Producer Supply and Producer Welfare

Dr Damien S. Eldridge

Australian National University

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Sources Part 1

- This material has been drawn from, or influenced by, a number of sources.
- Some of these include those listed below.
  - Alchian, AA, and WR Allen (1983), *Exchange and production: Competition, coordination and control (third edition)*, Wadsworth Publishing Company, USA: pp. 63–64.
  - Hamermesh, DS (2006), *Economics is everywhere (second edition)*, McGraw-Hill-Irwin, USA: Chapters 1, 2, and 7 (pp. 3–24 and 81–90).

Marginal Private Cost and Supply

- The marginal cost of supplying an additional unit of a good is the minimum amount that a producer would need to be paid to supply that additional unit, given the current production level of the good without the additional unit.

- The marginal private cost schedule for a good is a function of the form $MC(Q; other)$, where Q is the quantity of the good that is supplied, *other* is the values that are taken by a set of other factors that affect the marginal cost of the good in question and $MC(Q; other)$ is the cost incurred by the producer from the production of the last of the Q units of the good.

- As a matter of convenience, we will often write $MC(Q; other)$ as simply $MC(Q)$.

Increasing Marginal Costs

- We will assume that the marginal private cost schedule displays increasing marginal costs.

- In other words, holding the values of the things that are in *other* fixed, the cost of producing a further unit of the good (that is, the marginal cost) will increase as Q increases.

- This means that the marginal private cost schedule for a good will be upward sloping sloping in (Q, P)-space.

- We will provide two justifications for this assumption, both of which make use of the concept of "diminishing marginal returns". The first justification will be in the context of a pure exchange economy. The second justification will be in the context of a production economy.
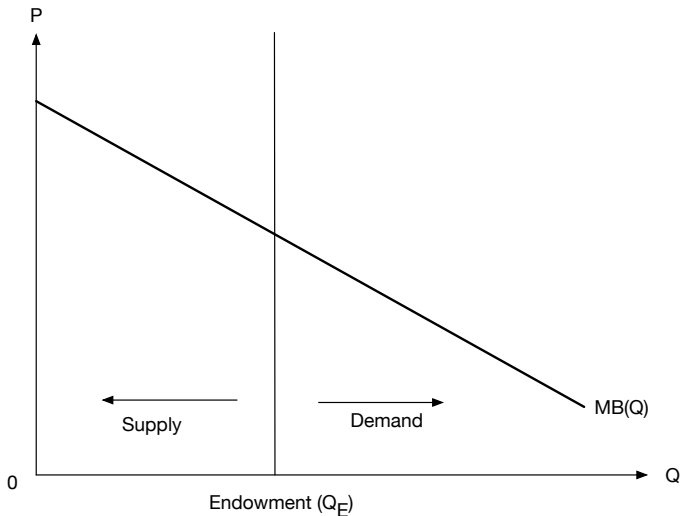
Marginal Cost in a Pure Exchange Economy Part 1

- A pure exchange economy is one in which no production takes place. Each agent in the economy is endowed with some bundle of commodities. If an agent wants to consume some other bundle of commodities, then he or she must seek to conduct one or more trades with other agents in an attempt to obtain that bundle.

- Here we will consider a simple partial equilibrium version of a pure exchange economy. In other words, we will focus on the market for a single commodity. Indeed, we will focus on the behaviour of a single agent with respect to that commodity.

- As in our discussion of consumer demand, we will assume that this agent receives diminishing marginal benefits from the consumption of this commodity. This means that his or her marginal benefit schedule will be downward sloping.

Marginal Cost in a Pure Exchange Economy Part 2

- If this consumer desires more of the good than his or her endowment of it, then he or she will need to purchase the additional units. This constitutes a situation of "net demand".

- If this consumer desires less of the good than his or her endowment of it, then he or she will be able to sell the additional units. This constitutes a situation of "net supply".

- This situation is depicted in the diagram on the next page.

  - Notice that "supply" of the good is measured in the leftwards direction in this diagram. This is because "supply" of an additional unit involves giving up an additional unit of "demand".

  - If we want to obtain the supply schedule for this agent, we simply need to flip the diagram. This is done in the diagram on the following page.

  - The marginal cost schedule in the second diagram slopes up precisely because the marginal benefit schedule in the first diagram slopes down. In other words, increasing marginal costs follows directly from the behavioural assumption of diminishing marginal benefits.
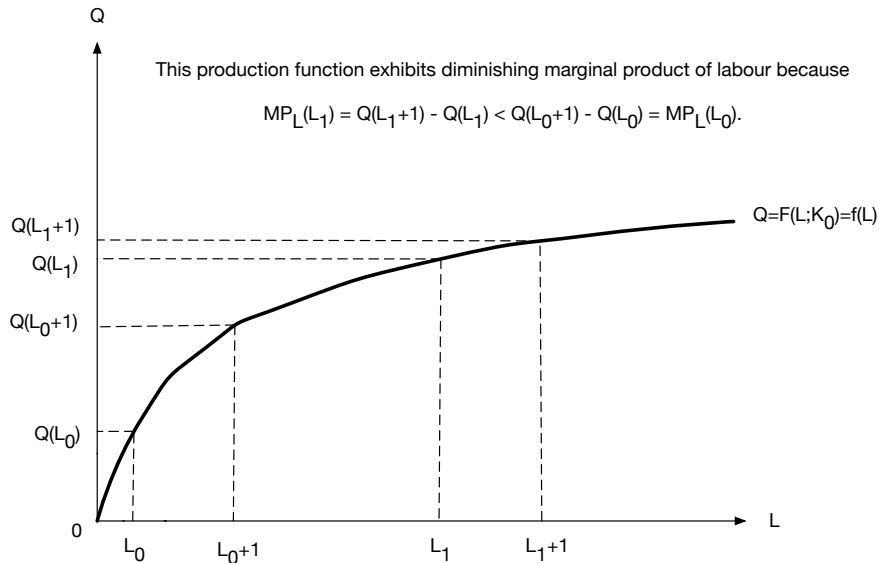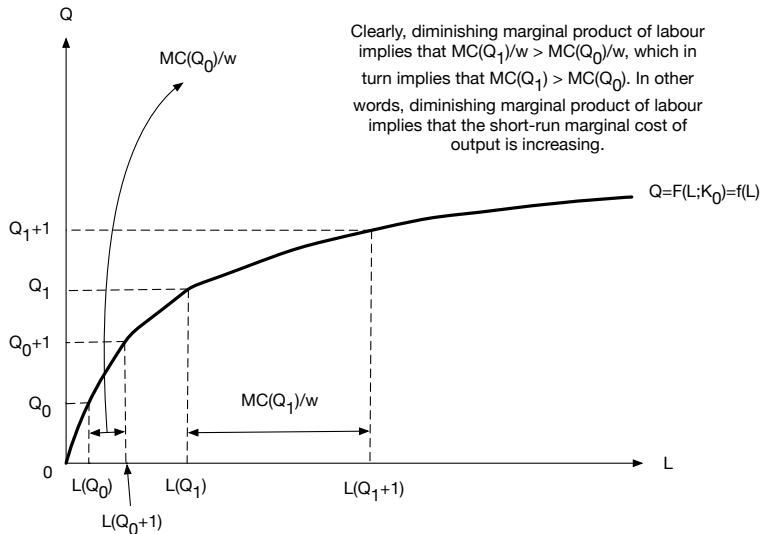
Marginal Cost in a Pure Exchange Economy Part 3
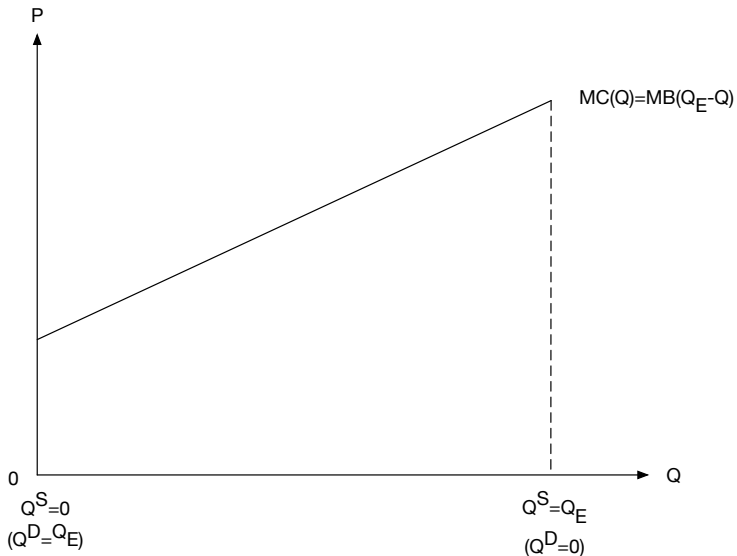
Short-Run Marginal Cost in a Production Economy Part 1

- Suppose that the output of of good (Q) can be produced using two inputs, capital (K) and labour (L) according to a production technology that can be represented by a profuction function $Q = F(L, K)$.
- In the short-run, the capital stock is fixed at $K = K_0$, so that the short-run production function is given by $Q = F(L; K_0) = f(L)$.
- We will assume that this production technology displays a diminishing marginal product of labour. This means that the production of each additional unit of output in the short-run (when the capital stock is fixed) requires the use of more labour than the previous unit of output.
- If the producer is a price-taker in the labour market, so that every unit of labour costs w per unit, then the presence of a diminishing marginal product of labour results in an increasing marginal cost of output.
- This situation is depicted in the following two diagrams.

This production function exhibits diminishing marginal product of labour because

$$MP_L(L_1) = Q(L_1+1) - Q(L_1) < Q(L_0+1) - Q(L_0) = MP_L(L_0).$$

Short-Run Marginal Cost in a Production Economy Part 3

Clearly, diminishing marginal product of labour implies that $MC(Q_1)/w > MC(Q_0)/w$, which in turn implies that $MC(Q_1) > MC(Q_0)$. In other words, diminishing marginal product of labour implies that the short-run marginal cost of output is increasing.

Increasing Marginal Cost Once Again

The idea that, in general, marginal costs are increasing, is nicely presented in the following quote from Alchian and Allen (1983, p. 63).

> "Normally, at higher prices rates of production are higher and amounts supplied are larger. (Remember, when we say that a price is higher or lower, we mean the *relative* price—that one price, in dollars, relative to prices, in dollars, of other goods and services.) Higher rates of production of any good require more resources. And resources, like goods, remember, are scarce. For example, say we want to expand the national annual output of wheat. The amount of arable land having the best soil composition and located in the best climate is limited, and virtually all of it is already in use. Thus, land more valuable for corn or cattle must be diverted to wheat. Resources that are increasingly more valuable elsewhere must be attracted."

Short-Run Costs and Long-Run Costs

- In economics, the difference between short-run and long-run depends on whether or not it is possible to vary all of the factors of production.

- In the short-run, at least some factors of production are fixed. The quantity of these fixed factors that is employed cannot be varied in the short-run. These fixed factors of production must be paid for their services. Fixed costs are simply payments for the services of these fixed factors of production. Short-run variable costs relate to payments made to factors of production that can be varied in the short-run. Short-run total cost is equal to the sum of short-run fixed cost and short-run variable cost.

- In the long-run, all factors of production can be varied. As such, there are no fixed costs in the long-run. All long-run costs are variable costs. Long-run total cost is equal to long-run variable cost.

Total Variable Costs and Marginal Costs Part 1

- The total variable cost of producing Q units of output is simply the sum of the marginal cost of producing each of those units of output.
- If output must be produced in discrete units, this means that

$$TVC(Q) = MC(1) + MC(2) + \cdots + MC(Q) = \sum_{q=1}^{Q} MC(Q).$$

- If output is infinitely divisible, this means that

$$TVC(Q) = \int_{q=0}^{Q} MC(q) dq.$$

- In both of these cases, the total variable cost of producing Q units of output is simply the area under the marginal cost schedule and above the quantity axis between $q = 0$ and $q = Q$.
- This is illustrated for the case in which output is infinitely divisible on the next page.

Total Variable Costs and Marginal Costs Part 2



The shaded area is equal to TVC(Q).
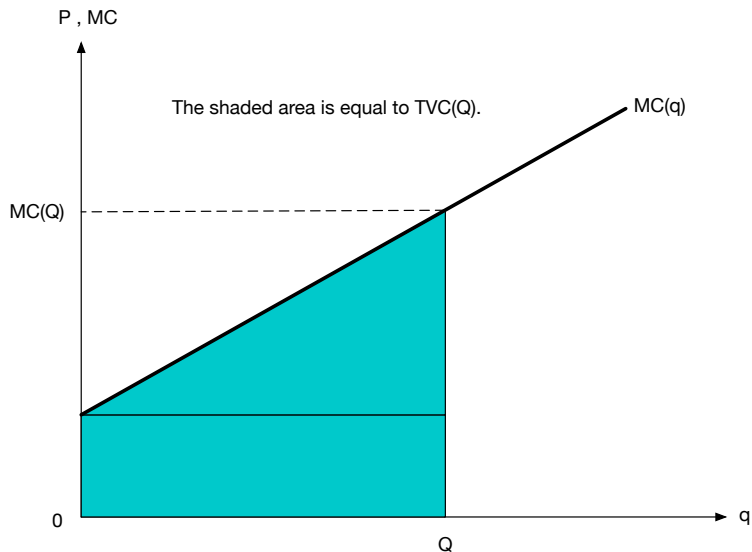
Producer Revenue Part 1

- Consider a producer of some commodity who is a price-taker in the market for that commodity.
- Suppose that the price of the commodity is P.
- Recall that the producer's marginal cost schedule can be interpreted as his or her inverse supply schedule. Thus we can find the maximum quantity of the commodity that the producer is willing to supply by determining the quantity at which the price line intersects the marginal cost schedule. Suppose that this quantity is given $Q = q^S(P)$.
- The total revenue that the producer receives from sales of Q units of the commodity at a price of P per unit is simply $R = PQ$.
- This area is equal to the area of the shaded region in the diagram on the next page.

Producer Revenue Part 2

P , MC

The shaded area is equal to producer revenue:

$R(P)=Pq^S(P).$

$MC(q)=S^{-1}(q)$

P

0

$Q=q^S(P)$

q
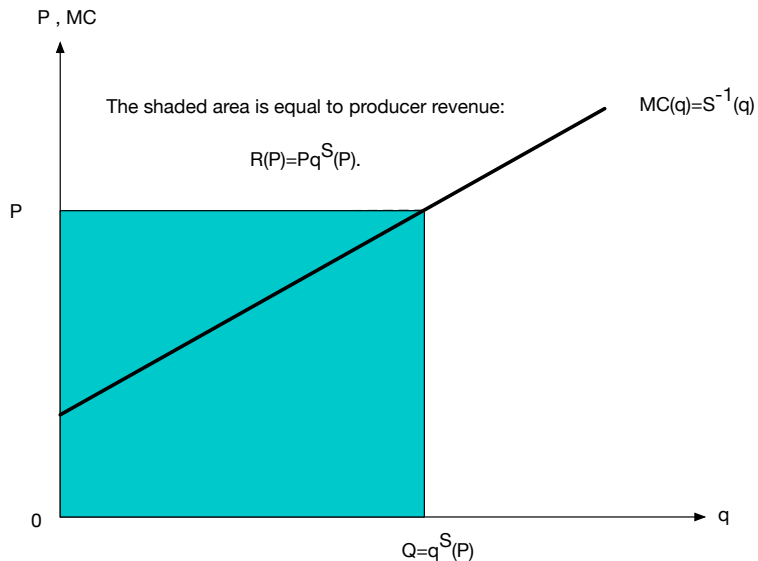
Producer's Surplus Part 1

- The revenue that a producer receives from sales of the commodity is, in a sense, the total benefit to the producer from producing that quantity of the commodity.

- However, the production of the commodity costs the producer some resources.

- Thus the net benefit to the producer from the sale of Q units of a commodity is less than the total revenue from those sales.

- In order to obtain the welfare gain (or net benefit) to the producer from sales of the commodity, we need to subtract the opportunity costs of production from revenue.

- As a first step in this process, let us ignore any fixed costs of production that might exist.

- If we subtract total variable costs from revenue, we obtain what is known as producer's surplus.

Producer's Surplus Part 2

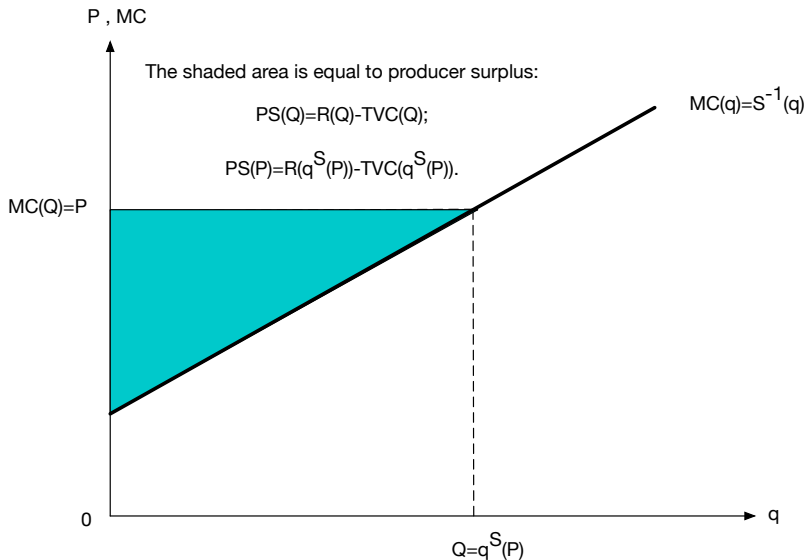- If output must be produced in discrete units and $Q = q^S(P)$, then producer's surplus is given by

$$PS(Q) = PQ - \left(\sum_{q=1}^{Q} MC(q) \right).$$

- If output is infinitely divisible and $Q = q^S(P)$, then producer's surplus is given by

$$PS(Q) = PQ - \left(\int_{q=0}^{Q} MC(q) dq \right).$$

- Producer's surplus is equal to the area of the shaded region in the diagram on the next page (for the case in which output is infinitely divisible).

Producer's Surplus Part 3

P , MC

The shaded area is equal to producer surplus:

$$PS(Q)=R(Q)-TVC(Q);$$

$$PS(P)=R(q^S(P))-TVC(q^S(P)).$$

$MC(q)=S^{-1}(q)$

$MC(Q)=P$

0

$Q=q^S(P)$

q

Producer's Surplus and Profit Part 1

- One possible measure of producer welfare in this setting is given by the profit received by a producer. Another possible measure is that of producer's surplus. What is the relationship between these measures?

- The profit from selling Q units of a commodity is equal to the revenue received from those sales minus the total cost of producing those Q units of the commodity being sold: $\Pi(Q) = PQ - TC(Q)$.

- Recall that total cost is equal to the sum of fixed cost and total variable cost: $TC(Q) = F + TVC(Q)$.

- Thus we have: $\Pi(Q) = PQ - TVC(Q) - F$.

- Recall that the producer's surplus from selling Q units of a commodity is equal to the revenue received from those sales minus the total variable cost of producing those Q units of the commodity being sold: $PS(Q) = PQ - TVC(Q)$.

- Thus we have $\Pi(Q) = PS(Q) - F$, which can be rearranged to obtain $PS(Q) = \Pi(Q) + F$.

Producer's Surplus and Profit Part 2

- In the long-run, there are no fixed factors of production and hence no fixed costs.
- As such, we know that in a long-run competitive equilibrium, we have $PS(Q) = \Pi(Q)$.
- Thus there is no ambiguity about which welfare measure to use for producers in the long-run.
- But what about the short-run? Should we use $PS(Q)$ or $\Pi(Q)$ as the measure of producer welfare?
- Recall that the fixed cost does not vary with the chosen output level. It must be paid (in the short-run) even if the producer shuts down the production plant and produces nothing. As such, the fixed cost is a "sunk cost".

Producer's Surplus and Profit Part 3

- Sunk costs are not part of the true short-run opportunity cost of producing any chosen level of output because they cannot be avoided. This means that they should not be included in the calculation of short-run producer welfare.

- In other words, the appropriate measure of short-run producer welfare (and long-run producer welfare for that matter) is given by producer's surplus.