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CAPITAL-LABOR SUBSTITUTION IN WEST MALAYSIA: APPRAISAL OF ELASTICITY ESTIMATES FROM DATA ON EMPLOYMENT SIZE GROUPS

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Introduction

In a recent paper published in the *Journal of Developing Economies*, (March 1970, pp. 24-38) Gerardo P. Sicat made estimates of the elasticity of substitution between capital and labor for Philippine manufacturing. The elasticities for several of the industries were quite high and Sicat observed that "the evidence shows therefore that capital-labor elasticities of substitution in the Philippines (and perhaps for other less developed countries as well) are at least as great in degree as those found in the industrially advanced countries." (p. 32); and "in any case, these elasticities of substitution appear to contradict the well-known hypothesis in the economic development literature that less developed countries face smaller degrees of capital-labor substitution possibilities" (p. 37). The Philippine elasticities were estimated for 2-digit industries on the basis of data classified by employment size groups.

In this paper we estimate the elasticities for West Malaysian manufacturing using data by employment size groups and the well known method of regressing the log of value added per worker on the log of average wage. In the appraisal of the estimates, it is contended that (a) the results for 2-digit industry groups may be spurious and (b) the model assumed may not be compatible with the data used.

West Malaysian Elasticity Estimates for 2-digit Industries

In the 1968 Census of Manufacturing Industries of West Malaysia, data on value added, employment (full-time and part-time), and wages and salaries are available at the 4-digit industry level by

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employment size. There are nine employment size groups. The data for the 4-digit industries can be added up to get the data for 2-digit industries. In the case of each 2-digit industry, all the relevant 4-digit industries for which data is available at least by 3 or 4 employment groups are considered for aggregation. The West Malaysian data is tabulated as per the *Federation of Malaya Industrial Classification (FMIC), 1963.*

We assume that the production process in each of the industries is represented by a Constant Elasticity of Substitution production function. The assumptions of constant returns to scale, perfect competition in product and factor markets and profit maximization, etc., will give us

$$\log (V/E) = a + b \log (W/E)$$

where V = value added, E = employment and W = wages and salaries and 'b' stands for the elasticity of substitution.

On the assumption that the data correspond approximately to the concepts implied in the production function, we estimate 'b' by least squares regression of log (V/E) on log (W/E).

The regression results for 2-digit industries are shown in Table 1 along with the estimates of 'b' for the Philippines as obtained by Sicat. It may be noted that Sicat has presented 8 sets of results for the estimate of 'b'. We have chosen the set most comparable to our results. It is the set based on 17 employment groups, the employment concept that includes all workers, and the output concept restricted to value added.

From Table 1, we note that in respect of many industries, the West Malaysian elasticity estimates are lower than the Philippine estimates. On the face of it, one might opine that the lower elasticities of West Malaysia and the higher elasticities of the Philippines are indicative of their relative technological positions. However, we are obliged to pinpoint some of the limitations of the results. An important question is the validity of assuming that a unique elasticity can be specified for a 2-digit industry. This aspect is discussed in the next section.

Table 1

Estimated Elasticities for 2-Digit Industries, West Malaysia and the Philippines

2-Digit Industry	West Malaysia (1968) Elasticity	Philippines (1960) Elasticity*
Food	1.42	1.698
Beverages	1.13	1.357
Tobacco	1.56	1.499
Textiles	1.03	NA
Footwear and apparel	1.45	0.512
Wood and cork	0.43	0.631
Furniture and fixtures	NS	1.256
Paper products	1.14	1.967
Printing and publishing	0.82	NA
Leather products	NS	NA
Rubber products	0.95	1.726
Chemical products	1.26	1.324
Non-metallic mineral products	0.88	2.035
Basic metals	NS	1.362
Metal products	0.64	0.875
Non-electrical machinery	NS	1.488
Electrical machinery	NS	1.216

NS = Not statistically significant at 5% level
* = From the Sicat study.
NA = Not Available

West Malaysian Elasticities at Different Levels of Data Aggregation

In Appendices I and II, the estimated elasticities for 4-digit, 3-digit and 2-digit industries are tabulated. Appendix I is about food manufacturing which in the FMIC code is industry 30. For this 2-digit industry the elasticity is 1.42. The data at the 2-digit level is actually made up of 15 four digit industries. Of this 15, only 5 have an elasticity significantly different from zero. Of the 15 four-digit industries, 13 can be reclassified into three 3-digit industries as follows:

FMIC Code	3 digit industry
305	Grain Milling
306+308	Confectionary
309	Miscellaneous food products

Each of the 3-digit industries have significant elasticities. As for the industries which make them up, we have significant elasticities in only 4 cases. On the basis of Appendix I, we may note that as data aggregation and the 'breadth' of the industry group increases, the estimated elasticity may be biased upwards.

Appendix II relates to manufacturing industries other than food manufacturing. On the basis of the data in Appendix II, we give in Table 2 the 4-digit and 2-digit industry results for six industries. These six were chosen since their 2-digit data is made up of the data on at least four sub-industries. For four of the six industries considered, we can say that the 2-digit elasticity has an upward bias. Our judgement may be explained with reference to say, non-metallic mineral products (industry 43). Here, for the four sub-industries, 3 have statistically insignificant elasticities. For the other two remaining industries, one had an elasticity lower than the 2-digit elasticity. Thus, three out of four sub-industries have elasticities less than the 2-digit industry elasticity. Hence we may say that for industry 43, the elasticity for the 2-digit classification has an upward bias. In

Table 2

2-digit FMIC code	Short Title of 2-digit industry	Number of 4-digit or 3-digit industries covered	Number of 4-digit or 3-digit industries for which the elasticity is not significant	Estimates (significant) elasticity for the 4-digit or 3-digit industries	Elasticity for the 2-digit industry
34	Footwear & apparel	4	3	0.93	1.45
35	Wood & cork	6	5	0.53	0.43
40	Rubber products	4	3	1.17	0.95
41	Chemical products	5	—	1.19 1.94	1.26
				1.20 2.28	
				1.39	
43	Nonmetallic mineral products	4	2	0.74 0.84	0.88
45	Metal products	9	3	0.31 0.85	0.64
				0.78 1.03	
				0.83 1.48	

contrast, for industries 41 and 45 the elasticity at the 2-digit level is biased downwards.

In all, we have estimated elasticities for 75 industries at different levels of aggregation. We consider in Table 3 the frequency of obtaining significant results. If one is interested in obtaining statistically significant results, he may be more successful with 3-digit and 2-digit industry data than with 4-digit industry data. There is also the possibility that at a higher degree of aggregation, there may be a relatively larger number of estimates which are greater than unity.

Compatibility Between the Model and the Data

The theoretical basis for our estimating equation is worth recapitulating. By regressing the log of value added per worker on the average wage we are trying to estimate the elasticity of factor substitution or the ratio of the proportionate change in the capital-labor ratio for a given proportionate change in the wage rate. We are thus assuming that our data relate to different entrepreneurs who are now facing or who have faced at one time different labor markets with differences in wage rates. We are also assuming that the differences in wage rates have induced the different entrepreneurs to choose different capital-labor ratios to produce a homogeneous product or homogeneous bundles of products. Thus when international or inter-regional data are the basis for estimation, we can be at least sure of the existence of separate labor markets and separate wage rates, whatever may be the validity or otherwise of the other assumptions. Unfortunately, when data are from a single country and by employment size groups, we may be actually comparing the decisions of entrepreneurs facing the same or nearly the same labor market but employing different bundles of skills. Increase in firm size, an upward shift in the skill-mix of employees, a higher average wage and a higher output per worker go together ex-post. (For, if better skills, higher size, etc. were not to enhance output per worker, there would not exist firms in larger sizes.) Thus the positive relation one gets between the average wage and output per worker as the firm size increases is a state of nature rather than evidence of elasticity of factor substitution. Such positive relationship becomes stronger as we move to a broad industry classification (2-digit), because as we move from smaller to larger size we confront relatively higher-cost and higher-priced products. In value terms, output per worker increases faster than the average wage rate and we are likely to obtain greater than unitary regression coefficients which however should not be interpreted as relatively higher elasticities of substitution.

Table 3
Total Number of Estimates and Number of Significant Estimates by Level of Data Aggregation

Level of Aggregation	Total No. of estimates	No. of significant estimates	No. of significant estimates as a proportion of total	Of the significant estimates, proportion greater than unity
1. 4-digit or aggregates from 4-digit industries but not 3-digit or 2-digit	44	16	0.37	0.44
2. 3-digit or aggregates from 3-digit industries but not 2-digit	14	10	0.71	0.50
3. 2-digit industries	17	12	0.70	0.58

Estimated Elasticities at Different Levels of Data Aggregation: Food Manufacturing Industry

FMIC* Code	Name of Industry	Basic Data	Aggregate I (3-digit)	Aggregate II (2-digit)
3021	Ice-cream	.66		
3032+39	Pickles, sauces, etc.	NS		
3051	Small rice mills	NS	1.99	
3054	Sago and tapioca	NS		
3055	Large rice mills	NS		
3059	Other grain milling	NS		
3061	Biscuit factories	.47	.94	1.42
3062	Bakeries	.88		
3080	Cocoa, chocolate, etc.	1.57		
3091	Meehoons, noodles, etc.	NS	1.20	
3093	Spices and curry powder	NS		
3095	Soya bean products	NS		
3096	Coffee factories	NS		
3097	Ice factories	.91		
3098	Animal feeds	NS		

APPENDIX B
Estimated Elasticities at Different Levels of Data Aggregation: Other Manufacturing Industries

Code	Title	Basic Data	2-digit Aggregate
3140	Soft drinks and carbonated beverages	1.13	
3200	Tobacco		1.56
3300	Textiles		1.03
3411	Footwear other than rubber and wooden	N.S	
3412	Wooden clogs, sandals and shoe heels	NS	1.45
3432	Clothing factories	0.93	
3433+39+40	Hats, caps, etc.	NS	
3511	Saw mills	NS	
3513	Planning mills, window and door mills and joinery works	0.53	
3521+22+23	Rattan processing etc. and attap products	NS	0.43
3531	Wooden boxes, cases and crates	NS	
3591	Carpentry shops	NS	
3592	Coffin manufacture	NS	
36	Furniture and fixtures		NS
37	Paper and paper products		1.14
38	Printing and publishing		0.82
39	Leather and leather products		NS
1121+31	Rubber re-milling and latex processing	NS	
1122	Rubber smoke houses	NS	0.95
4010+21+30+90	Rubber footwear, tyres, tubes, etc.	1.17	
4022	Retreading, vulcanizing, etc.	NS	

Code	Title	Basic Data	2-digit Aggregate
1331	Crude coconut oil mills	2.28	
4191	Soaps, washing and cleaning compounds	1.39	
4192	Medicinal and pharmaceutical preparations	1.19	1.26
4194	Perfumes and cosmetics	1.20	
4196+99	Candles, etc. and Misc. chemical products	1.94	
4310+30	Structural clay products, pottery, china	0.84	
4320	Glass and glass products	NS	
4350	Structural cement and concrete products	0.74	0.88
4391	Cut stone and stone products	NS	
4421	Iron foundries	NS	
4510	Fabricated structural shapes	NS	
4520	Architectural metal products	0.85	
4530	Wire and wire products	NS	
4541+42	Hardware, tools and cutlery	NS	.64
4550+69+90	Boilers, tanks, etc. and misc. metal products	0.71	
4561	Tin cans and metal boxes	1.03	
4562	Tin smithing	1.48	
4563	Brass, copper, pewter and aluminum products	.78	
4581	Blacksmithing and welding	.31	
4623	Industrial machinery and parts	NS	
4661+59	Manufacture and repair of refrigerating, exhaust and related machinery	NS	
4711+12	Manufacture and repair of dry cells, batteries and related articles	0.68	
4721 etc	Manufacture and repair of electrical and related equipment	NS	
4881	Motor vehicle bodies	NS	
4940	Plastic products n.e.c.	NS	