Outline

1. The Own-Price Elasticity of Demand
   - Definition
   - Interpretation

2. Other Demand Elasticities
   - The Cross-Price Elasticity of Demand
   - The Income Elasticity of Demand

3. The Price Elasticity of Supply
Elasticities

In the past few years, the government has undertaken a number of policies to stimulate the economy, including:

1. Direct payments to individuals;
2. The “Cash-for-Clunkers” program to improve fuel efficiency and stimulate car sales;
3. Lower interest rates to encourage housing sales; and
4. Funding for massive highway and other infrastructure programs.

The efficacy of these programs depends, in part, on how much supply and demand change with these programs. Economists measure these responses using various elasticities:

- Price and Income Elasticities of Demand
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\[
\text{Own-Price Elasticity of Demand} = \frac{\text{Percent Change in the Quantity Demanded}}{\text{Percent Change in the Price}}
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We are measuring here movement along the demand curve.
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Car Demand and the Cash-for-Clunkers Program

Price

Quantity (millions/mo)

D

0

1.25

1.50

1.75

2.0

0

10000

12500

15000

17500

20000

22500
Car Demand and the Cash-for-Clunkers Program

Price

| 22500 |
| 20000 |
| 17500 |
| 15000 |
| 12500 |
| 10000 |
| 0     |

| 1.25 |
| 1.50 |
| 1.75 |
| 2.0  |

Quantity (millions/mo)
Car Demand and the Cash-for-Clunkers Program

The Own-Price Elasticity of Demand

Definition

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Car Demand and the Cash-for-Clunkers Program

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### Computing the Elasticity of Demand for Cars

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% Change in Price = \( \frac{\text{Change in Price}}{\text{Initial Price}} \times 100 \)

Own-Price Elasticity of Demand = \( \frac{\% \text{ Change in Quantity Demanded}}{\% \text{ Change in the Price}} \) = 20\% − 25\% = −0.80
Computing the Elasticity of Demand for Cars

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\[
\text{Own-Price Elasticity of Demand} = \frac{\% \text{ Change in Quantity Demanded}}{\% \text{ Change in Price}} = \frac{20 - (-25)}{1.25 \times 100} = -0.80
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% Change in Quantity Demanded = \left( \frac{\text{Change in Quantity Demanded}}{\text{Initial Quantity Demanded}} \right) \times 100

= \left( \frac{1.50-1.25}{1.25} \right) \times 100

= -0.80
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% \text{Change in Quantity Demanded} &= \frac{1.50 - 1.25}{1.25} \times 100 = 20 \\
% \text{Change in Price} &= \frac{15,000 - 20,000}{20,000} \times 100 = -25 \\
\text{Own-Price Elasticity of Demand} &= \frac{% \text{Change in Quantity Demanded}}{% \text{Change in the Price}} \\
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Own-Price Elasticity of Demand = \frac{\% \text{ Change in Quantity Demanded}}{\% \text{ Change in the Price}}

= \frac{20}{-25} = -0.80
More on the Own-Price Elasticity of Demand

- Notice that the own-price elasticity of demand will typically be negative;
More on the Own-Price Elasticity of Demand

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- This is due to the law of demand which says that quantity demanded goes down as price goes up.
More on the Own-Price Elasticity of Demand

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- The text drops the negative sign for convenience, with the understanding that the own price elasticity is negative.
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- This is due to the law of demand which says that quantity demanded goes down as price goes up.
- The text drops the negative sign for convenience, with the understanding that the own price elasticity is negative.
- I think this is a bad habit to get into and will retain the negative sign when discussing the elasticity.
The Midpoint Method

A problem with the elasticity formula above is that you will get a different elasticity if you consider the change in reverse.

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% Change in Quantity Demanded = \( \frac{1.25 - 1.50}{1.50} \times 100 = -16.67\% \)

% Change in Price = \( \frac{20,000 - 15,000}{15,000} \times 100 = -33.33\% \)

Own-Price Elasticity of Demand = \( \frac{-16.67\%}{-33.33\%} = 0.50 \)
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The Own-Price Elasticity of Demand

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Own-Price Elasticity of Demand = \frac{\% \text{ Change in Quantity Demanded}}{\% \text{ Change in Price}} = \frac{16.67}{33.33} = -0.50
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\frac{\text{% Change in Quantity Demanded}}{\text{% Change in Price}} = \frac{\left| \frac{\text{Change in Quantity Demanded}}{\text{Initial Quantity Demanded}} \right|}{\left| \frac{\text{Change in Price}}{\text{Initial Price}} \right|} \times 100
\]

\[
\frac{\text{Change in Quantity Demanded}}{\text{Initial Quantity Demanded}} = \frac{1.25-1.50}{1.50} \times 100 = 16.67
\]

\[
\frac{\text{Change in Price}}{\text{Initial Price}} = \frac{20,000-15,000}{15,000} \times 100 = -33.33
\]

Own-Price Elasticity of Demand = \[
\frac{\% \text{ Change in Quantity Demanded}}{\% \text{ Change in the Price}} = \frac{16.67}{-33.33} = -0.50
\]
The Midpoint Method (cont’d)

- The Midpoint Method avoids this problem by computing the percentage changes relative to the average value rather than relative to the initial value.

\[
\text{% Change in Quantity Demanded} = \frac{\text{Change in Quantity Demanded}}{\text{Average Quantity Demanded}} \times 100 = \frac{1.25 - 1.50}{1.375} \times 100 = 18.18. \\
\text{% Change in Price} = \frac{\text{Change in Price}}{\text{Average Price}} \times 100 = \frac{20,000 - 15,000}{17,500} \times 100 = -28.57.
\]

\[
\text{Own-Price Elasticity of Demand} = \frac{\text{% Change in Quantity Demanded}}{\text{% Change in the Price}} = \frac{18.18}{-28.57} = -0.64.
\]
The Midpoint Method (cont’d)

- The Midpoint Method avoids this problem by computing the percentage changes relative to the average value rather than relative to the initial value.
- In our car example, we would get:

\[
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\text{% Change in Price} = \frac{\text{Change in Price}}{\text{Average Price}} \times 100 = \frac{20,000 - 15,000}{17,500} \times 100 = -28.57\% \\
\text{Own-Price Elasticity of Demand} = \frac{\text{% Change in Quantity Demanded}}{\text{% Change in Price}} = \frac{18.18}{-28.57} = -0.64
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\]

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\]

\[
\text{Own-Price Elasticity of Demand} = \frac{\text{% Change in Quantity Demanded}}{\text{% Change in the Price}}
\]

\[
= \frac{18\%}{-28.57\%} = -0.64
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\]

\[
= \frac{1.25 - 1.50}{1.375} \times 100
\]

\[
= -18\%
\]

\[
\text{% Change in Price} = \frac{\text{Change in Price}}{\text{Average Price}} \times 100
\]

\[
= \frac{20,000 - 15,000}{17,500} \times 100
\]

\[
= -28.57\%
\]

\[
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The Own-Price Elasticity of Demand

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  \]

  \[
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  \[
  \text{Own-Price Elasticity of Demand} = \% \text{ Change in Quantity Demanded} \div \% \text{ Change in the Price}
  \]

  \[
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The Own-Price Elasticity of Demand

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The Own-Price Elasticity of Demand

Definition

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Interpreting the Own-Price Elasticity of Demand

- Elasticities are a convenient measure of the responsiveness of demand to changes in price.

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There are two extreme cases:

1. Perfectly Inelastic Demand: The Price Elasticity of Demand = 0. This corresponds to the case in which the quantity demanded does not change with a change in the price.

2. Perfectly Elastic Demand: The Price Elasticity of Demand = −∞. This corresponds to the case in which the quantity demanded switches from 0 to ∞ with a change in the price.
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The Extremes Graphically

Price

$P^*$

Quantity

Perfectly
Inelastic
Demand

D
The Extremes Graphically

Perfectly Inelastic Demand

Perfectly Elastic Demand

Price

Price

Quantity

Quantity

$P^*$

$Q^*$
Another convenient reference point in terms of elasticities is Unit-Elastic Demand.
Unit-Elastic Demand and Total Revenues

Another convenient reference point in terms of elasticities is Unit-Elastic Demand; This corresponds to the price elasticity of demand being equal to -1.

Knowing whether a price elasticity is greater or less than -1 tells us how a price change impacts the total revenues of the seller. Total Revenues = Price \times Quantity sold. If price increases, two things happen impacting total revenues:

1. The price effect: After a price increase, each unit sold sells for a higher price, raising revenues.
2. The quantity effect: After a price increase, fewer units are sold, reducing revenues.

Which effect dominates, depends on the price elasticity of demand.
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\begin{itemize}
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\end{itemize}
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Total Revenue Changes - Inelastic Demand

MWTP ($/pair)

Quantity (1000's pairs of shoes)

Total Revenues

D
Total Revenue Changes - Inelastic Demand

MWTP ($/pair)

Total Revenues

Quantity (1000's pairs of shoes)
Total Revenue Changes - Inelastic Demand

MWTP ($/pair)

Total Revenues

Quantity (1000's pairs of shoes)
Total Revenue Changes - Inelastic Demand

MWTP ($/pair)

120
110
100
90
80
70
60
50
40
30
20
10
0

Quantity
(1000's pairs of shoes)

1
2
3
4

D

Quantity Effect
Total Revenue Changes - Inelastic Demand

MWTP ($/pair)

Price Effect

Quantity Effect

D

Quantity (1000's pairs of shoes)
Total Revenue Changes - Elastic Demand

MWTP ($/pair)

<table>
<thead>
<tr>
<th>MWTP ($/pair)</th>
</tr>
</thead>
<tbody>
<tr>
<td>120</td>
</tr>
<tr>
<td>100</td>
</tr>
<tr>
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</tr>
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<td>60</td>
</tr>
<tr>
<td>40</td>
</tr>
<tr>
<td>20</td>
</tr>
<tr>
<td>0</td>
</tr>
</tbody>
</table>

Quantity (1000's pairs of shoes)

<table>
<thead>
<tr>
<th>Quantity (1000's pairs of shoes)</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
</tr>
<tr>
<td>3</td>
</tr>
<tr>
<td>2</td>
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<tr>
<td>1</td>
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</tbody>
</table>

Total Revenues
Total Revenue Changes - Elastic Demand

MWTP ($/pair)

Total Revenues

Quantity (1000's pairs of shoes)
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MWTP ($/pair)

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Price Effect

Quantity Effect

D
Unit-Elastic Demand and Total Revenues (cont’d)

- The graphs illustrate a basic result
Unit-Elastic Demand and Total Revenues (cont’d)

- The graphs illustrate a basic result; i.e., the larger the price elasticity (in absolute value), the larger the quantity effect will be and the more likely revenues are to fall with a price increase.
Unit-Elastic Demand and Total Revenues (cont’d)

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Three cases emerge:

1. **Unit-Elastic Demand**: When the Own-Price Elasticity of Demand equals -1, the price and quantity effects just offset and total revenues are unchanged when price changes.
The Own-Price Elasticity of Demand

Interpretation

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- Three cases emerge:
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  2. Inelastic Demand: When the Own-Price Elasticity is smaller than -1 (in absolute value; i.e., between 0 and -1), then...
Unit-Elastic Demand and Total Revenues (cont’d)

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     - the quantity effect is smaller than the price effect.
     - so that a price increase will cause total revenues to increase.
  3. **Elastic Demand**: When the Own-Price Elasticity is larger than -1 (in absolute value; i.e., between -1 and $-∞$), then
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Unit-Elastic Demand and Total Revenues (cont’d)

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     - the quantity effect is larger than the price effect.
     - so that a price increase will cause total revenues to decrease.
The Same Result Mathematically

- Mathematically, one can show that

\[
\frac{\% \Delta \text{ in Total Revenues}}{\% \Delta \text{ in Price}} = 1 + \text{Price Elasticity of Demand}
\]

Our three cases become:

- Unit Elastic Demand: \( \frac{\% \Delta \text{ in Total Revenues}}{\% \Delta \text{ in Price}} = 1 - 1 = 0 \)

- Inelastic Demand: \( \frac{\% \Delta \text{ in Total Revenues}}{\% \Delta \text{ in Price}} = 1 + (\text{Price Elasticity of Demand}) > 0 \)

- Elastic Demand: \( \frac{\% \Delta \text{ in Total Revenues}}{\% \Delta \text{ in Price}} = 1 + (\text{Price Elasticity of Demand}) < 0 \)
Mathematically, one can show that

\[ \% \Delta \text{ in Total Revenues} = \% \Delta \text{ in the Price} + \% \Delta \text{ in Quantity Demanded} \]
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Our three cases become:

- Unit Elastic Demand: \( \frac{\% \Delta \text{ in Total Revenues}}{\% \Delta \text{ in the Price}} = 1 + (-1) = 0 \)
- Inelastic Demand: \( \frac{\% \Delta \text{ in Total Revenues}}{\% \Delta \text{ in the Price}} = 1 + (>-1) > 0 \)
- Elastic Demand: \( \frac{\% \Delta \text{ in Total Revenues}}{\% \Delta \text{ in the Price}} = 1 + (<-1) < 0 \)
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  \]
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  \]
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\frac{\% \Delta \text{ in Total Revenues}}{\% \Delta \text{ in the Price}} = \frac{\% \Delta \text{ in the Price}}{\% \Delta \text{ in the Price}} + \frac{\% \Delta \text{ in Quantity Demanded}}{\% \Delta \text{ in the Price}} = 1 + \text{Price Elasticity of Demand}
\]

so that

- Unit Elastic Demand: \( \% \Delta \text{ in Total Revenues} = 1 + (-1) = 0 \)
- Inelastic Demand: \( \% \Delta \text{ in Total Revenues} = 1 + (> -1) > 0 \)
- Elastic Demand: \( \% \Delta \text{ in Total Revenues} = 1 + (< -1) < 0 \)
The Same Result Mathematically

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Our three cases become:

- **Unit Elastic Demand:** \( \frac{\% \Delta \text{ in Total Revenues}}{\% \Delta \text{ in the Price}} = 1 + -1 = 0 \)
- **Inelastic Demand:** \( \frac{\% \Delta \text{ in Total Revenues}}{\% \Delta \text{ in the Price}} = 1 + (> -1) > 0 \)
- **Elastic Demand:** \( \frac{\% \Delta \text{ in Total Revenues}}{\% \Delta \text{ in the Price}} = 1 + (< -1) < 0 \)
What Factors Determine the Price Elasticity of Demand?

Four factors are key in determining the Price Elasticity of Demand:

1. The Availability of Close Substitutes
   - All else equal, the price elasticity will be larger (more elastic) if close substitutes (alternative goods) are available.

2. Whether the Good is a Necessity or a Luxury
   - All else equal, the price elasticity will be smaller (more inelastic) for goods the individual views as a necessity.

3. The Share of Income Spent on the Good
   - All else equal, the price elasticity will be smaller (more inelastic) for goods that are only a small portion of their overall budget. A shift in the price of the good in this case has little impact on their other spending opportunities.

4. Time
   - All else equal, the price elasticity will be smaller (more inelastic) in the short-run, but increase (become more elastic) over time as they adjust to the price change.
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Example Elasticities

- Specific Brands:
  - Tide Detergent: -2.79
  - Pepsi: -2.08
  - Coke: -1.71

- Narrow Good Categories:
  - Trans-Atlantic Air Travel: -1.30
  - Ground Beef: -1.02
  - Cigarettes: -0.45
  - Beer: -0.26
  - Gasoline: -0.20

- Broad Categories
  - Transportation: -0.56
  - Food: -0.67
  - Clothing: -0.89
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The Cross-Price Elasticity of Demand

- Formally, the cross-price elasticity of demand of good A, given a change in the price of good B, is denoted by $\eta_{AB}$ and given by:

$$\eta_{AB} = \frac{\text{Percent Change in the Quantity of A Demanded}}{\text{Percent Change in the Price of B}}$$

The sign of the cross-price elasticity will depend upon whether the goods are substitutes or compliments.

- For substitutes, we would expect the quantity demanded to increase as the price of the substitute good increases.
  1. Margarine with the price of butter: 1.53
  2. Pepsi with the price of Coke: 0.80
  3. Coke with the price of Pepsi: 0.60
  4. Ground beef with the price of poultry: 0.24

- For compliments, we would expect the quantity demanded to decrease as the price of the compliment increases.
  1. Entertainment with the price of food: -0.72
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The Income Elasticity of Demand

- The **income elasticity of demand** is formally defined as:

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  \text{Income Elasticity of Demand} = \frac{\text{Percent Change in the Quantity Demanded}}{\text{Percent Change in Income}}
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- For normal goods, the income elasticity of demand will be positive:
  - Fresh fruit: 1.99
  - Computers: 1.71
  - Transatlantic travel: 1.40

- Income inelastic (i.e., income elasticity < 1):
  - Food: 0.75
  - Chicken: 0.42
  - Fresh vegetables: 0.26

- For inferior goods, the quantity demanded decreases as income increases and the income elasticity will be negative:
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The Income Elasticity of Demand

- The income elasticity of demand is formally defined as:

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\text{Income Elasticity of Demand} = \frac{\text{Percent Change in the Quantity Demanded}}{\text{Percent Change in Income}}
\]

- For normal goods, the income elasticity of demand will be positive.
  
  1. **Income elastic** (i.e., income elasticity > 1):
     - Fresh fruit: 1.99
     - Computers: 1.71
     - Transatlantic travel: 1.40
  
  2. **Income inelastic** (i.e., income elasticity < 1)
     - Food: 0.75
     - Chicken: 0.42
     - Fresh vegetables: 0.26

For inferior goods, the quantity demanded decreases as income increases and the income elasticity will be negative.

- Ground beef: -0.20
- Bread: -0.42
- Potatoes: -0.81
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The only real difference here from the demand elasticity is that we are now measuring movement along the supply curve, rather than along the demand curve. Since supply will typically increase with an increase in price, the own-price elasticity of supply will be positive. As we shall see, understanding the supply elasticity is important to understanding the impact of government interventions in the marketplace, including the impact of tax policies and price supports.
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The Extremes

As was the case with demand elasticities, there are two extreme cases:

1. Perfectly inelastic supply: The own-price elasticity of supply = 0.
   - In this case, supply does not change with a change in price.
   - This is usually driven by production constraints (i.e., limits in terms of human and physical capital used in production).
   - An example here might be the production of physicians, limited by the number of medical schools.

   - In this case, supply does change drastically (from 0 to ∞) with a change in price.
   - This is obviously an extreme case, but reflects a situation in which: Below a certain price (say $P^*$), production is not profitable, failing to cover the costs of production. Above that price, the firm can now make a profit and produce a large quantity of the good.
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The Extremes Graphically

- Perfectly Inelastic Supply
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Factors Affecting the Own-Price Elasticity of Supply

- There are many factors influencing the own-price elasticity of supply.
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- There are many factors influencing the own-price elasticity of supply.
- Two key factors are:
  
  1. **The Availability of Inputs**
     - Suppliers can quickly respond to changing prices if they have a ready and flexible supply of inputs.
     - Constraining inputs will often be capital equipment (machines) used in the production process, but can also include trained labor inputs.
  
  2. **Time**
     - The own-price elasticity of supply will usually increase as we consider longer time horizons.
     - This is largely because firms can work around input constraints, either by acquiring or building additional inputs or by altering the technologies used in production.
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