TRANSPORT DEMAND ELASTICITY

EE382

- The importance of an understanding of elasticity of demand in the planning of transport services and the analysis of transport markets
- Elasticity of demand and the three main types of elasticity of demand relevant to the transport sector in the form of own price, cross price, and income elasticity
- The major determinants of own price elasticity of demand for transport
- The significance of own price elasticity of demand and the revenue of the firm

INTRODUCTION

- What is important is not the fact that demand will fall but rather by how much the quantity demanded will fall, and thus how price sensitive are consumers in the market?

- Example – how sensitive are people to purchasing train tickets if the fare was to rise by 2 %, 5% or 20%?

Price elasticity of demand

- indicates the responsiveness of passengers or potential passengers to changes in the prices on offer
- The price mechanism can be used as an important tool of policy to either raise revenue through the imposition of a tax or by affecting demand through the payment of a subsidy to reduce price (Goodwin, 1992)
- The effectiveness of such a policy tool however is to a very large extent determined by the degree to which consumers are responsive to changes in the price of transport services
  - Example- paying a subsidy to a transport service where consumers are not price sensitive will only result in lowering the price and have little effect on the numbers using the service

PRICE ELASTICITY OF DEMAND FOR TRANSPORT SERVICES

$$\text{Price elasticity of demand} = \frac{\text{Percentage Change in Quantity demand}}{\text{Percentage Change in Price}}$$

$$\text{Price elasticity of demand} = \frac{\%\Delta D}{\%\Delta P}$$

- Price elasticity is an assessment of the relative changes in the quantity demanded to relative changes in price
- An indicator of the price sensitivity of consumers

EXAMPLE

- An operator was to increase its fares by 4 per cent but the quantity demanded was to fall by only 1 per cent then price elasticity would be -0.25

$$\text{Price elasticity of demand} = \frac{\%\Delta D}{\%\Delta P} = \frac{-1\%}{4\%} = -0.25$$

- Negative value – an ordinary good where a rise in the price will cause a fall in the quantity demanded

What does the Price elasticity of demand figure mean?

Consider the following quote taken from the Southend-London Route Study

For most categories of rail traffic, estimated elasticities on the basis of existing studies, particularly in the short run, are likely to be smaller than -1:i.e. an increase in price would lead to a less than proportionate decrease in number of passengers, hence revenue and profits would increase. Rail demand as a whole could therefore be regarded as a separate market. However, for leisure travel on certain routes, elasticities are likely to be larger than -1: i.e. a price increase would lead to a more than proportionate reduction in (the) number of passengers, reducing revenues.

- Price elasticity is a formal measure of the rate of change of the quantity demanded in comparison to the rate of change of the price

- Where the price elasticity is greater than negative one, this means that the proportionate change in demand is greater than the proportionate change in price

The coefficient of price elasticity of demand is between 0 and -1

- The quantity demanded is not very responsive to a change in its price
- Products are said to be price inelastic

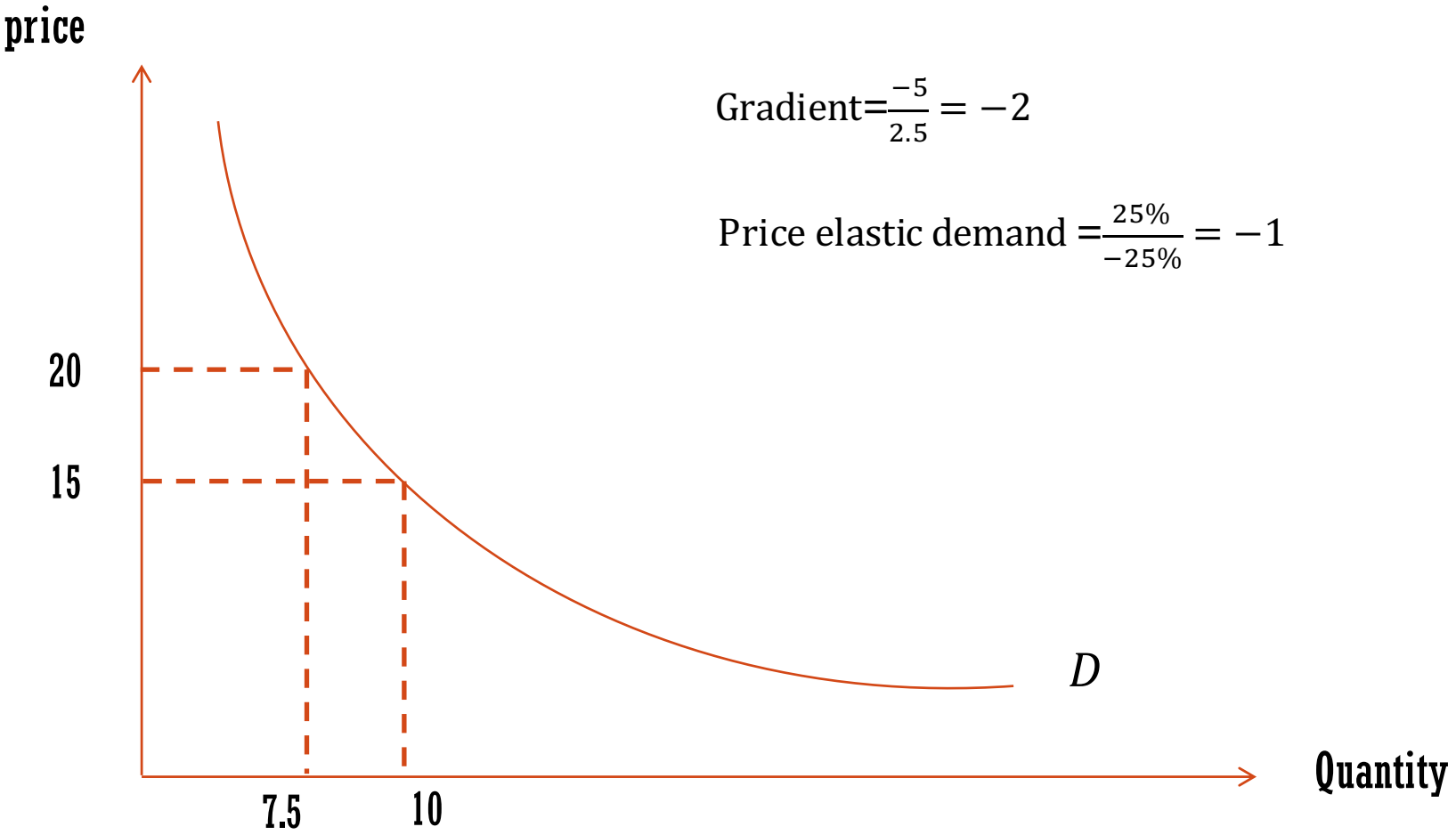
The coefficient of price elasticity of demand is less than -1 (for example, -1.5 or -2)

- The quantity demanded is responsive to a change in its price
- Products are said to be price elastic

If the coefficient is equal to -1, the product is said to have a unit price elasticity of demand (unitary price elastic)

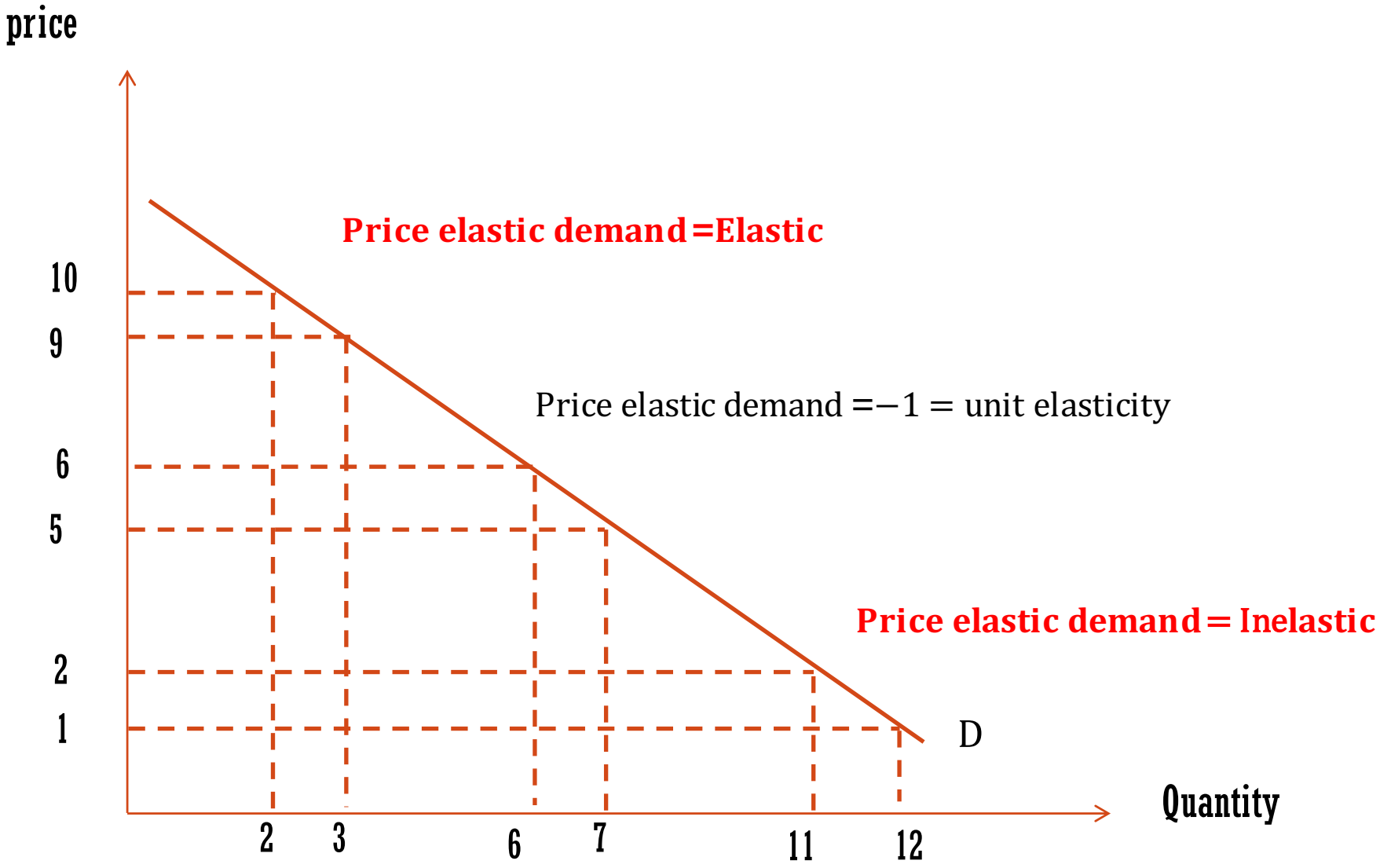
- A change in its price causes an equal but opposite percentage change in the quantity demanded of it

THE DIFFERENCE BETWEEN PRICE ELASTICITY OF DEMAND AND THE GRADIENT OF THE DEMAND CURVE



$$\text{Gradient} = \frac{-5}{2.5} = -2$$

$$\text{Price elastic demand} = \frac{25\%}{-25\%} = -1$$


price
Price elastic demand=Elastic
10
9
Price elastic demand =−1 = unit elasticity
6
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Price elastic demand= Inelastic
2
1
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Quantity
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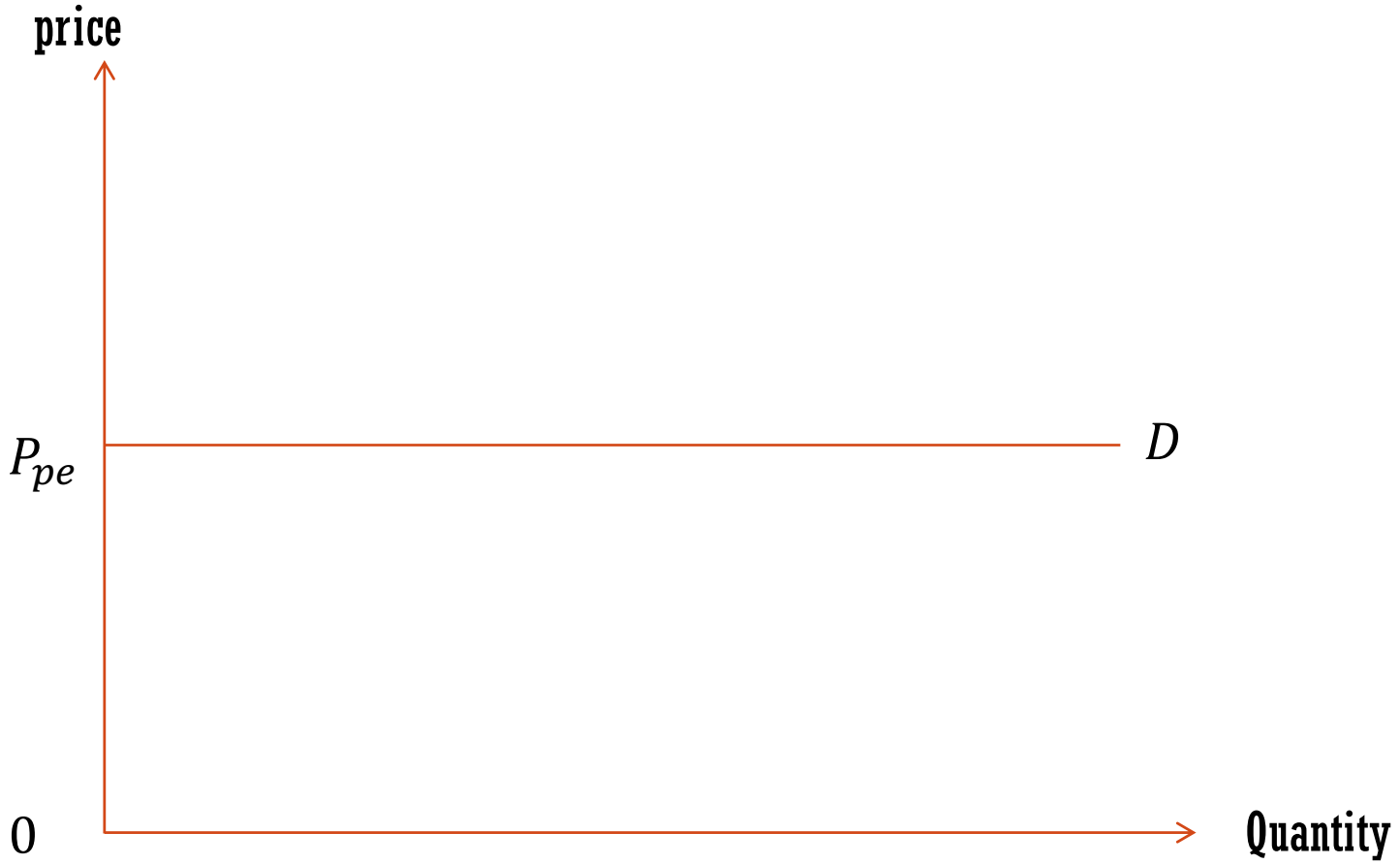
12

PERFECTLY PRICE ELASTIC DEMAND

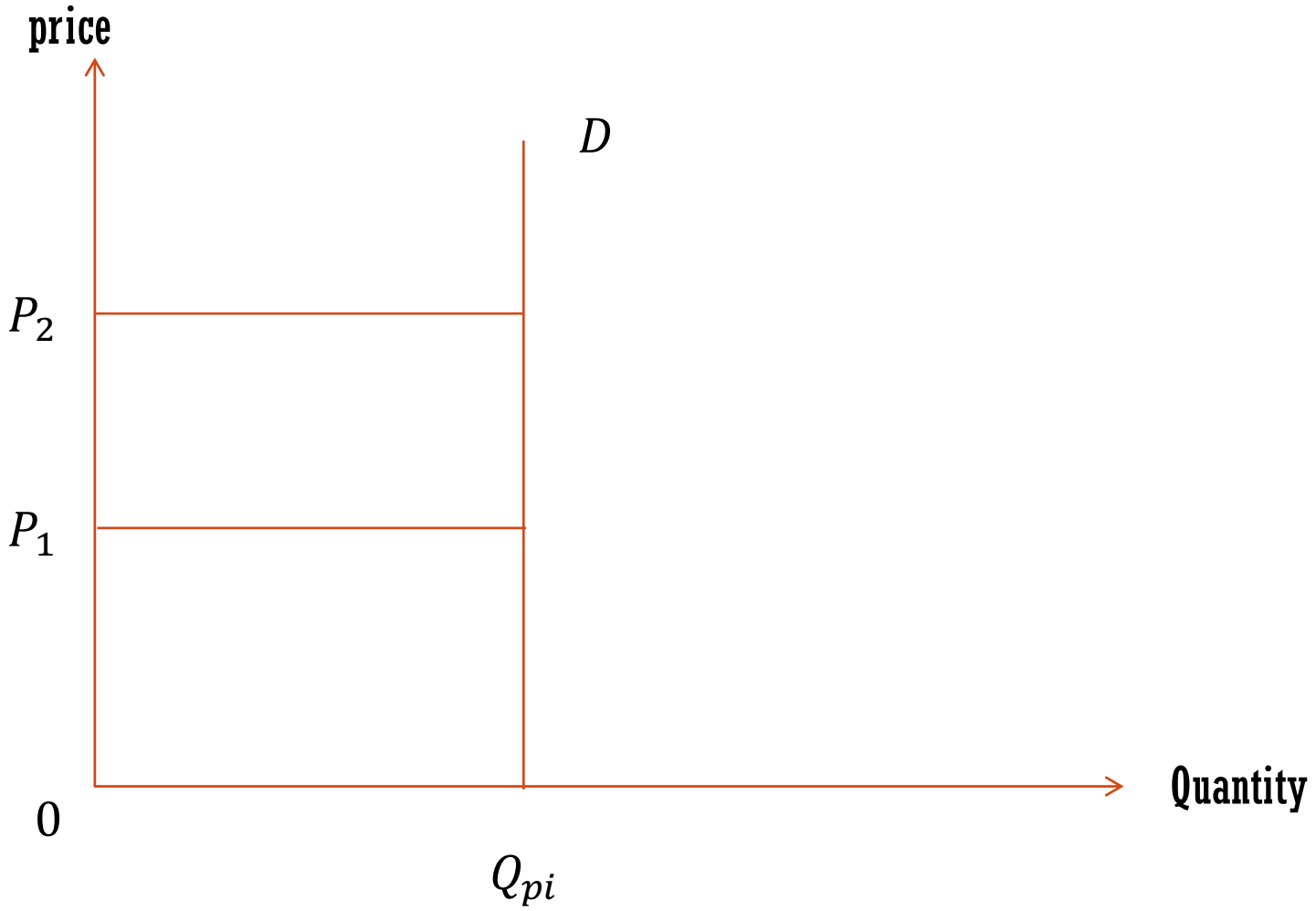


PERFECTLY PRICE ELASTIC DEMAND

Example, the price was $5, at which the quantity demanded is infinite (the firm can sell as much as it can produce), and then the firm for an unknown reason was to increase its price to $6, demand for its product would fall to zero

$$\text{Price elasticity of demand} = \frac{\%\Delta D}{\%\Delta P} = \frac{-\infty\%}{20\%} = -\infty$$

PERFECTLY PRICE INELASTIC DEMAND



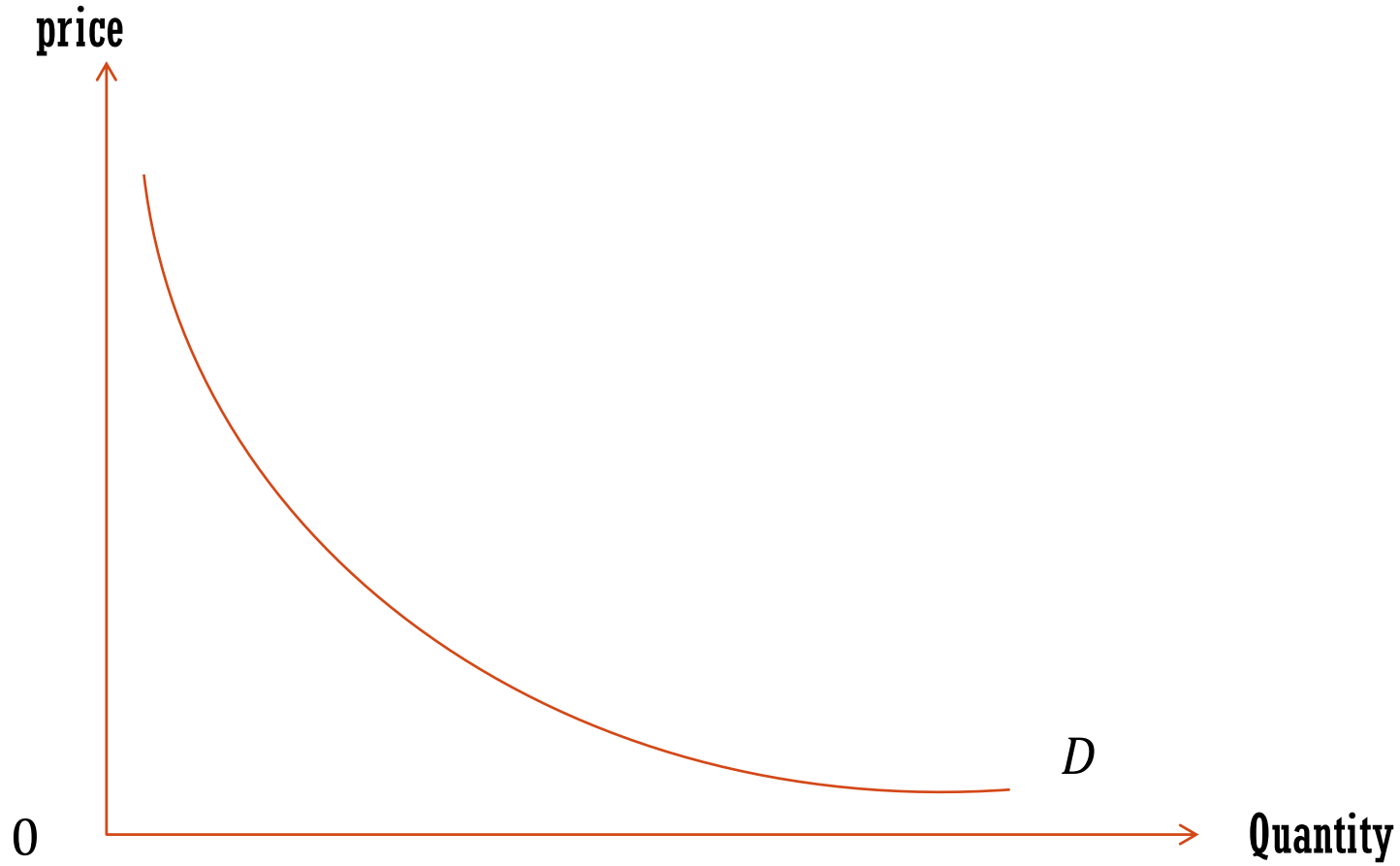
PERFECTLY PRICE INELASTIC DEMAND

- No matter the price consumers will purchase exactly the same quantity of the good or service, i.e. the demand curve is vertical

Example, the price was $5 and then the firm increases its price to $6

$$\text{Price elasticity of demand} = \frac{\%\Delta D}{\%\Delta P} = \frac{0\%}{20\%} = 0$$

UNITARY PRICE ELASTICITY DEMAND



UNITARY PRICE ELASTICITY DEMAND

- Example, a price $5 and then the firm increases its price to $6, then rather than demand falling to zero (perfect elastic), or remaining unchanged (perfectly inelastic), demand falls in direct proportion to the change in price

- If the quantity demanded was say 100 units at $5, then the increase to $6 would produce a reduction in the quantity demanded of 20 percent – the same proportionate change, hence demand would fall to 80 units

$$\text{Price elasticity of demand} = \frac{\%\Delta D}{\%\Delta P} = \frac{(80-100)/100}{(6-5)/5} = \frac{-20\%}{20\%} = 1$$

THE USES OF PRICE ELASTICITY OF DEMAND

For transport economists

- Forecasting the future trends to transport markets

Example

- oil continues to be consumed, petrol will become increasingly expensive over time

- Studying the relevant price elasticities of demand that economists can forecast the likely effects of this increase in motor-vehicle costs on the trends of car and bus usage

DETERMINANTS OF PRICE ELASTICITY OF TRANSPORT DEMAND

- The number and closeness of alternative modes of travel (substitutes)
- The proportion disposable income spent on the mode of travel
- The time dimension

THE NUMBER AND CLOSENESS OF ALTERNATIVE MODES OF TRAVEL (SUBSTITUTES)

- The higher the number of alternative modes available and the closer they are in meeting the same basic need, the higher will be the price elasticity for a particular transport service

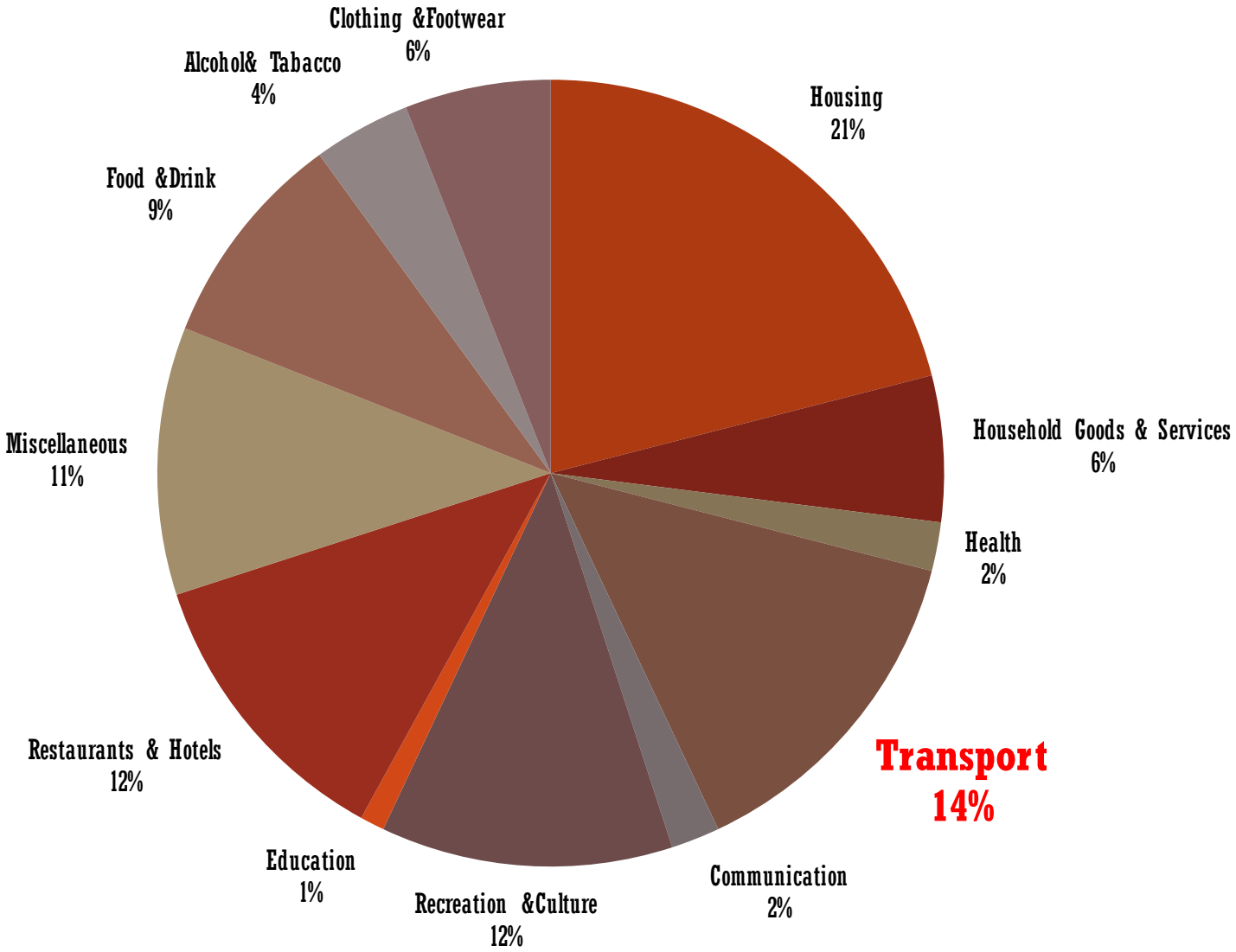
- Example- price of petrol

THE PROPORTION DISPOSABLE INCOME SPENT ON THE MODE OF TRAVEL

- The higher the proportion of disposable income spent on the mode of travel, then the higher the price elasticity of demand

- Within transport services the proportion of income spent in most(but not all) instances will be relatively small, although these will add up to significant amounts

SHARES OF HOUSEHOLD FINAL CONSUMPTION EXPENDITURE, 2007



Source: Drawn from ONS Statistics (ONS, 2008)

Modern life as such is structured around accessing goods and services that lie outside of the immediate vicinity of the home

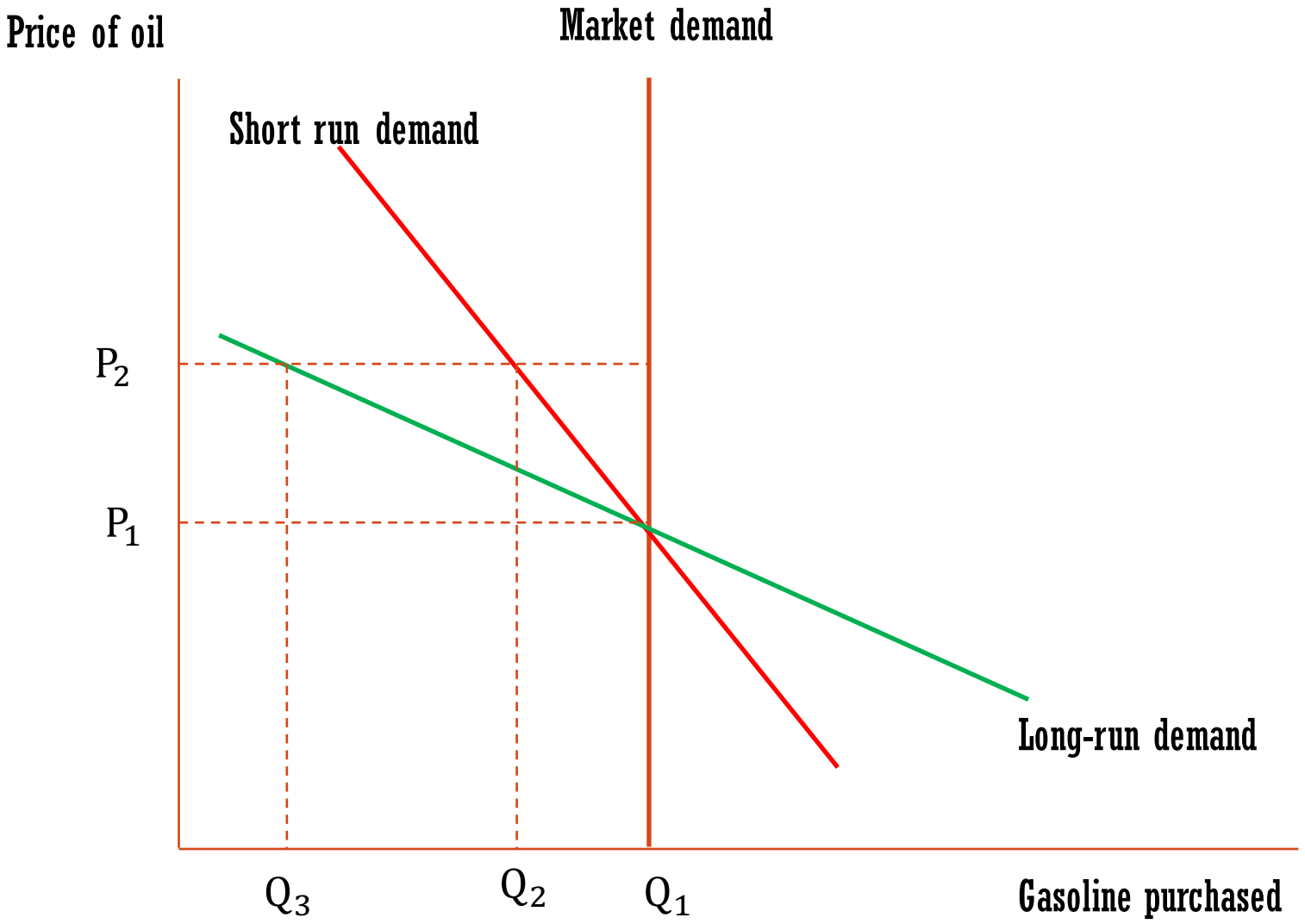
- Transport is therefore essential, and in the main that transport comes in the form of a car, because the car is viewed as the most convenient way of doing it and is thus seen as a necessity of modern life

- It is not the actual expenditure that is important, but rather the perception of that expenditure that matters as ultimately it is perceptions that affect behavior
  - Transport expenditure in many cases is far more scattered and, outside of car purchase, tends to be in relatively small amounts

TIME

- Short run and Long run
- Over the longer period of time, habits can change, thus there will almost always be a difference between long and short run elasticities
- An essential journey, such as where commuters have to travel into the center of a city each day for work or business purposes, will have relatively inelastic demand
- A non-essential journey, there is a far higher degree of flexibility with regard to when the journey can actually be made, and hence this would be more price elastic

CHANGES IN DEMAND ELASTICITIES OVER TIME



CASE STUDY 1:
PRACTICAL ESTIMATIONS AND REVIEWS OF OWN PRICE ELASTICITY OF DEMAND FOR TRANSPORT SERVICES

PRACTICAL ESTIMATIONS AND REVIEWS OF OWN PRICE ELASTICITY OF DEMAND FOR TRANSPORT SERVICES

Professor Goodwin's review and assessment of around 180 elasticity studies for car and bus travel throughout Europe (Goodwin, 1992)

- For urban bus travel, the review calculated an average value of price elasticity of -0.41, but indicated a wide variation between short and long term impacts

URBAN BUS PRICE ELASTICITIES BROKEN OUT BY TIME PERIOD

Time period	Average elasticity
Around 6 months	-0.21
0 to 6 months	-0.28
0 to 12 months	-0.37
Over 4 years	-0.55
5 to 30 years	-0.65

Source: Goodwin (1992)

$$PED = \frac{\%\Delta D}{\%\Delta P}$$

$$PED = \frac{\%\Delta D}{\%\Delta P} = -0.28$$

Thus a 10 percent increase in price will produce a 2.8 % decrease in demand, demand in the short term is highly inelastic

Overtime, elasticity increases…

Whole 4-year period, demand would have fallen by 5.5 %

- Goodwin's review indicated that over time elasticity values for transport have been increasing, hence consumers of transport services have been becoming more price sensitive over time

Garcia-Ferrara et al. (2006) study of public transport in the Madrid Metropolitan Area.

- The author calculated price elasticities using monthly data over the time period Jan 1987 to Dec 2000

- They compared two of the four basic modes available, namely the Metro and the Municipal Bus Company services, by ticket type
  - Single and ten trip tickets for bus and metro and a regular travel card covering all modes for adults and juniors

ELASTICITY VALUES, GARCIA-FERRARA ET AL. (2006)

Ticket type	Single	10 ticket	Travel card
Bus	-1.06	-0.52	
Metro	-1.03	-2.17	
Adult			-0.01
Junior			0.56

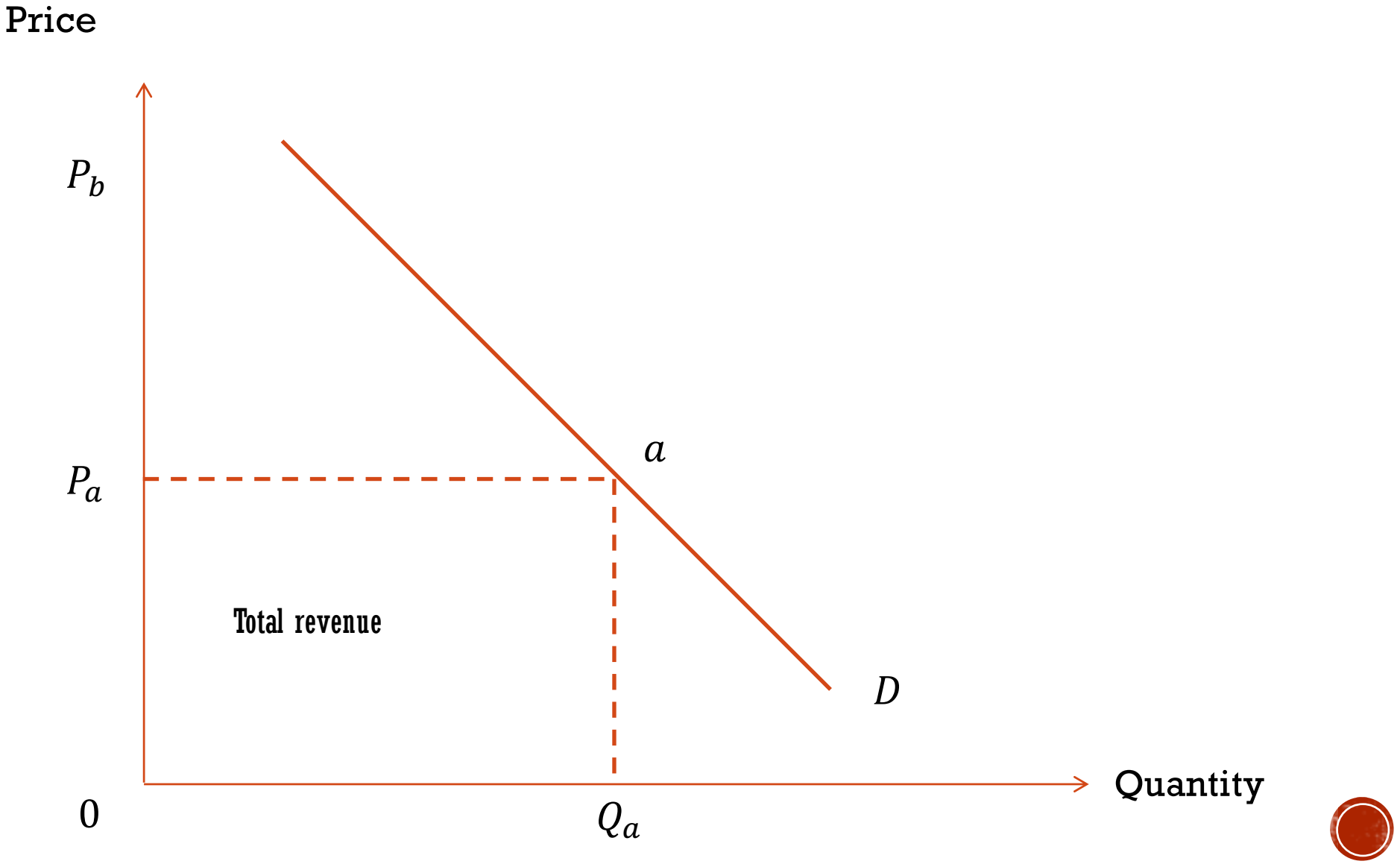
- Single fares were found to be generally unitary elastic, the 10 ticket metro ticket highly elastic while the 10 ticket bus fare was relatively inelastic

- The adult travel card was almost perfectly inelastic, and interestingly the junior travel card with a value of 0.56 off the end of our scale
  - The price increased for the junior travel card, demand increased
  - A Giffen good
  - The increase in price probably raised awareness of the junior travel card and hence led to more people buying it

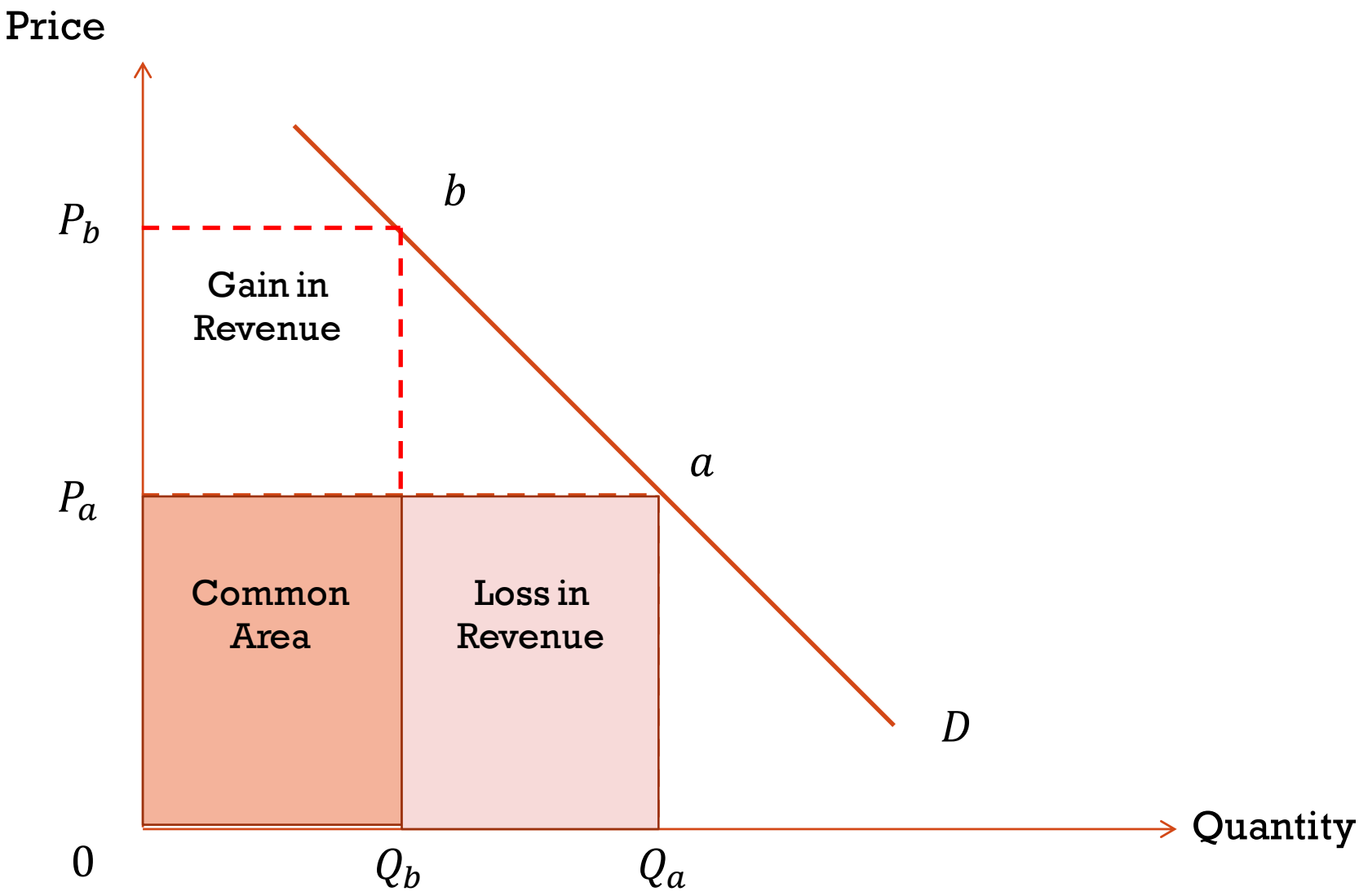
PRICE ELASTICITY, TOTAL REVENUE AND DEMAND CURVES

- A mechanism for assessing the extent to which consumers will react to changes in the price or other demand determinants of transport services

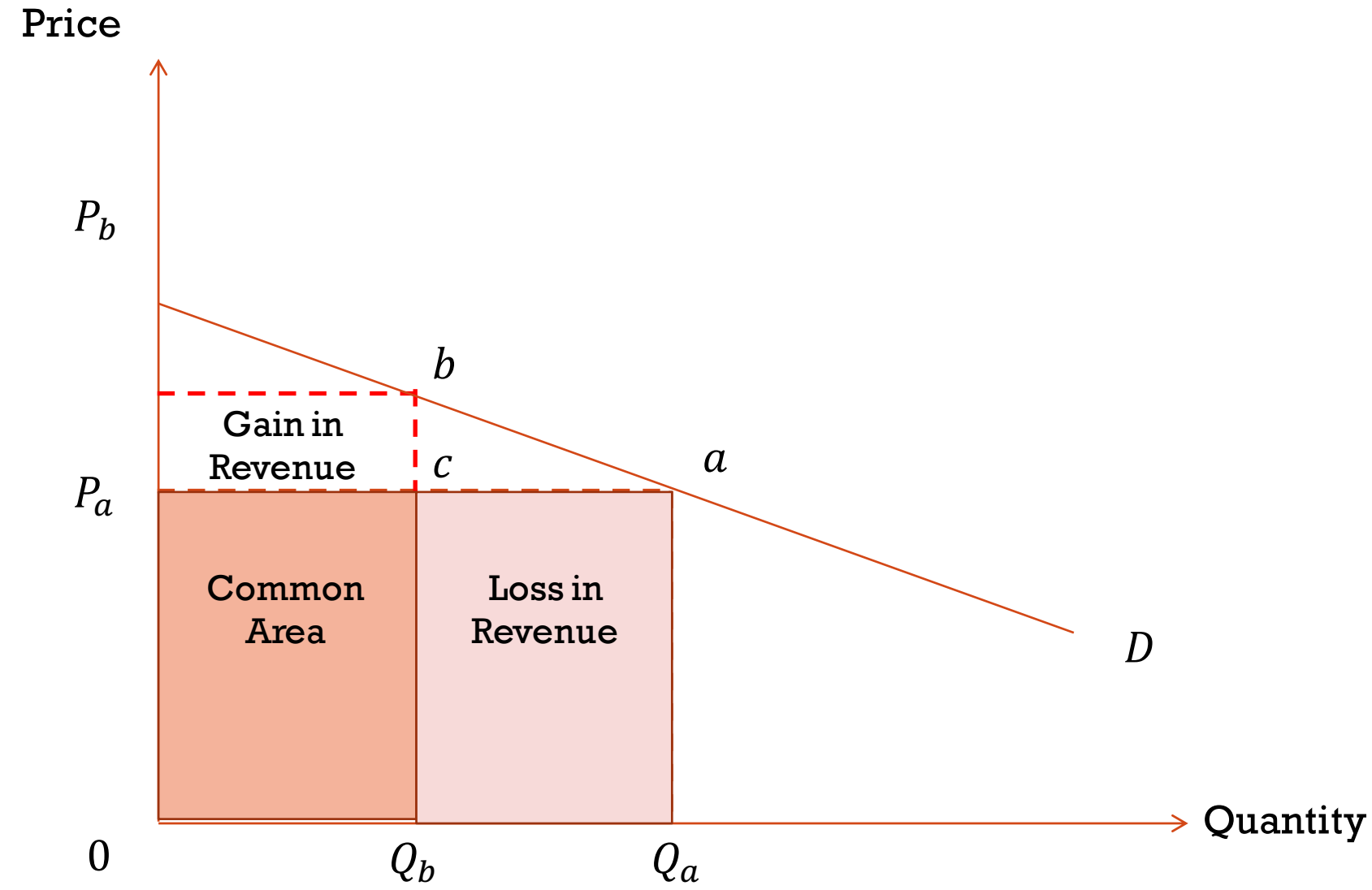
TOTAL REVENUE USING DEMAND CURVES



CHANGES IN TOTAL REVENUE USING DEMAND CURVES



THE EFFECT ON REVENUE OF PRICE CHANGES OF A RELATIVELY ELASTIC GOOD



CROSS PRICE ELASTICITY

CROSS PRICE ELASTICITY

- A measure of the effect of a change in the fares or rates of one mode of transport or transport operator on the demand for the services of another mode/transport operator

$$\text{Cross price elasticity} = \frac{\text{Percentage Change in Quantity demand of service A}}{\text{Percentage Change in Price of service B}}$$

$$\text{Cross price elasticity} = \frac{\%\Delta D_A}{\%\Delta P_B}$$

- Within the transport sector, these services could be examining at different levels
  - The cross price elasticity between two different transport modes such as the train versus the car
  - The cross price elasticity within the same mode such as National Express's East Coast Glasgow to London rail service versus Virgin's West Coast Glasgow to London rail service
  - Within a single operator if they offer a variety of fares for the same journey but different standards of service such as a train operator could examine the quantity demanded of their standard service versus the first class fare charge

- **Cross price elasticity** of demand also allows a distinction to be made between **substitute goods and services** and **complementary goods and services**

- If the effect of a price increase in one good has a positive effect in terms of the demand for another, then these two goods or services would be considered to be substitutes

EXAMPLE 1

- The reduction in the subsidy paid to rail operators effectively representing an increase in costs
- A shift in the supply curve to the left and eventually leads to an increase in the price
- This increase in the price of rail will cause an increase in the demand for bus services
- Cross price elasticity has a positive value

$$CPED = \frac{\%\Delta D_{BUS}}{\%\Delta P_{rail}} = \frac{+_{ve}}{+_{ve}} = +_{ve}$$

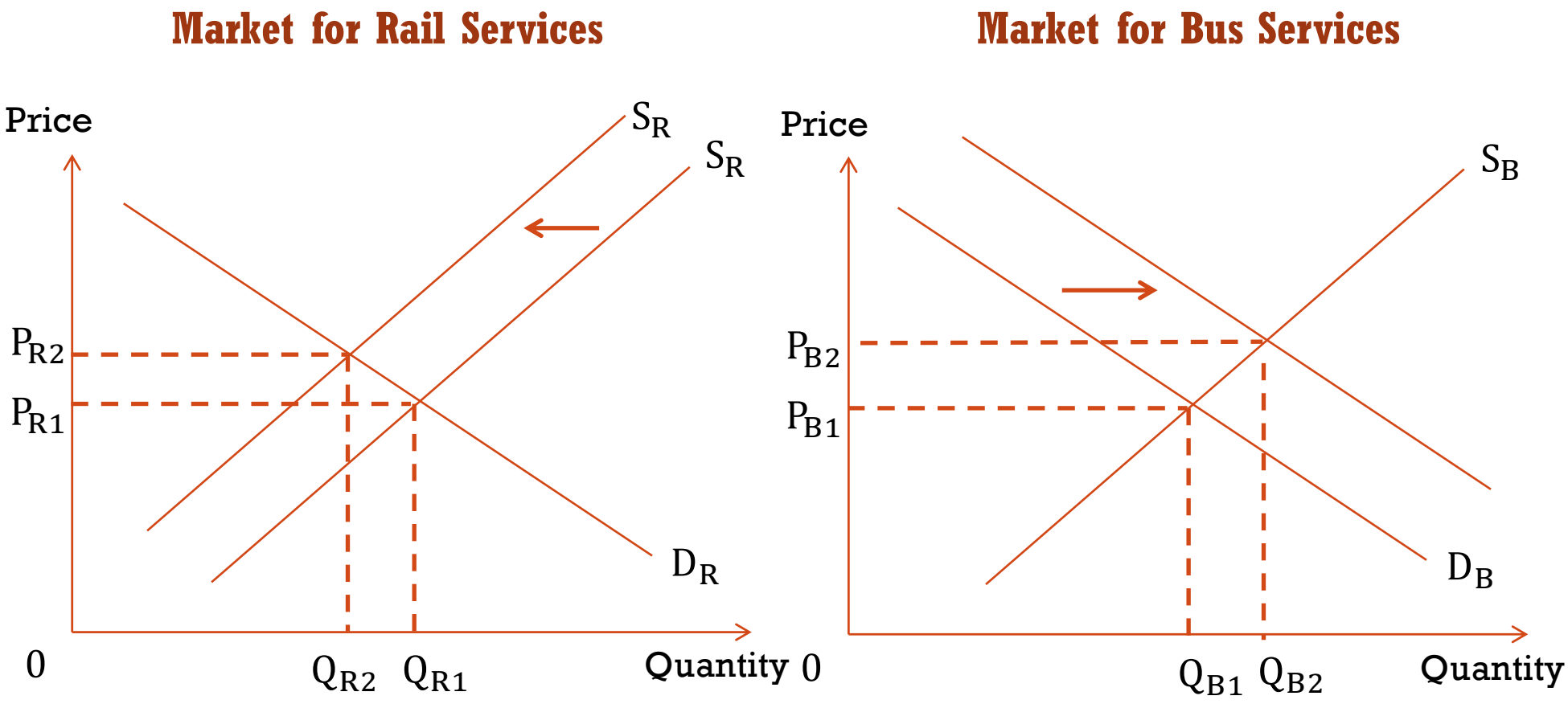
Where

$\%\Delta D_{BUS}$ = percentage change in quantity demanded of bus services

$\%\Delta P_{rail}$ = percentage change in price of rail services

$+_{ve}$ = a positive value

Cross price elasticity of demand, substitutes



- Substitute transport services, cross price elasticity will be positive

- As the price of one service rises, demand for the alternative service also rises and vice-versa

- The greater the degree of substitutability between the two services being compared, then the higher the value cross price elasticity will be

EXAMPLE II

- The price of cars and the market for petrol

- If the cost of manufacturing motor cars was to rise, then this would cause an increase in the price of cars and a reduction in the level of quantity demanded

- If there are less cars on the road, then petrol will be required, hence there will be a decrease in demand for petrol

$$CPED = \frac{\%\Delta D_{Petrol}}{\%\Delta P_{Car}} = \frac{-_{ve}}{+_{ve}} = -_{ve}$$

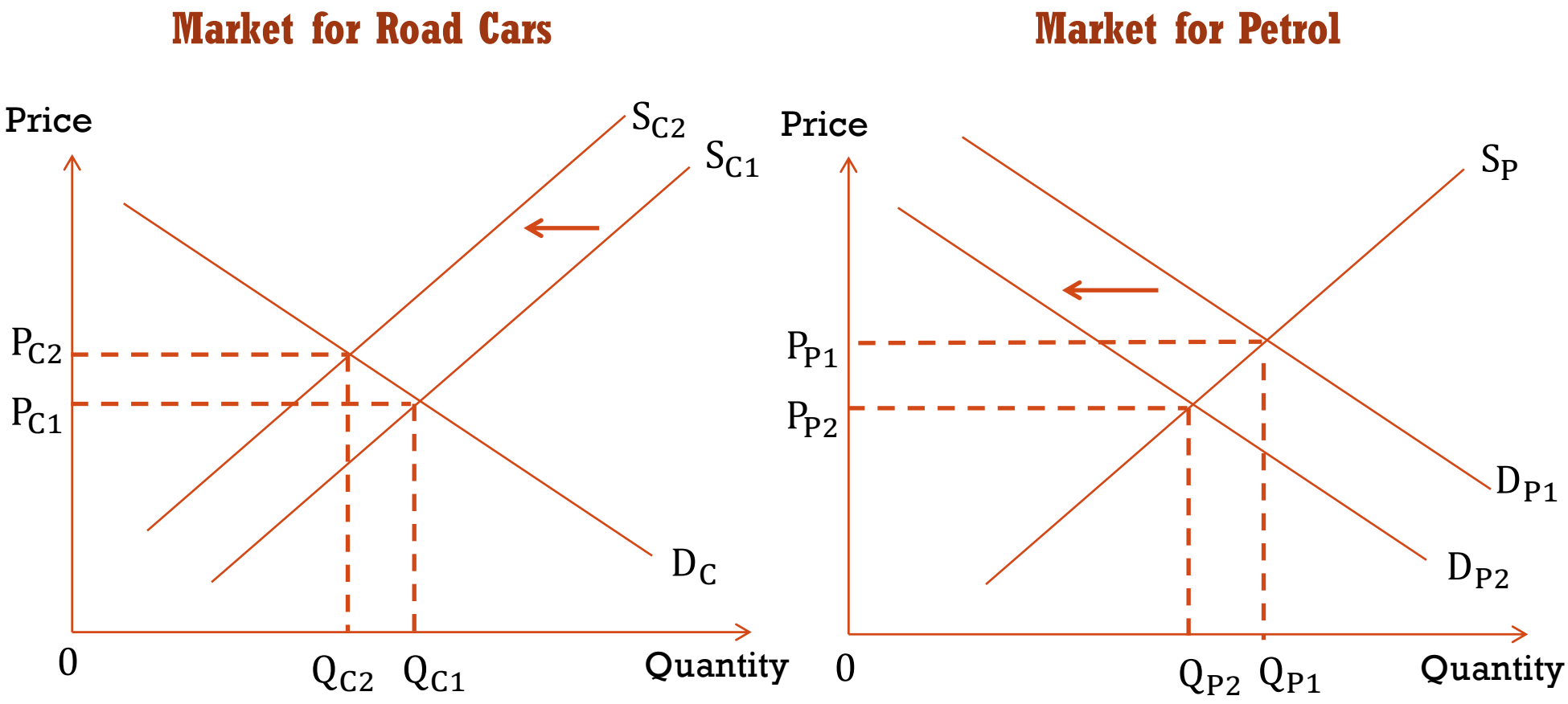
Where

$\%\Delta D_{BUS}$ = percentage change in quantity demanded of petrol

$\%\Delta P_{rail}$ = percentage change in price of cars

$-_{ve}$ = a negative value

Cross price elasticity of demand, complements



- The increase in the cost of manufacturing motor cars shown by a shift to the left of the supply curve and resulting in an increase in the price

- As cars and petrol are consumed at the same time, this increase in the price of cars changes the market conditions for petrol, causing a decrease in demand

- For complementary transport services, cross price elasticity will always be negative

CASE STUDY 2:
ISSUES IN CROSS PRICE ELASTICITY OF DEMAND

1. Cross price elasticities freight transport demand in Canada, mid range values, Oum and Gillen (1983)

2. Cross price elasticities intercity passenger transport demand in Canada, mid range values, Oum and Gillen (1983)

3. Short run own and cross price elasticities, London bus and underground ordinary tickets, Gilbert and Jalilian (1991)

CROSS PRICE ELASTICITIES FREIGHT TRANSPORT DEMAND IN CANADA, MID RANGE VALUES, SUMMARY OF OUM ET AL. (1990)

Mode	Truck	Rail	Waterway
Truck	-	0.127	-0.100
Rail	0.020	-	0.175
Waterway	0.005	0.710	-

Source: Adapted from Oum et al. (1990)

Note: the change in quantity A is shown on the rows, hence for example the truck-rail figure of 0.127 is the percentage change in truck haulage as a result of a price increase in rail freight

- There is no symmetry in cross price elasticity values
  - Example: A comparison of rail-truck is not the same as a comparison of truck-rail

WATERWAY-RAIL COMPARISON

$$CPED = \frac{\%\Delta D_{Waterways}}{\%\Delta P_{rail}} = \frac{+_{ve}}{+_{ve}} = 0.710$$

Where

$\%\Delta D_{Waterways}$ = percentage change in quantity demanded of waterways

$\%\Delta P_{rail}$ = percentage change in price of rail services

$+_{ve}$ = a positive value

A 10 % increase in price of rail freight would result in a 7.1% increase in the demand of water transport, underlying the apparent high degree of substitutability between the two modes. It strongly suggests that water transport is more of a substitute for rail than rail is for water

RAIL-WATERWAY COMPARISON

$$CPED = \frac{\%\Delta D_{Rail}}{\%\Delta P_{Waterways}} = \frac{+_{ve}}{+_{ve}} = 0.175$$

Where

$\%\Delta D_{rail}$ = percentage change in quantity demanded of rail services

$\%\Delta P_{waterways}$ = percentage change in price of waterways

$+_{ve}$ = a positive value

A 10 % increase in price of waterways would result in a 1.75% increase in the demand of rail services

Cross price values will be dependent upon **relative market shares**, with those modes with higher market shares having lower cross price elasticities as the relative increase in demand will be lower

Example

Say 100 million ton kilometers go by water and this represents 20 % of the market, and a 10% increase in the price of water transport results in 5 million ton kilometers shifting to rail

If prior to the price increase rail carried 200 million ton kilometers and thus 40 % of the market, this would give a cross price elasticity value rail water of +0.125

As the 10 % increase in the price of water transport would cause a 1.25 % increase in the level of rail freight

If then the price of rail was to increase by 10 % as a result the same shippers moved their cargo back to water, the cross price value water-rail would be far higher at +0.256, which is almost double because rail has double the market

Thus the 5 million ton kilometers that are switching between the two modes is far less of a proportion of total rail transport than it is of total water transport

CROSS PRICE ELASTICITIES INTERCITY PASSENGER TRANSPORT DEMAND IN CANADA, MID RANGE VALUES, OUM AND GILLEN (1983)

Mode	Air	Bus	Rail
Air	-	-0.015	0.025
Bus	-0.085	-	-0.340
Rail	0.295	-0.675	-

Source: Adapted from Oum et al. (1990)

Note again that quantity A is shown on the rows

- The negative sign in Bus-Rail and Rail-Bus cases indicates they are complementary goods

- Intercity services- Bus services feed into intercity rail services , this effect is far stronger than the direct competition between the two on intercity routes

- The positive sign in Rail-Air case indicates the plane competes with the train (+0.295)
  - A change in air fares has an impact on rail travel demand
- The rail does not compete with the air services (+0.025)
  - A change in rail fares has little effect on air travel demand

- A decrease in the air fare may cause some rail passengers to trade up to air travel, a decrease in the price of rail travel will not have the same effect of causing some air travellers to trade down to rail

SHORT RUN OWN AND CROSS PRICE ELASTICITIES, LONDON BUS AND UNDERGROUND ORDINARY TICKETS, GILBERT AND JALILIAN (1991)

Mode	Prices		
	Bus	Underground	British Rail
Bus	-0.839	0.476	0.082
Underground	0.041	-0.355	0.160

Source: Gilbert and Jalilian (1991)

- Bus- a 10% increase in the average fares, in the short run would be expected to produce an 8.39 % fall in bus usage
- The demand for bus travel is very much more price-responsive than is the demand for underground level
- A rise in bus fares, with underground and British Rail fares held constant, would result in a fall in revenue
- These estimates indicate a very substantial degree of potential competition between the bus and underground networks.
- Revenue from the bus network will depend in a sensitive manner on underground prices

INCOME ELASTICITY

INCOME ELASTICITY OF DEMAND

- A measure of the responsiveness of demand to changes in income

$$\text{Income elasticity of demand} = \frac{\text{Percentage Change in Quantity demand}}{\text{Percentage Change in income}}$$

$$\text{Income elasticity of demand} = \frac{\%\Delta D}{\%\Delta Y}$$

CASE STUDY 3:
ISSUES SURROUNDING INCOME ELASTICITY OF DEMAND

There are some important considerations when examining income elasticity of transport demand which this case will attempt to bring out, again with the assistance to real life examples

- The 'car ownership effect' – this occurs where the income elasticity for public transport is affected both directly by the increase in income that will be generating an increased demand for travel, but also by increasing levels of car ownership

- There will be a greater overall consistency in income elasticity of demand for transport than for either own or cross price elasticities, it will be nevertheless still be to a large extent dependent upon the area and hence the transport market in which people travel

- The effect of changes in income on bus demand

- National refers to the total which is then broken down into around 11 regions and finally county and PTE areas (the 6 largest English conurbations outside of London) within these regions

- Short run was defined as anything less than a year

BUS INCOME ELASTICITIES

Journeys	Short run	Long run
National data	0.00	-0.45 to -0.80
Regional data	0.00 to -0.29	-0.64 to -1.13
Country data	-0.30 to -0.40	-0.60 to -0.70
PTE data	-0.70	-1.60

Source: Dargay and Hanly (1999)

- The ATOC study was based upon relatively short journey (of less than 20 miles/ 32 kilometres), and as expected all are positive; hence an increase in income would result in an increase in the demand for rail services

- Trips into London therefore from the surrounding districts would increase the most with changes in income

SOUTH EAST BRITAIN INCOME RAIL ELASTICITIES (2002)

Area	Income elasticity
South East to London	2.07
London to South East	1.90
South East Non London	0.89
Non London	0.11

Source: ATOC (2002)

- In highly densely populated urban areas impacts on rail transport will tend to be strong in an upward direction, whilst in less populated areas the relatively higher car ownership levels will tend to dominate and consequently income elasticities for public transport as a whole are likely to be considerably lower

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