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Sproul, Michael

University of Southern California, Dept. of Economics

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The Shut-down Price, Reconsidered

by

Michael F. Sproul *

Abstract

The textbook assertion that the shut-down price is at the minimum point of average variable cost AVC is shown to be incorrect. Once we properly distinguish between fixed costs and sunk costs, it becomes clear that the shut-down price is at the minimum point of average cost AC.

Economists make an elementary mistake when they claim that a competitive firm will operate at a loss in the short-run, so long as price exceeds average variable cost. Economists sometimes recognize that this criterion fails to properly distinguish between avoidable costs and sunk costs, but the recognition of this flaw has yet to trickle down to economics textbooks.

Mankiw's discussion is typical of introductory textbooks.

...a firm chooses to shut down if the price of the good is less than the average variable cost of production. This criterion is intuitive: When choosing to produce, the firm compares the price it receives for the typical unit to the average variable cost that it must incur to produce the typical unit. If the price doesn't cover the average variable cost, the firm is better off stopping production altogether. The firm still loses money (because it has to pay fixed costs), but it would lose even more money by staying open. (Mankiw, 2015, p. 286.)

The same idea is expressed in Graduate level textbooks.

If the firm produces a positive amount of output, then it will produce an amount of output where price equals marginal cost (and marginal cost is nondecreasing) and price will exceed the average variable cost at that level of output. If price is less than the average variable cost, where price equals marginal cost, the firm will shut down and produce no output. (Jehle and Reny, 1998, p. 244.)

The trouble with this idea is that if fixed costs must be paid even if the firm shuts down, then they are not *avoidable* or *recoverable* costs, but *sunk* costs. But since sunk costs are not true costs, then saying that a firm's fixed costs cannot be avoided by shutting down is equivalent to saying that the firm has no fixed costs. Carleton and Perloff's *Modern Industrial Organization* textbook

*University of Southern California, Department of Economics

tries to correct for the failure to distinguish between fixed costs that are avoidable and those that are sunk.

The price at which shutdown occurs is above average variable cost and closer to average cost the greater the proportion of fixed costs that are avoidable. In the extreme, when there are no sunk costs (all fixed costs are avoidable), the shutdown point coincides with the minimum point on the AC curve. Thus, if it has no sunk costs, a firm shuts down before it incurs economic losses. (Carlton and Perloff, 1999, p. 61.)

Carleton and Perloff's treatment improves on the typical textbook coverage, but neglects to say that sunk costs are not costs at all. Thus the presence or absence of sunk costs makes no difference to whether "a firm shuts down before it incurs economic losses." All firms will shut down before they earn economic losses, regardless of sunk costs.

A Numerical Example

Assume a competitive firm's cost functions are given by the following:

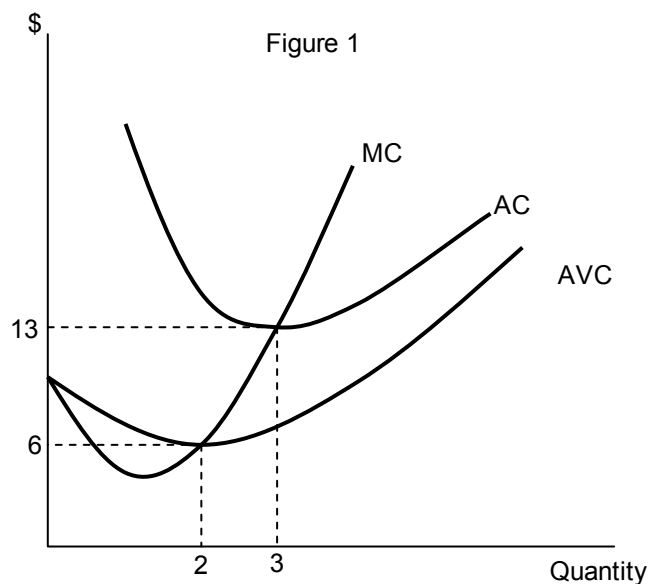
Total Cost: $TC=18+10q-4q^2+q^3$

Average Cost: $AC=18/q+10-4q+q^2$ (minimized at $q=3, AC=13$)

Average Variable Cost: $AVC=10-4q+q^2$ (minimized at $q=2, AVC=6$)

Marginal Cost: $MC=10-8q+3q^2$

Where q is quantity of output per day and fixed cost $FC=18$.



Case 1: Fixed Cost is Entirely Avoidable

Assume that the \$18 fixed cost is the cost of keeping the lights on in a factory. The lights must be on to produce any output, but lighting costs do not vary with output. If the owner decides to shut down at any point in the day, he has only to turn the lights off, at negligible cost. If price ever drops below the minimum of average cost AC (i.e., \$13), the firm will shut down and turn off the lights. A firm that shuts down will have zero losses, while a firm that operates will do so at a loss. Thus the shutdown price is at the minimum of the AC curve, not the AVC curve.

Note also that both the shutdown price and the start-up price (the price above which the firm will enter the industry) are \$13.

Case 2: Fixed Cost is Entirely Sunk

Assume that the \$18 fixed cost is the amortized expense of a billboard placed in front of the factory. In this case the \$18 is a sunk cost and should therefore not be considered as a true cost. The firm's new average cost function is $AC=10-4q+q^2$, which is identical to AVC. The shutdown price is now \$6, which is the minimum point of both AVC and the new AC.

The \$18 fixed cost is only avoidable before the firm opens for business and buys the billboard, so in this case the firm's start-up price is \$13, but once in business (with \$18 sunk in the billboard, and FC therefore zero) it will not shut down until price drops below \$6.

Case 3: Fixed Cost is Partially Sunk

Assume that the \$18 fixed cost is the daily rent on the firm's building, but that if the firm shut down it could sublet the building for a net daily rent of \$11. Fixed cost is therefore \$11, with sunk cost=\$7. Average cost is now $AC=11/q+10-4q+q^2$, which is minimized at $q=2.7$ and $AC=10.56$ (with rounding). The shutdown price is thus \$10.56. This is above AVC, which is \$6.49.

When the lease expires, the entire \$18 once again becomes a true avoidable cost, and both the shutdown price and the start-up price return to \$13, at the minimum of the AC curve.

An Objection Considered

One could argue that the \$18 lighting cost is actually a variable cost, since it rises from \$0 to \$18 when output rises from 0 to 1. A similar claim could be made regarding the \$11 cost that results from being able to sublet a building. But if this

were the case then all true costs would have to be called variable costs. If lighting cost falls from \$18 to 0 as output falls from 1 to 0, then lighting would be a true (avoidable) cost, and would have to be called a variable cost between outputs of 0 and 1, but a fixed cost at all other outputs. If lighting cost remained at \$18 even as output fell from 1 to 0, then lighting would have to be called a sunk cost, that is, not a true cost. Similarly, if a building could be sublet for \$11 when output dropped from 1 to 0, then building rent would be a true cost, which is variable between outputs of 0 and 1, and fixed at all other outputs. If the building could not be sublet, then the entire \$18 rent would be sunk, which is to say, not a true cost. For the sake of coherence, economists should therefore define fixed costs in such a way that fixed cost is constant for all outputs greater than zero, but drops to zero once output reaches zero. Once this is done, it is apparent that the shutdown price is at the minimum point of average cost AC, and not average variable cost AVC.

Carlton, Dennis W. and Perloff, Jeffrey M., *Modern Industrial Organization*, Addison Wesley, Reading, Massachusetts, 1999.

Jehle, Geoffrey A. and Reny, Philip J., *Advanced Microeconomic Theory*, Addison Wesley, Reading, Massachusetts, 1998

Mankiw, Gregory N., *Principles of Microeconomics*, Cengage Learning, Stamford, CT, 2015.