

A Mathematical Study of COBWEB Model for Economic Demand Analysis

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Article Info

Volume 83

Page Number: 2068 - 2070

Publication Issue:

March - April 2020

Abstract

In order to illustrate the various significant applications of first order differential equations specifically in the field of economical analysis, there are especially two models for a single commodity in particular. The first model is known as 'COBWEB Model' and the second model is referred as 'Market Model'. The first model is having significant merits when compared to the second model in terms of price-demand analysis. Mathematically, this model is simple to analyze. The COBWEB model could be applied to the prices and output of commodities whose production is not continuous in nature. Thus, this model assumes the present's demand for any commodity is a function of price. Hence, in this paper much emphasis is given to study about the mathematical analysis of the COBWEB model and its various diagrammatic representations.

Article History

Article Received: 24 July 2019

Revised: 12 September 2019

Accepted: 15 February 2020

Publication: 18 March 2020

Keywords: COBWEB, Commodity, Economic analysis, price.

I. INTRODUCTION

The cobweb model is considered to be an economic model that, basically explains the reasons, why the market prices might be subjected to periodic fluctuations respectively. It mainly describes the supply and demand situations in a market where the amount generated must be selected before the actual prices are being observed [1].

The COBWEB model basically assumes that, there is perfect competition. Thus, the output is depended upon the previous old price. The model clearly explains the variation in supply and demand changes [2, 3]. The variations in prices shall also be illustrated clearly.

The following are the conditions that occur in the

supply – demand variations, namely:

1. If there is exist good harvest, then the supply will be higher than the expected and in turn, this condition will leads to fall in price.
2. Further, however this fall in price may cause few farmers to think in order go out of the business. Thus, farmers may reduce the supply.
3. If supply of the commodity is reduced further, then this will in turn causes the price to hike a little bit.
4. If farmers observe the hike in prices with good profits, then next further years, they are supposed to increase the supply to get more profits.

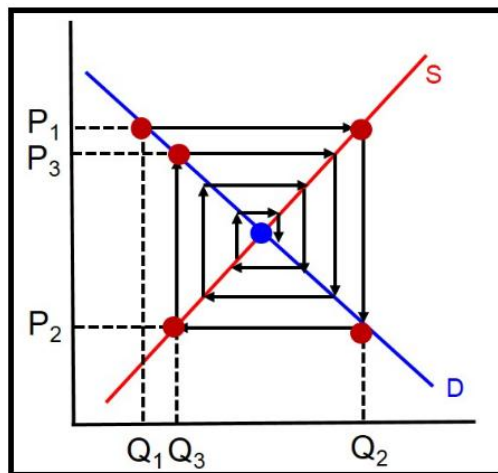


Fig: 1 COBWEB Model

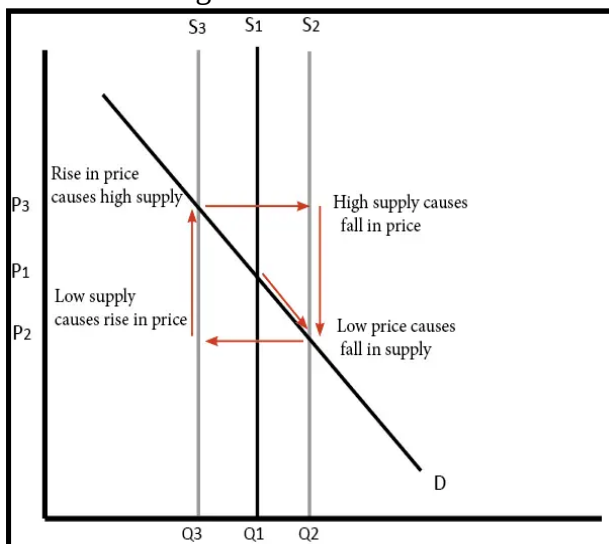


Fig: 2 Price versus Quantity plot

II. MATHEMATICAL ANALYSIS

Mathematically, the model can be explained as follows:

For demand function, we have the relation,
 $D = x + \alpha P_t$ ----- (1)

Where, P_t = Price depending on present time.

For supply function, we obtain, $S = y + \beta P_{t-1}$ -----
--- (2)

According to the model, both the demand and supply functions are assumed to be linear. Hence, we get the relation, $D = S$

i.e. $x + \alpha P_t = y + \beta P_{t-1}$ ----- (3)

on further re-arranging and solving the above equation, we get,

Let $P_t = \bar{P}$ then we have, $x + \alpha \bar{P} = y + \beta \bar{P}$ -----
(4)

$\bar{P}(\alpha - \beta) = y - x$ ----- (5) Thus, we can obtain the value of equilibrium price ($\bar{P}$)

Furthermore, performing equation (4) – equation (3) and solving, we obtain equation as follows,

$$P_t = \frac{\beta}{\alpha} (P_{t-1}) \text{----- (6)}$$

Where α and β are termed as the slopes of the demand and supply curves. In general, $\alpha < 0$, $\beta > 0$.

Thus we get, the ratio of β to α is obtained as ‘negative’ sign.

The various types of cobweb models are depicted below:

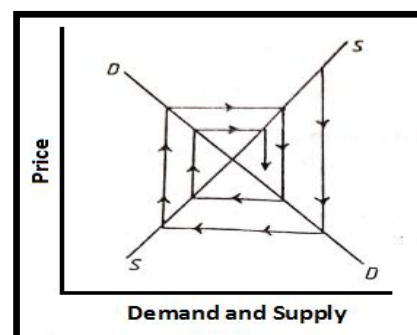


Fig: 3 Damped Cobweb model diagram

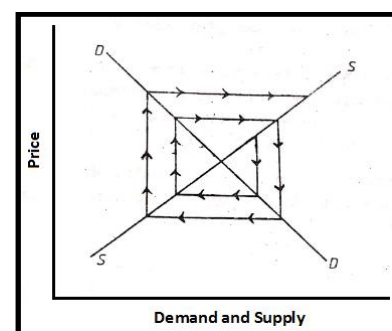


Fig: 4 Explosive Cobweb model

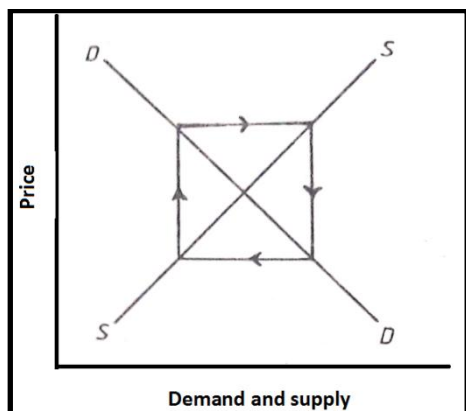


Fig: 5 Perpetual Cobweb model

III. INFERENCES

The explanation for the Fig. 3, 4 and 5 are illustrated as follows:

a) In Fig. 3, the condition is implied that, $\beta > \alpha$. If $\beta > \alpha$, then it can be observed that, the demand is relatively inelastic and slope of the demand curve is greater than the slope of the supply curve. It is also seen that, the price and the output flap up and down initially and finally reaching the equilibrium value. Hence, this condition is referred as “Damped cobweb”.

b) If $\beta > \alpha$, the slope of demand curve is less than the slope of the supply curve. In this case, the price fluctuations will tend to become wider going away from equilibrium. This condition is referred to as “Diverging cobweb” which is represented in Fig. 4.

c) If $\beta = \alpha$, then the slope of the demand curve is equal to the slope of the supply curve. In this situation, the price regularly oscillates from high to low and vice versa. Hence, the equilibrium is never achieved. Thus, this condition is called as “perpetual cobweb” which is depicted in Fig. 5.

IV. CONCLUSION

This paper explained about the variation in the price and demand parameters based on the cobweb model by adding the necessary mathematical treatment. Mathematically, certain equations are obtained which describe about the slopes of the demand and supply curves. Few inferences have been

presented in this paper, to illustrate the variations happening in the price and supply thereby altering the demand of the commodity.

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