The short-and long-run marginal cost curve: a pedagogical note

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Robert L. Sexton, Philip E. Graves, and Dwight R. Lee

The standard description of the relationship between the long-run marginal cost curve (*LRMC*) and the short-run marginal cost curve (*SRMC*) for output levels *below* the optimum for a particular plant size in most economics texts is misleading and imprecise. As a consequence, students are frequently confused as to how the *SRMC* can ever be lower than the *LRMC*, because everything is variable in the long run.

A sampling of textbooks published over the last several years confirms the potential for confusion. Many texts (e.g., Browning and Browning 1989; Nicholson 1990; Pindyck and Rubinfeld 1989; Kohler 1990; Glahe and Lee 1989; and Varian 1990) either do not make the distinction or conceal much and reveal little about the relationship between short-run marginal costs and long-run marginal costs. Other authors more clearly explain the relationship using a geometric approach but omit the economic intuition necessary to make the geometry understandable (e.g., Miller and Meiners 1986, 291; Salvatore 1991, 232). According to Miller and Meiners, if a firm has an output rate between *0* and q_0 (where q_0 is the intersection of the *SRMC* and the *LRMC*), "short-run average costs as measured on *SAC* will be greater than *LRAC* measured on *LRAC*. Hence short-run total costs will be greater than long-run total costs. In order for long-run total costs to catch up with short-run total costs, long-run total costs must be rising at a more rapid rate than short-run total costs. But the rate of change, or rise, in *STC* is *SMC*, while the rate of change in *LTC* is *LMC*. Thus, below output rates of q_0, short-run marginal costs must be less than long-run marginal costs" (p. 291) (Figure 1).

Although such accounts are (as here) usually technically accurate, they fail to fully clarify the intuition behind the curves. Students will better understand the theory of the firm if the short-run/long-run distinction is made more clearly.

MARGINAL COSTS: SHORT-RUN AND LONG-RUN

The concept of long-run marginal cost refers to the increase in total cost when there is a shift to one unit higher output level, with optimum input mixes before and after the changes. In Figure 1, for output levels to the right of that at which

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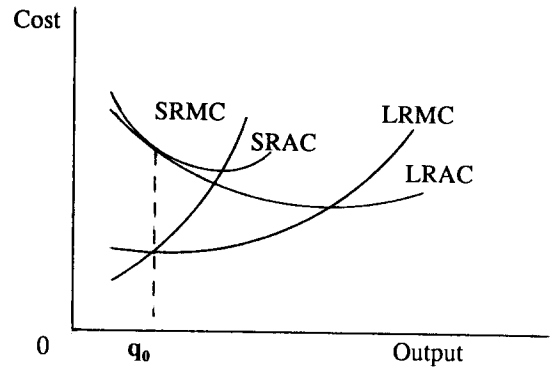
FIGURE 1
Short-Run and Long-Run Costs

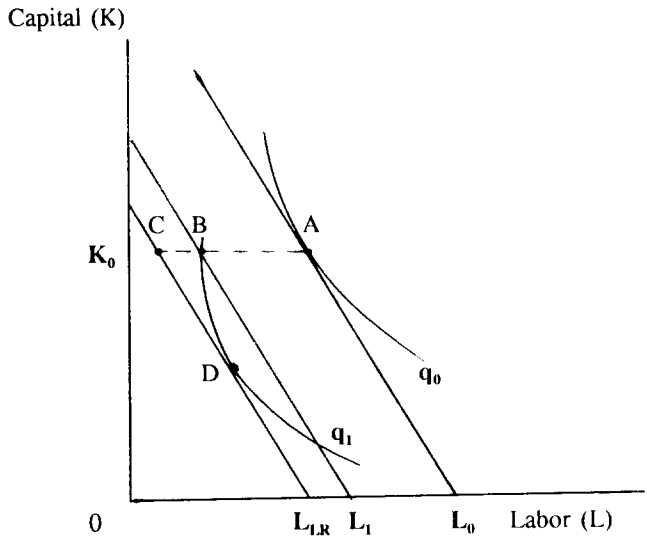


SRMC = *LRMC*, the *SRMC* is greater than the *LRMC*. The situation to the right of the output level at which *SRMC* = *LRMC* (the optimal mix of inputs) is straightforward, and indeed authors generally make this case clear. That is, to increase output from an input mix that is initially optimal will optimally involve the use of more of both the variable input and capital in the long run. Therefore, it would cost more to increase output in the short run because some of the inputs are fixed, yielding an inappropriate input mix from a long-run perspective. Labor has too little capital to work with, hence lower marginal product (that is, higher marginal cost).

However, the situation to the left of the optimal resource bundle is somewhat less intuitive than the case to the right, and this is reflected in the many confusing text discussions. In Figure 1, we can see that to the left of q_0 the *SRMC* is less than the *LRMC*. By using isoquants as in Figure 2, students can easily see why this is so. Isoquant q_1 shows the combinations of labor and capital that can produce a smaller amount of output than q_0. Capital is fixed in the short run at K_0. The marginal cost saving from decreasing output from q_0 to q_1 can be seen in Figure 2 by the changing position of the isocost line. In the short run, when capital is fixed, there is a smaller reduction in costs as we move from the original isocost L_0 to isocost L_1 than if we move to isocost L_{LR} when all inputs are variable. That is, in the short run the firm goes from A to B, while in the *LR* it goes from A to D, a cost saving larger by the distance from C to B. Conversely, to go from q_1 to q_0, with a plant designed for q_0 (going from B to A) clearly has lower marginal costs than going from q_1 to q_0 with plants of long-run optimal size before and after the output increase (going from D to A, which is a cost increase also seen as C to A). Hence, short-run marginal costs are less than long-run marginal costs at output levels less than the designed capacity.

The preceding may still seem too technical for many students, relying as it does on cost curves. An alternative approach, stressing marginal productivity,

FIGURE 2
Seeing Why SRMC Can Be Less Than LRMC



may be useful for such students. For output levels smaller than designed plant capacity, labor (which is variable) has relatively large amounts of fixed capital to work with—as a consequence, the marginal product of labor is high (hence the marginal cost of production is low). The high marginal product of labor means that fewer units of labor are needed to get any given output increase (say, from q_1 to q_0). Thus marginal costs are low—but marginal costs are low precisely because fixed costs (hence, average costs) are nonoptimally high at q_1, from a long-run perspective!

CONCLUSION

As Sir John Hicks (1946, 23) observed, "Pure economics has a remarkable way of producing rabbits out of a hat—apparently *a priori* propositions which apparently refer to reality. It is fascinating to try to discover how the rabbits got in; for those of us who do not believe in magic must be convinced they got in somehow." The concern of the present note has been that many intermediate microeconomics texts fail to communicate the economic intuition—particularly of output levels below the optimum for a given plant—behind the short-run and long-run marginal cost curves. This lack of completeness about what goes on in the derivation of these curves appears to us to be an important source of confusion for intermediate microeconomics students.[1]

NOTE

1. Indeed, one of the present authors used to insert an (optional) question on microeconomic Ph.D. prelim exams inquiring about how the *SRMC* could lie below the *LRMC* curve. Most students always chose not to answer the question, and those who did generally failed to give a cogent explanation.

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