Stochastic and Deterministic theories in reference to market concentration

Introduction

Market concentration is used when smaller firms account for large percentage of the total market. It measures the extent of domination of sales by one or more firms in a particular market. The market concentration ratio is measured by the concentration ratio.

The market concentration ratio measures the combined market share of all the top firms in the industry. 'Market Share' is used as a reference here in the formulae. It could be sales, employment statistics, number of people using a company's services, number of outlets etc. The value of top firms or top 'n' firms may be three or maximum five. If the top firms keep on gaining market share, then we say that the industry has become highly concentrated.

Concentration in markets can be understood by modeling the dominating position of the firms. Therefore, the engineering models are being used in economics for determining the market concentration.

In economics a model is a theoretical construct representing economic processes by a set of variables and a set of logical and/or quantitative relationships between them. The economic model is a simplified framework designed to illustrate complex processes, often but not always using mathematical. Frequently, economic models posit structural parameters. Structural parameters are underlying parameters in a model or class of models. A model may have various exogenous variables, and those variables may change to create various responses by economic variables. Methodological uses of models include investigation, theorizing, and fitting theories to the world. Models in economics can be classified into two-stochastic and deterministic.

1. Stochastic Modeling

A stochastic model represents a situation where uncertainty is present. In other words, it's a model for a process that has some kind of randomness. In this model ranges of value in the form of probability distribution are used. In other words we can say that stochastic modeling concerns the use of probability to model real-world situations in which uncertainty is present. Stochastic modeling is a form of financial modeling that includes one or more random variables. The purpose of such modeling is to estimate how probable outcomes are within a forecast to predict conditions for different situations. The Monte Carlo simulation is one example of a stochastic model; when used for portfolio evaluation; various simulations of how a portfolio may perform are developed based on probability distribution of individual stock returns.

Thus stochastic approach here focuses attention squarely on the problem of actual concentration change. Fundamental to this approach is the idea that the actual process of concentration change reflects the net effect of a multitude of uncertain influences affecting the decisions and growth rates of individual firms. Among these influences, certain things like days lost through strikes, exchange rate movements, the success of advertising campaign or a new product launch may be listed. The important point from the stochastic point of view, however is not what these factors are but rather that each firm's performance in a particular period is likely to be uncertain because of the multitude of influences at work. Given this view, the appropriate thing to do is not to look in detail at these influences but rather to make general assumptions about the process of concentration change. The approach, thus argues that chance plays a crucial role in explaining concentration change, but that such change is not random but is subject to general rules.

Stochastic models of various degrees of sophistication can be constructed, but for present purpose we stick to the simplest case in order to bring out general principles. Consequently, we abstract from the possibilities of entry, exit and merger and assume a given number of firms in an industry. Our central hypothesis, called the law of proportionate effect, is that each of these firms faces a given probability distribution of proportionate growth which is independent of its size. Thus, according to this assumption, the chance that each firm will grow by *p* percent in a certain period does not depend on its current size. A process which supports this assumption is called a *Gibrat* process. The first formal model on industrial dynamics was presented by Robert Gibrat in 1931, where he proposed that firm growth is independent of the firm size. In general, processes characterized by Gibrat's law converge to a limiting distribution, which may be log-normal or power law, depending on more specific assumptions about the stochastic growth process.

The law is thus of equiproportionate growth in the probability sense, although of course the actual outcome growth rates for each firm will not be equal.

Several points should be noted before we look at a simple example of the law in action. First the law is one of the proportionate rather than absolute growth, and this may seem intuitively reasonable *a priori*. This is the factor that imparts the empirically desirable property of positive skewness to the firm size distribution. Second, the *Gibrat* process gives rise to a tendency for concentration to increase persistently over time by increasing the inequality aspect of market concentration in contrast to the emphasis on firm numbers. It should also be noted that this feature of the process is not dependent on proportionate rather than absolute growth effects, but rather arise if there is any dispersion in firm growth effects.

Three comments can be enlisted.

1. While more complicated models than that outlined may be developed, in so far as they embody a *Gibrat* type process of proportionate growth, they typically give rise to firm size distributions with positive variance and skewness similar if not identical to a lognormal distribution. It is this factor more than any other which supports the use of the stochastic approach in the theory of concentration because it is just these features which characterize many empirical firm size distributions. Typically, industries consist of a large number of small firms and small number of large firms giving a characteristic positive skew to the distributions of firms by size. The statistical regularity with which such distributions arise represents strong *a priori* grounds for believing that a *Gibrat* type process is at work, although of course it may not represent the whole story.
2. It is important to note the neutrality of the process with respect to firm size. In postulating that the probabilities of proportionate growth are independent of firm size, the theory in no way derives the prediction of increasing competition by assuming large firm advantage. This contrasts with the scale

economies theory which gives larger firms the advantage of having lower unit costs. According to the present theory, however concentration will increase stochastically even when unit costs are similar for all sizes of firm. If important scale economies exist favoring the growth of larger firms relative to small, then this offers an additional reason for expecting concentration to increase.

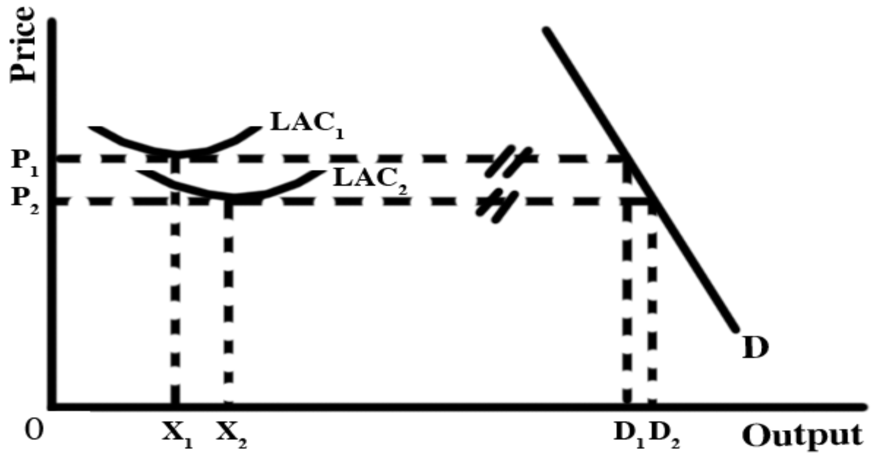
3. While additional effects may retard or speed the concentration process, the theory suggests that laissez-faire policies may not be sufficient to protect the competitiveness of the economy. It will, of course, be true that the tendency for concentration to increase owing to the *Gibrat* process can be offset if sufficient new firms enter the market and if small firms grow faster than large firms on average. Against these influences, however, we have firm deaths arising from bankruptcy or merger, plus, the fact that often large firms do not have significant advantages over small firms. The overwhelming predominance of mergers over the divestment of companies, in particular, acts as a force favoring concentration. This simultaneously leads to a large increase in firm size and reducing firm numbers, and this factor has been important in previous times. Underlying the mergers phenomenon, however, differential internal growth rates of firms can also persistently increase concentration. This suggests that, in the long run at

least, a commitment to maintain a competitive economy may require a policy not only to control mergers but also to support small businesses in a positive way.

2. Deterministic Modeling

Mathematical model in which outcomes are precisely determined through known relationships among states and events, without any room for random variation. In such models, a given input will always produce the same output, such as in a known chemical reaction. In comparison, stochastic models use ranges of values for variables in the form of probability distributions. Deterministic modeling also typically dictates there is only one set of specific values. It means that a deterministic model does not include elements of randomness. Every time you run the model with the same initial conditions you will get the same results. In mathematical modeling, deterministic simulations contain no random variables and no degree of randomness, and consist mostly of equations, for example difference equations. These simulations have known inputs and they results in a unique set of outputs. Contrast stochastic (probability) simulation, which includes random variables. An example of a deterministic model is a calculation to determine the return on a 5-year investment with an annual interest rate of 7%, compounded monthly.

According to the deterministic approach, there will be a determinant equilibrium level of concentration in a market at a point in time, determined by given demand and cost conditions and the behavior of the market participants and towards which the market will be continuously adjusting. In particular it is argued that technological factors will play a central role in determining efficient levels of plant operation and hence this equilibrium concentration level. An implication of this particular hypothesis is that high or increasing levels of market concentration can be explained by underlying, mainly technological changes – an argument which has been used by some authors as a justification for such high levels of, or increases in, market concentration. The basic argument for this hypothesis comes from the standard micro-economic theory.

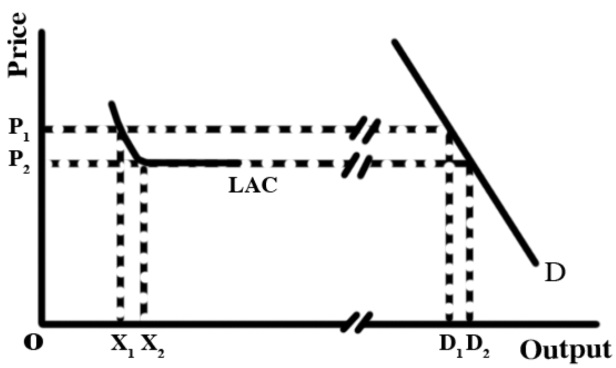


The figure here depicts the conventional U shaped long run average cost curve, LAC_1 for a firm in a competitive industry. Scale economies operate up to the least cost or optimal scale of production x_1 and then scale diseconomies immediately set in. in long run competitive equilibrium price will be p_1 (such that p_1=LAC_1=LMC_1 (not drawn) and there is a corresponding market demand $D_1=f(p_1)$. Each firm will be of optimal size x_1 and the level of concentration in the market, as measure by 1/n, i.e x_1/D_1. It follows that a rise in the ratio of optimal scale to market size owing to a technological change will reduce the number of market participants, thereby increasing market concentration. This is illustrated in the figure by a downward shift in the long run average costs to LAC_2, which increases optimal scale to x_2 and reduces the competitive price to p_2. Concentration will increase in competitive equilibrium of the growth in market size (D_2/D_1) which will be less than the increase in optimal scale (x_2/x_1).

The comments regarding this are enlisted here;

1. The scale of economies hypothesis concerns the number of firms which, can operate in a market given cost and demand conditions; it does bit specifically address aspects of the market share inequality of market concentration.
2. The hypothesis emphasizes the importance of scale economies relative to market size, rather than scale economies per se. The existence of substantial scale economies implies large firms, but if the market is also very large then it may not necessarily be the case that the number of market participants will be low. Finally it should be noted that the theory is a long run equilibrium theory and in particular that a change of the type envisaged in the shift from LAC_1 to LAC_2 might take many years to establish a new equilibrium. Technical developments, may permit the bulk handling of chemical products, thereby enabling firms to gain economies of increased dimensions; but plant capacities cannot be increased overnight and a long period of investment and adaption to the new opportunity may be necessary. The

theory suggests that eventually a new equilibrium with fewer firms will arise but the prediction is a long run one. This point is of some relevance in interpreting the evidence and implications of this hypothesis.



The theory outlines above is a simplification in at least two respects.

First, it assumes that long run average cost curves are U shaped when a great deal of evidence suggests that they are in fact L shaped. The figure here introduces this modification wherein scale economies operate to scale x_1, the minimum efficient scale (MES), and constant costs prevail thereafter. This modification suggests only that scale economies set a lower bound to concentration in competitive conditions in that $1/n >= x_1/D_1$. Indeed, in this case, firms may be of unequal size (x_1 or above), so that without some specification of the distribution of firm size we no longer have a completely specified theory of concentration. Second this problem is complicated if equilibrium price is greater than p_1, as it may be in oligopolistic or monopolistic circumstances. If the equilibrium price is p_2, say in figure, then firms of less than minimum efficient scale may operate, so that x_2/D_2 sets the minimum concentration level 1/n. Clearly the distance x_2x_1, which measures the extent to which production at less than MES is possible, depends upon the steepness of LAC i.e. the cost disadvantage of operation at suboptimal scale. The specified provisions weaken the scale economies theory of market concentration, in that it is necessary to introduce arbitrary hypotheses to take account of firm size inequality and suboptimal production. The simplest hypotheses is that equilibrium is such that the distribution of market shares is fixed about the ratio of MES to market size. This hypothesis is unlikely to be true. A central problem with the empirical studies of the scale economies hypothesis centers on the measurement of scale economies. Broadly speaking the estimates of scale economies are obtained either in limited quantity by painstaking research or in greater numbers by more arbitrary procedures.

Given these reservations, conclusions at this stage must be tentative. It does not seem unreasonable to suggest that the evidence is consistent with a technological effect in changing concentration which is however, only part of the story. Given that the scale economies hypothesis is a very long run one, it is observed that the broad pattern of concentration in a ten year period or less, however are due partly to technological changes but predominantly to other unspecified forces.

Thus, Deterministic approach emphasizes on equilibrium concentration level whereas the stochastic approach focuses on the problem of actual concentration change. Stochastic models of various degrees can be constructed. Stochastic process says that each firm's performance in a particular period is likely to be uncertain.

Summary:

In this session we learnt that modeling can help us to understand the concept of concentration of the market. In economics a model is a theoretical construct representing economic processes by a set of variables and a set of logical and/or quantitative relationships between them. A model establishes an argumentative framework for applying logic and mathematics that can be independently discussed and tested and that can be applied in various instances. We have studied two types of model. Firstly, a stochastic model: it represents a situation where uncertainty is present. In other words, it's a model for a process that has some kind of randomness. Secondly a deterministic model: this is a Mathematical model in which outcomes are precisely determined through known relationships among states and events, without any room for random variation. We have examined the issue of concentration from view point of both stochastic and deterministic situations.