

to maximization of economic entropy with the maxima condition-  $W_1 = -W_2$ . Hence, the second law of thermodynamics, applied to modern economic frameworks, can show how a policy like the Washington Consensus is a legislative catalyst that maximizes global entropy and leads to the formation of massive inequities in the process. However, the third law (also known as the zero law) which says that heat transfer between two bodies of the same temperature does not take place (molecular motion ceases at absolute zero) implies that as soon as inter-nation entropies are equal and total entropy is maximum, human-capital flows will stop. Thus, according to this perspective, inequalities arising as a result of globalization appear to be unavoidable and would maximize at a particular time period. (shown in the graph below).

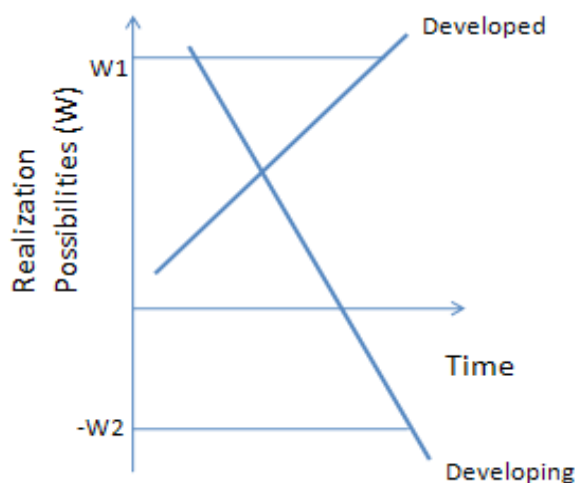


Figure: Entropy Maximization with respect to the Washington Consensus Paradigm

While the above made analysis can be criticized on the basis of scientism, it leads to the conclusion that several economic activities that base themselves on rational, empiricist models are primarily focused on short-run objectives. Using various analogies from the study of matter, one can make various predictions, which might highlight the 'dismal' character of the economic science if they come true. Economic inequality is not just a social phenomenon but a lot of its causes and effects have a strong scientific logic. Since the matters of a natural science are considered indisputable in popular discussions, certain analogies have been used to interpret the social science in a new way. What qualifies as progress and development in the pure economic sense, might lead to a catastrophic outcome, which given the prophecies made using physics, can be prolonged but not avoided.

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## The Validity of the Cournot Model in Present Times

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**ABSTRACT:** Game theory is one of the most studied topics in the subject of Economics. The presence of many firms, increased competition and market conditions give scope for research. Strategic behavior of the firms in an industry is an interesting aspect. Strategic decision making with the use of mathematical models enables the producer of a firm to achieve

leadership in the market. Nash equilibrium, Cournot Competition model, the Bertrand model, the Stackelberg model and price and quantity leadership models are various strategies that producers use in their best interests. This paper attempts to understand the Cournot competition model and analyze it by understanding the Cement industry in India. The paper

*checks how far the cement industry puts into use the Cournot model while it also questions the applicability of the model in India in the present time.*

### **Introduction:**

Competition between markets is inevitable. Each firm chooses a strategy that it thinks is appropriate so as to achieve profit maximization. The Cournot model is a simple model that explains competition between two firms i.e. competition in a duopoly. Here, output is the variable under consideration.

The Cournot model gets its name from the French economist who introduced the model- Antoine Augustin Cournot. The theory was developed in his book 'Researches on the Mathematical Principles of the Theory of Wealth', which was first published in the year 1838. As he was more of an economist than a mathematician, he has used mathematical tools extensively in his work on economic models.

According to the model, "each firm must decide how much to produce, and the two firms must make their decisions at the same time. Each firm treats the output level of its competitor as fixed when deciding how much to produce" (Pindyck, Rubinfeld and Mehta, 2009).

Cournot's model is the study of the 'behaviour of independent decision makers whose fortunes are linked in interplay of collusion, conflict and compromise' (Shubik, 1983 cited in Rutherford, 2002). Similar to Cournot's model is Bertrand's Competition Model and the Stackelberg model which can be used to analyse strategic behaviour.

The model initiated by Cournot works under certain assumptions. Firstly, the two firms under consideration produce homogenous goods and secondly, the cost of production of the firm is zero. Since it is only the demand side of the market that is analysed, it is also assumed that the duopolists are aware of the linear market demand curve. The duopolist also believes that regardless of his decision, the output of his rival firm will remain constant (Ahuja, 2011).

### **Cournot equilibrium and Reaction Curves**

The output reaction curve is not the reaction of the rival firm that the seller anticipates. Rather, it is the reaction of the seller to the rival's decisions. This view is supported by Ahuja (2011).

Thus, as Sciubba (n.d.) has pointed out, equilibrium occurs when the quantity that one firm produces is the optimal quantity for that firm, given the quantity produced by its rival; and the quantity that the rival produces is the optimal quantity for it, given the quantity that the former firm produces. The reaction

function for each firm would then be the optimal quantity produced by that firm for each level of output by the other firm. The point where these two reaction functions intersect represents equilibrium for this market. (See appendix, fig. 2)

Cournot's model of duopoly can be extended so as to study markets with more than two firms like the Cement Industry. Here, "each firm has an expectation about the output choices of the other firms in the industry and seeks to describe the equilibrium output" (Varian, 2010, pp.511-12). The cement industry is one such oligopolistic market where the Cournot model can be analyzed so as to see whether it holds true in the real world scenario.

The cement industry in India is very large. However, due to existence of homogeneity in the product there are not many players. Hence, the cement industry can be analyzed through the Cournot model. The analysis will be based on the data obtained in the last three years.

India, being the second-largest producer for cement in the world has seen a large increase in the rate of growth of the cement industry. The demand for cement continues to expand due to the huge infrastructural developments. Under such circumstances, it can be well assumed that the players involved in this market definitely employ economic game theories so as to carve their way to the top along with the aim of profit-maximization.

Therefore, this paper tries to study the game play of the cement industry using Cournot model of competition. It seeks to arrive at a conclusion as to whether the classic duopoly model is still applicable to the industry or has it since been replaced by some others strategic competition model

### **The Case Study:**

The cement industry in India is a classic example of oligopoly market structure such that the product under consideration (cement) is homogenous in nature and new/potential producers face barriers to enter the market that is dominated by big players.

The major domestic cement companies in India include Ultratech Cement, Ambuja Cement, JK Cements, ACC Cement, Century Cements, India Cements, Sanghi Cements, Dalmia Cements, Saurashtra Cements and Madras Cements.

It is expected that the cement industry will grow at a compound annual growth rate (CAGR) of around 12 per cent during time period 2011-12 to 2013-14. The estimated production output of the cement industry is projected to be 303 Million Metric Tons at the end of

the time period, according to Indian Cement Industry Forecast 2012.

### Analysis of the case study:

Output is the essence of the Cournot model. If each firm decides to produce its output depending on the output of its rivals, it can be said that the Cournot model game strategy is being used.

As mentioned before, firms under duopoly and oligopoly face barriers to entry. The cement industry faces barriers like high capital costs and long gestation periods and access to limestone reserves (key input). (Equity Master.com)

According to reports in IIFL, Ultra Tech Cement Ltd. will increase their volume to 62 mtpa in the next financial year (2014). On the other hand, India cements have already increased their volume by about 11% during this financial year.

Both Ambuja cements and ACC have experienced a growth in volume, the former at 2.5% and the latter at 5.5%.

Reports and statements given by each firm specify the volume produced each year, the increase in their volume, the estimated increase in the future and so on. This could merely mean expansion of the plant or it could be a result of decisions taken by rival firms. For the firm to employ the Cournot model, it should speculate the output of its rival firms because the model works on the assumption that all firms under consideration make their decisions simultaneously.

An article in The Hindu in November, 2013 had pointed out that India Cements went through a loss of Rs. 22.53 crore in the last quarter that ended in September due to a weak demand and increased costs. Since then, the company has decided to increase their exports to 20,000 tonnes a month so as to recover from their losses. Such a decision is independent of the decisions of its competitors. This example explicitly points out to the fact that the decision of a company to increase its output may not necessarily be a response to the speculated output of the other companies.

Looking at various studies, reports and analysis, one cannot say that the cement industry does not employ other game strategies. It is therefore essential to look at other competitive models so as to understand the game strategy/strategies used by cement companies.

The Bertrand model is a response to the model given by Cournot. According to this model, the firms choose the price at which they would sell their product and the market decides the quantity, unlike the Cournot model where the price is determined by the market (Varian, 2010).

However, the Bertrand model cannot be applied to the cement industry. In a Bertrand equilibrium, price equals marginal cost. In the case of multiple firms, competitive bidding is observed where prices are much lower than can be achieved by other means (Varian, 2010). A cement industry incurs huge production costs and would not be able to thrive if the prices are so low that production costs cannot be recovered. Also, cement is price inelastic as there is no substitute for it. Therefore, cement companies do not engage in price cutting strategies.

The only route for profit maximization for a cement company is to raise the price of cement or the volume of production. Recent articles (TOI and World Cement, 2013) show that the price of cement has shot up drastically from about Rs. 215 to Rs. 315 per 50kg. Analysts have stated that the reason cannot be attributed to any demand and supply changes. All cement manufacturers have hiked up the cement price. This tendency of the cement manufacturers is an example of price leadership.

A firm may either set a price on its own accord or set the price of its product based on the price set by its competitor. When a firm gets to set the price before its rivals, it is a price leader. Such a firm is a major player in the market. The other firms would have to set the prices of their product keeping in mind the price set by the price leader. These firms are called price followers. In the cement industry, Ultra Tech Cement Ltd. and Ambuja Cement are the big market players and smaller cement firms are forced to be price followers.

Quantity leadership is similar to price leadership, except the variable involved here is quantity. The firm that decides its output first is the leader. This model is also called the Stackelberg model eponymously named after the economist Stackelberg who first studied the leader-follower interactions. The firms act according to the decisions made by the dominant player, the dominant player being the Stackelberg leader and the smaller firms being the Stackelberg follower (Varian, 2010). Statistics provided by ISE (2011) show that UltraTech Cement Ltd. has an annual capacity of producing 24.3 metric tonnes of cement. The other firms, the Stackelberg followers have lower capacities of production. It would be unrealistic and irrational if these firms try to produce as much as the dominant firm. It would only increase production costs and generate a surplus stock.

Market conditions force firms to alter their decisions constantly. The cement industry also succumbs to various conditions, which compel the firms to make

new decisions regarding the price, quantity, etc. Cartels could also be formed for the benefit of the industry. The Routledge Dictionary (2002) defines a cartel as an association of producers who agree to fix common prices and output quotas in an oligopolistic market. As the aim of a cartel is to prevent competition, there is a tendency for the producers to strive to maintain existing market shares, with the consequence that a firm can only increase its output if total market demand rises. The device of a cartel has long been used as a method of restricting competition.

Last year (2012), eleven cement companies including ACC, Ambuja Cement, Ultra Tech Cement and Jaiprakash Associates were fined as they had engaged in cartelization. The cement companies allegedly decreased production in a bid to increase prices, which restricted output and had an adverse effect on the economy. The top 11 companies by the virtue of the fact that they collectively hold more than 57% of the market share in India enjoy a position of dominance and arbitrarily increased the price of cement (Mishra et al, 2012). The smaller companies were forced to change their strategy as well as output decisions owing to the market dominance. A cartel in the industry would take game play to another level where each firm is tempted to sell more than the output that was agreed upon if it believes that the other firms will not respond. This will eventually lead to instability (Varian, 2010).

#### **Applicability of the theory in India:**

The Cournot classical model uses a duopoly market structure. It has been further developed by many economists so as to analyze oligopolistic markets. Firms in the cement industry do use output as a variable to compete against their rivals. This strategy is used along with interplay of one or more game theories. As analyzed above, price leadership models are also used. This does not limit the applicability of the theory.

Other industries where the Cournot model could hold true are the timber industry, the airline industry and the computer industry, and more recently, the tablet industry, to name a few. These industries are oligopolistic in nature and sell homogenous goods to some extent. They do compete once in a while, using output as their variable. What is impossible to believe is that these industries always use the Cournot model as their strategy.

The current market situation is complex where one market analyst cannot hope to bring out a result that is the same as that of another market analyst. Market forecast changes quickly, which compels the firms to constantly change their game play. Therefore, firms depending on the market situation employ a variety of

strategies. This does not make an age-old model redundant. In fact, the model is altered so as to suit present times.

#### **Conclusion:**

The Cournot model, by itself is not enough if a firm has to survive the tough competition prevalent in the economy. The theory has certain flaws in it that do not allow for testing in the market. For example, the assumption that all firms simultaneously make their decisions does not hold true in the real world. It is impossible to speculate randomly and expect to arrive at an equilibrium. Firms speculate based on the reports published by other firms. The assumption of the behaviour of the two firms in the model is rather unrealistic and more theoretical. It would be hard for two or more firms to behave exactly as explained in the model. Consequently, the theory has been retained for academic purposes but it has definitely left scope for alterations and additions.

A firm finds it easier to maximize profits by using multiple strategies. Therefore, it can be observed that the cement industry puts to use leadership models, both price and quantity, along with a limited use of the Cournot competition model.

Thus, the study of the cement industry in India with respect to the Cournot competition model is easier said than done.

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