A Note on the Correct Diagrammatic Presentation of the Case of Perfectly Elastic Demand and Supply

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Abstract

This short note tries to highlight an egregious error present in the diagrams of perfectly elastic demand and perfectly elastic supply in microeconomic textbooks. Both these diagrams are incomplete in most of the books as far as the second price is concerned. It should have been taken to show the infinite change in demand and supply, which is missing in the diagram. The subject having been accorded the status of science, this mistake needs to be rectified on an immediate basis, at least by teachers dealing with the instruction of microeconomics, for the purpose of maintaining academic purity and mathematical consistency in the treatment of this topic. I have presented the correct diagrams of perfectly elastic demand and supply along with the necessary mathematical explanation in the concluding part of this paper.

***Keywords*: demand, supply, price, elasticity, infinite**

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In microeconomics, one thing that has kept me pondering for quite a long time are the incomplete and ,therefore, inappropriate diagrams or figures of the case of perfectly elastic demand as well as supply that appear in most of the microeconomic textbooks (meant for both traditional courses and professional programs) as well as popular guide-type books. I have not come across a single textbook which contains the correct diagram along with the accurate explanation of these two cases. In this short note, I have made an attempt to highlight the error in these two diagrams and then have presented the correct diagrams.

To start with the basics, almost all the textbooks define price elasticity of demand mathematically as:

$$E_d = \% \Delta D \times \% \Delta P$$

Where,

E_d is the price elasticity of demand ; D stands for quantity demanded ; P stands for price of the concerned commodity, and Δ stands for a change.

Each textbook then goes on to explain the following five types of price elasticity:

(1) Relatively elastic demand (value of $E_d > 1$ as $\% \Delta D > \% \Delta P$),

(2) Relatively inelastic demand (value of $E_d < 1$ as $\% \Delta D < \% \Delta P$),

(3) Unit elastic demand (value of $E_d = 1$ as $\% \Delta D = \% \Delta P$),

(4) Perfectly inelastic demand (value of $E_d = 0$ as $\% \Delta D = 0$),

(5) Perfectly elastic demand (value of $E_d = \alpha$ when $\% \Delta D = \alpha$).

There is no flaw so far as the theoretical explanation and the diagrams are concerned for the first four cases. The error lies in the treatment of the fifth case of perfectly elastic demand. At the very outset, one has to be clear about the fact that a ratio would become infinite in the following two cases :

(1) numerator is infinite, given a non-zero denominator or ,

(2) denominator is zero, given a non-zero numerator.

So, there are two mathematical ways in which the value E_d can become infinite. But going by the meaning of E_d ,

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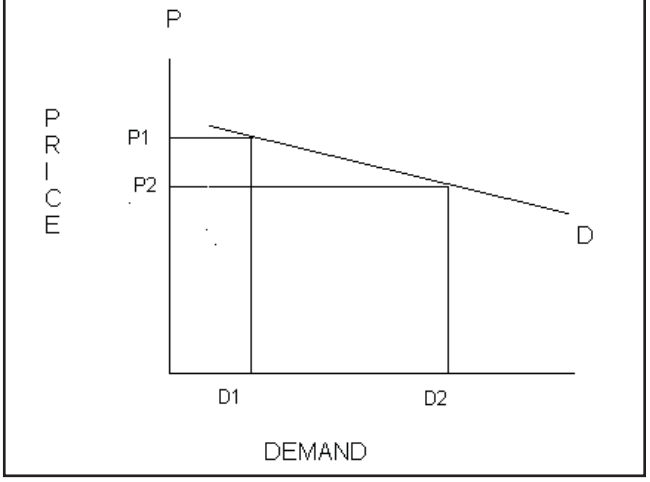
the second of the two cases above is easily ruled out as no change in price would amount to not discussing the concept of price elasticity. Therefore, we need to comprehend the case of infinite E_d when a change in price (small or big does not matter) results in infinite change in demand. In the diagrams of the first four values of E_d, two price levels were taken on the Y-axis to show that price is changing and then a comparison of this change was done with the resulting change in demand to arrive at a conclusion with respect to the numerical value of E_d . A brief description of these four cases is presented herein:

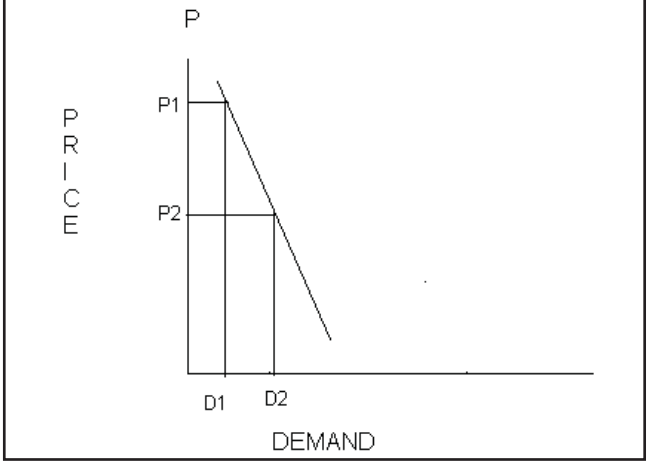
1) Relatively Elastic Demand (E_d > 1) : Proportionate change in demand is greater than proportionate change in price, giving the value of E_d greater than 1 as shown in the Figure 1.

Figure 1. Relatively Elastic Demand



2) Relatively Inelastic Demand (E_d <1) : Proportionate change in demand is less than proportionate change in price, giving the value of E_d less than 1 as shown in the Figure 2.

Figure 2. Relatively Inelastic Demand



3) Unit Elastic Demand (E_d = 1) : Proportionate change in demand is equal to proportionate change in price giving the value of E_d equal to 1 as shown in the Figure 3.

4) Perfectly Inelastic Demand (E_d = 0) : Demand does not change at all in response to change in price, giving the

Figure 3. Unitary Elastic Demand

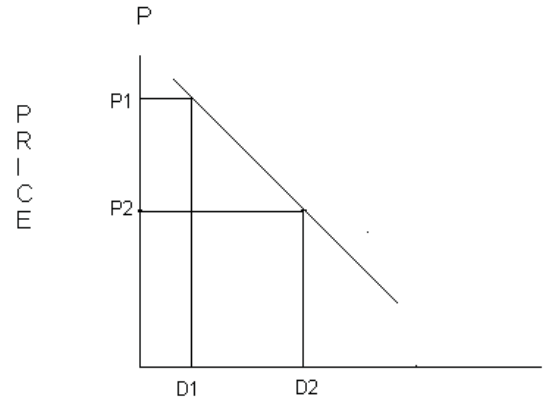


Figure 4. Perfectly Inelastic Demand

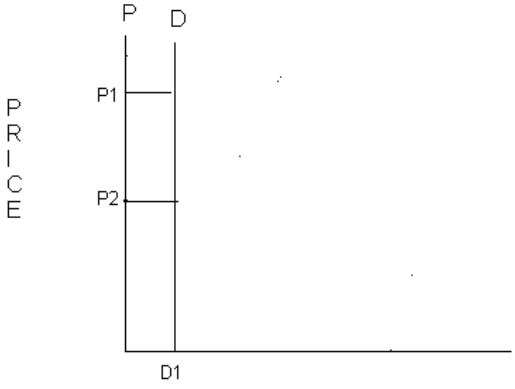
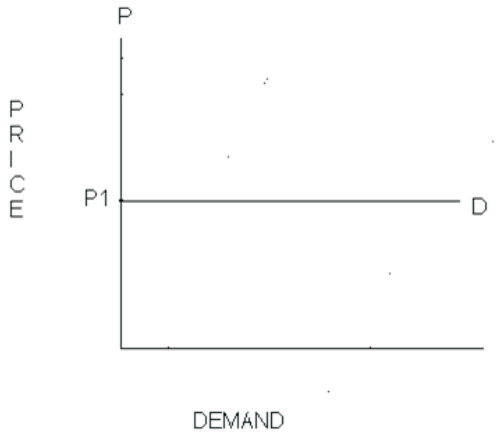


Figure 5. Perfectly Elastic Demand



value of E_d equal to 0 as shown in the Figure 4. As can be seen, these diagrams are very convincing and logically correct. But the diagram of the fifth case of perfectly elastic demand is incorrect, which has been discussed in the following section.

5) Perfectly Elastic Demand ($E_d = \alpha$) : Change in demand is infinite in response to a given change in price, giving the value of E_d equal to infinity as shown in the Figure 5. From the description that follows immediately after this incomplete diagram, one can gather that one is made to believe that the horizontal line representing the demand curve can be stretched to the far right and so, the conclusion that demand is infinite and the case is about perfectly elastic demand. Here lies the catch. The second price in the diagram is missing!!

Allen, Doherty, Mansfield, and Weigelt (2005) stated that "the demand curve is a vertical line if the price elasticity is zero and a horizontal line if it is negative infinity" (p. 93) but nothing has been mentioned in detail about the perfectly elastic case under discussion. Similarly, Griffiths and Wall (1996) defined the concept as "an infinitely small percentage change in price leads to an infinitely large percentage change in quantity demanded" (pp. 58 - 59). The same is true even if the change in price is not infinitely small. Secondly, their diagrammatic analysis too relies on one price taken on the vertical axis.

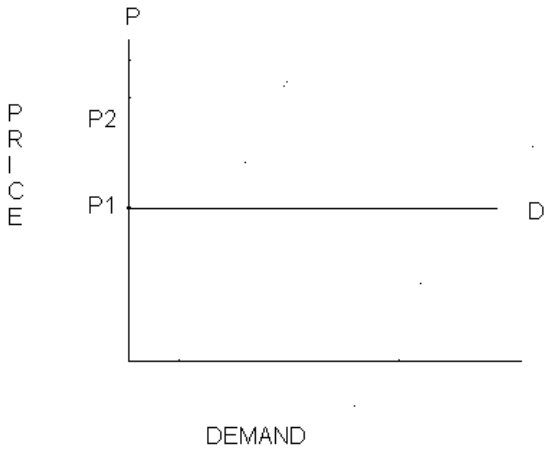
Mehta (1999) defined the case of perfectly elastic demand as the one "where no reduction in price is needed to cause an increase in the quantity demanded" (p. 99). However, he failed to answer the question of a change in price and its effect on the quantity demanded. Also, the diagram in this particular case contains only one price on the Y -

axis; whereas two prices have been considered in each of the other four cases. Ahuja (2010) correctly defined the concept as "this horizontal demand curve for a product implies that a small reduction in price would cause the buyers to increase the quantity demanded from zero to all they could obtain. On the other hand, a small rise in price of the product will cause the buyers to switch off completely away from the product so that its quantity demanded falls to zero" (p. 207). The description is correct, except for the mention of a small change in price, but the diagram presented does not contain the second price on the vertical axis.

Kennedy (1999) defined the concept of perfectly elastic demand as " it refers to a situation where a minute change in price evokes an enormous change in quantity. In other words, a slight increase in price brings down the quantity demanded to zero" (pp. 217-218). Here too, the description is correct, but the diagram drawn misses out on the second price to be taken on the *Y*-axis. Misra and Puri (1998) faulted on both the fronts - the description as well as the diagram - when these authors wrote "if the demand for a commodity changes though there is no change in its price, it is a case of perfectly elastic demand. In other words, if the quantity demanded keeps on increasing or decreasing in spite of the fact that the price remains constant, elasticity of demand is said to be equal to infinity" (p. 91). Their diagram too does not contain the second price.

So, where should the second price be taken to complete the diagram? Two possible answers are - above the existing price ($P1$) and below the existing price ($P1$). If we take the second price below the existing price, it would result in violation of law of demand, as it would mean that at a given price ($P1$), the demand for some commodity is infinite and with a decrease in price to P_2 below the existing price, demand shrinks to zero (there is no demand curve at P_2 price). Hence, the second price ($P2$) should be taken above the existing price and the complete and correct diagram should look like as shown in the Figure 6.

Figure 6. Correct Diagram of Perfectly Elastic Demand



It can be seen in the Figure 6 that there is no demand curve and hence, no demand at price $P2$. How to explain infinite elasticity? The explanation should run like this - when the price was $P1$, the demand for the given commodity was infinite and as the price increases to $P2$, the demand becomes zero. Therefore, the change is :

(-) infinite [change = final value – original value]

But if we were to start from $P2$, the explanation can be given as : When the price was $P2$, there was no demand for the commodity, but when the price decreases to $P1$, the demand increases infinitely. Here, the change in demand is calculated as :

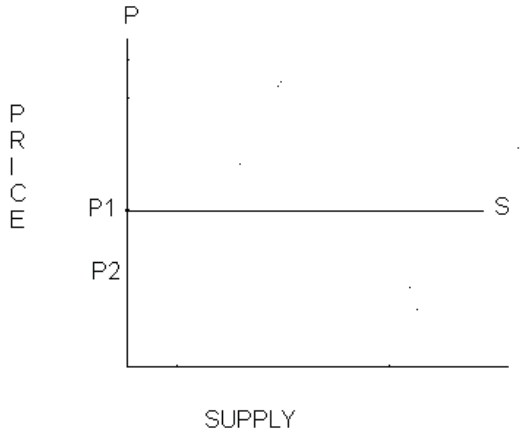
$$\alpha \text{ (final value)} - 0 \text{ (original value)} = (+)\ \alpha$$

As has been proved in both the cases, the change is infinite (+ or – sign does not make a difference so far as our topic is concerned). Lastly, such a case is only a theoretical possibility. There is no commodity whose value of price elasticity of demand is infinite. The discussion of perfectly elastic demand is helpful to understand why a firm

under perfect competition faces a horizontal demand curve. Similarly, Ahuja (2010) defined the concept of perfectly elastic supply as "if at a price, any quantity of the good is supplied, its elasticity will be equal to infinity and its supply curve will be a horizontal straight line parallel to the quantity axis and is said to be perfectly elastic" (p. 362). Here too, the impact of change in price on quantity supplied is not considered and only a single price is taken on the price axis. The correct way of defining the case of perfect supply would be the one where the quantity supplied of a commodity changes infinitely in response to a given change in price.

Relying on the analysis done in case of perfectly elastic demand, it would now be easy to understand that the correct and complete diagram of perfectly elastic supply would be the one where two prices are taken on the *Y*-axis, and particularly, the second price is taken below the existing price as shown in the Figure 7.

Figure 7. Correct Diagram of Perfectly Elastic Supply



The reason for taking the second price *P*2 below the existing price *P*1 lies in the operation of the law of supply. Here too, the movement from *P*1 to *P*2 or from *P*2 to *P*1 would result in (-) α or (+) α value of change in supply, resulting from the respective price changes.

References

Ahuja, H. L. (2010). *Modern economics* (p. 207, p. 362). New Delhi: S Chand & Co Pvt. Ltd.

Allen, W. B., Doherty, N., Mansfield, E., & Weigelt, K. (2005). *Managerial economics* (p. 93). New York: W. W. Norton & Company.

Griffiths, A., & Wall, S. (1996). *Intermediate microeconomics* (pp. 58 - 59). New York: Longman.

Kennedy, J. M. M. (1999). *Advanced microeconomic theory* (pp. 217-218). Mumbai: Himalaya Publishing House.

Mehta, P. L. (1999). *Managerial economics* (p. 99). New Delhi: Sultan Chand & Sons.

Misra, S. K., & Puri, V. K. (1998). *Modern microeconomics* (p. 91). Mumbai: Himalaya Publishing House.