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THE ELECTRICITY-BASED MEASURE OF CAPITAL UTILIZATION IN PHILIPPINE MANUFACTURING INDUSTRIES: ESTIMATION AND ANALYSIS

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THE ELECTRICITY-BASED MEASURE OF CAPITAL UTILIZATION IN PHILIPPINE MANUFACTURING INDUSTRIES: ESTIMATION AND ANALYSIS

Romeo M. Bautista*

I. Introduction

What may be called simply the "electricity measure" of capital utilization represents a frequently used approximation of the proportion of time that installed machinery and equipment are in operation by the relative extent of electric motor use. It requires data on actual consumption of electric energy and the rated capacity of installed electric motors with appropriate adjustment relating to the conversion of electrical into mechanical power. Murray Foss /6/ first applied this measure to the U.S. economy for the years 1929, 1939 and 1954 in his comparison of prewar and postwar capital utilization. The same method was used subsequently, among others, by Jorgenson and Griliches /7/ for U.S. manufacturing in 1954 and 1962, and by Kim and Kwon /8/ for South Korean industries over the period 1962-1971.

The chief virtue of the electricity measure is the relative ease with which one can obtain the required data for the estimation of the capital utilization rate. Information on electric energy consumption and installed electric motor capacity is generally available with industrial breakdown from published sources reporting the results of periodically conducted manufacturing censuses or even annual surveys. In the Philippines the two postwar censuses of

manufactures undertaken in 1961 and 1967 provide the necessary data up to the 4-digit ISIC (old) level of disaggregation. Such information, however, are not solicited in the annual survey of manufactures (ASM). If it can be shown that the electricity measure does proxy reasonably well for the time-intensity utilization of installed machinery and equipment, then a strong case might be made for the ASM to provide supplementary electricity data (entailing very low additional cost) and become an annual source of information on industrial capital utilization in the Philippines.[1]

One major objective of the present study is to determine whether the electricity measure could be linked with the time-intensity estimates of industrial capital utilization derived from our original survey interviews with 400 manufacturing firms. In Section II of this paper we discuss the procedure used in deriving the electricity-based estimates, presenting the computed values jointly with the survey estimates for purposes of firm-by-firm and industry-by-industry comparisons. As it is widely assumed /5/ that the electricity measure reflects temporal changes in the capital utilization rate (CUR), Section III examines the pattern of electricity-based estimates for Philippine manufacturing industries in 1961 and 1967 derived from economic census data. The findings of the present study are summarized and some recommendations for the improvement of needed statistical data are given in the final section.

II. Derivation of the Electricity Measure from 1972 Survey Data

We shall follow closely the established method of computing the utilization rate of installed electric motors by comparing the amount of electric energy actually consumed with the maximum amount, i.e. with continuous operation of the electric motors, for any given year. The electricity measure is commonly represented by the following formula:[2]

$$U_{it}^{m} = \frac{E_{it}^{m} \times 100}{C_{it} \times 8760 \div 0.90}$$

where

U_{it}^{m} = electric motor utilization rate in plant (industry) i in year t, in per cent

E_{it}^{m} = amount of electric energy consumed by electric motors in plant (industry) in year t, in kilowatt-hours

C_{it}^{m} = rated capacity of electric motors in plant (industry) i in year t, in kilowatts

8760 is the number of hours in one year and 0.90 is the efficiency of electric motors on the assumption that 10 per cent of the electric energy input is dissipated in the form of heat.

The rationale for using this measure as proxy to the proportion of time worked by machinery and equipment "is that electricity is the dominant source of energy in modern manufacturing; and to learn how intensively the electric motors are worked is to know how intensively the machinery driven by the

electric motors is operated" [8, p. 7]. It would seem an empirical matter to test whether such premise is valid, however.

Our source of information in the derivation of the electricity measure at the establishment level is our own mailed questionnaire survey[3] which supplemented the earlier interviews with plant managers for the determination of the CUR measure based on time and intensity of capital use. Of the 400 "large establishments" (employing 20 or more workers) to which the supplementary survey questionnaire was sent, only 271 replied -- from which in turn 209 replies were found usable.[4] None of the latter provided a breakdown of electricity consumption into electric motor use and others, i.e., only the last line of the questionnaire form (cf. Appendix A) was fully answered.

Our survey data consist therefore of the rated capacity of electric motors[5] and actual consumption by the entire plant of electric energy (purchased and self-generated). To obtain the amount consumed by electric motors alone, we used the estimates given by Foss [6, p. 11] and Kim and Kwon [8, p. 10] of the percentage of total electricity consumption contributed by motors among the different industries.[6]

Table 1 presents the computed values of the electric motor utilization rate U^m by establishments, arranged according to their 3-digit ISIC categories. Also shown in the table are the corresponding CUR estimates obtained from the original survey, and average U^m and CUR values for each 3-digit industry. The industrial CUR values derived from these subsets of the

TABLE 1

Comparison of electric motor utilization rate with time-intensity CUR, 1972

ISIC No.	Electric Motor utilization rate (per cent)			Time-intensity utilization rate (per cent)		
311	9.94	18.32	2.39	26.90	61.44	6.96
exc. 3118)	23.47	30.18	20.16	58.81	95.20	85.29
	10.69	3.19	16.00*	18.74	17.45	7.85*
ood manufactures	21.00	31.61	18.72	76.54	95.07	35.62
except sugar and	16.13	32.58	29.60	42.62	52.60	54.79
misc. foods)	27.39*	6.38	30.70	27.85*	17.02	48.95
	14.90	26.73		27.58	43.55	
		Average: 19.53			Average: 45.04	
3118	18.54	12.29	16.44	40.98	30.41	53.15
	21.99	12.58	16.23	52.88	45.30	51.82
ugar	47.67	19.22	20.04	59.18	65.94	81.58
	27.36	37.29	24.86	51.38	60.99	57.72
	23.80	17.54	14.01	56.07	35.07	25.75
	14.45	10.15		42.15	39.43	
		Average: 20.85			Average: 49.99	
312	10.14	21.81	7.32	26.80	58.22	46.31
	26.22	8.82	34.36	67.85	47.77	68.49
Other foods	13.90*	11.73	15.01	9.41*	58.32	86.03
	7.73			17.61		
		Average: 15.70			Average: 48.68	
313	11.12	13.45	25.72	20.55	27.67	59.91
	13.55	17.85	21.77	26.57	38.93	28.40
Beverages	10.30*	14.31	16.53	9.64*	22.37	24.63
	3.47	8.14	18.19	13.61	19.91	49.24
		Average: 14.53			Average: 28.45	

Table 1. Comparison of electric motor ....

314	17.63	5.93	12.00	57.17	28.19	28.62
	12.79	10.20	9.75	24.75	26.00	33.81
Tobacco manufactures	12.73	4.91	7.32	35.80	13.35	21.60
	4.73	7.59	6.31	19.80	27.39	20.76
		Average: 9.32			Average: 28.10	
321	50.27	23.46	37.31	92.05	44.85	97.26
	41.44	30.06	33.57	80.55	80.64	80.63
Textiles	28.60	21.69	34.36	78.36	46.94	64.09
	14.14*	22.82	6.80	14.06	85.94	22.85
	18.18	15.78		65.75	40.56	
		Average: 27.03			Average: 63.90	
322	8.06	22.31	11.21	22.06	49.63	13.93
Wearing apparel	30.14			79.54		
		Average: 17.93			Average: 41.29	
323	39.3	5.17	2.54	31.50	13.79	27.57
Leather & leather products						
		Average: 3.88			Average: 24.29	
324	7.30	10.17	9.32*	15.79	24.02	8.55*
Footwear						
		Average: 8.93			Average: 16.12	
331	33.43	18.34	40.78	73.91	55.62	83.11
	6.17	28.07	8.21	16.82	36.83	18.10
Wood & wood products	18.00	19.11	10.36	27.10	69.73	28.40
	8.95	15.03	13.78	20.02	68.19	27.51
		Average: 18.35			Average: 43.78	
332	8.67	8.56	8.28	34.71	29.34	28.12
Furniture & Fixtures	6.78			35.04		
		Average: 8.07			Average: 31.80	

able 1. Comparison of electric motor .....

341	33.81	4.36	3.82	97.81	55.16	20.08
Paper & paper products	12.44	13.63	3.31	71.26	49.12	20.41
		Average: 11.90			Average: 50.31	
342	6.10	17.90	15.37	41.74	69.19	45.75
Printing & publishing	2.06	17.02	7.35	24.65	45.77	16.85
	9.65	9.59		24.40	65.51	
		Average: 10.63			Average: 41.73	
351	12.24	32.93	34.56	73.09	86.16	83.56
Basic chemicals	8.23	17.53	7.87	57.26	51.65	38.72
	2.89	19.65	18.68	32.49	24.90	95.37
		Average: 17.18			Average: 60.36	
352	13.48	9.90	3.12	28.09	28.12	18.91
	5.39	9.79	3.78	32.31	22.38	21.90
Other chemicals	17.51	30.75	29.13	82.03	80.11	42.24
	10.02	12.53	6.13	65.46	25.29	22.83
	13.21	9.26	5.76	28.77	25.69	19.95
	6.87	8.99	7.98	27.48	28.58	25.30
		Average: 11.31			Average: 34.75	
355	27.93	10.88	5.75	85.85	73.23	24.58
Rubber products	15.21	11.17	8.43	54.75	42.99	14.21
	17.04			46.43		
		Average: 13.77			Average: 49.29	
356	18.64	3.02	12.16	39.32	32.22	44.48
Plastic products						
		Average: 11.27			Average: 38.67	
361	22.71	27.63	7.07	35.51	53.78	27.75
Pottery, etc.						
		Average: 19.14			Average: 39.01	

Table 1. Comparison of electric motor .....

362 Glass & glass products	8.03	12.16	16.07	30.50	48.42	67.72
		Average: 12.09			Average: 48.88	
369 Other non-metallic mineral products	6.93	10.31	48.26	26.15	28.30	88.13
	5.53	8.82	40.14	17.68	54.70	85.67
	17.58	30.57	38.17	42.07	92.70	91.78
	27.35			89.26		
		Average: 23.37			Average: 61.64	
371 Iron and steel	11.74	8.12	8.16	80.90	53.62	60.97
	6.55	7.86		42.57	27.04	
		Average: 8.49			Average: 53.02	
381 Other metal products	5.58	8.33	18.55*	27.21	27.39	14.07*
	13.81	20.50	5.97	33.56	62.47	14.67
	11.99	17.99	25.18	26.49	27.21	81.37
	14.45	20.61		33.98	38.57	
		Average: 14.81			Average: 35.18	
382 Machinery	3.68	9.92	7.91	22.14	29.95	27.67
		Average: 7.17			Average: 26.59	
383 Electrical machinery	5.30	3.06	9.31	14.87	13.34	38.18
	8.14	11.71	15.03	18.78	24.57	46.36
	19.65			64.11		
		Average: 10.31			Average: 31.46	
384 Transport equipment	10.80	11.81	9.33	19.37	25.58	27.67
	7.14	8.33		26.02	27.48	
		Average: 9.48			Average: 25.22	
		All manufacturing: 13.80			All manufacturing: 40.70	

establishments turn out to be very close to the actual values observed for each industry from the original random sample of 400 firms.[7] It seems safe to assume therefore, that the electric motor utilization rates shown in Table 1 are representative values across 3-digit industries. There are 25 industries which are included in the table; the missing ones, viz., ISIC 353, 372, 385, and 390, are not represented by at least three firms responding to the survey on electricity data.

The first observation to make is that the computed utilization rates of electric motors generally understate the time-intensity utilization of installed machinery and equipment. The difference between the two values is quite significant in most cases, as is evident from a visual comparison of the industria averages. Only 7 of the 209 responding establishments show a higher U^m than the CUR, and they are noticeably operating at relatively lower utilization levels.[8]

Two reasons may be cited for any observed divergence of electric motor utilization from the extent of actual capital use. One is the existence of other primemovers in the plant which are being operated more or less intensively than the installed electric motors. In sugar mills, for instance, heavy machineries like the cane crushers and rollers are usually being driven by steam engines and turbines rather than by electric motors. Another reason is that some manufacturing plants have major pieces of equipment which

require for their operation direct heat input rather than mechanical or electrical energy. The burning section (kiln) in cement manufacture, furnaces in the metal industries and ovens in food manufacturing are examples of such equipment the operation of which is not governed by the actual use of electric motors in the plant.

Since industries vary in the relative significance of electric motor use vis-a-vis other primemovers and direct heat-using equipment, there will exist industrial differences in the relationship between the electricity and time-intensity measures of capital utilization. Having observed from Table 1 that U^m is generally lower than CUR, one could make the inference that equipment and machinery not coupled to electric motors are being operated a greater proportion of the time in Philippine manufacturing. As is to be expected, however, the discrepancies vary across industries, and to a lesser extent across firms under the same 3-digit industry.

From the last line of Table 1 the utilization rate of electric motors is seen to be nearly three times that of installed machinery and equipment in "all manufacturing". If something similar holds true in South Korea and the United States, then the interpretation and use of the electricity measure to represent the level of capital utilization as done in the studies cited earlier are inappropriate. However, its usefulness in representing temporal changes in the extent of capital use in specific industries is not necessarily invalidated.

That the industrial pattern of capital utilization is also not reflected fully in the interindustry variation in electric motor utilization rates seems clear from Table 1. Thus, looking at the industry averages, one finds ISIC 371 (Iron and steel) and 341 (Paper and paper products) to have the fourth and fifth highest CUR, respectively, among the 25 3-digit industries entered but which are placed close to the bottom end of the U^m spectrum. More generally, the Spearman rank correlation between U^m and CUR is computed to be .483, indicating no marked correlation. Industries with relatively low ratios (from 1.8 to 2.3) of CUR to U^m are ISIC 324 (Footwear), 313 (Beverages), 361 (Pottery, etc.) and 322 (Wearing apparel), while those showing relatively high values (from 4.6 to 6.3) are ISIC 323 (Leather and leather products), 371 (Iron and Steel), 341 (Paper and paper products) and 362 (Glass and glass products).

Our primary interest is in establishing, if at all possible, a link between the electricity and time-intensity measures of capital utilization. We use here the standard least squares method to correlate paired observations on the sampled establishments of the electric motor utilization rate and time-intensity CUR as listed in Table 1. A priori considerations mentioned earlier and the above observation of industrial differences within manufacturing in the relationship between the utilization rates of electric motors and installed capital suggest the adoption of as detailed a sectoral breakdown as possible. The industrial distribution of the responding firms allows the estimation of

the empirical relationship between the two measures for the 2-digit categories and also for some more disaggregative industries. The results of the regressions are given in Table 2.

It is evident from the table that there exists a strong correlation between electric motor utilization rate and time-intensity CUR among establishments in the same 2-digit industry group. The values of the t-statistic indicate significance of the regression coefficients at the 5 per cent level, except in the regression for ISIC 37 which involves only five observations. Likewise the results for the finer industry categories considered imply statistical significance of the correlation. The low explanatory power of the regression for certain industries (e.g. ISIC 3118 and 35) is presumably due to the neglect of the other influences on CUR touched upon earlier. As a final remark on the content of Table 2, the differing values of the regression coefficients and test statistics across industries serve to confirm the earlier observation of heterogeneity within the manufacturing sector in the relationship between the electricity and time-intensity measures of capital utilization.

Several things need to be pointed out concerning the possible use of the estimated equations as a means of linking the utilization of electric motors to the extent of industrial capital use. First, these equations are based on a relatively small proportion of manufacturing establishments operating in 1972 (about 10 per cent). Although this is not saying that

TABLE 2

Estimated Equations from Regressions of Time-Intensity CUR on Electric Motor Utilization

Industry	No. of plants	Equations	t-value of regression coefficiant	correlative coefficient
ISIC 31	71	$CUR = 14.79 + 1.570\ U^m$	7.21	.656
32	24	$CUR = 9.66 + 1.811\ U^m$	6.44	.809
33	16	$CUR = 14.95 + 1.637\ U^m$	4.57	.774
34	14	$CUR = 21.34 + 2.231\ U^m$	4.27	.777
35	37	$CUR = 25.09 + 1.430\ U^m$	3.66	.525
36	16	$CUR = 20.88 + 1.668\ U^m$	5.67	.834
37	5	$CUR = 17.50 + 8.310\ U^m$	2.29	.798
38	26	$CUR = 6.99 + 2.076\ U^m$	5.37	.739
ISIC 311	20	$CUR = 6.66 + 1.965\ U^m$	3.97	.684
3118	17	$CUR = 35.44 + .698\ U^m$	2.14	.484
312,313,314	34	$CUR = 11.20 + 1.771\ U^m$	4.74	.642
321	14	$CUR = 15.77 + 1.780\ U^m$	4.71	.806
331	12	$CUR = 11.42 + 1.763\ U^m$	3.81	.770

the data used are unrepresentative of the industry groups considered, one has to exercise caution in interpreting the results from a small information base. It should also be noted that the estimated equations have been derived from cross-section data for one particular year. Their validity for temporal analysis of industry aggregates would depend on whether such intra-industry relationships are stable over time. Lastly, we have used only the simplest of possible specifications in (a) assuming a linear form of the regression and (b) abstracting from factors affecting the time-intensity of capital utilization other than the rate of electric motor use.

The foregoing qualifications would best be accommodated in future detailed studies of individual industries that will place quantitative relationship between the two measures of capital utilization in the context of the evolving technological characteristics of each industry over time. Until such in-depth studies are actually undertaken, however, we think that our present findings provide a reasonably sound basis for transforming the relatively easily available electricity data into a meaningful measure of industrial capital use.

III. Electric Motor Utilization Rates from Census Data, 1961 and 1967

The examination of possible changes in industrial capital utilization in the Philippines over the postwar period should be of considerable interest in view of the divergent forms of economic policy adopted which intimately

affected the manufacturing sector. Power and Sicat, for example, are of the opinion that the lifting of import and exchange controls in the early 1960s "permitted a fuller utilization of resources" /10, p. 57/ which accompanied the improvement in resource allocation.[9] As reflected in the studies of Lampman /9/ and Williamson /11/, however, there has been little recognition of the possibilities of greater utilization of existing capital as a source of output growth in the manufacturing sector.

The electricity measure provides a relatively inexpensive means of representing the time pattern of industrial capital utilization, availability of the necessary data allowing one to derive electric motor utilization rates for the economic census years 1961 and 1967. This is attempted in the present section together with a comparison with the 1972 estimates derived in Section II; however, as will be made clear below, the poor quality of the published data renders the results of any such attempt highly tentative. Our objective here is in large part to provide an assessment of the reliability of available electricity data for use in the temporal analysis of capital utilization in Philippine manufacturing industries, which in turn will serve as point of departure for the subsequent discussion of the improvement of statistical data gathering and publication.

Roughly 80 per cent of the 4,085 manufacturing establishments classified in the 1961 economic census as "large" (employing ten or more

workers) have reported electricity data, the proportion varying significantly across 4-digit ISIC industries. The amount of electric energy consumed is provided, "obtained by deducting the quantity sold from the sum of the quantity purchased and generated by each reporting establishment" [3, p. 2213]. Data on electric motors consist of the number of units and total rated horsepower. To obtain the electricity consumption of electric motors alone, we followed the method used earlier on our survey data, adopting the estimates given in [6] or [7] of the percentage of total electricity consumption due to the operation of electric motors.

The Economic Census of 1967 [4] provides the same set of relevant data as the 1963 Census, except that the amount of purchased electricity rather than total electricity consumption is reported.[10] In the absence of more recent information, we made the necessary adjustment using the 1961 ratio of total electric energy consumed to the amount purchased by each 4-digit industry.

Computations were made initially at the 4-digit level, the results revealing some absurd values. Specifically, the following industries showed values of the computed electric motor utilization rate greater than 100 per cent: ISIC 3114, 3117, 3119, 3233, 3513, 3720, 3812, 3844 and 3849 -- nine altogether using 1961 data; and ISIC 3114, 3117, 3121, 3140, 3233, 3320, 3513, 3523, 3812, 3832, 3841 and 3844 -- a total of twelve industries

on 1967 data.[11] On the basis of this observation alone, one can already say that inaccuracy in the reported data prevailed to a significant degree in both censuses, at least among the above-mentioned 4-digit industries.

We made a further assumption that the Census data are unrealiable in other industries where the computed electric motor utilization rate is more than three times that estimated for corresponding industries from our survey data for 1972. This is of course an arbitrary assumption, but it seems rather inconceivable that utilization rates will triple in any 4-digit industry from 1961 to 1972. For comparison the phenomenal growth of South Korean manufacturing output over the period 1962-1971 has been accompanied by only a doubling of electric motor utilization rate /8/.

What we have done is discard the data that are patently of questionable reliability. From the pre-screened set of electric motor utilization rates at the 4-digit level, averages for 3-digit industries were obtained using value of fixed assets as weight. The results are presented in Table 3 for the two census years. Immediately apparent is the significant change in utilization levels that seem to have taken place in several industries from 1961 to 1967. For the manufacturing sector as a whole, however, the observed change in electric motor utilization rate is quite small (cf. last line of Table 3).

Among the 3-digit industries showing increased utilization, ISIC 313 (Beverages), 321 (Textiles), 351 (Basic Chemicals) and 362 (Glass and

TABLE 3

Computed Electric Motor Utilization Rates from Census Data, in per cent

ISIC No.	Name of Industry	1961	1967
311-312 (exc. 3118)	Food manufactures except sugar	24.0	26.7
3118	Sugar	25.2	31.8
313	Beverages	28.6	38.6
314	Tobacco manufactures	12.6	*
321	Textiles	27.1	41.1
322	Wearing apparel	19.1	9.3
323	Leather and leather products	7.4	5.3
324	Footwear	8.3	5.0
331	Wood and wood products	26.0	15.2
332	Furniture and fixtures	28.6	*
341	Paper and paper products	52.4	39.4
342	Printing and publishing	14.2	13.0
351	Basic chemicals	17.5	28.0
352	Other chemicals	11.6	7.8
353	Petroleum refineries	14.3	13.7
355	Rubber products	23.2	21.8
356	Plastic products	16.2	10.5
361	Pottery, etc.	13.2	13.8
362	Glass and glass products	27.1	35.9
369	Other non-metallic mineral products	14.2	18.0
371	Iron and steel	15.9	18.7
372	Non-ferrous metal	*	11.1
381	Other metal products	17.3	20.6
382	Machinery	11.8	13.9
383	Electrical machinery	18.9	19.6
384	Transport equipment	11.3	9.9
385	Professional and scientific equipment	18.7	10.5
390	Other manufacturing	10.5	9.6
	All manufacturing	19.1	18.8

*Census data deemed unreliable

glass products) have had the most significant gains. On the other hand, the following industries appear to have suffered most from increased underutilization: ISIC 341 (Paper and paper products), 331 (Wood and wood products) and 322 (Wearing apparel). There are quite a few industries that show little change in electric motor utilization rates from 1961 to 1967; some examples are ISIC 353 (Petroleum), 361 (Pottery, etc.), 383 (Transport equipment) and 390 (Other manufacturing), in each of which the utilization rate has changed by less than one percentage point.

In comparison with the findings of our survey on electricity data for 1972 as presented in the preceding section, the utilization rates computed from the 1961 and 1967 Census data are seen to be substantially higher in certain industries as well as in the overall. The food, paper, rubber, glass and metal industries are some important examples. In a few industries, however, the utilization rates in 1972 are roughly equal to, if not actually higher than, those computed for 1961 and 1967.

In view of the likelihood that the three sets of utilization rate estimates are not strictly comparable for reasons indicated earlier,[12] the foregoing discussion of temporal changes in electric motor utilization in Philippine manufacturing industries has been confined to an examination of observed values for the three years. While we have provided earlier an empirical relationship between the electricity and time-intensity measures

of capital utilization, to attempt an explanation of the varying industrial pattern over time of capital utilization in the Philippines on the basis of the results presented above would run the risk of being presumptuous, considering the deficiencies of some of the basic data used.[13] It suffices to state here our inference that the manufacturing sector has not availed of the opportunities offered by increased utilization of installed machinery and equipment as a source of output growth. If anything, the utilization estimates provided in this section indicates an appreciably greater underutilization of existing capital in 1972 compared to the earlier years 1961 and 1967. Further work seems warranted that will improve the data base for the investigation of past changes in industrial capital utilization in the Philippines beyond what we have done in the present study.

IV. Summary and Concluding Remarks

There are many difficulties, mostly data-related, that have attended the effort in the present study to link the electricity and time-intensity measures of capital utilization in Philippine manufacturing industries. Such difficulties pale in significance, however, to the need to convert easily obtainable electric motor utilization rates into measures that can be used directly in evaluating the economic cost of existing capital underutilization and the benefits to be gained from higher utilization rates. Although admittedly of a preliminary nature which future work of a kind indicated above could improve on, our

empirical results, based on survey data for 1972, give quantitative expression to the relationship between the two measures of capital utilization for the 2-digit ISIC industries and a few finer industry categories.

Our estimates of electric motor utilization rates at the 3-digit level reveal a generally substantial understatement of the actual utilization of installed machinery and equipment, the latter being about three times the former on the average. To the extent that such discrepancies are present, previous studies in other countries that made use of the electricity measure as proxy for the level of capital utilization have misinterpreted their data. The error, however, does not necessarily extend to the use of electric motor utilization rates in representing temporal changes in relative capital use provided that a stable relationship holds between the two utilization variables. For Philippine manufacturing the present study has shown that there is a significant variation across industries in this relationship; hence any assumed equality of the aggregative trends in capital and electric motor utilization rates must be viewed with caution.

As mentioned at the outset, the economic censuses of 1961 and 1967 have solicited information necessary for the calculation of electric motor utilization rates. Based on our examination of the reported data, however, a strong case could be made for some effort in improving the collection, processing and presentation of the electricity data. Particularly worrisome

is the likelihood that the tabulation of the 1961 and 1967 Census data has not ensured the correspondence in establishment coverage between the rated capacity of installed electric motors and the consumption data by industry. For purposes of deriving the electricity measure of capital utilization, it is of vital necessity that these data pertain to the same set of establishments. One specific recommendation that we can make here is for the presentation of the two sets of electricity data in a single table in future reports of the economic census of manufacturing.

The information needs of industrial policy formulation will also be served better if a comprehensive source of information on capital utilization in the manufacturing industries is provided by the survey of manufactures conducted annually (since 1956) by the Bureau of the Census and Statistics. It would be adequate to include the items on electricity data in the questionnaire for the large establishments only as they account already for more than 90 per cent of the total value of fixed assets in organized manufacturing. The BCS or the Statistical Office of NEDA could also undertake some special studies designed to firm up the basis for linking electric motor utilization to the time-intensity of industrial capital use that has emerged from the present study.

Our attempt at an assessment of the temporal pattern of capital utilization in Philippine manufacturing has been hampered by the probable lack of comparability among our survey data for 1972 and the Census data for 1961

and 1967. Based on the relative values of the electricity measure computed for these three years, the tentative conclusion reached is that between 1961 and 1967 sharp changes have taken place in both directions among certain industries but that the overall level of capital utilization in the manufacturing sector differed only slightly in the two years; from 1967 to 1972, however, under-utilization of existing capital appears to have aggravated in some major industries and also for "all manufacturing." The South Korean experience in the trend of electric motor utilization (which doubled during 1962-1971) presents a striking contrast.

It should be of some interest to students of Philippine development and to economic policymakers to be able to ascertain whether such changes over time in industrial capital use as inferred from the observed pattern of electric motor utilization rates did occur and if so, to gain quantitative knowledge on the extent of influence of the differing policy climate in the past. Looking forward, an even more important concern is the improvement of existing policy in order to induce greater utilization of installed machinery and equipment in Philippine industries. These would seem relevant items in any research agenda for the study of increased capital utilization as a source of industrial output growth.

FOOTNOTES

*This preliminary paper is part of a larger study on capital utilization in Philippine manufacturing being undertaken by the National Economic and Development Authority and the author in collaboration with the Development Economics Department of the World Bank, Washington, D.C. Views and recommendations expressed in the paper are however the sole responsibility of the author. The active encouragement and support of NEDA Director-General Gerardo P. Sicat for the research project is gratefully acknowledged.

[1]In /1/ and /2/ the present writer has argued for the very real need to gather data on the magnitude and pattern of capital underutilization in Philippine manufacturing industries.

[2]See, for example, /8, p. 20/.

[3]The questionnaire form is reproduced in Appendix A.

[4]The questionable or, more frequently, missing data usually pertain to the capacity of electric motors, which unlike electricity consumption is not given systematic recording in most firms.

[5]In cases where electric motor capacity is given in horsepower, conversion into kilowatts was done by multiplying by the factor 0.746.

[6]The latter estimates were given preference over those provided by Foss because of the more disaggregative (although not exhaustive) classification of industries done by Kim and Kwon. The variation across 2-digit industry groups is similar in the two cases.

[7]Cf. Appendix B below.

[8]The values of U^m and CUR are starred in the Table for the seven cases.

[9]See also /12/ for a quantitative evaluation of relative allocative efficiency in Philippine manufacturing industries over the period 1957-1965.

[10]The proportion of manufacturing establishments that did not report electricity data is also not given in [4].

[11]It is noteworthy that certain industries, viz., ISIC 3114, 3117, 3233, 3513, 3812 and 3844, exhibit such impossible values of U^m computed from data in both censuses. A more careful scrutiny of the responses of firms in these industries seems called for.

[12]In addition, the population in our survey consists of firms employing 20 mor more workers, while that of the Census includes establishments with employment of 10 or more.

[13]Such data deficiencies notwithstanding, the levels of electric motor utilization for Philippine manufacturing industries as presented in this paper are fo found to be within the range of those estimated for South Korea during 1962-1971; cf. [8, pp. 24-28].

APPENDIX A

Questionnaire Form Used in Supplementary Survey on Electricity Data

Name of Firm: _____

ELECTRIC MOTOR CAPACITY AND ELECTRICITY CONSUMPTION DATA FOR 1972

	Installed Capacity*	Self-generated electricity	NPC or Meralco-supplied electricity	Total Electricity Consumption (self-generated plus purchased)
		kw	kwh	kwh
Electric Motors				
Others				
Total				

*Please indicate whether in kw or hp.

APPENDIX B

Capital Utilization Rates from Survey Data for 1972
(in per cent)

ISIC No.	Name of Industry	Simple average of CUR	Weighted mean of CUR by assets
311	Food manufactures	42.99	53.22
312		47.27	64.38
313	Beverages	40.04	50.07
314	Tobacco manufactures	26.41	52.68
321	Textiles	57.93	69.07
322	Wearing apparel	38.51	64.68
323	Leather and leather products	24.29	26.75
324	Footwear	14.96	17.01
331	Wood and wood products	35.31	65.12
332	Furniture and fixtures	35.72	36.23
341	Paper and paper products	51.84	67.56
342	Printing and publishing	40.87	49.91
351	Basic chemicals	53.62	67.46
352	Other chemicals	32.29	45.12
353	Petroleum refineries	67.49	65.73
355	Rubber products	37.70	69.53
356	Plastic products	37.93	38.41
361	Pottery, etc.	39.01	46.59
362	Glass and glass products	46.09	63.22
369	Other non-metallic mineral products	57.72	75.96
371	Iron and steel	50.19	54.37
372	Non-ferrous metal	34.94	35.05
381	Other metal products	36.18	37.88
382	Machinery	31.38	52.25
383	Electrical machinery	37.99	44.94
384	Transport equipment	23.88	26.46
385	Professional and scientific equipment	63.64	78.92
390	Other manufacturing	29.13	42.45
	All manufacturing	41.61	61.74

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