
Original Paper

Market Power Index of Firms in Differentiated Oligopoly

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Abstract

Firms operating in differentiated oligopoly derive market power in their interface with the consumers (and the implied elasticity of demand) and their interaction with rival firms (reflected in their market shares). A change in the concept of demand for the product of any one firm and the corresponding definition of the elasticity of demand are warranted. The present study develops the requisite concepts.

1. Introduction

Most industrial firms encountered in practice can be designated as operating in a market characterized as differentiated oligopoly. The products offered by different firms are either substitutable or complementary. Each of the firms experiences a demand contingent on the variety on offer. In general, the price charged by the firm per unit of output depends on its volume of output as well as the output of other firms. Such a definition is more inclusive in the context of markets where several firms compete for the total demand from the consumers.

Three approaches have been at the forefront of measuring the market power of such firms.

(a) The Lerner (1934) measure $v = (p - MC)/p = 1/\eta$ (where p = price, MC = marginal cost, and η = elasticity of demand). Conceptually, this measure can be used for each firm. This measure is not meant to acknowledge the possible interrelationships between products and the necessity for aggregation at the industry level.

(b) The Herfindahl index $H = \sum s_i^2$ (where s_i = market share of firm i in the total output of the industry)¹ does not consider a firm level measure as relevant. In fact, it assumes that all the firms have the same demand curve based on the total industry output. The differences across firms are not acknowledged. That is, H considers only the industry level market power. Further, note that v is a measure of the market power of a firm per unit of its sales whereas H portrays the market power of the industry per unit of output of the industry.

(c) Fischer and Kamerschen (2003) acknowledged the interaction between firms. They took into account the conjectural variations in the output of each firm in response to the output choice of other firms. They neglect the differences in demand between the firms since they postulate the market as a homogenous oligopoly. The emphasis was only on the changes in market shares.

Both the above measures postulate that the firm maximizes profits in its choice of the levels of production. Elzinga and Mills (2011) noted that the welfare maximizing choice of the output of a product satisfies $p = MC$ if $\eta = \infty$. Hence, the market power, irrespective of the way it is measured, is due to the nature of the market². Two criticisms of the Herfindahl index were noted. First, Scherer (1970, p.73) argued that the use of the quadratic term cannot be justified on economic grounds. Second, Hall and Tideman (1967, p.164) noted that equal weights to all s_i^2 cannot be justified. Syverson (2019)

¹ Some details of this measure have been presented in Kwoka (1985).

² There have been difficulties in measuring MC in practice. Hall (1998) and Perloff et al. (2007) presented different methods of estimation.

pointed out other limitations. All these limitations relate to the mechanics of measurement rather than the economic process that underlie the conceptualization.

The above argument indicates that three aspects require attention while developing a measure of the market power of firms in a market characterized as differentiated oligopoly. (a) The notion of demand and the implied elasticity of demand for each firm, (b) the output over which the market power is achieved, and (c) the strategic interactions between the firms in the industry. The present study offers a modification to the market power index based on these characteristics observed in empirical reality. Section 2 deals with the necessary concepts. Section 3 presents the modified indices. Section 4 offers an overview and suggestions for further work.

2. Modification of Concepts

Consider an industry consisting of n firms producing differentiated products. Let the price p_i of product i decrease. It is expected that y_i (where y_i = output of firm i) will increase. The adjustments of the consumers and rival firms may be detailed as follows: (a) the product of the i^{th} firm will be substituted for each of the rival firms' products. A reduction in y_j can be expected. However, some consumers would have developed loyalty to the products of firm j based on (i) the positive experiences with the use of the product, (ii) the reputation of the firm reflected in its brand name, and (iii) the search and transaction costs in locating and procuring the product of firm i . The reduction in y_j tends to be small. Conjectural variation of rival firms will not be significant if brand loyalty is significant. (b) The sum total of the reduction in the products of all the rival firms may overtake the increase in y_i only if the rival products are of very low quality. This cannot be expected as a general proposition. (c) Since most firms operate at less than full capacity a decrease in y_j may increase the AC_j (average cost of production). This may induce firm j to offer a lower y_j and increase p_j . Note that this effect is from the supply side in addition to the reaction from the consumers. (d) *Ceteris paribus*, as y_j decreases there will be an increase in the price p_j . This may reduce y_j further. There will be a series of subsequent changes that culminate in the total demand for the total output of the industry.

In general, an increase in both y_i and $y = \sum y_i$ will be expected. Along with it the industry will experience some changes in s_i . Hence, it would be necessary to postulate that $p_i = p_i(y)$;

$\partial p_i / \partial y < 0$, indicating that only the partial effect of the change in p_i on y should be accounted for. The effect of changes due to rival outputs will be only on the market shares. Observe that these functions are specific for different firms. The changes in the market shares will be incorporated in the process of specifying the market power index.

Note that there may be several rounds of changes in p_i and y_i . Hence, the above specification takes only the first round effects into account. It therefore suggests that the above mentioned partial effects should be reflected in the definition of the elasticity of demand as well. The changes in the prices of the other products will be reflected in the variations in η_j and s_j . With the above conceptualization in perspective the elasticity of demand may now be defined as

$$\eta_i = - (\partial y / \partial p_i) (p_i / y)$$

The following conceptualization of the market power index will keep these changes in perspective.

3. Market Power Index

Let the cost of production be $C_i(y_i)$. Assume that the firm chooses y_i to maximize profits. Then, maximizing

$$\pi_i = y_i p_i(y) - C_i(y_i)$$

results in

$$p_i(y) + y_i (\partial p_i / \partial y) (\partial y / \partial y_i) - MC(y_i) = 0$$

However, $\partial y / \partial y_i = 1$ and hence

$$p_i - MC_i = p_i y_i / \eta_i y$$

It can be inferred that

M_i = market power attributable to firm i per unit of its sales is

$$= v_i s_i, \text{ where}$$

v_i = conventional Lerner measure, and

$s_i = y_i/y$ = market share of firm i in the total sales of the industry

The total market power attributable to firm i will be

$$M_i^* = v_i s_i y_i = v_i s_i^2 y$$

That is, the market power of the i^{th} firm in the total output of the industry will be $v_i s_i^2$, and the market power of the industry is

$$M = \sum v_i s_i^2$$

per unit of y .

4. Conclusion

The primary achievement of this note is the recognition that a change in the definitions of the demand for a firm and the elasticity of demand require a fundamental revision. Second, note that the market power may also be due to the change in the cost of production. In general, cost changes lead to changes in the market shares. This requires further analysis. In addition, note that the network effects due to consumer loyalty can also be taken into account by adopting the suggested approach. Third, each of the firms may utilize non-price strategies to alter the market shares. Their contribution to the market power may well be over and above the market shares as Rao and Bhattachayya (2021) documented.

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