ON MEASURES OF PRODUCTWISE CONCENTRATION [*]

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PART I

1. THE ONLY MEASURE of productwise concentration used in the recently published report of the Monopolies Inquiry Commission is the 'degree of concentration' defined by the extent of the percentage share of top three producers (enterprises) in the production of a commodity.[1] This index is insensitive to the size-pattern of the top three or of the remaining enterprises, and so seriously limits the utility of the study. It is shown below that the use of some other measures, particularly that of the Herfindhal Summary Index, in conjunction with the above greatly enhances the value of the study.[2]

2. Although economists have long been concerned with the causes and consequences of industrial concentration, its precise measurement in any scientific and comprehensive way is of a fairly recent origin. The first study published in 1939 related to the U.S. Economy of 1935.[3] In 1945 the first study pertaining to the British Industry appeared for the year 1935.[4] For the Canadian Manufacturing Industry the first tables were published only in 1957 for the year 1946.[5] In all these studies the basic source of data was the Censuses,

and the rules prohibited the publication of any measure that could be utilized for obtaining the size of individual plants or companies. That is why they were confined to the measurement of the shares of three, four, or eight largest industrial concerns in output, employment, etc., in industries/products. In more recent studies some additional measures of concentration have been used by Nelson, and Evely and Little.[6]

3. The Commission had access to the establishmentwise data, and the authority to publish even those measures which might indicate the size of an individual enterprise (as revealed by the Appendix C of the Report). It could therefore use somewhat more refined measures of concentration besides the crude shares. These measures are not merely of purely theoretical interest, but they have great practical significance as well. The choice of the measures is necessarily restricted by the (i) assumptions, if any; (ii) data availability; (iii) computational time involved; (iv) sensitivity; and (v) interpretation.

4. It is well known that there can be no unequivocal measure of concentration, and none can be derived from purely objective methods. No measure can claim absolute superiority over all others.[7] But it can be shown that under certain conditions a particular measure is superior (in terms of sensitivity) to some other measures.[8] Some of the more common measures of concentration are :

Group A

    (1) Crude percentage share of top, say three, enterprises (C);[9]

    (2) Size-ratio of enterprises, say of top three with remaining enterprises (S);

    (3) Area under Concentration Polygon through 'n' top enterprises (A);

    (4) Herfindhal Summary Index (H).

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[6] NELSON, R.L., Concentration in Manufacturing Industries in the United States of America — A Midcentury Report, (New York, 1964);

   (ii) EVELY, R. and I. M. D. LITTLE, Concentration in British Industry, (Cambridge, 1960).

[7] RANADIVE, K. R., The Equality of Incomes in India (Bulletin, Oxford University, Institute of Economics and Statistics, May 1965).

[8] IYENGAR, N. S., Some Measures of Inequality (Fifth Econometric Conference, Delhi, December 1965).

[9] Another variant can be the number of top enterprises sharing a given percentage of products, or percentage share of a given percentage of top enterprises, or percentage of top enterprises sharing a given percentage of product.

Group B

(5) Gini Square (G) ;

(6) Standard Deviation of Log Size (L) ;

(7) Iyengar Index (I).

5. If P_i is the percentage share of ith top enterprise in the total product/industry (say in production) consisting of 'n' enterprises, then each of the above measures is defined as :

Group A

(1) $C = P_1 + P_2 + P_3$

(2) $S = 1/3 [P_1 + P_2 + P_3] / \dfrac{1}{n-3} \sum\limits_{i=4}^{n} P_i,$

or $\dfrac{n-3}{3} \cdot \dfrac{C}{100-C}$

(3) $A = 1/n \sum\limits_{i=1}^{n} (n + \tfrac{1}{2} - i) P_i$

(4) $H = \dfrac{1}{(100)^2} \sum\limits_{i=1}^{n} (P_i)^2$

Group B

(5) $G = \dfrac{2}{n(n-1)} \sum\limits_{i \neq j}^{n} \left| P_j - P_j \right|$

(6) $L = \dfrac{1}{n-1} \sum\limits_{i=1}^{n} (p_i - \bar{p})^2$

where $P_i = \log P$, and $\bar{p} = 1/n \sum\limits_{i=1}^{n i} p_i$

(7) $I = (\tfrac{1}{2} - q)/(\tfrac{1}{2} + q)$ where $q = \dfrac{1}{100} \sum\limits_{i=1}^{n/2} P_i$

PART II

6. The measures in group A have been used in the studies on industrial (or productwise) concentration, while those in group B and many of the others have not been generally used. The 'G' and 'L' measures are perhaps more laborious to compute than any one of group A and 'I', and they require individual information on all the

enterprises. Direct economic interpretation of measures 'G' and 'L' is also not easy. On the other hand, index 'I' may be easier to work out than most of the indexes of group B. It is generally more sensitive, and its interpretation is easy.[10] However, when there are very large as well as very small enterprises with varying reliability, the sensitivity of this index may not be high, as the data pertaining to the smaller industrial enterprises may not be very reliable.

7. Among the measures of group A, one finds that index 'C' is the easiest to compute; it only requires data regarding production of the top three and of all the enterprises, and can be directly interpreted. However, it is not sensitive either to the size-pattern of the top three or to the size-pattern and number of the remaining enterprises. Index 'S' can be worked out only if there are at least four or more enterprises producing the same product, and so cannot be worked out for more than 50 per cent of the industrial products covered in the Report. In addition to the data needed in the calculation of 'C', one needs to know the total number of enterprises for computing 'S'. The latter is also insensitive to the size-pattern of the top three or of the remaining enterprises, but does take care of the number of the remaining enterprises. Obviously it is not necessary to have enterprisewise data for the calculation of 'C' or 'S' but for index 'A' or 'H' comprehensive enterprisewise data are needed.[11]

8. When there is unequal number of enterprises in producing different products, the productwise comparison of 'S' might be vitiated to some extent. This difficulty is not likely to be serious if the number of enterprises is large. Similar difficulties are encountered in the case of 'A'. As data regarding the smaller enterprises is generally not as precise as for the larger ones, the index 'H' seems to be the least affected by the data errors. It would appear on the whole that one should use the index 'H' in conjunction with 'C' in order to draw conclusions of any practical significance.

9. No fresh collection of data is needed for the computation of the size-ratio index 'S' and its significance can be easily seen. Consider two products (X) and (Y) and let the share of the top three be 75 per cent for each of them. But the total number of enterprises is four

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[10] IYENGAR, N. S., *op. cit.*

[11] Whenever there are many relatively small enterprises producing a product, enterprisewise data about them could be pooled for computing 'A' and ignored for computing 'H' without the loss of much precision.

in the case of X and eight in the case of Y. The size-ratio of enterprises in (X) is one whereas in (Y) it is five. Though the extent of concentration as adopted in that study is exactly the same, namely, 75 per cent, in practice it depends *ceteris paribus* upon the prevalence of competition or tacit collusion among the top three and the remaining enterprises. If the latter exists, the possibilities of any monopolistic or restrictive trade-practices may be much more in (X) than in (Y). As stated earlier, this measure is also independent of change in the size-pattern of the top three or of the remaining enterprises.

10. The area under a concentration polygon 'A' does reflect a change in the relative share of the top three or of the remaining enterprises. The divergence of size among the top as well as among others is indicated by the shape of the polygon. A short high polygon indicates "high" concentration and a low-lying indicates "low" concentration. The area under the polygon varies from a half to one depending upon the variability of size among the enterprises. The higher the concentration, the higher is the area under the polygon, for any given number of enterprises. As the construction of polygon is time consuming, one can replace it by working out the area under it.

11. The Herfindhal Summary Index 'H' which depends on the size-pattern of enterprises is easy to compute. It also appears to be more sensitive than the other measures discussed here. Consider two products (X) and (Y) each with eight enterprises, with same share of the top three, say 75 per cent, and each of the remaining enterprises also sharing the same percentage, viz. five per cent. But in product (X) each of the top three is also of the same size, i.e., 25 per cent, while those in product (Y) of varying sizes, say 60 per cent, 10 per cent, and 5 per cent. For both products (X) and (Y), the measure of concentration adopted in the Report and the size-ratio index 'S' are identical. The area under the concentration polygon 'A' is 0.75 for product (X) and 0.82 for product (Y) (the latter portion of the broken line concerning fourth to eighth enterprises being identical). The index 'H' is 0.200 for product (X) and 0.385 for product (Y). Hence, one finds that the indexes 'C' and 'S' are not at all sensitive to these varying size-patterns (total number of enterprises being the same), while index 'A' is slightly sensitive, and index 'H' is the

most sensitive. The latter indicates distinctly that there may be greater concentration in product (Y) than in product (X). This may also be true of the potential monopolistic/restrictive trade-practices in these products *ceteris paribus*, since for product (Y) a price leadership, a curb on the competition or any other monopolistic/restrictive practice is more plausible (as it largely depends upon the top enterprise) than for product (X) where a tacit collusion among the top three enterprises may be essential for any such practice.

PART III

12.   It will be shown now that the problem of varying size-pattern (of the top three or of the remaining enterprises with or without the same number of enterprises) is a real one, and one can find a large number of instances where the measure followed up in the Report completely fails to discriminate between the varying situations.[12] As such one should have access to other measures as well. As it is not the intention of this paper to review the concentration in all the industries in the light of the new indexes, only illustrative examples are worked out and given below in a statistical statement. They should reveal the necessity of using other measures, particularly of 'H', in addition to the one used throughout by the Commission. The measures of group B are also presented there.

13.   In all 18 products from four industrial groups are presented below.   Products of I or II group are manufactured by the same number of enterprises, whereas those of groups III and IV by the unequal number. The index 'C' treats all the products of group I at par with each other, while both indexes 'A' and 'H' positively discriminate them; as there is almost monopoly in *Cylinder Liners* while there can be only duopoly in *Scooters*; whereas in *Motor Cycles* a tacit collusion among all the three producers may be essential for following any monopolistic or restrictive practice.

14.   Corresponding to a small fall of 1.4 in 'C' between the first two products of group II — *Pressure-type Stoves* and *Steel Belt Lacing* — there is a fall of 50 in 'H' and 14 in 'A', indicating that the scope of monopolistic or restrictive practices might be much more in *Stoves* than in *Lacing*. Such a conclusion appears reasonable on the

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[12] As revealed by the total number and percentage shares of individual enterprises, and not by extent of the countervailing powers which are outside the purview of this paper.

basis of the data. Further, the stronger position of the biggest enterprise of *Typewriters* than that of *Lacing*, in dictating its terms to other enterprises, is also revealed by the index 'H'.

15. In group III 'C' for *Naphthols* and *Oil soluble Dyes* are almost the same, whereas the upward change in 'H' or 'A' seems reasonable to indicate the almost monopolistic condition of *Oil Soluble Dyes* in comparison to the duopolistic condition of *Naphthols*. All the six varieties of *Soap* are considered in group IV. 'C' varies from 100 to 76 only, even though the number of enterprises varies from 1-22. The comparison of various indexes is rendered more difficult by the widely varying number of enterprises. Nevertheless, of all the indexes, 'H' appears to reflect the most precise picture.

16. The applicability of the measures 'S' and 'A' is severely restricted in these illustrative examples as they are mostly confined to a small number of enterprises. As the Commission probably had the comprehensive data, it could make use of these measures more meaningfully. It is natural to believe that the Commission is not interested in a measure of deviation from monopoly just for its own sake; it is interested in it from the point of view of the possibilities of the monopolistic or restrictive trade-practices by the dominant enterprise or enterprises. The so-called "degree of concentration" as used by the Commission is based on the crude measure 'C' which is not a very sensitive measure, being invariant to the size-pattern of the enterprises. The size-pattern forms a very important basis of the plausible adoption of the monopolistic or restrictive trade-practices. The extent of high concentration based on the 'C' measure is likely to be exaggerated. Consequently the picture depicted by the Commission may not be quite satisfactory. The illustrations given in this paper reveal that the crude percentage share of the top three (measure 'C') may be supplemented at least by the Herfindhal Summary Index 'H'. Whenever the number of enterprises is fairly large, indexes 'A' and 'S' can also be gainfully used.

STATEMENT SHOWING PRODUCTWISE PERCENTAGE SHARE OF TOP ENTERPRISES AND MEASURES OF CONCENTRATION

Sl. No.	Name of product	No. of enterpri- ses 'n'	% share of top					Measures of concentration						
			1st P_1	2nd P_2	3rd P_3	4th P_4	5th P_6	C	S	A	100H	G	100L	100I
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
I Automobiles and allied Industries														
1.	Cylinder liners	3	94·3	5·1	0·6	—	—	100 H	—	81	89	62	122	88
2.	Three-wheelers (Auto)	3	67·5	28·7	3·8	—	—	100 H	—	71	54	42	41	47
3.	Scooters	3	51·9	41·6	6·5	—	—	100 H	—	65	45	30	25	29
4.	Motor cycles	3	35·7	32·5	31·8	—	—	100 H	—	51	33	3	0·1	4
II Light mechanical engineering industries														
5.	Stoves (Pressure type)	4	94·4	3·2	2·3	0·1	—	99·9H	33	85	89	47	148	94
6.	Steel bolt lacing	4	48·4	37·0	13·1	1·5	—	98·5H	22	71	39	27	47	55
7.	Typewriters	4	62·1	24·6	10·7	2·6	—	97·4H	12	71	46	32	34	58
8.	Stranded wire	4	44·2	25·2	19·2	11·4	—	88·6H	3	63	31	17	6	24

STATEMENT SHOWING PRODUCTWISE PERCENTAGE SHARE OF TOP ENTERPRISES AND MEASURES OF CONCENTRATION
— (Contd.)

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
III	*Dyes & explosives coke-oven by-products & coal tar distillation products*													
9.	Naphthols	4	53·3	38·8	7·8	0·1	—	99·9H	333	74	44	32	158	73
10.	Oil-soluble dyes	5	93·2	4·7	1·9	0·2	neg.	99·8H	167	88	87	19	185	92
11.	Optical Bleaching agents	6	60·9	14·4	12·1	5·4	4·0	87·4H	7	77	41	22	22	60
12.	Solvent naphths	5	37·7	32·8	15·1	7·8	6·6	85·2H	4	67	28	9	12	39
IV	*Oils, soaps, paints & food*													
13.	Soap-soft	1	100	—	—	—	—	100 H	—	50	100	—	—	—
14.	Soap-shaving	3	57·3	42·4	0·3	—	—	100 H	—	69	51	38	164	40
15.	Soap-Liquid	7	72·5	15·6	6·2	3·0	1·1	94·3H	22	86	55	24	56-	84
16.	Soap-other sorts	10	62·0	19·3	10·4	3·0	2·5	91·7H	26	87	43	17	67	89
17.	Soap Toilet	22	58·7	23·4	5·7	3·6	2·5	87·8H	46	93	40	9	64	95
18.	Soap-medicated	11	49·4	14·3	12·5	10·4	7·9	76·2H	8	83	30	13	57	83

Source : Cols. (2) to (9) : Report of the Monopolies Inquiry Commission (Appendix C).

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Summary

The Monopolies Inquiry Commission measured the product-wise concentration by the extent of percentage share of top three enterprises (producers) in the production of a commodity. It is contended that this index is completely insensitive to the size-pattern of the enterprises, which is very important in revealing the possibilities of monopolistic and restrictive trade-practices.

It is known that no single measure of concentration can be invariably best. Several indexes including the (above) crude share of top three enterprises (C), size-ratio of top three enterprises with the remaining enterprises (S), area under concentration polygon through 'n' enterprises (A), and Herfindhal summary index (H) are discussed here along with the illustrative numerical examples. In the present context one finds that 'H' is most sensitive to the size-pattern.

It is shown that in the absence of supplementing 'C' by any other measure, particularly by 'H', the results obtained by the Commission are hardly realistic and precise, thereby seriously limiting the utility of the otherwise extensive and painstaking study.

सारांश

उत्पादन संकेन्द्रण[1] के कुछ वैकल्पिक नाप[2]

विनोद प्रकाश

एकाधिकार जांच आयोग ने पदार्षवार संकेन्द्रण को पदार्थ के उत्पादन में शिखरस्थ तीन उद्यमों[3] (उत्पादकों) के प्रतिशत हिस्से की मात्रा द्वारा नाप लिया. यह तर्क प्रस्तुत किया गया है कि यह सूचकांक उद्यमों के उस आकार–संरचना के प्रति पूर्णतः हीनग्राही[4] है जो एकाधिकारात्मक और निर्बंधात्मक व्यापारिक कार्यप्रणालियों की संभावनाओं को उद्घाटित करने में बहुत महत्वपूर्ण है.

यह विदित है कि संकेन्द्रण का कोई एकमेव नाप निरपवाद रूप से सर्वोत्तम नहीं हो सकता. कई सूचकांकों की चर्चा दृष्टांत–स्वरूप संख्यात्मक उदाहरणों के समेत यहां की गयी है. शिखरस्थ तीन उद्यमों का (उपर्युक्त) अशोधित[5] हिस्सा (क), शिखरस्थ तीन उद्यमों का शेष उद्यमों के साथ आकार–अनुपात (स), 'न' उद्यमों के द्वारा संकेन्द्रण बहुभुज[6] के अंतर्गत क्षेत्र (अ), और हर्फिंघल सारांश सूचकांक (ह) इन में समाविष्ट हैं. इस संदर्भ में पाया जाता है कि (ह) सूचकांक आकार–संरचना के प्रति सर्वाधिक सुग्राही[7] है.

यह दिखा दिया गया है कि क का किसी अन्य नाप, विशेषकर ह द्वारा, अनुपूरण किये जानेके अभाव में, आयोग द्वारा पाये गये परिणाम शायद ही वास्तविक और परिशुद्ध[8] हैं. इस कारण, इस अन्यथा व्यापक और परिश्रम से संपन्न अध्ययन की उपयोगिता गंभीर रूप से सीमित हो जाती है.

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१. संकेन्द्रण – concentration

२. नाप – measure

३. उद्यम – enterprise

४. हीनग्राही – insensitive

५. अशोधित – crude

६. बहुभुज – polygon

७. सुग्राही – sensitive

८. परिशुद्ध – precise