UNIT5

TRANSPORT COST

Transport economics [TEC711S]
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In the course of this Unit, you will learn about:

- The theory of production
- Definitions of technical, cost and allocative efficiency
  How time is divided in economics
- How transport costs behave in the short and long runs
- Returns to scale and economies of scale in the transport industries
- The relevance of production costs to the supply of transport services
Introduction

• In retrospect to elasticity of demand which concentrates on the demand side of the market, cost of production concentrate on the supply side of the market.

• **Definition of Transport cost:** the expenses involved in moving products or assets to a different place, which are often passed on to consumers.
Classes or Types of cost

• **private costs** - costs that impact on the individual user of a particular mode of transport who directly benefits from undertaking a journey
  – E.g. financial costs involved, such as the fare in the case of public transport, as well as non financial costs, such as the time involved in undertaking the journey (generalised cost)

• **public costs** - costs of transport that fall on non users of the transport service who do not benefit from that transport service.
  – E.g. polluted air, the congested road, noise and visual intrusions.
Classes or Types of cost Cont..

• **Production costs** - costs that fall on the operators of a transport service or in the case of private transport the financial costs incurred when undertaking the activity.

• In many ways these are essentially private costs, as the individual that incurs the cost (the operator/road user) is the one that benefits from the provision of that service
• Public transport costs have received a large amount of attention over the years, as these services are a vital component of the economy and society and have been to a greater or lesser extent subsidised by national and local governments.

• Attempting to reduce and maintain downward pressure on public transport costs has therefore been a main concern of government policy.
THE EFFICIENT PRODUCTION OF TRANSPORT SERVICES

• The costs of transport operations are primarily dependent upon a combination of the production processes used and the efficiency of the management of that production process

• It may be difficult to reconcile transport operators with the idea of the traditional firm, where inputs are fed in at one end of the factory and finished goods emerge from the other

• The focal point of transport is that it’s a form of “service” and therefore in order to achieve optimal production, the “service unit” should be taken into consideration

• In order to get transport efficiency how, therefore, should the output of the transport firm be measured, by journeys or by vehicle - kilometres produced?
Not all of the output of the combination process is sold for an economic return, as the process also results in the output of other factors such as wastage or pollution.
• **Land** is an important factor in the production process, but of the three it is the one that is least under the control of transport operators.

• **Labour** relates to all staff involved in the production of transport services, whether that be operational or administrative staff.

• **Capital** relates to any goods that have been manufactured in order to be put into the production process. This includes the vehicle stock, but also any other physically made equipment, e.g. terminal buildings, infrastructure, bridges, tunnels, handling equipment, depots and IT facilities.

• production function; this is formally specified as: \( Q = f(A, L, K) \)

• Where; \( Q \) = quantity of output produced
  
  \( f = \) ‘some function of’
  
  \( A \) = quantity of land and raw materials used in the production process
  
  \( L \) = quantity of labour used in the production process
  
  \( K \) = quantity of capital used in the production process
Finding out if production process is efficient or not is dependent on the input/output ratio of the bases of production.

‘Efficiency’ however is an often over-used term and has different meanings to different people.

Three basic types of efficiency:

Technical efficiency: this relates to the outputs to inputs ratio, with a technically efficient operator being one that uses the minimum level of inputs to produce the maximum level of outputs.

Cost efficiency or productive efficiency: arises because there may be several different ways to produce the output, all of which would be technically efficient. For example, a high level of capital and a low level of labour could be employed, or alternatively a high level of labour and a low level of capital employed. Both production processes may be technically efficient.

Allocative efficiency: it relates to usage; allocative efficiency is therefore said to exist where goods and services are produced cost efficiently and in the ‘right’ quantities.
shown are the relative positioning of four hypothetical firms, A to D
Firms A, B and C have the lowest possible combinations of labour and capital, thus an efficiency frontier can be drawn between these points
Consequently points above that ‘frontier’ would represent inefficient firms and points below simply unobtainable with the level of today’s technology
• Assuming that all firms within the industry face identical cost conditions, added to the figure are budget lines which are linear combinations of the costs of employing labour and capital and are drawn as straight lines out from the origin.

• Firm B has the lowest cost combination of inputs, as it lies both on the technical efficiency frontier and the lowest budget cost line.
• **firm C** is on a higher budget line and hence would have a higher cost combination, and point A would lie on a higher budget line again.
The economist’s definition of time

• Time is defined in terms of the extent to which the factors of production can be varied in order to produce a different level of output. The following are seen as “Economist Time”
  – **The short run**: at least one factor of production is fixed (capital)
  – **The long run**: all factors of production are varied including capital
  – **The very long run**: that period of time where all factors of production are variable, including the level of technology
COSTS AND PRODUCTION IN THE SHORT RUN
We determine the Average Product, Total product, Marginal product
• The total output produced is known as the **total product**.

• **The average product** - the total product divided by the number of units of the variable factor.

• **The marginal product** - is the change in the total product that results from adding one more unit of the variable factor into the production process.
The main issue to consider

1. Firstly, the total product curve - is in the form of an ‘S’ shape, meaning as more units of labour are added to the fixed amount of capital, production will increase, reach a maximum and then decline.

• At the point at which the outputs start falling is, this tailing off effect is known as the law of diminishing marginal returns.

2. A second point to note is that the marginal product curve cuts the average product curve at the latter’s highest point
Points b and c in the Figure can be used to break down the production process into three stages:

- **Stage 1 production**, the marginal product is always increasing, hence total product is increasing at a rising rate. This would be up to point b.

- **Stage 2 production**, diminishing marginal returns set in. Thus although the marginal product is positive it is falling in value, and thus total product is increasing at a declining rate; point b to point c.

- **Stage 3 production** the marginal product becomes negative and total product is decreasing, as shown by all points beyond point c.
Table 5.1  Variable labour and the production of bus services

<table>
<thead>
<tr>
<th>(1) Labour units</th>
<th>(2) Total product (thousands)</th>
<th>(3) Average product (thousands)</th>
<th>(4) Marginal product (thousands)</th>
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Costs in short run production

- Costs in economics include profit, or to be more exact, what is known as normal or economic profit.
- A simplified definition of normal profit would be the opportunity cost of being in business plus some form of risk premium in recognition of the risks that the investor is taking.
- Normal profit is therefore the cost to the firm of the investor’s outlay, and this is normally paid in the form of a dividend.
- Anything earned above the level of normal profit would be termed abnormal or supernormal profits, as these are rewards in excess of the risks of being in business.
Transport classification of costs

1. **Fixed Cost** - cost that does not vary with the level of output, e.g. cost of purchasing an aeroplane, rent for bus station etc.

2. **Variable cost** – vary with the level of production, e.g. wage, fuel etc.

3. **Semi-variable** – fall between fixed and variable cost

4. **Depreciation** - reduction in economic value to the firm of using an asset in the production process.
• average cost curve is ‘U’ shaped
• As total productivity increases (Stage 1 production), then average costs fall
• when total productivity decrease (Stages 2 and 3 production), average costs increase.
• cost curve is “U” shaped because of the law of diminishing returns
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<th>Labour units</th>
<th>Output produced (000s)</th>
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COST AND PRODUCTION IN THE LONG RUN

• in the long run because all input factors are variable there is no division between fixed and variable costs.
• As with the short run, the long run production function is S shaped in nature.
• At first there are large gains when firm size increases - the relative percentage gain in output is greater than the relative percentage increase in inputs. Note also that this effect increases as firm size increases.
• These gains in total productivity, or increasing returns to scale, continue up to point b.
• Once firm size (as measured by the level of inputs) rises past point b, however, the proportionate gains from adding more inputs are not as large as before, hence the firm experiences decreasing returns to scale
The long run production function
Sources of increasing returns to scale

- **Specialisation of labour** - As firm size increases, more labour can be employed in specialised tasks and thus become more proficient at those tasks. Leading to increase in productivity.

- **Scheduling of inputs** - As firm size increases, there exists greater flexibility in how the inputs can be combined and hence better utilisation of all of the inputs may be expected
  - E.g. scheduling of drivers to ensure that the vehicle stock is operated over the longest possible number of hours

- **Capital inputs** - purchasing capital inputs to increase efficiency
  - E.g. increasing a railway line from single to double track increases capacity by a factor of four, hence potentially significantly increasing the productivity of rail services.

- **Indivisibilities** – e.g. a telephone line, When setting up in business, a company will need to install and rent a phone line. With small expansions in size, there will probably be no need to install a second phone line, hence this ‘input’ is spread over a larger output.
Sources of decreasing returns to scale

• **Loss of control** ; (‘X-inefficiency’)
  – as firm size increases, there is a loss of control over the whole organisation. This loss of control decreases overall productivity.

• **Geographical location** - when a firm initially sets up in business it will probably be on or near to the optimal location.
  – Increasing size in the longer term means building other production facilities, such as depots, and these will not necessarily be at the best location.
  – This can result in fairly long distances between the depot and the market served, hence a significant proportion of time is spent in driving vehicles between the two and not actually providing transport services. As a result, productivity decreases.

• **Administration procedures**
  – large firms often require many more layers of middle and upper management, plus administration procedures, in order to control costs and processes within the organisation.
  – This is commonly known as ‘bureaucracy’.
Average and marginal costs in the long run

• As can be seen from Figure below,
  
  – average costs at first fall as firm size (as measured by output) increases.
  
  – This continues up to the point where average costs are minimised at the optimum level of production, known as the minimum efficiency scale (MES).
  
  – After this point the trend is reversed and average costs rise as firm size increases.
  
  – Along the part of the curve where the average cost is falling the firm would be said to be experiencing economies of scale.
  
  – Along the part of the curve where average costs are rising the firm would be said to be experiencing diseconomies of scale.
Long run average and marginal costs
Sources of economies of scale

- **Increasing returns to scale**: relatively lower levels of the inputs need to be employed to produce higher levels of output, hence the average costs per unit of output falls.

- **Bulk buying**: discount for buying capital equipment and supplies in larger numbers, and hence average costs would be expected to be lower for larger firms.

- **High cost inputs**: advertising

- **Financial economies**: larger firms are normally better placed to secure additional finance as they can offer greater security.
Sources of Diseconomies of scale

• Decreasing returns to scale

• Red tape; the need for greater office space and more IT facilities and so on result in diseconomies of scale
Long and short run average and marginal cost curves

- The long run average cost curve is a summation of a series of short run average cost curves.
- Beginning at an output level of Q1, the firm is operating at point a on both the short run and long run average cost curves.
- If the firm was to increase production from Q1 to Q2 in the short run, however, i.e. where at least one of the inputs is fixed, average costs would increase to point c on the short run average cost curve.
- This would be considerably higher than if production was increased to Q2 in the long run.
- This is because in the short run the firm would encounter the law of diminishing marginal returns while in long run, experiences economies of scale till MES.
Exercise 1. Total, average and marginal products and costs

• This exercise concerns the provision of rail services, and the task is comparatively straightforward if slightly involved. Quite simply, you have to fill in all the blanks, for which you will need the following information:

• Fixed Costs: 100000
• Price of a variable factor: 50000

• You should round all figures to two decimal places.
Table 5.2a

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<th>Labour Units</th>
<th>TP</th>
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TP = total product  
AP = average product  
MP = marginal product  
TFC = total fixed costs  
TVC = total variable costs  
TC = total costs  
ATC = average total costs  
MC = marginal costs
Once you have completed this table, you should use your calculations to answer the following questions:

a) At what level of output should the firm operate at?
b) What is the most ‘efficient’ level of output in terms of:
   i Technical efficiency?
   ii Cost efficiency?
   iii In terms of measuring the firm’s ‘efficiency’, which of these two measures should be used and why?

c) What units is the level of output measured in?