

Economics of Transportation

EE 382
Introduction

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GRADING

The final grade of the course will be based on the following items:

| | |
|------------------------|----|
| Mid-term exam | 30 |
| Paper and presentation | 15 |
| Article presentation | 5 |
| Class participation | 5 |
| Final exam | 45 |

The scope of the subject

- **Transport economics** is a branch of economics that deals with the allocation of resources within the transport sector and has strong linkages with civil engineering
(source: http://en.wikipedia.org/wiki/transport_economics)
- Transport economists are interested in the economic problems of moving goods and people

Transport issues

- Congestion and the role of road pricing
- The impact on traffic on the environment
- The Organization of public transport services
- The rise of low-cost airlines
- The capacity of the rail network

The economic analysis of transport issues is at the micro level

- What determines the demand for a particular journey?
- What may happen to the level of congestion if a road pricing system is introduced?
- How can an airline operator charge passengers different prices for the same flight?
- What influences the level of competition within the bus sector?

Scarcity, Choice and Opportunity cost

- Individuals cannot have everything that they want because there is a finite limit on the resources that can be used to satisfy their 'wants'
- Any resources is therefore scarce
- If individuals cannot have all that they want, then choices need to be made, and put simply every choice involves a cost
- This will always be the next best alternative that could have had been selected when that choice was made
- This is known as the **opportunity cost** of that decision

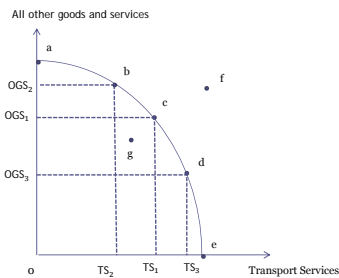
Example

If a particular society does not have sufficient resources to build both a new stretch of motorway and a new airport - a choice between the two

- If it chooses to build the motorway then the opportunity cost of the motorway is the airport that was not built

Opportunity cost - the next best alternative forgone

Production Possibility Frontier



The choice is between either transport services or all other goods and services

As resources are finite there is a maximum level or combination that can be produced

- As any economy cannot provide its citizens with all that they want, there is scarcity, a choice has to be made with regard to three basic questions
 - What to produce?
 - How to produce?
 - And for whom to produce it?
- This has led to the development of different economic systems or types of economies to answer these questions

The three market systems

- The command economy
- The free market
- The mixed market

A command economy

- the government decides what to produce, how it will be produced and who will receive the output
- The government also decides how the factors of production are employed
 - Land and raw materials, labor, and capital
- The state organises the factor of production to resolve
 - What and how to produce and distributes the resultant production on the basis of equity

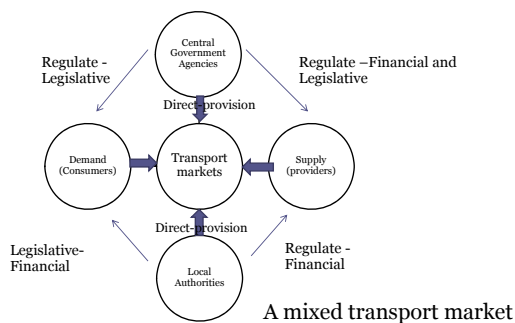
A Free market economy

- In its most extreme form, a completely free market economy has no government input into the decision of what, how and for whom to produce
- Government's only function is to provide law and order
- Economic decisions are left purely to the market in the form of private buyers and sellers, with the **price mechanism** and the profit motive playing central roles in the operation of the whole economic system

A mixed market economy

- A market based system - one primarily (but not entirely) based upon the price mechanism, and one that uses a mix of public decisions of the state and the private decisions of the market to determine the outcome to the questions of what, how and for whom to produce
- Examples- health, education and many social services

Transport markets



Case study

Private and public sector roles in the provision of public transport in and around the Glasgow conurbation

- In Glasgow there are three main forms of public transport: the bus, the train, and the Glasgow underground
- All three operate through the price mechanism - a fare is charged for their use, the provision of each mode operates along very different economic principles

Bus Services

- Free market system - privately owned and operated companies decide which bus services they will operate
- Usually based upon providing a network of services that they believe will make them a profitable return

Rail services

- Glasgow has the largest suburban rail network in the UK outside of London
- Services provide based not on the profit motive, but rather on the basis of the public interest
- Transport Scotland determines the pattern of rail services to be provided and sets the fares to be charged
- Transport Scotland contracts a private sector operator- First Scotrail- to provide the services to the specified pattern and fare structure

Glasgow underground

- The public body, the Strathclyde Passenger Transport (SPT), act as both operator and principal funder of the system
- Provided on the basis of the public interest, hence passenger revenues fail to cover the cost of operation
- The economics of the whole venture however still need to add up, they the difference between costs and revenues are made up by subsidy

Questions for discussion

Pros and Cons on each mode of transportation

Air

Pros

Cons

Air

Pros

- Fast delivery
- This mode of transport is useful to deliver products with short lead time, fragile goods and products that are not bulky
- Products in high demand and in short supply may also airfreighted in order to meet customer demands

Cons

- Cost
- Flight delays and/or cancellations
- Custom and Excise restriction

Source: Serroukh (2011)

Rail

Pros

Cons

Rail

Pros

- Fast delivery
- Capacity
- Cost effective
- Safe mode of transport
- Reliable

Cons

- Subject to unforeseen delays
- Reliance on rail freight operator's timetable
- Suppliers/ customers are not always located near a rail freight depot and delivery to/from the depot can be costly and time consuming

Source: Serroukh (2011)

Road

Pros

Cons

Road

Pros

- Cost effective
- Fast delivery
- Ideal for short distances, national or mainland Europe
- Ideal for transportation perishables (e.g. fruit and vegetables)
- Easy to monitor location of goods
- Easy to communicate with driver
- Ideal for sending by courier shortage to customers

Source: Serroukh (2011)

Cons

- Transport subject to traffic delays
- Transport subject to breakdown
- Goods susceptible to damage through careless driving
- Bad weather
- Driving regulations can cause delay

Sea

Pros

Cons

Sea

Pros

- Ideal for transporting heavy and bulky goods
- Suitable for products with long lead times

Cons

- Longer lead/delivery times
- Bad weather
- Difficult to monitor exact location of goods in transit
- Customs and Excise restrictions
- Could be costly

Source: Serroukh (2011)

Pipeline

Pros

Cons

Pipeline

Pros

- Large volume transportation (E.g. 60 million liters per day)
- Excellent safety (E.g. fewer than 2 incidents per 10,000 kilometers of pipeline per year)
- Secure supply (unaffected by weather, operating 24/7/365)
- Cost efficiency for medium and long haul transportation, with no need for handling operations
E.g. comparison purposes, the average cost per metric ton per 100 kilometers is:
 - Pipeline: €1.8 to € 2.1
 - Train (2,000 tons): €2.7
 - Truck (38 tons): €4.1

Cons

- Narrow specialization

Source: Societe Des Transports Petroliers Par Pipeline website

Multimodal Transportation

- The transportation of goods under a single contract, but performed with at least two different means of transport

The Global picture

- Transport requires infrastructure as well as vessels, planes and vehicles, to move goods and people around the globe

GDP and merchandise trade by region, 2005-07 (annual percent change at constant prices)

| | GDP | | | Exports | | | Imports | | |
|------------------------------------|------|------|------|---------|------|------|---------|------|------|
| | 2005 | 2006 | 2007 | 2005 | 2006 | 2007 | 2005 | 2006 | 2007 |
| World | 3.3 | 3.7 | 3.4 | 6.5 | 8.5 | 5.5 | 6.5 | 8 | 5.5 |
| North America | 3.1 | 3 | 2.3 | 6 | 8.5 | 5.5 | 6.5 | 6 | 2.5 |
| USA | 3.1 | 2.9 | 2.2 | 7 | 10.5 | 7 | 5.5 | 5.5 | 1 |
| South and Central America | 5.6 | 6 | 6.3 | 8 | 4 | 5 | 14 | 15 | 20 |
| Europe | 1.9 | 2.9 | 2.8 | 4 | 7.5 | 3.5 | 4.5 | 7.5 | 3.5 |
| EU (27) | 1.8 | 3 | 2.7 | 4.5 | 7.5 | 3 | 4 | 7 | 3 |
| Commonwealth of Independent States | 6.7 | 7.5 | 8.4 | 3.5 | 6 | 6 | 18 | 21.5 | 18 |
| Africa and Middle East | 5.6 | 5.5 | 5.5 | 4.5 | 1.5 | 0.5 | 14.5 | 6.5 | 12.5 |
| Asia | 4.2 | 4.7 | 4.7 | 11 | 13 | 11.5 | 8 | 8.5 | 8.5 |
| China | 10.4 | 11.1 | 11.4 | 25 | 22 | 19.5 | 11.5 | 16.5 | 13.5 |
| Japan | 1.9 | 2.4 | 2.1 | 5 | 10 | 9 | 2.5 | 2.5 | 1 |
| India | 9.0 | 9.7 | 9.1 | 21.5 | 11 | 10.5 | 28.5 | 9.5 | 13 |
| Newly industrialized economies(4) | 4.9 | 5.5 | 5.6 | 8 | 12.5 | 8.5 | 5 | 8.5 | 7 |

World seaborne trade by types of cargo and country groups, annual, 1985-2011 (Metric tons in millions)

| CARGO TYPE | Year | | | | | | |
|-------------------------------------|------|------|------|------|------|---------|---------|
| | 1985 | 1990 | 1995 | 2000 | 2005 | 2010 | 2011 |
| Crude Oil loaded | 1049 | 1287 | 1532 | 1605 | 1857 | 1787.68 | 1762.37 |
| Petroleum products and gas loaded | 410 | 468 | 518 | 558 | 565 | 983.75 | 1033.51 |
| Dry cargo loaded | 1895 | 2253 | 2601 | 3821 | 4687 | 5637.47 | 5951.86 |
| Total goods loaded | 3330 | 4008 | 4651 | 5984 | 7109 | 8408.90 | 8747.74 |
| Crude Oil unloaded | 1128 | 1315 | 1550 | 1633 | 1854 | 1933.23 | 1907.03 |
| Petroleum products and gas unloaded | 367 | 466 | 508 | 513 | 573 | 979.18 | 1038.62 |
| Dry cargo unloaded | 1938 | 2365 | 2685 | 4097 | 4696 | 5531.42 | 5823.65 |
| Total goods unloaded | 3433 | 4126 | 4743 | 6242 | 7122 | 8443.83 | 8769.30 |

Source: UNCTAD, UNCTADstat

The world's largest container ports

| Rank | Port, Country | Volume 2010 (million-TEUS) | Volume 2011 (million-TEUS) |
|------|--|----------------------------|----------------------------|
| 1 | Shanghai, China | 29.07 | 31.74 |
| 2 | Singapore, Singapore | 28.43 | 29.94 |
| 3 | Hong Kong, China | 23.70 | 24.38 |
| 4 | Shenzhen, China | 22.51 | 22.57 |
| 5 | Busan, South Korea | 14.18 | 16.17 |
| 6 | Ningbo-Zhoushan, China | 13.14 | 14.72 |
| 7 | Guangzhou Harbor, China | 12.55 | 14.26 |
| 8 | Qingdao, China | 12.01 | 13.02 |
| 9 | Jebel Ali, Dubai, United Arab Emirates | 11.60 | 13.01 |
| 10 | Rotterdam, Netherlands | 11.14 | 11.88 |

Source: World Shipping Council website

What is TEU?

- The Twenty-foot equivalent unit (TEU)
- Often used to describe the capacity of container ships and container terminals
- A standard-sized metal box which can be transferred between different modes of transportation, such as ships, trains, and trucks

Transport at the National Level

A major component of the national output and accounts for a large part of national expenditure in most developed countries

Examples:

- >14.5% of national expenditure in Great Britain

Weekly household expenditure in Great Britain (2001/2002)

| Average weekly expenditure all households (pounds) | |
|--|--------|
| Food & non-alcoholic drinks | 41.80 |
| Alcoholic drink, tobacco & narcotics | 11.40 |
| Clothing and footwear | 22.90 |
| Housing, fuel and power | 35.90 |
| Household goods & services | 30.50 |
| Health | 4.50 |
| Transport | 57.80 |
| Communication | 10.40 |
| Recreation and culture | 54.10 |
| Education | 5.60 |
| Restaurants and hotels | 33.40 |
| Miscellaneous goods and services | 30.70 |
| Other expenditure items | 59.50 |
| Total | 398.30 |

US passenger transport by mode (2007)

| Mode of passenger transport | Passenger-miles (millions) | Percent |
|-----------------------------------|----------------------------|---------|
| Highway-total | 4,884,557 | 88.79 |
| Passenger vehicles, motorcycles | 4,520,810 | 82.18 |
| Trucks | 222,836 | 4.05 |
| Buses | 162,908 | 2.96 |
| Air carriers | 583,689 | 10.61 |
| Rail- total | 30,972 | 0.56 |
| Transit | 16,118 | 0.29 |
| Commuter | 9,473 | 0.17 |
| Intercity/Amtrak | 5,381 | 0.10 |
| All other modes (e.g. ferryboats) | 2,091 | 0.04 |

Source: Button, K. (2010).

Local transport

Urban transport

- Traffic congestion problems
- Public transport use and levels of car ownership

Indicators of public transport competitiveness in various cities where public transport (PT) market share grew between 1995 and 2001

| | | London* | Madrid | Vienna | Singapore | Hong Kong | Paris |
|---|-------|---------|--------|--------|-----------|-----------|-------|
| Market share of motorised and mechanised journeys by PT (%) | 1995 | 23.9 | 27.2 | 43.2 | 44.2 | 71.8 | 27.1 |
| | 2001 | 26.8 | 30.2 | 46.6 | 45.7 | 73.9 | 27.5 |
| Annual number of journeys on public transport per inhabitant* | 90-95 | 345 | 250 | 490 | 480 | 545 | 260 |
| | 96-01 | 390 | 290 | 495 | 485 | 525 | 310 |
| Average annual investment (% of GDP) | 1995 | 1.13 | 0.88 | 1.07 | 0.44 | 0.37 | 0.45 |
| | 2001 | 0.64 | 0.81 | 0.62 | 0.84 | 1.00 | 0.32 |
| Length of reserved routes (km/millions of inhabitants) | 1995 | 172 | 84.5 | 174 | 22.5 | 17.5 | 149.5 |
| | 2001 | 176 | 92.5 | 185 | 29.5 | 22.5 | 151.5 |
| PT speed (in km/h) | 1995 | 31.3 | 28.5 | 24.9 | 27.0 | 26.4 | 31.6 |
| | 2001 | 34.6 | 30.7 | 27.0 | 28.6 | 26.0 | 30.9 |
| PT vehicle x km/haectare per inhabitant | 1995 | 145 | 67.5 | 87 | 110 | 146 | 71.5 |
| | 2001 | 157 | 85 | 106 | 112 | 172 | 84 |
| PT vehicle x km per hectare | 1995 | 7.850 | 4.500 | 5.850 | 10.300 | 46.700 | 3.400 |
| | 2001 | 8.650 | 4.750 | 7.100 | 11.500 | 49.200 | 3.400 |

* traffic including non-residents

Indicators of public transport competitiveness for Eastern European and Far Eastern cities where public transport (PT) market share is 50% or higher

| | Singapore | Prague | Budapest | Moscow | Warsaw | Hong Kong |
|---|-----------|--------|----------|--------|--------|-----------|
| Market share of motorised and mechanised journeys by PT (%) | 45.7 | 54.2 | 55.9 | 63.6 | 64.0 | 73.9 |
| Number of cars for every 1,000 inhabitants | 125 | 535 | 330 | 190 | 380 | 50 |
| Parking spaces/jobs in the CBD | 165 | 45 | 95 | 30 | 60 | 25* |
| PT place x km per inhabitant | 14,300 | 16,100 | 11,100 | 17,400 | 8,900 | 16,100 |
| PT place x km per hectare (in thousands) | 1,460 | 705 | 515 | 2,800 | 460 | 4,620 |
| Length of reserved routes (km/million inhabitants) | 29.5 | 235 | 197 | 40 | 178 | 22.5 |
| Proportion of PT rail services as a% of place x km | 40 | 72.5 | 64.5 | 84 | 46 | 31.5 |
| PT commercial speed (km/h) | 28.6 | 28.6 | 21.2 | 36.6 | 23.1 | 26.0 |
| PT speed door-to-door (km/h) | 13.3 | 16.2 | 13.1 | 21.0 | - | 12.0 |

* excluding car parks of firms and retail businesses

Rural transport

- Has its origins and destination outside of urban areas
- Involves movement between cities and non-city areas
- Example - the movement of agricultural products, tourism etc.

Emerging Trends

- The established industrial world the long-term trend, despite periodic downturns in the business cycle
- The liberalization of Eastern Europe, coupled with the new political geography that is emerging is posing problems as well as offering opportunities, for the countries in the region
- Economic development in the low-income countries in Africa, Asia, and South and Central America then transport will inevitably change

Car ownership per 1000 population in selection countries (2006)

| Country | Car ownership | Country | Car ownership |
|-------------|---------------|--------------|---------------|
| USA | 765 | Greece | 329 |
| Luxembourg | 686 | South Korea | 293 |
| Malaysia | 641 | Israel | 263 |
| Australia | 619 | Hungary | 262 |
| Italy | 566 | Poland | 261 |
| Canada | 563 | South Africa | 146 |
| Japan | 543 | Mexico | 138 |
| Norway | 494 | India | 12 |
| Belgium | 484 | China | 10 |
| Spain | 471 | Pakistan | 8 |
| UK | 426 | Bangladesh | 2 |
| Netherlands | 417 | Ethiopia | 1 |
| Denmark | 408 | | |

Source: United Nations

Durable goods for 1,000 households (2006 or most recent prior year)

| | China | | India | |
|--------------------|-------|-------|-------|-------|
| | Urban | Rural | Urban | Rural |
| Automobiles | 4.3 | | 4 | 0.7 |
| Bicycles | 117.6 | 98.4 | 51.9 | 57.2 |
| Cameras | 48 | 3.7 | | |
| Computers | 47.2 | | | |
| Microwave ovens | 50.6 | | | |
| Motorcycles | 20.4 | 44.6 | 28.3 | 7.9 |
| Refrigerators | 91.8 | 22.5 | 30.8 | 4.8 |
| Telephones | 93.3 | 64.1 | | |
| Mobile telephones | 137.4 | 89.4 | 70.4 | 27.5 |
| Televisions | 137.4 | 89.4 | 70.4 | 27.5 |
| Video disc players | 70.2 | | 8.2 | 1.7 |
| Washing machines | 96.8 | 43 | 12.5 | 0.9 |

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