2.97	5.62	2.28	4.19
Capital input	6.25	8.10	— 2.37	3.61
Total factor input	5.58	7.58	— 1.43	3.72
Capital-labor input ratio	— 3.28	— 2.48	4.65	0.58

Source: Computed from Table A.3.

Table 5 — Total Manufacturing: Average Annual Percentage Rates of Change in Output, Inputs, and Productivity Ratios, Philippines: 1956-70 (by subperiods)

	1956-60	1956-64	1964-70	1956-70
Output	9.87	11.26	7.11	9.48
Inputs				
Labor	6.75	5.69	5.10	5.44
Capital	3.66	3.60	9.47	6.12
Total	4.31	4.05	8.57	5.99
Productivity Ratios				
Output per unit of:				
Labor input	3.12	5.57	2.01	4.05
Capital input	6.21	7.65	— 2.36	3.36
Total factor input	5.56	7.21	— 1.45	3.50
Capital-labor input ratio	—3.09	— 2.08	4.37	0.68

Source: Computed from Table A.4.

Turning to partial productivity measures, there has been a decline in the rate of growth of output per unit of labor input and per unit of capital from the 1956-64 to the 1964-70 subperiods in small, large, and total manufacturing. The lower productivity of capital is partly explained by the movement in the capital-labor ratio; however, the case for labor could not be explained by factor substitution alone. Due to its level of aggregation, this study may have missed a lot of the explanatory forces that could be revealed under a more disaggregated data set for manufacturing and agriculture. This analysis tries to make the best of existing data employed in this study (see Figures 3 and 4).

3. Sectoral Variations in Growth Rates

For analytical purpose, several completed "cycles" were designated in each sector depending on the time path of growth of real output. To abstract from cyclical fluctuations, the following measures were estimated: (1) average annual percentage rates of change in real output and productivity between "cycle" peaks and (2) average annual percentage rates of change between "cycle"

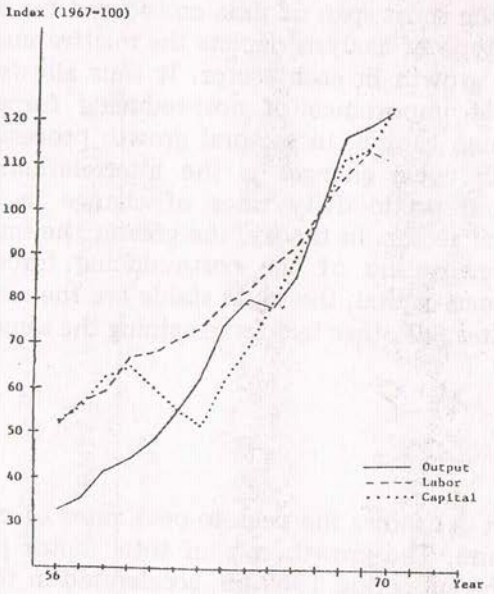

Figure 3 — Output and Inputs in Total Manufacturing, 1956-1970

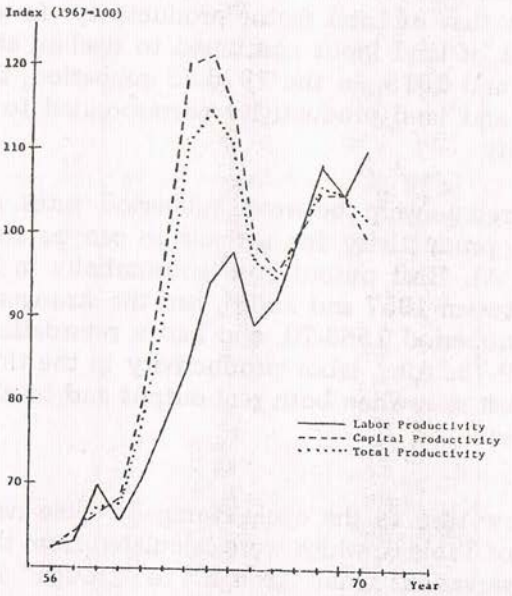

Figure 4 — Total and Partial Productivity in Total Manufacturing, 1956-1970

averages (Kendrick 1973, pp. 51-59). Some of our "cycles" are quite brief considering the short span of time considered for each sector. Nevertheless, this type of analysis depicts the relative smoothness of the time path of growth in each sector. It thus allows inferences about the possible importance of cost-reducing forces, such as investment in human capital, in sectoral growth process. Also considered along with cycle changes is the interrelationship among output, input, and productivity rates of change in the various subperiods for each sector. In theory, the greater the impact of the growing institutionalization of the cost-reducing forces, such as investment in human capital, the more stable are the sectoral variations in growth rates, all other factors remaining the same (Kendrick 1973, pp. 62-63).

3.1 Agriculture

Table 6 (Part A) shows the peak-to-peak rates of change since 1956 for agriculture. The growth rate of total factor productivity declined in the first subperiod 1957-59, accelerated in the next two subperiods (1959-63 and 1963-70), and declined again in the last subperiod 1970-73. Output per unit of capital input followed a rather different growth pattern: it slowed down in the third subperiod (1963-70) while both labor and total factor productivity experienced their highest rates of change in real output. This was consistent with that of total factor productivity. In addition, real output per unit of land input continued to decline at a slow rate between 1959 and 1973. In the 1970-73 subperiod, the decline in labor, capital, and land productivity corresponded to a decline in total productivity.

The interrelationship between subperiod rates of change in output and in productivity for agriculture can be seen further in Table 6 (Part A). Real output rose substantially in the first two subperiods (between 1957 and 1963), had the strongest growth rate in the third subperiod 1963-70, and had a retardation in the last subperiod 1970-73. Also, labor productivity in the third subperiod was at its highest rate when both real output and total productivity were at their peak.

Let us now turn to the cycle-average-to-cycle-average rates of change (Part B of Table 6) which were calculated from the averages of the annual observations from "trough" to "trough" in each cycle. The patterns of cycle-average-to-cycle-average rates of change are

Table 6 — Agriculture: Average Annual Percentage Rates of Change In Real Output and the Productivity Ratios, Philippines: 1956-74 (by cycle subperiods)

	A. Peak to Peak				
	1956-74	1957-59	1959-63	1963-70	1970-73
Real Output	3.12	2.88	2.90	7.55	0.02
Total Factor Productivity	1.54	− 0.99	2.26	3.96	− 0.93
Real Output Per Unit of:					
Labor Input	3.98	− 2.11	3.95	8.20	0.50
Capital Input	− 2.32	− 1.62	1.97	0.24	− 6.27
Land Input	0.01	1.75	− 1.10	− 0.52	− 0.24

Table 6 (Continued)

	B. Cycle Average to Cycle Average				
	1956-58 to 1972-74	1956-58 to 1958-60	1958-60 to 1960-64	1960-64 to 1964-72	1964-72 to 1972-74
Real Output	4.14	1.95	3.62	6.19	2.87
Total Factor Productivity	1.34	− 1.91	2.18	3.06	2.02
Real Output Per Unit of:					
Labor Input	4.44	− 2.42	3.88	6.27	5.34
Capital Input	− 1.62	− 2.84	0.33	0.29	− 4.24
Land Input	− 0.31	0.01	− 0.95	− 0.17	− 0.22

Source: Computed from Table A.1.

almost identical to those of peak-to-peak rates. Tables 7 and 8 show the rates of change from peak to peak since 1957 and from cycle average to cycle average since 1956-1958. Predictably, there is no marked difference in the pattern of either intercycle growth rates or of average deviation from the mean rates of growth in the period 1956-58. The higher output mean deviations in a few subperiods could be attributed to many factors, such as the random occurrence of major typhoons, floods, drought, and plant diseases in the Philippines which devastated crop, livestock, and facilities.[2] Regardless of the underlying forces explaining the patterns observed in the rate of change in output and in productivity, Tables 7 and 8 clearly indicate that over the entire period (1956-1974), the mean deviation in output as calculated from cycle-to-cycle averages is definitely lower (1.27 per cent) than that calculated from peak-to-peak averages (2.11 per cent). The same is true with respect to the mean deviations of total factor productivity which had 1.59 and 2.06 per cent for the two respective measures. Generally, the mean deviations in the rates of change of the inputs as well as in the partial productivity measures are approximately lower when measured on a cycle-average than on a peak-to-peak basis (shown in Part B of Tables 7 and 8).

3.2 Manufacturing

Variations in the growth rates of output, input, and productivity for manufacturing are shown in Tables 9 to 11. Table 9 shows that both real output and total productivity rose faster in the 1956-64 subperiod than in the 1956-70 subperiod. Table 10 shows that the average deviation in output and productivity between small and large manufacturing was sizeable (see Part B of Table 11). Interestingly, the average deviations from the mean rates of growth as a percentage of the growth rates are generally lower in manufacturing than in agriculture. On the whole, output and productivity estimates in manufacturing are higher than those observed in agriculture. This suggests a greater concentration of cost-reducing forces.

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[2] Crisostomo and Barker (1972) mentioned other factors responsible for output fluctuations such as the imposition of tariff duties and marketing quotas, overvalued currency, diminishing returns to labor and land inputs, among others. Nevertheless, an ideal frame of analysis should employ the Denison (1972) method of attributing a component of output growth to a particular source. Future productivity research work could possibly employ this framework.

Table 7 — Agriculture: Output, Inputs and Productivity Ratios:Average Annual Percentage Rates of Change Between Cycle Peaks

A. Change From Previous To Current Peaks

Cycle Peak Years	Real Output	Factor Inputs				Productivity Ratios			
		Total	Labor	Capital	Land	Total	Labor	Capital	Land
(1957)									
1959	2.88	3.90	4.99	4.48	1.09	− 0.99	− 2.11	− 1.62	1.75
1963	2.90	0.63	− 1.05	0.92	4.00	2.26	3.95	1.97	− 1.10
1970	7.55	3.59	− 0.64	7.31	8.07	3.96	8.20	0.24	− 0.52
1973	0.02	0.96	− 0.47	6.30	0.28	− 0.93	0.50	− 6.27	− 0.24

B. Averages of Peak-To-Peak Rates of Change with Mean Deviations, by Subperiods

Period	Real Output	Factor Inputs				Productivity Ratios			
		Total	Labor	Capital	Land	Total	Labor	Capital	Land
1957-73									
Rate	3.34	2.27	0.71	4.73	3.36	1.08	2.64	− 1.42	− 0.03
Ave. Dev.	2.11	1.48	2.14	2.05	2.68	2.04	3.44	2.53	0.89
1959-73									
Rate	3.49	1.73	− 0.72	4.84	4.12	1.76	4.22	− 1.35	− 0.62
Ave. Dev.	2.71	1.24	0.22	2.62	1.64	1.80	3.66	3.28	0.32
1957-70									
Rate	4.44	2.71	1.10	4.24	4.39	1.74	3.35	0.20	0.04
Ave. Dev.	2.07	1.38	2.59	2.21	2.46	1.82	3.64	1.21	1.14

Table 8 — Agriculture: Output, Inputs, and Productivity Ratios:
Average Annual Percentage Rates of Change Between Cycle Averages, 1956-1974

A. Change From Previous To Current Cycle Average

Cycle Years	Real Output	Factor Inputs				Productivity Ratios			
		Total	Labor	Capital	Land	Total	Labor	Capital	Land
(1956-58)									
1958-60	1.95	3.60	4.11	4.71	1.93	— 1.91	— 2.42	— 2.84	0.01
1960-64	3.62	1.50	— 0.26	3.30	4.53	2.18	3.88	0.33	— 0.95
1964-72	6.19	3.01	0.15	5.89	6.45	3.06	6.27	0.29	— 0.17
1972-74	2.87	1.02	— 2.55	6.09	3.05	2.02	5.34	— 4.24	— 0.22

B. Averages of Rates of Change Between Cycle Averages, with Mean Deviations, 1956-58 to 1972-74, By Subperiods

Period	Real Output	Factor Inputs				Productivity Ratios			
		Total	Labor	Capital	Land	Total	Labor	Capital	Land
1956-58 to 1972-74									
Rate	3.66	2.28	0.36	5.00	3.99	1.34	3.27	— 1.62	— 0.33
Ave. Dev.	1.27	1.02	1.87	0.99	1.50	1.62	2.84	1.93	0.31
1956-58 to 1964-72									
Rate	3.92	2.70	1.33	4.63	4.30	1.11	2.58	— 0.74	— 0.37
Ave. Dec.	1.51	0.80	1.85	0.89	1.58	2.01	3.66	1.40	0.38

Source: Computed from Table A-1

Table 9 — Manufacturing: Average Annual Percentage Rates of Change in Real Output and the Productivity Ratios, 1956-70
(by cycle periods)

A. Peak-To-Peak

	Small Manufacturing			Large Manufacturing			Total Manufacturing		
	1956-70	1956-64	1964-70	1956-70	1956-64	1964-70	1956-70	1956-64	1964-70
Real Output	1.81	0.03	3.84	10.27	12.48	7.31	9.48	11.26	7.11
Total Factor Productivity	1.89	4.77	− 1.94	3.72	7.58	− 1.43	3.50	7.21	− 1.45
Real Output Per Unit of:									
Labor Input	1.29	3.85	− 2.12	4.19	5.62	2.28	4.05	5.57	2.01
Capital Input	2.11	5.10	− 1.87	3.61	8.10	− 2.37	3.36	7.65	− 2.36

B. Cycle Average To Cycle Average

	Small Manufacturing 1956-64 to 1964-70	Large Manufacturing 1956-64 to 1964-70	Total Manufacturing 1956-64 to 1964-70
Real Output	4.51	9.55	9.19
Total Factor Productivity	0.28	2.76	2.57
Real Output per Unit of:			
Labor Input	3.06	3.95	3.96
Capital Input	− 0.70	2.41	2.16

Table 10 — Manufacturing: Output, Inputs, and Productivity Ratios: Average Annual Percentage Rates of Change Between Cycle Peaks

A. Change From Previous to Current Peaks

Cycle Peak Years	Real Output	Factor Inputs			Productivity Ratios		
		Total	Labor	Capital	Total	Labor	Capital
			Small Manufacturing				
(1956)							
1964	0.30	— 4.49	— 3.57	— 4.82	4.77	3.85	5.10
1970	3.84	5.77	6.01	5.70	— 1.94	— 2.12	— 1.87
			Large Manufacturing				
(1956)							
1964	12.48	4.90	6.86	4.38	7.58	5.62	8.10
1970	7.31	8.74	5.03	9.69	— 1.43	2.28	— 2.37
			Total Manufacturing				
(1956)							
1964	11.26	4.05	5.69	3.60	7.21	5.57	7.65
1970	7.11	8.57	5.10	9.47	— 1.45	2.01	— 2.36

Table 10 (Continued)

B. Averages of Peak-To-Peak Rates of Change with Mean Deviations

	Real Output	Factor Inputs			Productivity Ratios		
		Total	Labor	Capital	Total	Labor	Capital
			Small Manufacturing				
1956-70							
Rate	2.07	0.64	1.22	0.44	1.42	0.87	1.62
Ave. Dev.	1.77	5.13	4.79	5.26	3.35	2.98	3.48
			Large Manufacturing				
1956-70							
Rate	9.90	6.82	5.95	7.04	3.08	3.95	2.87
Ave. Dev.	2.58	1.92	0.91	2.65	4.50	1.67	5.23
			Total Manufacturing				
1956-70							
Rate	9.19	6.31	5.39	6.54	2.88	3.79	2.65
Ave. Dev.	2.07	2.26	0.30	2.94	4.33	1.78	5.00

Source: Computed from Tables A.2, A.3, and A. 4.

Table 11 — Manufacturing: Output, Inputs, and Productivity Ratios: Average Annual Percentage Rates of Change Between Cycle Averages, 1956-70

A. Change From Previous To Current Cycle Average

Cycle Years	Real Output	Factor Inputs			Productivity Ratios		
		Total	Labor	Capital	Total	Labor	Capital
(1956-64) to (1964-70)							
I. Small Mfg.	4.51	3.97	1.29	4.89	0.28	3.06	— 0.70
II. Large Mfg.	9.55	7.02	5.88	7.33	2.76	3.95	2.41
III. Total Mfg.	9.19	6.78	5.46	7.16	2.57	3.96	2.16

B. Averages of Rates of Change Between Small and Large Manufacturing with Mean Deviations, 1956-70

Period	Real Output	Factor Inputs			Productivity Ratios		
		Total	Labor	Capital	Total	Labor	Capital
(1956-64) to (1964-70)							
Rate	7.03	5.50	3.59	6.11	1.52	3.51	0.86
Ave. Dev.	2.52	1.53	2.29	1.22	1.24	0.45	1.56

Source: Computed from Tables A.2, A. 3, and A.4.

4. A Suggested Interpretation

To supplement the reported productivity measures, Table 12 reports the regression results of the equation which relates the rates of change in total factor productivity to the rates of change in real output in each sector. The results indicate that the two variables moved in the same direction in both sectors. For agriculture, the 1956-70 period has shown not only larger coefficients but also higher coefficients of determination and lower standard errors. The fitted relationship for the 1956-70 period in agriculture may be less spurious than that for the 1956-74 period because the former period contains most of the independent time-series data and thus a minimum of extrapolation; furthermore, it corresponds to the period considered for the manufacturing sector. Again, the similarity between the first and the variant measures of productivity (see specifications A and B in Table 12) is consistent with the previous results. Furthermore, all the coefficients are statistically significant at the customary levels. To the extent that there were errors in the output and input measures, it is therefore still possible to arrive at a spurious relationship after all the manipulations. On the other hand, cost-reducing forces such as human capital and other intangible inputs could have truly explained the observed movements in output and productivity. As noted earlier, a more stable rate of sectoral economic growth can be expected in the long run once the cost-reducing forces become gradually institutionalized; sectoral variability of output and productivity rates of change reflect the differential pace of institutionalization of human capital in the two sectors. To the extent that education contributed to these cost-reducing forces, it can in principle be tested directly by adjusting the labor input for educational attainment in the process of estimating productivity change. However, this was not done because time-series data for educational attainment were not available. Limited data have mainly caused our inability to evaluate the effect of education on sectoral growth via the productivity ratio approach.

Table 12 — Relationship Between Productivity Change and Output Change, 1956-74
(by sectors)

	Agriculture				Manufacturing		
	1956-70		1956-74		1956-70		
	A	B	A	B	Small	Large	Total
Constant	— 0.0189	— 0.0180	0.00083	0.00678	0.015	— 0.0712	— 0.0521
Output Change	0.760 (0.133)	0.923 (0.154)	0.465 (0.134)	0.552 (0.159)	0.217* (0.360)	1.054 (0.298)	0.919 (0.325)
R^2	0.73	0.75	0.43	0.43	0.03	0.51	0.40
S.E.	0.032	0.037	0.044	0.052	0.192	0.047	0.069

Notes: *Statistically not significant.
Figures in parentheses refer to standard errors.
Basic data taken from Tables A.1 to A.4.

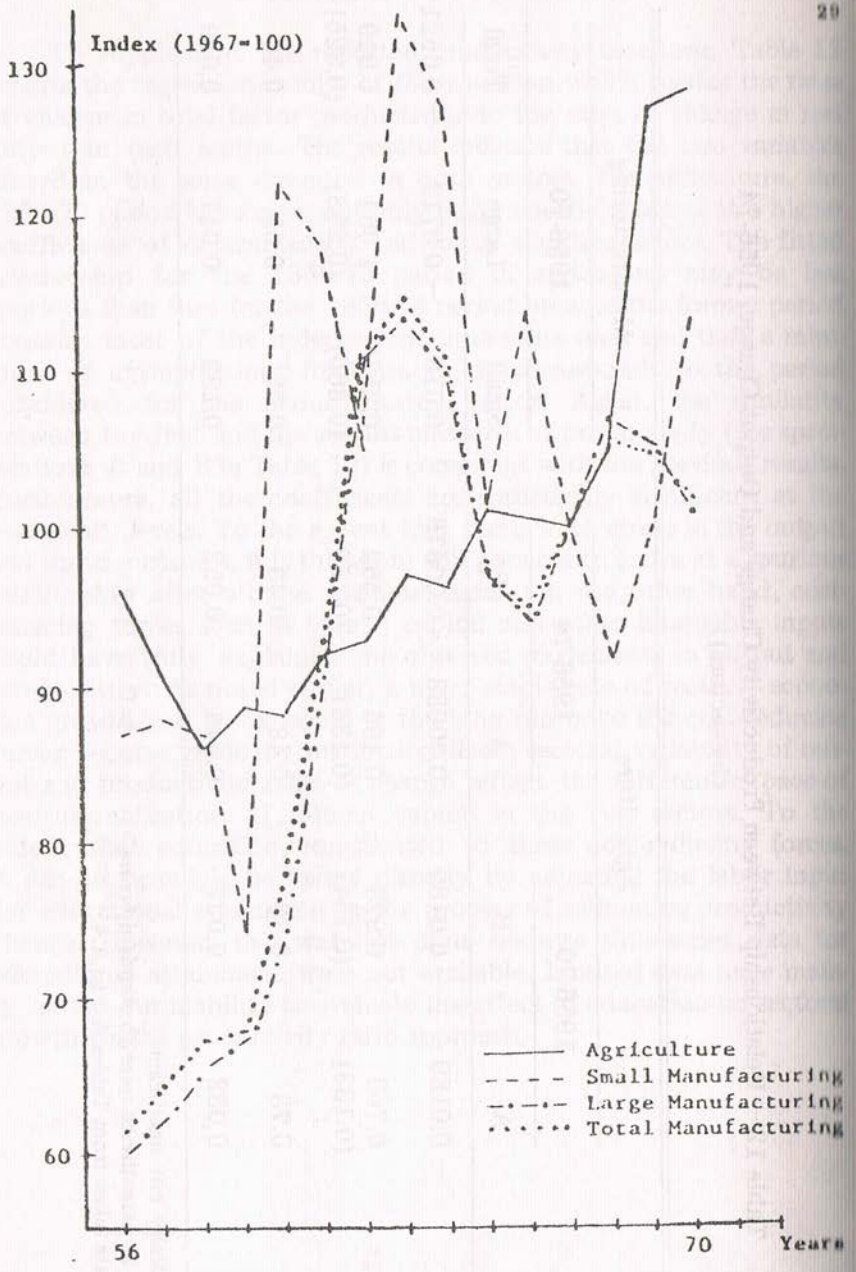

Figure 5 — Productivity in Agriculture and in Manufacturing, 1956-1970

Appendix

1. Agriculture[1]

The data for agricultural output are in terms of gross value of production of agricultural crops, livestock, and poultry. The main data source is the Bureau of Agricultural Economics (BAECON) of the Philippine Ministry of Agriculture.

Two types of land area are used as our input in agriculture: effective crop area and cultivated land area. For reasons of data availability, land input is limited to effective crop area. Two variants of land input are employed. First, land is treated as if it were a homogeneous input. Second, irrigated land is distinguished from non-irrigated land before making aggregate estimates of land values, to take quality change into account.

In estimating capital services in Philippines agriculture, the service flows of fixed capital and operating capital are measured. Agricultural machinery, equipment, and work animals comprise the fixed capital, while operating capital is composed of fertilizers, agricultural chemicals, feeds, seeds, and irrigation services.

The labor input is compiled from the May and October labor force series, published by the National Census and Statistics Office (NCSO), for the period 1956-1974. The May-October average multiplied by the average real hourly labor compensation is the labor input employed in this study. The average of the May-October data is used to avoid the possible bias of the May and October series since Philippine schools are out in May and October is close to the harvesting period when the seasonal peak demand for labor is expected.

NCSO data for agricultural labor force refer to the total of agriculture, hunting, fishing, and forestry. Since the output series refers only to agriculture, the labor force of hunting, fishing, and forestry is eliminated after calculating that the average ratio of

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[1] The methods and assumptions employed here to derive appropriate output and input estimates in Philippine agriculture for productivity comparisons draw heavily from the study of Tirso B. Paris, Jr. in his *Output, Inputs, and Productivity of Philippine Agriculture* (M.A. Thesis, University of the Philippines, 1971).

those employed in agriculture to the total persons employed in agriculture, hunting, fishing, and forestry is 91.1 per cent for the period 1963-1975.

Agricultural wages refer to the weighted daily average wage rates without meal as taken from *Farm Wages*, Bureau of Agricultural Economics. The data for crop year 1955-1956 are the average of the 1954-55 wage as estimated by Hicks and McNicoll, *Trade and Growth in the Philippines: An Open Dual Economy* (Cornell University Press, 1971), and the 1956-57 figure obtained by this study. Figures for 1973-74 and 1974-75 are extrapolated values. To impute wages in kind, wage data are multiplied by an adjustment factor of 1.28 which is adopted from the Hicks and McNicoll study.

Two series of labor input values are generated. First, agricultural labor in man-equivalent is estimated by assuming that the female worker's labor input is equivalent to 0.8 of the male worker's, and that those of ages 10-14 and 65 or older are equivalent to 0.6 of the adult male worker's. The resulting series of man-equivalent employed labor in agriculture is converted into man-days equivalent by applying the average number of days of work for male and female workers, respectively. Man-days equivalent labor is multiplied by the wage rate to obtain the value of man-days equivalent labor. The second series of agricultural labor value is in terms of man-hours. Labor values in man-hours are estimated by multiplying the male and female man-hours per week by 23 and 15 weeks, respectively, and then multiplying the resulting product by the hourly rate.

The generation of productivity ratios necessitates using weights — prices in this case — to arrive at homogeneous measures of output and inputs. Output- and input-specific price indices are employed in this study. Thus, rice and corn values are deflated by the retail price index for cereals; the retail price index for vegetables and fruits is used to deflate the current values of bananas, mangoes, citrus, root crops, vegetables, beans and peas, coffee, cacao, peanuts, and other fruit crops; the retail price index for meat is used to deflate the current values of livestock production; and the general wholesale price index for manufactured goods is employed to deflate the current value of gross output in manufacturing. From the input side, the implicit price index for gross capital formation on durable equipment is used to deflate the current value of agricultural equipment and machinery as well as manufacturing equipment; the wholesale price index of imported chemicals for the current value of agricultural chemicals; fertilizer price index for fertilizer, and the consumer price index for both agricultural and manufacturing wages.

Whichever output and input data are in crop year series, they are converted into calendar year series for comparability with the other data series used in the study.

Partial factor productivity ratios are calculated by dividing the output index series by the particular input index series. Consequently, total factor productivity ratios are calculated by dividing the output index numbers by the index numbers for total inputs. The index numbers shown in Table A.1 are the bases for most of the growth rate estimates around which most of the analysis in this paper revolves.

2. Manufacturing

Output and input data for manufacturing are taken and calculated from *Manufacturing Statistics of the Philippines: 1956-1970* (Tokyo: Institute of Developing Economies, 1974.) This volume compiles manufacturing data into two sub-aggregates: small manufacturing, referring to establishments employing 5 to 19 workers; and large manufacturing, referring to establishments employing 20 or more workers. Thus, total manufacturing refers to establishments employing 5 or more workers. Data for 1961 and 1967 are interpolated values since they are not given by the data source.

Manufacturing output refers to the value of gross output in manufacturing. The total book value of fixed assets comprises the manufacturing capital input for this study. The total number of paid employees for all manufacturing industries under small, large, and total manufacturing, is taken as the measure of the manufacturing labor force.

Partial and total productivity indices for small, large, and total manufacturing are presented in Tables A.2, A.3, and A.4, respectively. The growth rates of manufacturing output, inputs, and productivity discussed in this paper are calculated from these tables.

Table A.1 — Agriculture: Real Output, Inputs, and Productivity Ratios, Philippines: 1956-1974
(1967 = 100)

Year	Real Output	Man-hour Labor Input	Real Output Per Unit of Man-hour Labor Input	Man-days Labor Input	Real Output Per Unit of Man-days Labor Input	Land Input A	Real Output Per Unit of Land Input A
1956	67.4	75.4	89.5	78.6	85.8	65.7	102.7
1957	69.1	83.9	82.3	83.9	82.3	68.3	101.2
1958	67.3	89.3	75.4	88.6	76.0	64.3	104.7
1959	73.2	92.7	78.9	90.6	80.8	69.8	104.8
1960	71.4	88.0	81.1	87.3	81.8	72.0	99.2
1961	77.8	91.4	85.2	90.3	86.2	76.3	102.0
1962	81.2	92.6	87.7	91.1	89.1	81.7	99.3
1963	82.2	88.9	92.4	88.6	92.7	81.9	100.3
1964	80.9	85.5	94.6	83.4	97.0	81.6	99.1
1965	91.3	91.5	99.7	86.6	105.4	88.0	103.7
1966	97.8	102.2	95.7	96.2	101.6	92.8	105.3
1967	100.0	100.0	100.0	100.0	100.0	100.0	100.0
1968	107.2	94.5	113.4	90.7	118.2	110.4	97.0
1969	134.5	83.9	160.3	83.6	160.9	137.4	97.9
1970	139.4	85.0	164.1	81.7	170.6	144.1	96.7
1971	138.9	79.3	175.1	75.4	184.2	144.1	96.4
1972	137.2	89.3	153.7	85.1	161.3	144.5	95.0
1973	139.5	83.8	166.6	81.2	171.8	145.3	96.0
1974	118.3	64.7	183.0	61.1	193.7	115.1	102.8

Table A.1 (Continued)

Year	Land Input B	Real Output Per Unit of Land Input B	Capital Input	Real Output Per Unit of Capital Input	Total Factor Input A	Total Factor Productivity A
1956	66.3	101.8	60.1	112.1	70.2	96.0
1957	62.9	109.9	65.1	106.2	76.4	90.4
1958	60.9	110.6	66.1	101.9	78.2	86.0
1959	72.8	100.6	71.2	102.8	82.6	88.6
1960	73.0	97.8	73.0	97.8	80.9	88.2
1961	79.6	97.8	75.5	103.0	84.5	92.1
1962	89.7	90.5	81.1	100.0	87.6	92.7
1963	91.3	90.0	73.8	111.2	84.7	97.0
1964	87.4	92.6	83.5	96.9	84.0	96.3
1965	96.1	95.0	89.4	102.1	90.1	101.3
1966	93.9	104.1	87.2	112.2	97.2	100.6
1967	100.0	100.0	100.0	100.0	100.0	100.0
1968	110.6	96.9	112.1	95.6	101.9	105.1
1969	121.5	110.7	121.8	110.5	106.0	127.0
1970	141.3	98.7	123.2	113.1	108.9	128.1
1971	149.8	92.8	135.1	102.8	107.4	129.4
1972	142.5	96.3	139.1	98.6	113.5	120.9
1973	136.1	102.5	148.8	93.7	112.0	124.6
1974	109.2	108.4	160.2	73.9	93.5	126.6

Table A.1 (Continued)

Year	Total Factor Input B	Total Factor Productivity B	Total Factor Input C	Total Factor Productivity C	Total Factor Input D	Total Factor Productivity D
1956	73.6	91.6	73.1	92.3	70.7	95.4
1957	76.9	89.9	77.6	89.0	75.4	91.6
1958	79.6	84.5	79.6	84.5	78.1	86.1
1959	84.2	86.9	82.9	88.3	84.2	87.0
1960	82.4	86.7	81.6	87.5	81.8	87.3
1961	86.1	90.4	84.9	91.7	85.9	90.6
1962	89.6	90.6	87.5	92.8	90.1	90.0
1963	87.5	93.9	85.2	96.5	87.4	94.0
1964	84.3	95.9	83.0	97.5	85.7	94.4
1965	89.1	102.4	87.3	104.5	92.5	98.7
1966	94.6	103.3	94.3	103.7	97.8	100.0
1967	100.0	100.0	100.0	100.0	100.0	100.0
1968	97.8	109.6	98.3	109.0	101.4	105.6
1969	96.8	139.0	102.2	131.6	99.7	135.0
1970	100.2	139.1	103.0	135.4	105.9	131.6
1971	99.5	139.7	100.4	138.4	106.7	130.3
1972	104.6	131.2	106.9	128.3	111.0	123.6
1973	101.8	137.1	105.9	131.8	107.4	129.9
1974	83.8	141.2	86.6	136.7	90.5	130.7

Notes: See text for the calculation of this table. Land Input A refers to total effective crop area; Land Input B refers to total effective crop area adjusted for irrigated and non-irrigated land areas.

Table A.2 — Small Manufacturing: Real Output, Inputs, and Productivity Ratios, Philippines, 1956-1970 (1967 = 100)

Year	Real Output	Labor Input	Real Output Per Unit of Labor Input	Capital Input	Real Output Per Unit of Capital Input	Total Factor Input	Total Factor Productivity
1956	78.4	105.9	74.1	85.9	91.3	90.3	86.9
1957	66.2	93.2	71.0	70.4	94.0	75.4	87.8
1958	73.7	96.1	76.7	81.9	90.0	84.9	86.8
1959	71.2	110.5	64.5	92.2	77.2	96.2	74.1
1960	76.4	89.7	85.1	54.9	139.0	62.5	122.2
1961	67.7	81.7	82.8	50.4	134.4	57.2	118.4
1962	54.7	72.6	75.3	46.3	118.3	52.0	105.2
1963	67.0	79.3	84.4	42.2	158.8	50.3	133.3
1964	80.3	79.6	100.8	58.4	137.3	63.1	127.3
1965	75.7	83.3	90.9	72.1	105.0	74.5	101.6
1966	82.6	83.0	99.5	69.7	118.6	72.6	113.8
1967	100.0	100.0	100.0	100.0	100.0	100.0	100.0
1968	121.3	118.9	102.0	136.1	89.1	132.4	91.6
1969	117.0	109.5	106.9	119.3	98.1	117.1	99.9
1970	101.0	113.8	88.7	82.3	122.7	89.2	113.3

Note: See text for the generation of this table.

Table A.3 — Large Manufacturing: Real Output, Inputs, and Productivity Ratios, Philippines, 1956-1970 (1967 = 100)

Year	Real Output	Labor Input	Real Output Per Unit of Labor Input	Capital Input	Real Output Per Unit of Capital Input	Total Factor Input	Total Factor Productivity
1956	29.5	47.6	62.1	49.7	59.4	49.3	59.9
1957	34.2	54.1	63.1	55.1	62.0	54.9	62.2
1958	39.4	56.4	69.8	61.1	64.4	60.2	65.4
1959	42.3	63.3	66.8	62.7	67.5	62.8	67.4
1960	46.5	66.5	69.9	61.0	76.2	62.1	74.9
1961	54.0	70.2	76.9	56.5	95.7	59.3	91.1
1962	62.8	74.2	84.7	52.3	120.1	56.7	110.9
1963	75.4	79.6	94.8	63.3	119.1	66.6	113.3
1964	80.2	82.4	97.3	70.6	113.5	73.0	109.8
1965	78.9	88.6	89.1	79.8	98.9	81.6	96.7
1966	85.7	93.3	91.9	91.1	94.1	91.5	93.7
1967	100.0	100.0	100.0	100.0	100.0	100.0	100.0
1968	116.6	107.2	108.8	109.8	106.2	109.2	106.8
1969	119.3	114.0	104.7	113.4	105.2	113.5	105.1
1970	124.3	111.4	111.6	126.3	98.4	123.3	100.8

Note: See text for the generation of this table.

Table A.4 — Total Manufacturing: Real Output, Inputs and Productivity Ratios, Philippines, 1956-1970
(1967 = 100)

Year	Real Output	Labor Input	Real Output Per Unit of Labor Input	Capital Input	Real Output Per Unit of Capital Input	Total Factor Input	Total Factor Productivity
1956	32.6	52.1	62.5	52.3	62.3	52.3	62.3
1957	36.1	57.1	63.2	56.2	64.3	56.4	64.1
1958	41.5	59.5	69.8	62.6	66.3	62.0	67.0
1959	44.1	67.0	65.8	64.8	68.1	65.2	67.6
1960	48.3	68.3	70.8	60.1	79.8	62.1	77.8
1961	54.9	71.1	77.2	55.8	97.9	59.1	92.8
1962	62.3	74.1	84.2	51.9	120.1	56.3	110.6
1963	74.9	79.6	94.1	61.8	121.1	65.4	114.5
1964	80.2	82.2	97.6	69.8	114.9	72.3	110.9
1965	78.7	88.2	89.3	79.3	99.3	81.0	97.1
1966	85.5	92.5	92.4	89.6	95.5	90.2	94.9
1967	100.0	100.0	100.0	100.0	100.0	100.0	100.0
1968	116.9	108.1	108.2	111.6	104.7	110.9	105.4
1969	119.2	113.6	104.9	113.8	104.7	113.8	104.7
1970	122.8	111.6	110.1	123.2	99.7	120.8	101.7

Note: See text for the generation of this table.

REFERENCES

Crisostomo, Cristina (1972), *Sources of Output and Productivity Growth in the Postwar Philippine Agriculture*, M.A. Thesis, University of the Philippines.

Crisostomo, Cristina and Barker, Randolph (First Semester, 1972), "Growth Rates of Philippine Agriculture, 1948-1969," *Philippine Economic Journal*, No. 21: 88-148.

Denison, Edward (May 1972), "Some Major Issues in Productivity Analysis: An Examination of Estimates by Jorgenson and Griliches," *Survey of Current Business*, 52: 5, Part II: 37-63.

Institute of Developing Economies (1974), *Manufacturing Statistics of the Philippines: 1956-1970*, Tokyo: Asian Economic Press.

Jorgenson, Dale and Griliches, Zvi (July 1967), "The Explanation of Productivity Change," *Review of Economic Studies*, 34: 3: 249-282.

Kendrick, John (1973), *Postwar Productivity Trends in the United States, 1948-1969*, New York: National Bureau of Economic Research.

Paris, Tirso (July 1971), "Outputs, Inputs, and Productivity of Philippine Agriculture, 1948-1967," *Journal of Agricultural Economics and Development*, I: 2.

Republic of the Philippines (1956), *BCS Survey of Households Bulletin*, Manila: Bureau of the Census and Statistics.

Trinidad, Levy (Second Semester, 1964), "Private Capital Formation in Agriculture," *Philippine Economic* Journal, III: 2: 130-154.