one could almost detect some similarity in relative proportions of the factor shares. This can be noted in the case of food (ISIC 20), footwear & apparel (ISIC 24), paper products (ISIC 27), chemical products (ISIC 30), basic metal (ISIC 34), non-electric (ISIC 36), electric machinery (ISIC 37) and transportation (ISIC 38). These represent at least 8 out of the possible 12 pairs of industries for which computed ratios exist. The above results are somewhat similar also to the range of values of the ratios obtained for Indian and Pakistani production functions.

Do the Cobb-Douglas input elasticities estimate the actual factor shares? There is [redacted] a growing body of literature tending to show that they do not. The ratio of wage shares do not agree with the Murti and Sastry findings. The actual wage shares are less than the labor elasticity coefficients. In general, this is also found in this study, just as in the US findings of Hildebrand and Liu.[5]

An explanation of this phenomenon may be partly due to the error terms in the production function estimates. But

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[5] On the Murti-Sastry findings, see also Walters (1963) Table III, p. 31; on the Philippines, refer back to Chapter 4, Table 4.12, above; on the US, see Hildebrand & Liu (1965), pp. 111-4.

no doubt market imperfections which lead to other-than-optimal resource allocation also account for these deviations. It is quite clear that marginal productivity pricing of inputs may not be achieved in view of these imperfections. An attempt to explain these deviations in the case of the Philippines is made in Chapter 4.

Chapter 7. SUMMARY AND CONCLUSIONS

This study has attempted estimations of alternative production functions for two-digit Philippine manufacturing industries. The basic data which were utilized were derived from an establishment by establishment tabulation of the 1960 Survey of Manufactures in the Philippines. In view of this, the author was given additional degrees of freedom with respect to experimentations in aggregation techniques. An attempt was therefore made to expand the number of observations by a reclassification of two-digit industries by employment size.

Cobb-Douglas production functions with two inputs -- capital and labor -- were fitted over a number of possible data specifications as well as types of aggregations. After some experimentations, only restricted Cobb-Douglas production functions were fitted, utilizing (1) simple aggregation of each establishment observations per employment class and (2) sampled establishments in each employment class. In general, production functions derived from simple aggregates of employment class observations yielded relatively better estimates.

Three-factor Cobb-Douglas production functions were estimated next. These yielded relatively poorer fits, although the Cobb-Douglas factor shares when adjusted seemed to correspond with those found for 2-factor production functions.

An attempt was made to choose the "statistically" best Cobb-Douglas production functions. The implied "best" Cobb-Douglas factor shares were then compared with actual factor shares and there is some divergence between each. For instance, the actual non-labor share which accrues to the capital input have been consistently higher than the estimated Cobb-Douglas capital share. On the other hand, the actual labor shares were underestimated by estimated Cobb-Douglas labor shares. Statistical error terms, market imperfections, and simple accounting aggregation techniques account for this.

Estimates of constant elasticity of substitution (or CES) functions for the same 2-digit manufacturing industries were made and they tended to be higher than unity. In view of the upward bias in these estimates and the possibility of factor pricing policy of the Philippines affecting capital-labor substitution, these estimates are probably no different from those found for the US, which are close to 1. Therefore, the use of Cobb-Douglas production functions for Philippine manufacturing industries is probably the closest approximation to an empirical production function specification. An attempt to extend the estimation of capital-labor elasticities of substitution with the use of a "generalized" CES production function yielded negative results.

In addition to the above estimates, earlier production functions which were estimated for the Philippine manufacturing sector are reported for the first time. These included Cobb-Douglas and CES production functions estimated. These estimates were made by industries and by form of business organizations. These were then compared with the estimates found in the earlier chapters. The Cobb-Douglas estimates are found to be better production function fits compared to the CES.

An international comparison of cross-section Cobb-Douglas production function estimates is attempted finally, by comparing estimates made for other countries and the Philippines. There appears to be constant returns to scale in production structure, suggesting a Cobb-Douglas production function with factor elasticities adding up to 1. The relative shares of factors tend to be similar over all. But individual industries by country display individual peculiarities.

Final Word

This study was primarily concerned with estimates of cross-section production functions. By their nature, these production functions are statical. The estimates of empirical production functions of this type are essential ingredients before more dynamic considerations, such as studies incorporating technological change, can be considered. As of this writing, some research on technological change in Philippine manufacturing is in progress. So many new and important questions have been posed about the importance of production function research, especially in relation to studies of the less developed countries.[1] These new challenges will undoubtedly yield new responses.

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[1] See J.G. Williamson and G.P. Sicat (1968) and J.G. Williamson (1968).

Appendix. Production Function Regressions

In this appendix, all the regression results for the production functions estimated in this study from employment size observations are reported. This includes the estimates which are very poor from a statistical viewpoint. The reader can totally dispense with this appendix, except for a few who are curious enough to want to know more about the estimates not reported. Note, too, that the intercept terms, their standard errors, and the (multiple) correlation coefficient are reported in these tables, while they were not in the text.

The total number of observations per regression are reported in the last column of Table 4.4, p. 4-24.

Appendix Table 1. COBB-DOUGLAS PRODUCTION FUNCTIONS
(Data Based on Simple Aggregation)

ISIC	Value Added			Gross Sales		
	Constant	α_K	R	Constant	α_K^*	R
20	0.784 (0.304)	0.765 (0.170)	R = 0.768	2.162 (0.165)	0.545 (0.092)	R = 0.845
21	0.667 (0.427)	0.963 (0.277)	R = 0.681	1.369 (0.230)	0.963 (0.149)	R = 0.865
22	0.870 (0.173)	0.566 (0.137)	R = 0.754	1.784 (0.154)	0.481 (0.121)	R = 0.740
23	1.388 (0.238)	-0.020 (0.128)	R = 0.043	2.214 (0.233)	0.150 (0.126)	R = 0.305
24	0.812 (0.107)	0.257 (0.169)	R = 0.417	1.836 (0.232)	0.340 (0.365)	R = 0.271
25	1.722 (0.194)	-0.343 (0.130)	R = 0.589	2.626 (0.253)	-0.389 (0.170)	R = 0.536
26	0.715 (0.235)	0.404 (0.243)	R = 0.485	1.319 (0.302)	0.493 (0.312)	R = 0.466
27	2.211 (0.606)	0.034 (0.260)	R = 0.043	3.206 (0.513)	-0.016 (0.220)	R = 0.025
28	1.743 (0.222)	-0.056 (0.177)	R = 0.088	2.321 (0.194)	0.002 (0.155)	R = 0.004
29	C.919 (0.223)	0.391 (0.179)	R = 0.665	1.909 (0.151)	0.481 (0.122)	R = 0.850
30	1.001 (0.411)	0.542 (0.244)	R = 0.572	1.975 (0.384)	0.468 (0.228)	R = 0.545
31	2.983 (0.783)	-0.250 (0.375)	R = 0.182	4.431 (0.767)	-0.428 (0.367)	R = 0.307
33	0.722 (0.323)	0.520 (0.152)	R = 0.702	1.508 (0.307)	0.409 (0.145)	R = 0.632
34	1.641 (0.186)	0.037 (0.098)	R = 0.126	2.501 (0.154)	0.049 (0.081)	R = 0.196
35	1.434 (0.285)	0.240 (0.173)	R = 0.372	2.455 (0.405)	0.155 (0.246)	R = 0.179
36	1.094 (0.351)	0.296 (0.210)	R = 0.408	1.490 (0.348)	C.305 (0.208)	R = 0.420
37	1.336 (0.145)	0.367 (0.097)	R = 0.725	2.000 (0.159)	0.414 (0.106)	R = 0.735
38	2.139 (0.233)	-0.320 (0.156)	R = 0.511	2.903 (0.432)	-0.225 (0.288)	R = 0.220

Note: Standarderrors in parentheses.

Appendix Table 2. COBB-DOUGLAS PRODUCTION FUNCTIONS
(Data Based on Sampled Observations)

ISIC	Value Added: Constant	Value Added: α_K	Value Added: R	Gross Sales: Constant	Gross Sales: α_K^*	Gross Sales: R
20	1.306	0.453	R = 0.828	2.410	0.333	R = 0.749
	(0.169)	(0.082)		(0.162)	(0.079)	
21	1.784	0.282	R = 0.335	2.354	0.359	R = 0.550
	(0.385)	(0.220)		(0.265)	(0.151)	
22	0.910	0.197	R = 0.256	1.892	0.183	R = 0.232
	(0.286)	(0.206)		(0.296)	(0.213)	
23	0.759	0.266	R = 0.332	2.021	0.138	R = 0.172
	(0.350)	(0.202)		(0.366)	(0.211)	
24	0.799	0.071	R = 0.129	1.752	0.141	R = 0.208
	(0.131)	(0.165)		(0.159)	(0.200)	
25	0.637	0.377	R = 0.485	1.442	0.362	R = 0.571
	(0.288)	(0.188)		(0.221)	(0.144)	
26	0.344	0.529	R = 0.687	0.835	0.643	R = 0.758
	(0.341)	(0.186)		(0.337)	(0.184)	
27	3.322	-0.324	R = 0.247	4.619	-0.444	R = 0.352
	(1.244)	(0.424)		(1.154)	(0.394)	
28	1.835	-0.155	R = 0.289	2.329	-0.029	R = 0.050
	(0.223)	(0.143)		(0.250)	(0.160)	
29	1.122	0.206	R = 0.344	1.985	0.346	R = 0.676
	(0.350)	(0.230)		(0.234)	(0.154)	
30	1.121	0.324	R = 0.404	2.126	0.274	R = 0.368
	(0.427)	(0.232)		(0.401)	(0.218)	
31	2.204	0.100	R = 0.135	3.172	0.092	R = 0.116
	(0.349)	(0.203)		(0.376)	(0.219)	
33	1.369	0.052	R = 0.113	2.097	-0.006	R = 0.014
	(0.358)	(0.133)		(0.321)	(0.119)	
34	1.797	0.042	R = 0.137	2.658	0.051	R = 0.156
	(0.218)	(0.100)		(0.235)	(0.108)	
35	1.011	0.406	R = 0.690	1.850	0.447	R = 0.786
	(0.231)	(0.123)		(0.191)	(0.102)	
36	1.236	0.056	R = 0.080	1.644	0.068	R = 0.092
	(0.418)	(0.220)		(0.438)	(0.230)	
37	1.269	0.449	R = 0.704	1.887	0.471	R = 0.611
	(0.182)	(0.125)		(0.246)	(0.169)	
38	2.405	0.070	R = 0.175	1.701	-0.034	R = 0.123
	(0.240)	(0.114)		(0.164)	(0.078)	

Note: Standard errors in parentheses.

Appendix Table 3. THREE-FACTOR COBB-DOUGLAS PRODUCTION FUNCTIONS
(Based on Simple Aggregation)

ISIC	Value Added				Gross Sales			
	Constant	α_K	α_J	R	Constant	α_K^*	α_J^*	R
20	1.500	0.927	-0.389	R = 0.813	1.486	0.393	0.367	R = 0.929
	(0.523)	(0.189)	(0.237)		(0.215)	(0.078)	(0.097)	
21	0.729	1.030	-0.082	R = 0.682	1.156	0.730	0.282	R = 0.877
	(0.578)	(0.497)	(0.492)		(0.298)	(0.256)	(0.254)	
22	0.449	0.453	0.348	R = 0.792	0.974	0.264	0.668	R = 0.912
	(0.352)	(0.156)	(0.256)		(0.205)	(0.091)	(0.149)	
23	0.563	-0.154	0.513	R = 0.580	0.877	-0.066	0.831	R = 0.961
	(0.380)	(0.120)	(0.200)		(0.133)	(0.042)	(0.070)	
24	0.708	0.238	0.078	R = 0.564	1.307	0.244	0.396	R = 0.986
	(0.124)	(0.161)	(0.053)		(0.051)	(0.066)	(0.022)	
25	1.002	-0.198	0.347	R = 0.771	1.166	-0.096	0.703	R = 0.971
	(0.310)	(0.120)	(0.128)		(0.145)	(0.056)	(0.060)	
26	0.649	0.070	0.379	R = 0.894	1.223	0.006	0.551	R = 0.979
	(0.129)	(0.150)	(0.080)		(0.074)	(0.086)	(0.046)	
27	-0.149	0.083	0.864	R = 0.747	0.684	0.036	0.923	R = 0.943
	(0.858)	(0.184)	(0.272)		(0.362)	(0.078)	(0.115)	
28	1.246	-0.076	0.342	R = 0.352	1.282	-0.037	0.714	R = 0.819
	(0.450)	(0.174)	(0.271)		(0.240)	(0.093)	(0.144)	
29	-0.592	-0.156	1.050	R = 0.816	0.444	-0.049	1.018	R = 0.975
	(0.846)	(0.335)	(0.573)		(0.315)	(0.125)	(0.213)	
30	-0.454	0.147	0.973	R = 0.938	0.501	0.068	0.985	R = 0.987
	(0.293)	(0.126)	(0.152)		(0.122)	(0.052)	(0.063)	
31	1.806	-0.134	0.306	R = 0.409	1.462	-0.135	0.773	R = 0.964
	(1.134)	(0.372)	(0.220)		(0.334)	(0.109)	(0.065)	
33	0.032	0.326	0.745	R = 0.890	0.710	0.184	0.864	R = 0.961
	(0.278)	(0.113)	(0.188)		(0.147)	(0.060)	(0.100)	
34	0.342	-0.001	0.672	R = 0.597	0.836	0.000	0.861	R = 0.916
	(0.651)	(0.086)	(0.326)		(0.272)	(0.036)	(0.136)	
35	0.619	0.205	0.413	R = 0.831	1.031	0.093	0.721	R = 0.981
	(0.256)	(0.108)	(0.093)		(0.113)	(0.048)	(0.041)	
36	1.103	0.222	0.190	R = 0.533	1.508	0.166	0.359	R = 0.771
	(0.343)	(0.213)	(0.156)		(0.257)	(0.160)	(0.117)	
37	1.127	0.264	0.191	R = 0.764	1.404	0.121	0.545	R = 0.961
	(0.213)	(0.123)	(0.146)		(0.099)	(0.057)	(0.068)	
38	1.564	-0.278	0.270	R = 0.820	1.509	-0.124	0.655	R = 0.976
	(0.225)	(0.109)	(0.073)		(0.139)	(0.067)	(0.045)	

Note: Standard errors in parentheses.

Appendix Table 4. THREE-FACTOR COBB-DOUGLAS PRODUCTION FUNCTIONS
(Based on Sampled Observations)

ISIC	Value Added				Gross Sales			
	Constant	α_K	α_J	R	Constant	α_K*	α_J*	R
20	0.578 (0.442)	0.358 (0.094)	0.377 (0.214)	R = 0.864	0.952 (0.190)	0.142 (0.040)	0.755 (0.092)	R = 0.964
21	0.559 (0.687)	-0.098 (0.269)	0.898 (0.436)	R = 0.587	1.127 (0.367)	-0.022 (0.144)	0.900 (0.233)	R = 0.830
22	0.303 (0.350)	0.164 (0.176)	0.471 (0.195)	R = 0.609	0.884 (0.175)	0.128 (0.088)	0.782 (0.097)	R = 0.923
23	0.056 (0.419)	0.212 (0.176)	0.457 (0.189)	R = 0.621	0.751 (0.144)	0.040 (0.060)	0.825 (0.065)	R = 0.963
24	0.729 (0.206)	0.067 (0.172)	0.064 (0.140)	R = 0.191	1.212 (0.110)	0.106 (0.091)	0.489 (0.075)	R = 0.905
25	0.119 (0.314)	0.113 (0.188)	0.741 (0.288)	R = 0.712	0.894 (0.171)	0.084 (0.102)	0.783 (0.157)	R = 0.884
26	0.560 (0.278)	0.120 (0.213)	0.440 (0.168)	R = 0.846	1.112 (0.175)	0.116 (0.134)	0.567 (0.106)	R = 0.952
27	0.233 (1.301)	0.019 (0.317)	0.762 (0.238)	R = 0.767	0.944 (0.502)	-0.035 (0.122)	0.907 (0.092)	R = 0.966
28	1.335 (0.301)	-0.173 (0.126)	0.373 (0.170)	R = 0.588	1.390 (0.180)	-0.062 (0.075)	0.700 (0.102)	R = 0.893
29	0.502 (1.012)	0.017 (0.375)	0.446 (0.677)	R = 0.434	0.880 (0.464)	0.010 (0.172)	0.794 (0.311)	R = 0.874
30	0.514 (0.512)	0.263 (0.213)	0.380 (0.211)	R = 0.620	1.201 (0.308)	0.179 (0.128)	0.579 (0.127)	R = 0.860
31	1.579 (0.599)	0.100 (0.199)	0.244 (0.192)	R = 0.366	1.320 (0.226)	0.092 (0.075)	0.722 (0.072)	R = 0.945
33	0.281 (0.333)	0.095 (0.084)	0.835 (0.189)	R = 0.802	0.933 (0.151)	0.040 (0.038)	0.893 (0.086)	R = 0.953
34	1.873 (0.458)	0.043 (0.107)	-0.037 (0.195)	R = 0.152	1.607 (0.245)	0.036 (0.057)	0.519 (0.104)	R = 0.873
35	0.855 (0.414)	0.348 (0.179)	0.128 (0.279)	R = 0.698	1.065 (0.188)	0.152 (0.081)	0.648 (0.127)	R = 0.942
36	1.228 (0.386)	0.003 (0.205)	0.264 (0.159)	R = 0.490	1.630 (0.292)	-0.021 (0.155)	0.443 (0.120)	R = 0.778
37	1.034 (0.175)	0.288 (0.120)	0.274 (0.104)	R = 0.826	1.395 (0.100)	0.133 (0.069	0.573 (0.059)	R = 0.964
38	1.303 (0.196)	-0.104 (0.068)	0.284 (0.103)	R = 0.646	1.568 (0.144)	-0.079 (0.050)	0.598 (0.076)	R = 0.924

Note: Standard errors in parentheses.

Appendix Table 5. CES PRODUCTION FUNCTIONS

(Based on Simple Aggregation)

ISIC	Model	Value Added				Gross Sales			
		Constant	b_{w1}	b_{w2}	R	Constant	b^*_{w1}	b^*_{w2}	R
20	1	1.973	1.696		R = 0.850	3.041	0.711		R = 0.549
		(0.083)	(0.281)			(0.085)	(0.289)		
	II	0.958		1.698	R = 0.820	2.466		0.939	R = 0.699
		(0.227)		(0.317)		(0.184)		(0.256)	
21	I	2.527	1.626		R = 0.958	3.115	1.253		R = 0.938
		(0.075	(0.129)			(0.072)	(0.123)		
	II	0.922		1.357	R = 0.861	1.933		0.979	R = 0.790
		(0.210)		(0.214)		(0.199)		(0.203)	
22	I	1.295	1.585		R = 0.713	2.170	1.604		R = 0.833
		(0.176)	(0.432)			(0.120)	(0.296)		
	II	0.787		1.499	R = 0.792	1.676		1.427	R = 0.871
		(0.167)		(0.320)		(0.117)		(0.223)	
23	I	1.352	-0.189		R = 0.202	2.475	-0.315		R = 0.327
		(0.079)	(0.245)			(0.078)	(0.243)		
	II	1.461		-0.238	R = 0.143	2.487		-0.025	R = 0.015
		(0.217)		(0.441)		(0.225)		(0.458)	
24	I	0.983	0.542		R = 0.520	2.029	0.114		R = 0.054
		(0.052)	(0.268)			(0.125)	(0.641)		
	II	0.819		0.512	R = 0.618	1.847		0.673	R = 0.398
		(0.069)	(0.196)			(0.164)		(0.468)	
25	I	1.235	0.028		R = 0.023	2.110	-0.280		R = 0.186
		(0.087)	(0.336)			(0.107)	(0.412)		
	II	0.925		0.631	R = 0.350	1.964		0.226	R = 0.101
		(0.243)		(0.468)		(0.322)		(0.620)	
26	I	0.924	1.390		R = 0.895	1.571	1.806		R = 0.917
		(0.095)	(0.230)			(0.108)	(0.262)		
	II	0.492		1.256	R = 0.953	1.016		1.617	R = 0.967
		(0.081)		(0.133)		(0.086)		(0.142)	
27	I	2.187	0.300		R = 0.232	3.086	0.252		R = 0.231
		(0.228)	(0.419)			(0.192)	(0.354)		
	II	0.478		1.967	R = 0.689	1.704		1.594	R = 0.661
		(0.647)		(0.689)		(0.567)		(0.603)	
28	I	1.353	0.540		R = 0.532	2.099	0.368		R = 0.417
		(0.176	(0.238)			(0.164)	(0.222)		
	II	1.481		0.208	R = 0.068	1.899		0.438	R = 0.166
		(0.821)		(0.840)		(0.705)		(0.722)	
29	I	1.374	1.101		R = 0.758	2.461	1.259		R = 0.902
		(0.126)	(0.386)			(0.081)	(0.246)		
	II	1.102		0.504	R = 0.238	2.050		0.836	R = 0.410
		(0.372)		(0.841)		(0.336)		(0.760)	