Forthcoming in the Journal of Economic Education

AN INSTRUCTIONAL EXERCISE IN COST-RAISING STRATEGIES AND PERFECT COMPLEMENTS PRODUCTION

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[*] The author is grateful to Inung Jung and Daigyo Seo for expert research assistance, to Dong Li and Melanie Weisman for helpful discussions, and to the co-editor, Hirschel Kasper, and two anonymous referees for numerous constructive suggestions for revision.

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Abstract: An account of the contract negotiations between the United Auto Workers (UAW) and Ford Motor Company is presented to assist students in developing facility with perfect complements production/cost functions and cost-raising strategies. Specifically, this discussion seeks to answer the question of why the UAW targeted Ford for contract negotiations to establish a benchmark for subsequent negotiations with Chrysler and General Motors. Contrary to the popular business press that asserted at the time that "Ford drew the short straw" in being the first of the "Big Three" automakers to negotiate with the UAW, the author believes it is not implausible that this arrangement served the economic interests of both Ford and the UAW. To wit, the UAW targeted Ford because it was more likely to go along with a liberal wage and benefits package given its investment in robotics. In turn, Ford was able to raise, albeit indirectly, its rivals' costs.

Keywords: cost-raising strategies, perfect complements production

JEL classification: A20; A22

For me, the beauty of economics lies in its ability to provide answers to questions that elude cursory analysis. The discussion that follows is based on one of my more successful attempts—as measured by student reactions—to enlighten undergraduates and MBA students to the power of economic analysis in understanding strategic behavior. Specifically, I discuss the contract negotiations between the United Auto Workers (UAW) and Ford Motor Company that took place in 1993 to motivate the concepts of

perfect complements production and the strategic behavior of raising rivals' costs. [See Salop and Scheffman (1983, 1987) and Krattenmaker and Salop (1986) for a formal discussion of cost-raising strategies and Carlton and Perloff (2005, 371-375) for an overview of the literature.] This discussion should be regarded as a well-motivated story rather than a case study because the factual basis for parts of the analysis cannot be verified with complete certainty. And yet, like any good teaching exercise, this discussion serves to raise more questions than it answers.

It is important to underscore three additional points related to this discussion. First, this analysis focuses on one particular aspect of the bargain between Ford and the UAW. Second, economics can provide important insights into targeting of a particular firm and the bargain that is ultimately reached. Third, whereas the rationale put forth to explain the behavior of Ford and the UAW is plausible and based on sound economic reasoning, it is not necessarily the only explanation for the observed behavior.

In this article, I provide the institutional background for this account, develop the economic analysis, and discuss possible strategic behavior and discussion questions.

Institutional Background

The stylized facts underlying the institutional foundation for the contract negotiations between Ford and the UAW are summarized as follows:

1) In the early 1990s, Ford Motor Company initiated a massive capital investment program (PR Newswire 1993; Kyodo News Service 1993). The result was a greater utilization of robotics and a lower utilization of labor per vehicle relative to its domestic rivals, General Motors (GM) and Chrysler.[1]

2) In 1993, the UAW chose to negotiate first with Ford before engaging in contract negotiations with GM and Chrysler (*The Economist*, September 4, 1993).

Although Ford was also the target in 1976 and 1987, GM was the target in 1979 and 1990 (Budd 1992, p. 524; Levin 1993).

3) Ford agreed to what was then generally considered a fairly liberal wage and benefits package with the UAW.[2] Negotiations went down to the wire, but there was no strike or work stoppage of any kind.

4) The UAW's contract with Ford established a benchmark for its negotiations with GM and Chrysler (*The Economist*, September 4, 1993).[3]

The fundamental questions for analysis concern why Ford agreed to a liberal wage and benefits package with the UAW and whether this contract and the pattern it set for subsequent negotiations with the other "Big Three" automakers constitute strategic behavior on the part of Ford and/or the UAW.

Economic Analysis

Production Functions

I begin the economic analysis by attributing to Ford and GM/Chrysler a production function for automobiles that reflects the institutional background outlined in the previous section.[4] As capital and labor are not substitutable in the short run in the production of automobiles, the functional form of the production function is that of perfect complements.[5]

The production function for Ford (F) is assumed to be given by:

$$Q^F = \min \{1/2K, 1/3L\}, \qquad (1)$$

where Q^F denotes the physical number of automobiles produced by Ford, K is capital and L is labor. This production function indicates that Ford requires 2 units of capital and 3 units of labor to produce each automobile efficiently—with no excess capital or labor.[6] The isoquant map for the production function in equation (1) is illustrated in Figure 1.[7]

The production function for GM/Chrysler (G/C) is assumed to be given by:

$$Q^{G/C} = \min \{1K, 1/5L\}, \quad (2)$$

where $Q^{G/C}$ denotes the physical number of automobiles produced by GM or Chrysler. This production function indicates that GM/Chrysler requires 1 unit of capital and 5 units of labor to produce each automobile efficiently. The isoquant map for the production function in equation (2) is illustrated in Figure 2. Recognize that Ford uses more capital and less labor per automobile relative to GM/Chrysler because of its significant investment in robotics.

Cost Functions

Suppose that prior to contract negotiations with the UAW the price of capital per unit is \$4,000 and the price of labor per unit is \$2,000. Because Ford requires 2 units of capital and 3 units of labor per automobile, its cost function is given by

$$C^F (Q^F) = [(2 \times \$4{,}000) + (3 \times \$2{,}000)]Q^F = \$14{,}000Q^F.^8 \quad (3)$$

The marginal and average cost of an automobile for Ford is therefore \$14,000.

Similarly, because GM/Chrysler requires 1 unit of capital and 5 units of labor per automobile, its cost function is given by

$$C^{G/C} (Q^{G/C}) = [(1 \times \$4{,}000) + (5 \times \$2{,}000)]Q^{G/C} = \$14{,}000Q^{G/C}. \quad (4)$$

The marginal and average cost of an automobile for GM/Chrysler is therefore \$14,000, the same as for Ford. Hence, by construction, prior to the contract negotiations with the UAW, none of the "Big Three" automakers enjoyed a cost advantage over its domestic rivals.

Following the contract negotiations with the UAW, the price of labor per unit is assumed to rise from $2,000 to $3,000 to reflect the new wage and benefits package. The price of capital per unit is unaffected by the contract negotiations and remains unchanged at $4,000 per unit. Also, because the production function is of the perfect complements type, there is no flexibility on the part of the automakers to substitute capital for labor, at least in the short run, in response to the increase in the price of labor. Consequently, the input requirements per automobile remain unchanged as a result of the contract negotiations. The post-contract negotiation cost functions for Ford and GM/Chrysler are therefore given, respectively, by

$$C^F(Q^F) = [(2 \times \$4{,}000) + (3 \times \$3{,}000)]Q^F = \$17{,}000Q^F, \text{ and} \quad (5)$$

$$C^{G/C}(Q^{G/C}) = [(1 \times \$4{,}000) + (5 \times \$3{,}000)]Q^{G/C} = \$19{,}000Q^{G/C}. \quad (6)$$

Examination of equations (5) and (6) reveals that the marginal and average cost of an automobile increased for all of the "Big Three" automakers, but Ford now enjoys a $2,000 per unit, or approximately 12 percent, cost advantage over GM and Chrysler. The cost advantage derives from Ford's intensive utilization of robotics, which tempers the cost effect on Ford of higher union wage rates.

Strategic Behavior

When I first present this well-motivated story to my students they are somewhat incredulous. The most common question is "why would a rational firm ever choose to shoot itself in the foot?" The more relevant question for analysis concerns whether a firm can secure an advantage—in this case a cost advantage—over its rivals by engaging in some form of strategic behavior.[9] The key point is that a firm may rationally choose to

engage in behavior that raises its own costs if it simultaneously raises the costs of its rivals even more.[10]

In terms of strategic behavior, there are a number of possibilities to consider. First, did the UAW target Ford for contract negotiations because it recognized that Ford's investment in robotics would render it more likely to go along with a liberal wage and benefits package for its union members? Second, did Ford agree to the liberal wage and benefits package in order to raise its rivals' costs?[11] Third, did Ford and the UAW coordinate their actions strategically (collude) against GM/Chrysler?

Of course, if these actions constitute strategic behavior on the part of the Ford and/or the UAW, it would be difficult to establish this definitively unless one of the participants involved in the negotiations was willing to speak publicly about the matter. Ford could seemingly justify its actions by declaring publicly that paying its workforce a fair wage is consistent with its focus on quality.[12] In turn, it would be difficult for the government to meet the burden of proof necessary to establish that the actions of Ford and/or the UAW had as a primary, rather than ancillary, intent to inflict harm on GM/Chrysler.

Additional Questions for Discussion

The story outlined above leaves a number of questions unanswered. First, why did GM and Chrysler feel compelled to go along with the bargain reached by Ford?[13] Second, the analysis assumes, albeit implicitly, that there are only three automakers and that all three are subject to contract negotiations with the UAW. In fact, the "Big Three" automakers face stiff competition from Japan and Germany and more recently from Korea where the UAW has no presence. Hence, strategically raising domestic labor rates may prove self-defeating for Ford if its overseas rivals do not have to raise wages in concert. Third,

higher wage rates today would provide increased incentives for capital investment in robotics tomorrow. Should not the UAW be concerned about the substitutability of capital for labor in the long run? How does the UAW balance higher wages today against reduced labor utilization tomorrow?[14] These are a few of the outstanding questions raised by this discussion.

Conclusion

An account of the contract negotiations between the UAW and Ford is employed to develop students' facility with perfect complements production/cost functions and cost-raising strategies. In 1993, after Ford had made a significant investment in the use of robotics to produce automobiles, it was targeted by the UAW for contract negotiations. The contract between Ford and the UAW set a pattern for subsequent labor negotiations with GM and Chrysler.

This discussion prompts a number of questions for analysis. Did the UAW target Ford because it believed that it would be more likely to go along with a liberal wage and benefits package given its investment in robotics? Did Ford agree to a liberal wage and benefits package with the UAW because it recognized that its rivals would be disproportionately harmed as a result? If we appeal to the rationality axiom in economics—economic agents behave in their own self-interest—this story provides a seemingly plausible, if not the only, explanation for the behavior of Ford and the UAW during these contract negotiations.

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FIGURE 1
Automobile Isoquant Map For Ford

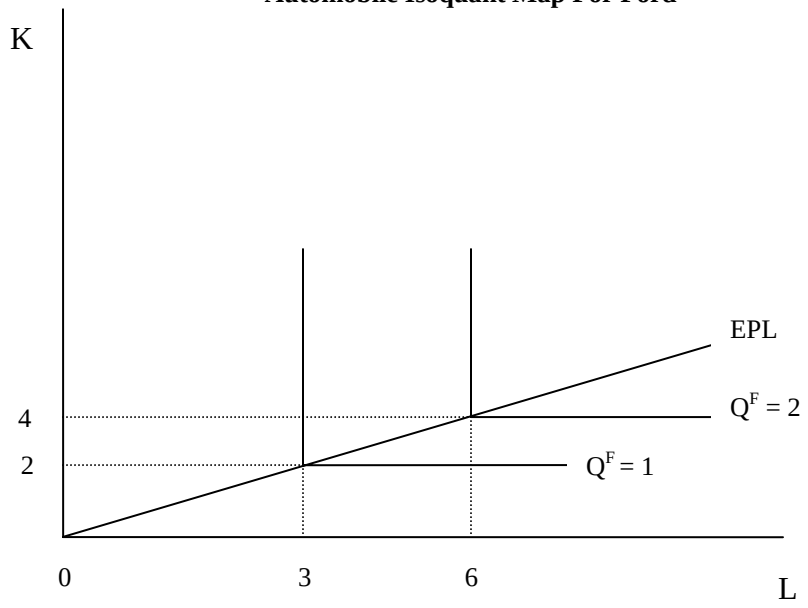
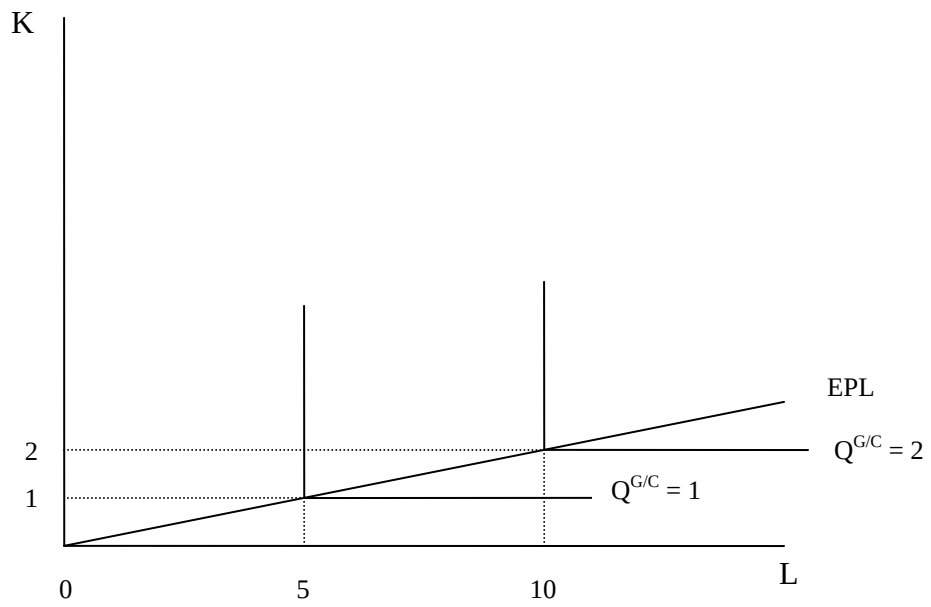


FIGURE 2
Automobile Isoquant Map For GM/Chrysler



[1]In 1993, the average number of labor hours per vehicle was 39.43 for Ford, 45.76 for Chrysler and 51.83 for GM (Harbour Report 1994, 64). In 1997, the average number of labor hours per vehicle was 34.71 for Ford, 45.52 for Chrysler and 46.52 for GM (Harbour Report 1998, 172). Whereas these numbers are consistent with the "cost-raising" hypothesis, some care should be exercised in interpreting them. An anonymous referee has indicated that the labor estimates for GM may be overstated because of the difficulties associated with controlling for the effects of vertical integration at GM.

[2] One industry analyst observed that "Ford or Chrysler negotiators might agree once more to generous benefits for long-term jobless, figuring that only G.M, with too many workers, would have to pay." (Levin 1993). Another auto analyst, David Healy of S.G. Warburg & Company, observed that "the new contract would only widen the gap between General Motors' labor costs and those of Ford. Mr. Healy estimates that it already costs G.M. $800 more to assemble a car than Ford" (Bennet 1993).

[3] Budd (1992, 524-25) described a two-stage process for wage bargaining. In the first stage, a target firm is chosen and in the second stage, the "UAW then bargains for this same settlement at the other auto producers." He further observed that "if pattern-following is important to the UAW, one would expect that the union would first try to settle with firms in which achieving the pattern is thought to be less difficult" (p. 533). In fact, the ratio of wages at GM to those of Ford is close to 1 (p. 529, Table 1), suggesting that it is difficult for firms in subsequent rounds of labor negotiations to break the pattern set by the target firm. An article quoting Douglas Fraser, the lead UAW official at Chrysler who negotiated the 1964 contract, observed that "In each round, the UAW focused its bargaining on one of the Big Three, and after a deal was struck, the other two fell in line." (Lowenstein 2005, 81).

[4] The numerical values used in this exercise are hypothetical, having been chosen for expositional simplicity, and should not be considered representative.

[5] Some textbooks refer to this method of production as "Leontief technology" after Wassily Leontief, the 1973 winner of the Nobel Prize in economics who employed this type of production function in his pioneering work on input-output analysis. See Leontief (1951) and Binger and Hoffman(1985, 254).

[6] This type of production function is also referred to as a *fixed proportions production function* because efficient production requires that the inputs be combined in fixed proportions.

[7] The EPL (efficient production locus) in Figures 1 and 2 represents the efficient combinations of K and L required to produce any given level of output. The slope of the EPL is the efficient capital-labor ratio.

[8] The technique of determining the efficient input requirements per unit of output and extrapolating to any given level of output to derive the cost function is valid only for production functions that exhibit constant returns to scale.

[9] Williamson (1968) was perhaps the first to observe that a firm might willingly concede to, or even orchestrate, a labor union's demand for a higher wage rate if the higher wage rate serves to increase a rival's marginal cost more than it increases the firm's own marginal cost.

[10] Sappington and Weisman (2005) show that a vertically integrated firm that is required by regulatory fiat to provide essential inputs to rivals at cost-based rates may have incentive to raise the costs of those inputs and/or diminish their quality in order to secure a competitive advantage. Notably, pattern wage bargaining can provide similar incentives for a target firm with high labor productivity.

[11] The share price performance of Ford and GM may provide some additional, albeit anecdotal, support for the "cost-raising" hypothesis. When Ford's contract with the UAW was announced on September 15, 1993, Ford's share price increased modestly over the next two weeks from 54.75 on the day of the announcement to 55.25 on September 30. Conversely, over this same time period, GM's share price declined sharply from 47.25 to 41.75. A definitive analysis of the effects of the UAW contract on the share prices of Ford and GM would require a formal event study.

[12] An anonymous referee suggested that Ford may realize higher incremental returns (measured in terms of worker motivation) from each unit increase in its wage rate relative to the other Big Three automakers—in part due to its reputation for being a fair employer—and this may offer an alternative explanation for Ford's willingness to pay higher wages.

[13] There are likely both supply- and demand-side forces at work here. On the supply side, the stability of the union leadership would be threatened if it settled for a wage markedly below that of the target firm (Budd 1995). On the demand side, a wage that exceeds that of the target firm could undermine the firm's competitiveness, whereas a wage that falls short of the target firm may be a signal that the firm places less value on its workers *vis-à-vis* its competitors. See also note 3.

[14] An anonymous referee suggested that the UAW has encountered difficulty in ensuring that the Big Three automakers comply with agreements in which the union trades current wages for future investment. Hence, if the union cannot enforce long-term agreements, it may discount the future heavily and get what it can in the present.