An Economic Analysis of Price Elasticity: Model, Challenges, and Implications

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Abstract: Price elasticity of demand is a critical concept in economics, measuring the responsiveness of quantity demanded to change in price. This paper builds a simple linear demand model to illustrate how price elasticity functions under different market conditions. It further analyzes factors influencing elasticity, such as necessity, availability of substitutes, consumer income, and consumer behavior. Despite the model's usefulness in theoretical analysis and policymaking, practical applications often face challenges including data limitations, model assumptions, and market complexities. The study concludes by highlighting the implications of these challenges for businesses and policymakers. This research aims to bridge the gap between theory and application by applying the model to real-world, such as healthcare markets where elasticity varies significantly among income groups. The background motivation is to help businesses and policymakers better understand how consumers' different reactions to price changes affect income and welfare.

Keywords: Price elasticity, Demand model, Consumer behavior, Market analysis, Economic modeling

1.   Introduction

In both microeconomics and real-life business, price elasticity of demand plays a very important role. It helps us understand how much the quantity people buy changes when the price changes. If something is very elastic, people buy a lot less of it when the price goes up, such as luxury goods. If its inelastic, people keep buying it even if it gets more expensive, such as basic needs for daily life. This is useful for companies setting prices, governments designing taxes, and economists trying to predict market trends. For example, when gas prices rise, some people still need to drive to work, so they keep buying gas this shows inelastic demand. But if the price of snacks increases, people might switch to other snakes that are cheaper showing elastic demand. Online platforms like Uber use this too: when demand is high, they raise prices through "surge pricing." That will only work on people who will pay more money to use this service, because they know some people will pay more but others will not.[1] This paper explores how elasticity works using a basic model and looks at real-world examples and challenges that make things more complicated than the simple math. When an enterprise is setting a price for a good or services, it must consider the price elasticity of demand. By studying price elasticity of demand, companies can predict the impact of price adjustments on sales and revenue and develop reasonable pricing strategies. For example, if the demand for a product is elastic (PED>1), a price reduction will cause a significant increase in demand, thereby increasing total revenue; If demand lacks elasticity (PED<1), price increases usually do not reduce many sales,

but can instead increase revenue. Therefore, price elasticity of demand analysis can guide companies to choose strategies of "low profit, high sales " or "high profit but low sales" to achieve maximum profits.[2]

2. Literature review

2.1. Price elasticity and relevant studies

The concept of elasticity isn't new. It was first introduced by Alfred Marshall in 1890, one of the most famous economists in history.[3] Later, more studies helped apply this concept to different places. For example, some people used it to study how farmers react to changes in crop prices.[4] That helped show how supply and demand work in the real world. In more recent years, economists have studied price elasticity in modern markets. Some people looked at how online platforms like Amazon and Barnes & Noble compete on price, showing how elasticity matters in digital markets.[5] Some people focused on fuel consumption and how demand changes with gasoline prices which is something that's still very important today.[6] In the healthcare field, price elasticity plays a major role in how people choose insurance plans. Studies show that when insurance expenses increase, many individuals especially lower-income groups are more likely to skip care. [7] There are also new approaches in studying elasticity using big data and machine learning. Some recent papers suggest that companies can now use artificial intelligence to predict how sensitive different customers are to prices. That way, they can adjust prices for different users.[8] These studies show that price elasticity isn't just a theory from textbooks, but something businesses use every day.

2.2. The impact of price elasticity on consumer behavior and market outcomes

Price elasticity of demand plays a major role in shaping consumer behavior and determine market outcome. When demand of a product is elastic, a small change in price will change purchase decisions, because consumers are more willing to buy substitute goods which is cheaper but has the same function. For example: Luxury goods, non-essential goods, price elastic goods typically face more elastic demand. In contrast, inelastic goods such as water, basic food, and fuel have more stable demand even the price change significantly, for the reason that those inelastic goods do not have many substitutes, and also those are basic needs for daily life. [9] Moreover, governments often impose tax on inelastic goods (like gasoline or cigarette), because quantity demand is less sensitive to price, ensuring higher tax revenue. However, this strategy might bring negative effects, such as impose unsuitable tax for low-income class which would rise concerns about equity. [10] Therefore, understanding demand elasticity is important not only for business, but also for policymakers to design effective and fair government interventions.

3. Methodology

To study price elasticity, this paper uses a basic linear demand model. The formula is:

$$Q\_d = a - bP$$

Where:
- Q_d = quantity demanded
- P = price
- a, b = constants, with b > 0

This shows that when price goes up, quantity demanded goes down. It's a straight-line model, meaning the relationship between price and quantity is linear.

To calculate the price elasticity of demand (E_d), we use this formula:

$$E\_d \ = \ (dQ\_d \ / \ dP) \ \times \ (P \ / \ Q\_d) \ = \ -b \cdot (P \ / \ (a \ - \ bP)) \ [11]$$

This tells how responsive demand is at different points on the curve. At high prices, demand tends to be more elastic (more sensitive), and at low prices, it's more inelastic (less sensitive). Although this model is simple and easy to use, it's not perfect. It assumes that all other things stay the same (ceteris paribus), and that the demand curve is straight, which isn't always true in real markets. Still, it gives us a good starting point.

4. Case analysis

There is an example about how elasticity changes at different prices.
Suppose the demand curve is:

$$Qd = 100 - 2P$$

Plug in some prices to calculate the elasticity.

Table 1: How elasticity changes at different prices

Price (P)	Quantity (Q)	Elasticity (E_d)
10	80	0.25
20	60	0.67
25	50	1.00
30	40	1.50
40	20	4.00

As table 1 shows, elasticity increases with price. At low prices, demand is inelastic, meaning people don't reduce their quantity much even when price go up. But when prices are high, a small increase can cause a big drop in demand. This matches what we see in the real world.

Also, when elasticity is exactly 1 (unit elastic), total revenue is at its maximum. This is useful for businesses trying to maximize profits. If they raise prices too much and demand is elastic, they could lose money. This result is very useful for businesses, especially those business trying to maximize total revenue. When the demand elasticity is exactly 1 (unit elasticity), the total income reaches its maximum. In this case, the price increase will not affect the total income, as the decrease in demand is offset by the price increase. At low prices (lack of demand elasticity): Enterprises can raise prices without losing too much demand. For example, basic commodities (such as daily necessities) often lack demand elasticity at low prices, and price increases can often bring in more income. At high prices (with elastic demand): Enterprises need to be cautious about price increases. If prices are too high and demand is elastic, companies may lose many consumers, leading to a decrease in income. For example, the demand for high priced products such as luxury goods, is sensitive to price changes, and a slight increase in price may lead to a big decrease in sales, thereby affecting overall profits.

5. Discussion

5.1. Limitations of the model

While the linear demand model is useful for learning and basic predictions, it has many limitations. Most demand curves in the real world are not straight lines. For example, people might be very sensitive to price near certain points.

Holding other things constant: In real life, things like advertising, seasonality, or news can also affect demand.

It's hard to calculate real elasticity unless we have a lot of accurate sales and price data. That's not always easy to find, especially for small businesses.

People aren't always rational: Sometimes consumers buy based on emotion, habit, or trend, not just price. For example, someone might still buy their favorite drink even if the price increases a lot, just because they're used to it.

5.2. Real-life challenges

Rich and poor consumers might react very differently to the same price change. So, a single elasticity number for the whole market might not reflect the full picture.

There might be some situation that is unpredictable: when there is shortage of fuel or pandemics, demand of some goods or services such as medical services might increase unpredictable. Elasticity may be higher or lower than normal situation.

Sometimes governments rely on average elasticity estimates when making decisions, like setting taxes. If the estimate is wrong, it can lead to negative outcomes such as hurting low-income families with regressive taxes. For example, if the government uses average elasticity estimates in the healthcare field, it could result in taxes that make healthcare too expensive for low-income people. As a result, low-income people might skip healthcare. This will directly affect their health level and even result in social inequality. Moreover, in the context of the epidemic, the demand of some good and services might increase such as medicine. For example, during the COVID-19 pandemic, there was a significant increase in demand for medical services and health insurance, and the price elasticity at this time was significantly lower than in normal times. This also serves as a reminder that elasticity is not a constant and requires adjustment in various situations. Based on these issues which might happened in different situation, there are several strategic suggestions.

First, calculate elasticity by group. In the formulation of medical policies, it is recommended to calculate price elasticity separately for different income groups or populations, such as different income classes, rather than simply using the average value. Second, the government can provide subsidies. The government can provide subsidies to low-income individuals to prevent them from giving up on purchasing healthcare. Another field is food, in the food industry, price elasticity has a significant impact on demand, especially in the difference between basic food and luxury food. Basic foods such as rice, bread, and milk usually have low demand elasticity (lack elasticity) because they are essential items in daily life, and consumers usually do not significantly reduce their purchases when prices rise. In contrast, for some luxury or non-essential foods (such as expensive chocolate, imported fruits, etc.), the price elasticity of demand is higher because there are more substitutes to choose from, and price increases may lead consumers to turn to other brands or products. Government could develop flexible pricing strategies: For essential foods, governments or businesses can consider controlling price increases to avoid food shortages for low-income groups due to price changes. By subsidizing or regulating market supply, ensure that consumers can afford to buy basic food.

6. Conclusion

This paper shows that price elasticity of demand is a powerful concept that helps people understand consumer behavior and market outcomes. By using a simple linear model, it can be seen clearly how elasticity changes at different prices and how that affects things like revenue and business strategy. However, real markets are much more complicated. Consumers are diverse, emotional, and sometimes unpredictable. Data can be hard to get, and the world is always changing. That's why businesses and policymakers need to be careful when applying elasticity in the real world. In the future, people can use more advanced tools like machine learning and big data analysis to improve

how people measure and predict elasticity. These tools can help companies personalize prices, governments design better policies, and economists understand markets more deeply.

Overall, learning about price elasticity isn't just about doing math, it's about seeing how people make decisions, and how those decisions affect everything from profits to public policy. Learning price elasticity to understand the consumer decision-making process is crucial. This not only helps companies develop effective pricing strategies to maximize their profits, but also provides data that supporting policymakers to set government policies such as taxes or subsidies. By deeply learning price elasticity of demand, policymakers can design more fair and efficient policies, reduce the impact of inequality, and ensure that market resources are allocated efficiently.

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