2. TRANSPORT DEMAND ELASTICITY

ELASTICITY

- Elasticity of demand is the **responsiveness** of demand to a change in one of its determinants
- **Price, cross-price, income, …..**
- Important for **evaluation**, business and transport policy

Policy

- Especially price elasticity has a **huge impact** on transport policy and decision making
- Given that many transport markets are regulated → setting **the right fare** is essential to achieving policy objectives
- Price elasticity is crucial in calculating revenues from the imposition of a **tax** or in the level of **subsidy** needed to reduce price

PRICE ELASTICITY

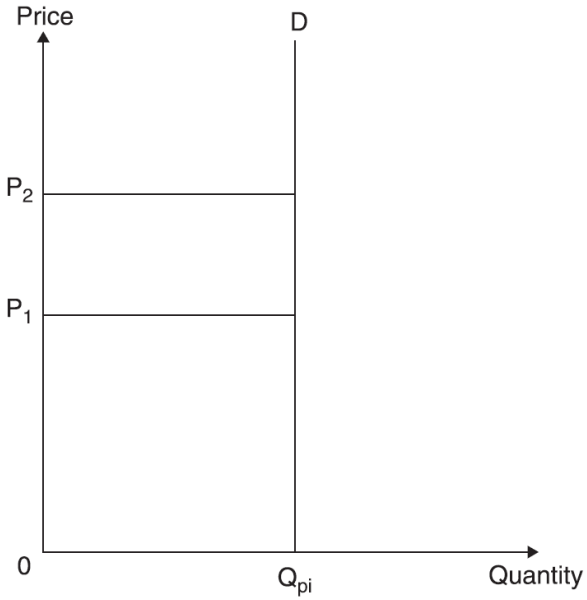
Price elasticity of demand = the consumer's demand responsiveness to changes in prices

$$\text{Price Elasticity of Demand} = \frac{\text{Percentage Change in Quantity Demand}}{\text{Percentage Change in Price}}$$

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

$$\text{PED} = \frac{\%\Delta D}{\%\Delta P} = \frac{-1\%}{+4\%} = -0.25$$

Demand curves



Elastic **Inelastic** **Unitary**

Determinants of price elasticity

- The number and closeness of alternative modes of travel (**substitutes**) → the higher the number of alternative modes and the closer they are in meeting the need → the higher price elasticity
- **Proportion of** disposable **income** spent on the mode of travel → if it is small, the price elasticity will be also small
- **Time** dimension → time may bring about a change in behaviour → over time habits may change

Time dimension

Table 4.1 *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)

Interpretation

- Over time **elasticity** values for transport have been **increasing** → consumers of transport services have been becoming **more price sensitive** over time
- Pauley et al. (2006): bus fare elasticities: **-0.4** in the short run; **-0.55** in the medium run and **-1.00** in the long run
- Beware of **high variability** of results among studies → each finding applies to a particular situation

Variability

Table 4.2 *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

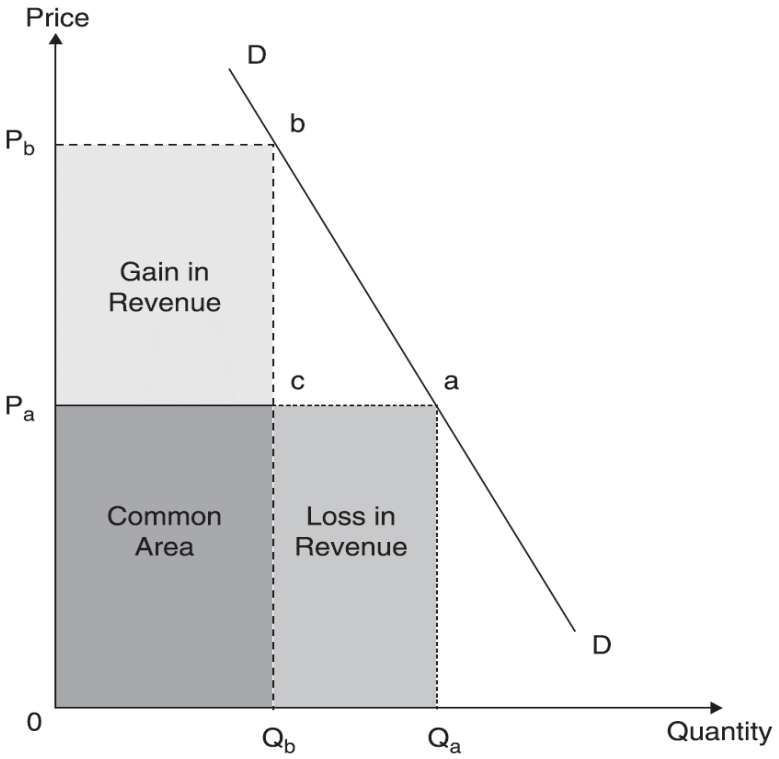
Interpretation

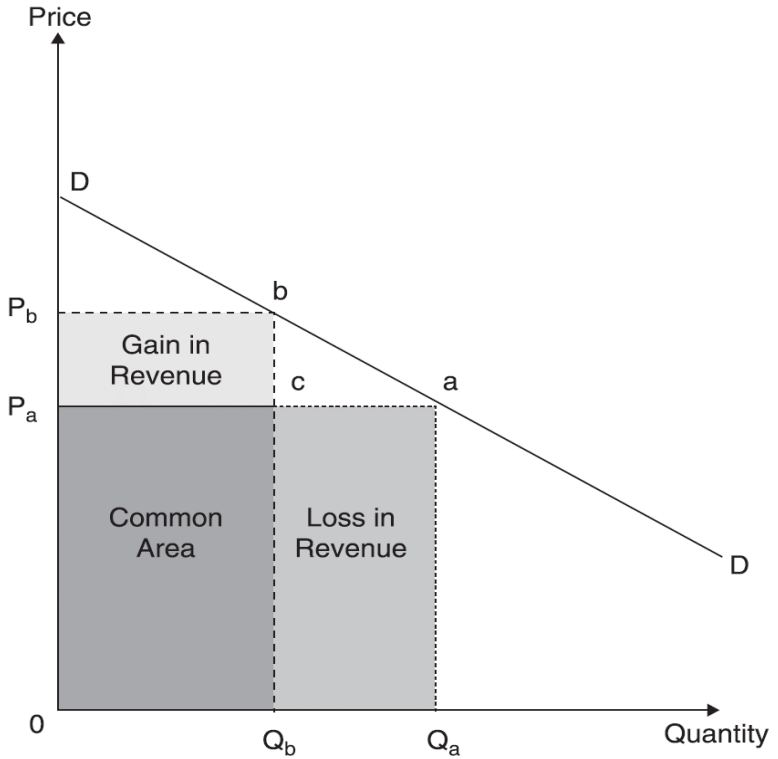
- **Single** fares unitary elastic, the **10 ticket metro** ticket highly elastic; **10 ticket bus** fare relatively inelastic
- **Junior travel card** +0.56! → Giffen good →raise in price probably raised awareness of it
- High degree of **variability** in elasticity values → due to **travel card option**

Purpose and length of journey

- Elasticities depend upon the purpose of the journey → e.g. rail fare elasticities (ATOC, 2002): -0.2 **business**; -0.3 **commuting**; -1.0 **leisure**
- The impact of distance → **bus elasticities** higher, the longer the journey (magnitude, leisure, alternatives)
- However, Preston and others found for **rail** decreasing elasticities with the distance (less alternatives for rail in longer distances?)
- The price elasticity of **petrol** follows the pattern of low price elasticity in SR and high price elasticity in LR → shift to more fuel efficient cars → increase in tax to limit car use may have little impact

Price elasticity and total revenue





Q: If operators face inelastic demands, why don't they simply keep increasing the fare?

Exercises

1. Is the price elasticity of **demand for airline industry** in short-haul markets more or less than long-haul markets? Why?
2. What are the factors that influence the elasticity of **demand for pilots**?
3. The price elasticity of **demand for Amtrak**, the US rail passenger service, among vacation travellers has been estimated as –1.20. Given that Amtrak faces the market demand for rail passenger trips, what effect will a 15% increase in fares have upon market demand? What effect will the fare increase have upon revenues?

Exercise: Demand estimations

According to demand theory, the market demand curve for transportation is downward-sloping.

- You are a transportation economist for rail operator and you are asked to estimate the price elasticity of demand for rail services. Describe in some detail **what steps** you would follow to obtain the price elasticity of demand.
- Suppose that your analysis found that the price elasticity of demand for rail services was **–0.78.** What impact would a 10% increase in price have upon the quantity of rail services demanded? Do you know whether revenues would rise or fall?

UK price elasticities – urban and regional market

	SHORT RUN	MEDIUM RUN	LONG RUN
BUS	-0.4	-0.56	-1.0
METRO	-0.3		´-0.6
RAIL	-0.6		

Source: Pauley et al. 2006

UK price elasticities – findings (1)

- Fare elasticities varies significantly depending not only on the mode and the time period over which is being examined, but also on the **specific circumstances**
- The **short** run elasticities **increased** on average from -0.3 to -0.4 between 1980 and 2004
- The **long run** elasticities are **close to -1.0** and may even exceed -1.0 → implications for fare/revenue policy

Source: Pauley et al. 2006

UK price elasticities – findings (2)

- Fare elasticities may be affected by the **magnitude of the fare change** → greater fare increases produces higher value of elasticities → the differences are greatest for long run elasticities
- Fare elasticity is also affected by the current level of the fare **relative to people‘s income**
- Elasticity values increase with **short distance** and for **rail** journeys **outside London**

Source: Pauley et al. 2006

UK price elasticities – findings (3)

- The response to a fare increase may **not be equal** and opposite to the response to fare decrease
- **London is a special** case due to size of the agglomeration and congestion
- **Off peak** elasticity values are about twice the peak values
- Elasticities for people travelling to work and school tend to be **lower** than for other purposes
- Those with access to cars (**males**) have higher elasticity values; the evidence about age is not clear cut
- As for distance, bus elasticities are higher for very short and very long trips; for rail elasticities decrease with distance

Source: Pauley et al. 2006

CROSS PRICE ELASTICITY

Cross price elasticity of demand is a measure of the effect of a change in the **fares of one** transport mode or transport operator on the **demand** for the services **of another**

$$\text{Cross price elasticity} = \frac{\text{Percentage change in quantity demanded of service A}}{\text{Percentage change in price of service B}}$$

$$\text{CPED} = \frac{\%\Delta D_A}{\%\Delta P_B}$$

Cross price elasticity

- Involves examining **two goods** or services
- Within transport → these services can be examined **at different levels** → two different modes (train x car) → within the same mode (RegioJet x ČD) → within a same operator (1st class x 2nd class)

Substitutes (Rail and Bus)

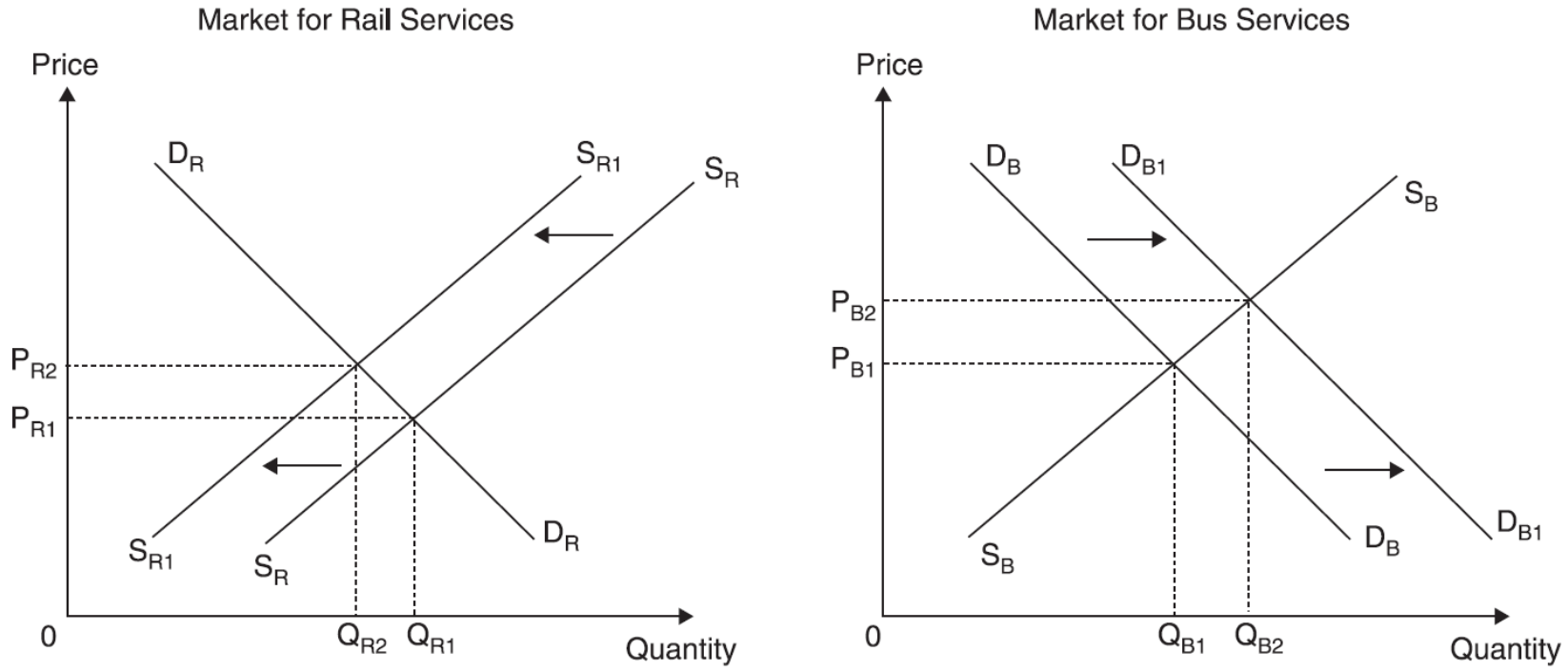


Figure 4.8 *Cross price elasticity of demand, substitutes*

If the effect of price increase in one good has a positive impact on the demand of the another good – **SUBSTITUTES**

Complements (Car and Petrol)

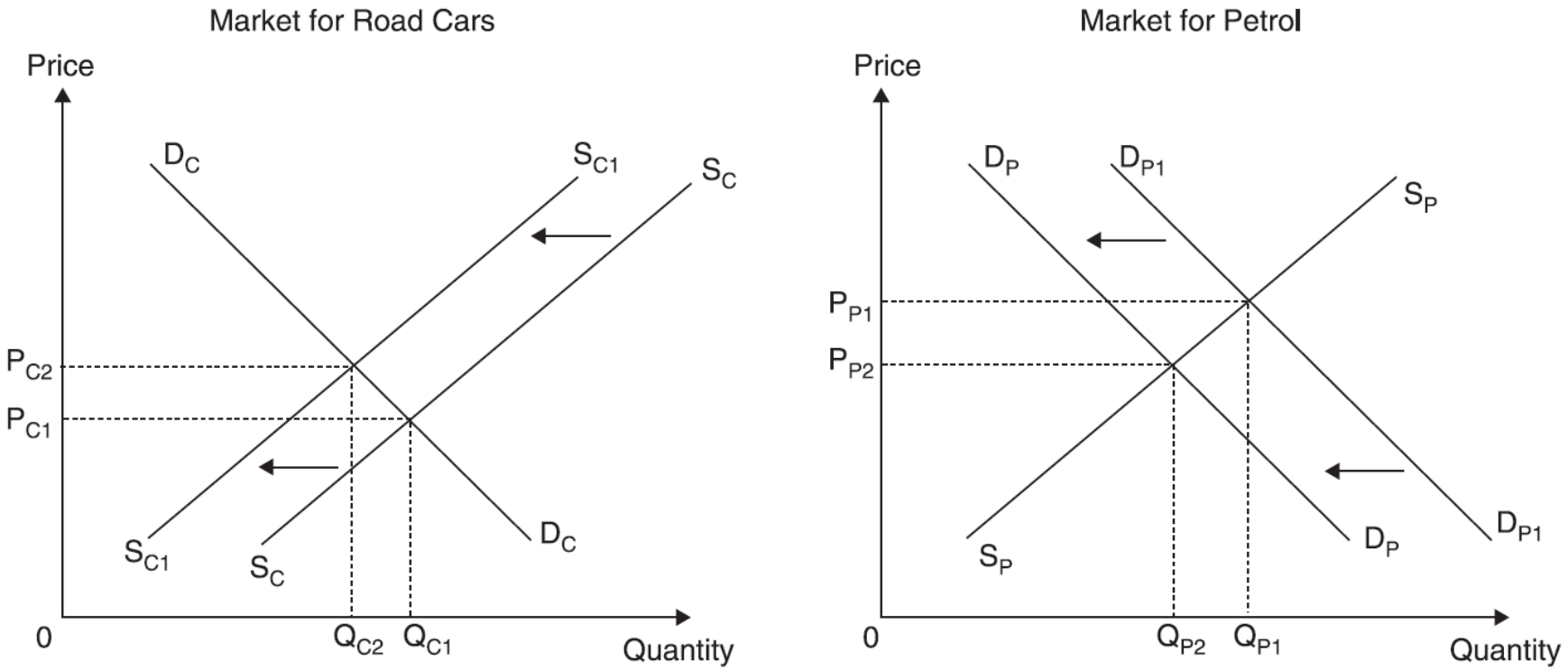


Figure 4.9 *Cross price elasticity of demand, complements*

If the effect of price increase in one good has a negative impact on the demand of another good - **COMPLEMENTS**

Freight

Table 4.3 *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.

Interpretation

- Elasticities are taken from **Canada** → the impact of geography and sheer distances
- **No symmetry** in the table: **rail-truck ≠ truck-rail** → there is no reason to believe that rail users due to increase in rail prices wil react in the exactly same way (by switching to truck) as truck users due to increase in truck prices (by switching to rail)
- **Rail-water** → whilst water is a substitute for the train, the train is far less substitute for water

Passenger

Table 4.4 *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.

Interpretation

- Little substitutability between **air and bus**
- **Bus and rail** → complements → why? → intercity markets where bus can feed ta rail services
- The **plane** competes with the **train** → train does not compete with the plane ≈ change in air fares has an impact on the rail travel demand, but a change in rail fares has little effect on air travel demand

Public transport

Table 4.5 *Short run own and cross price elasticities, London bus and underground ordinary tickets, Gilbert and Jalilian (1991)*

	Prices		
Mode	*Bus*	*Underground*	*Rail*
Bus	−0.839	0.476	0.082
Underground	0.041	−0.355	0.160

Source: Gilbert and Jalilian (1991)

Interpretation

- The demand for London **buses** is far more **elastic** than in other parts of the country
- The **underground** is a substitute for a **bus** → the bus is not a substitute for underground
- The impact of changes in **rail** fares on the demand for **bus** services is very small
- The **bus** and **rail** in London serve two distinct markets

Table 6
Urban cross elasticities

	Car use	Rail use	Bus use
Car cost	–	0.59	0.55
Rail cost	0.054	–	0.08
Bus cost	0.057	0.24	–

Sources: Toner (1993), Wardman (1997b).

Paulley, N., Balcombe, R., Mackett, R., Titheridge, H., Preston, J., Wardman, M., ... & White, P. (2006). The demand for public transport: The effects of fares, quality of service, income and car ownership. *Transport policy*, *13*(4), 295-306.

Table 7
Interurban cross elasticities

	Car use	Rail use	Coach use
Car time	–	0.33	0.60
Car cost	–	0.25	0.34
Rail time	0.057	–	0.20
Rail cost	0.066	–	0.32
Coach time	0.054	0.17	–
Coach cost	0.014	0.17	–

Source: Wardman (1997a).

Paulley, N., Balcombe, R., Mackett, R., Titheridge, H., Preston, J., Wardman, M., ... & White, P. (2006). The demand for public transport: The effects of fares, quality of service, income and car ownership. *Transport policy*, *13*(4), 295-306.

INCOME ELASTICITY

- Income elasticity of demand is a measure of the **responsiveness of demand to changes in income**
- As real incomes are likely to increase over time, income elasticity identifies **potentially growing and falling markets**

INCOME ELASTICITY

$$\text{Income elasticity} = \frac{\text{Percentage change in quantity demanded}}{\text{Percentage change in income}}$$

$$\text{YED} = \frac{\%\Delta D}{\%\Delta Y}$$

Goods

Income elasticity	Goods	Example
NEGATIVE	INFERIOR	BUS
POSITIVE (0 < IE < 1)	NORMAL	CAR, RAIL
POSITIVE (IE > 1)	LUXURIOUS	PLANE

Discussion questions

Q1: Will **bus** services **disappear**?

Q2: Are **air** services always **luxurious** good?

Q3: What is the **income elasticity** of **public transport**?

Income elasticity in the EU

Table 8
Growth in public transport use: European Union countries 1990–1999

Mode	Growth in passenger kilometres (%)
Passenger cars	18
Buses and coaches	9
Tram and metro	5
Railway	8
Air	65
All	19

Source: Paulley, 2006

Car ownership effect

- 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**
- Increase in income will cause an increase in the demand for rail travel, however, this would be smaller than expected as it will be **partially offset** by increasing levels of car ownership
- The effect will be dependent upon the area → in **London** the car ownership tend to be smaller → income elasticities of public transport tend to be larger → this is not the case for other major conurbation in Britain

British buses

Table 4.6 *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
County Data	−0.30 to −0.40	−0.60 to −0.70
PTE Data	−0.70	−1.60

Source: Dargay and Hanly (1999)

Interpretation

- **Data**: National → 11 Regions → County level → PTE = 6 largest English conurbations outside of London
- **Short run** = anything less than a year; **Long run** = anything over that
- Bus as an **inferior good**
- Long run effects significantly larger than short run
- Changes in income has the largest effect in **PTE** cities → in counties they are already using the car

British rail

Table 4.7 *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)

Interpretation

- **Data**: This ATOC study was based upon relatively short journeys (less than 20 miles)
- As expected, all elasticities are **positive** → strongly related to the economic importance and pulling power of London
- **Outside London**, there are more alternatives (car)
- *Q: Is south-east (of Britain) different to the rest of Britain?*

Summary: income elasticities

- The income elasticities are significantly **dependent upon the area**
- In densely populated area, the impact of rising income will be directed towards **rail**, in less populated areas towards **car ownership**
- In some areas with dominance of rail and metro, **buses** will have **hard times**

Appendix: Service (frequency) elasticities

Table 4
Bus and rail service elasticities

	Bus	No. of obs	Rail	No. of obs
Short run	0.38	27	0.75	3
Long run	0.66	23	–	–

Source: Paulley, 2006