Are Cost Curves Always U-Shaped?

The Example of a Budget Airline

In this article, **Patrick Cowie** *of Berkhamsted Collegiate School, examines one of the fundamental assumptions about the shape of the average cost curve.*

Introduction

A good theory in Economics should be both powerful and simple. It should be powerful in being able to answer a wide range of questions from the 'real world' and should be simple in that it can be easily explained, understood and used. Demand and supply is such a theory.

The traditional U-shaped cost structure can be considered to be a poor theory since it is both weak and complex and its relevance to the real world of business economics seems to be limited.

An alternative cost structure – certainly simpler, possibly more powerful and based on looking at modern businesses – is the 'L-shaped' cost curve.

Costs of Production

A business needs to consider all the costs of production that are involved in its output of goods and services as they will, in part, determine its prices and profits. They are usually divided into two types – *fixed costs* and *variable costs*. This distinction holds for the *short-run* where the business operates with a given scale of production. In the *long-run* the scale of production can be altered and – as a result – all costs of production become variable.

Let us examine short-run costs of production:

- **Fixed Costs** – can also be referred to as 'overhead costs' and they do not vary directly with output. They must be paid even if output is zero. For most firms, examples include rent and rates, interest on loans and management expenses.
- **Variable Costs** – can also be referred to as 'direct costs' and they do vary directly with output. They will be zero if output is zero. For most firms, examples include raw materials and non-salaried production workers.

Can we use this distinction to classify the costs of production that a budget airline such as Easyjet or Ryanair must pay?

Assume firstly that we are considering a short-run situation in which one aeroplane is being made ready to take on passengers. The aeroplane might be a Boeing 737 and when full it will take 150 'standard class' passengers and thus the passengers are each the unit of output.

So, which costs must be paid by the airline in full even if only 10 passengers are flying? And which costs will be reduced for the airline – at least for this flight – as more of the seats are filled?

The crew is a fixed cost. A full crew of pilot, co-pilot and cabin staff will be needed for each flight. Their pay is not cut if fewer passengers join them.

Fuel is a fixed cost. It is possible – for anyone who wants to quibble – that a large number of passengers will so push the weight up that more fuel is used. Possible yes, but not significant.

Maintenance is a fixed cost. It must be done before each flight and must not be skimped on even if there are only 10 passengers.

Landing and navigation charges are fixed costs. These must be paid to the airport and other authorities and will be charged per aeroplane.

Leasing and depreciation are fixed costs. Aeroplanes are leased for a fixed period of time but if they are owned outright then a depreciation allowance must be calculated. This will depend on the value of the aeroplane and its estimated useful life.

Airline overheads are fixed costs. The airline itself will have various overhead expenses such as management, HQ rent, marketing and so on. Each flight will be expected to make a contribution towards this.

Lastly, passenger service is a variable cost. Firstly, there is food and drink. Suppose budget airlines provide this to the passengers at a cost of perhaps £5 each. In addition, there are baggage handling charges. Let us assume that these are based on the number of

passengers rather than per aeroplane and that they are also £5 each. Therefore, in this example, it becomes obvious that fixed costs are far more important than variable costs.

Cost Data and Graph

Economists often use what they term 'stylised statistics' – that is, data that is not entirely accurate but nevertheless which tells a story with reasonable conviction. I am basing my data on an article from *The Independent* [19th June 2002] on budget airlines.

Let us assume that a passenger is paying £80 for a single flight to – let the reader decide! Let us also assume that when the flight is full, the airline will make £20 profit on each seat. Given that variable costs per passenger are £10 each it follows that fixed costs per passenger – when the flight is full – will be £50 each. With 150 passengers total fixed costs per flight will be £7,500. These figures are very rough and ready but they seem reasonable. Perhaps some enterprising student might like to do some research into the costs faced by a budget airline?

Anyway, this gives us the average cost schedules as shown in Table 1. This can be graphed and is shown in Figure 1.

We can see that the average total cost curve falls at all levels of output – the number of passengers – and that average variable and marginal costs are equal and constant. This gives the so called 'L-shaped' cost curve.

The graph shows that full capacity output is achieved at 150 passengers and that this cannot be altered – there is no flexibility at all.

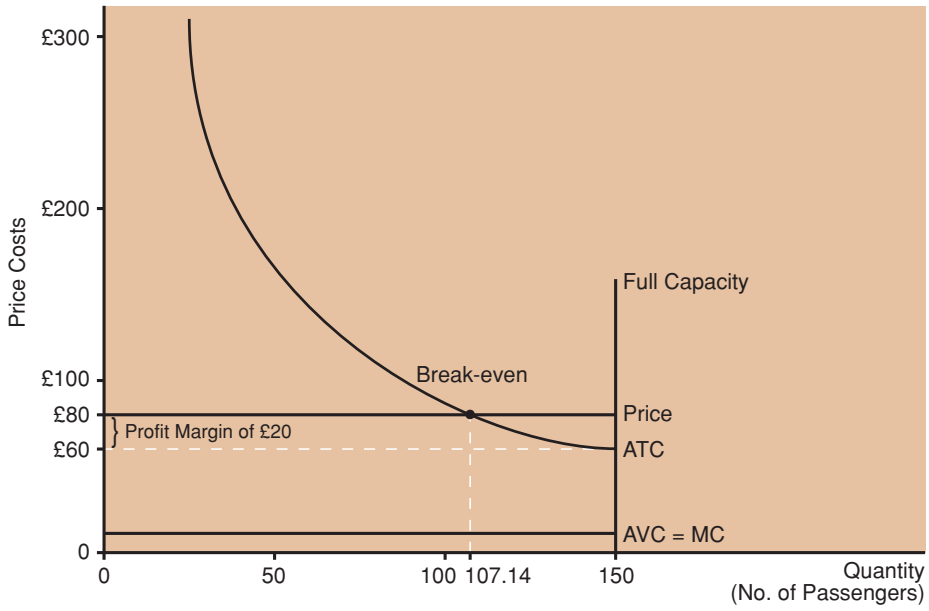
Lastly, if we show the ticket price of £80 on the graph then it is clear that the airline must fill 107.14 (i.e. 108) seats before it starts making a profit (break-even output fixed costs/contribution). If all the seats are filled then the airline will make £3,000 profit per flight. This is in the accounting sense and we cannot judge precisely whether it is only normal profit or whether some abnormal profit is also being made.

The budget sector of the airline market might be thought to be highly contestable – with low barriers to market entry and exit – and therefore, in the long-run only normal profits will be made. However, given that Easyjet and Ryanair are still expanding it might appear that abnormal profits are still available.

Table 1: Suggested Cost Figures

Passengers	AFC (£)	AVC (£)	ATC (£)
25	300	10	310
50	150	10	160
75	100	10	110
100	75	10	85
125	60	10	70
150	50	10	60

Figure 1: L-Shaped Average Cost Curve



Capacity Utilisation

It should be as clear that it is absolutely essential for the airline that the flight is fully booked. When the aeroplane is at full capacity then each passenger generates £20 profit out of the £80 ticket price, i.e. 25%. However, even when the aeroplane is at 80% capacity then each passenger generates only £7.50 profit out of the £80 ticket price, i.e. 9.4%. Lastly, it has been shown that when the aeroplane is at 71% capacity (107 seats) then no profit will be made.

How can the airline ensure that each flight is fully booked? A given aeroplane will make a number of flights each day. This is to ensure that it contributes the maximum possible towards fixed costs and profits. However, the demand for each flight will vary according to a number of factors – most important being the time of day. If all ticket prices were set at £80 each, then some flights would be over-booked and others may be almost empty. Therefore, the airline must use price to manage demand – this is known as 'yield management' (and it is a form of price discrimination). It must set the ticket price in such a way that demand for each flight is as near as is possible equal to 150 seats. Early morning and early evening flights might be more expensive than those at other times of the day.

This will also occur throughout a longer period of time. People who book in advance will pay less than those who book with less time to spare – although those who are willing to take 'pot luck' and take any flight will pay the lowest prices. As long as the ticket price covers variable costs the airline will accept it as it makes a contribution – perhaps only token – towards fixed costs. The very cheap ticket prices advertised in newspapers are usually for relatively unpopular flights and will come with various restrictions. On a popular flight there will be few such tickets.

Advertising in general will ensure high demand for the airline as a whole but not necessarily for the flights that it wants to promote. Pricing is the key weapon here.

Lastly, should an airline find that it has too much capacity overall – its flights are, on average, flying with perhaps 10% or 15% of the seats empty – then it must reduce capacity. This will

involve firstly trying to redeploy aeroplanes to the busiest routes, then cutting back on the number of aeroplanes overall and lastly cutting airline overheads. All of this will reduce their fixed costs and the latter will reduce fixed costs per flight.

The key to the L-shaped cost curve is understanding the importance of fixed rather than variable costs. In this it is very different to the U-shaped cost curve where variable costs are central and fixed costs peripheral.

Traditional Cost Curves and Diminishing Returns

The title of this article asks the question: 'Are cost curves *always* U-shaped?' It could be argued that a more appropriate title might be: 'Are cost curves *ever* U-shaped?'

The L-shaped cost curve that I have derived for a budget airline and its application to capacity utilisation and pricing policy is relevant to many other service sector businesses. An area for research and discussion might be this: attempt to apply the model to hotels and restaurants, travel agents, football clubs and even to schools. In all of them you might find that most of the costs of production faced by the business are fixed, that variable costs are relatively unimportant and are constant per unit of output. In a service sector business the unit of output is the individual customer and not a physical good. Of particular importance is the fact that in all these businesses labour is a fixed rather than a variable factor of production – consider a chef, a football player and an Economics teacher.

What about manufacturing industry? Consider a motor car factory. It could be suggested that on the production line there is a fixed capital/labour ratio, i.e. each worker has his/her own work station and a given task to perform – putting in the windscreen, for example. Additional workers will not raise output or productivity – both are governed by the speed of the production line. Therefore, the law of diminishing returns to labour does not apply. If so, variable costs – until full capacity is reached – will be constant per motor car produced and will largely consist of components and raw materials. The L-shaped cost curve would seem to be as relevant here as in the service sector.

So, where might the traditional U-shaped cost curve remain applicable?

Perfect competition can still be applied to agriculture.

Well, given that the law of diminishing returns was originally derived from agriculture – by Malthus and Ricardo, amongst others – perhaps we might leave it there? The law of diminishing returns is the essential basis of the upwards-sloping marginal cost curve – from which the perfectly competitive supply curve is derived. Perfect competition remains an appropriate market structure for the study of agriculture – although in the UK, with the giant supermarkets exercising monopsony power, the 'many buyers' assumption seems irrelevant today.

Conclusion

In most Economics text books, the U-shaped cost curve is derived not from any study of a particular business but by using somewhat arbitrary figures which are themselves assumed to be valid. I have attempted to show – by using some figures 'derived' from the budget airline industry – that the L-shaped cost curve might be more accurate and relevant. I hope that some students might do the same perhaps by looking at a local Indian or pizza restaurant. The research should be enjoyable!

Further Reading

A. Anderton – *Economics, 3rd ed* [Unit 48].

A. Koutsoyiannis – *Modern Micro-economics, 2nd ed* [Ch 4].

I. Marcousé – *Business Studies* [Unit 48].

J. Tribe – *The Economics of Leisure and Tourism* [Ch 5].

J. Hamilton-Jones – *The Law of Diminishing Returns* [**Economics Today** Jan 1999].

A. Reeve – *Why Might an Airline Charge Different Prices to Different Customers for the Same Service?* [**Economics Today** Jan 1998].

The Independent 19th June 2002.

Questions for Discussion

1. What are the fundamental differences between fixed and variable costs?
2. Why are fixed costs such an important part of total costs in so many industries?
3. Suggest examples where labour may be more of a fixed cost than a variable cost.
4. Why might the agricultural industry be more likely to have U-shaped cost curves?

Summary of Key Points

- Fixed costs are 'overhead costs' and do not vary with output.
- Variable costs are 'direct costs' and do vary with output.
- In the example of a budget airline, most costs are fixed, including labour.
- This gives rise to an L-shaped average cost curve.
- The L-shaped average cost curve may apply in many industries, although we can still apply the U-shaped average cost curve to agriculture.