

The Competitive Effects of Quantity Discounts

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I. Introduction

From the very earliest antitrust cases to the present, courts have struggled with a fundamental conflict involving contracts between buyers and sellers of intermediate goods. Namely, on the one hand, contractual agreements binding a buyer to a particular seller frequently are necessary to support efficient exchange and, therefore, are an integral component of a well-functioning market system. But on the other hand, such contracts plausibly can have exclusionary effects, foreclosing potential entrants' access to essential inputs and/or buyers for the duration of the contract.¹

For example, a long-term requirements contract may lock in a customer to a seller. At the same time, however, such a contract may facilitate investment by a new entrant by reducing the probability of exit. This underlying tension between the potential competitive effects of contractual provisions has, over the years, caused considerable confusion in the adjudication of antitrust cases involving these sorts of interfirm contractual relationships.²

Moreover, such confusion is exacerbated by the fact that real world contracts are often exceedingly complex. Many contain multiple provisions that affect the buyer/seller relationship in subtle and frequently poorly understood ways. In addition, the individual provisions contained in these contracts can exhibit either

¹ The potentially conflicting competitive effects of interfirm contracts were an important focus of early Sherman Act cases. Justice Peckham struggled with this issue in five major opinions handed down between 1897 and 1899. See John R. Carter, "From Peckham to White: Economic Welfare and the Rule of Reason," *Antitrust Bulletin*, Vol. 25 (Summer 1980), pp. 275-295; and Robert H. Bork, "Legislative Intent and the Policy of the Sherman Act," *Journal of Law and Economics*, Vol. 9 (April 1966), pp. 7-48.

² This is particularly true in the area of vertical contractual provisions, such as tying, exclusive dealing, territorial restraints, resale price maintenance, and so on. See, e.g., Michael L. Katz, "Vertical Contractual Relations," Ch. 11 in the *Handbook of Industrial Organization*, North-Holland, Amsterdam, 1989, pp. 655-721.

pro- or anticompetitive effects, depending upon the structural conditions present in the affected markets. Tying arrangements, territorial restrictions, exclusive dealing, liquidated damage provisions, and so on can all be motivated by either efficiency or exclusionary effects.³ And, while the task of distinguishing between these effects has been greatly facilitated by advances in our economic understanding of the likely motivation for and consequences of these contractual provisions, we are still a long way from being able to confidently decide individual cases.⁴

In this paper, we focus on a contractual pricing agreement that, while widely used, has not, to our knowledge, been fully addressed in the prior literature. Specifically, we examine the use of single-product quantity discounts as both an exclusionary, anticompetitive strategy and an efficiency-promoting procompetitive weapon.⁵ Next, we briefly survey the literature and recent case law. We then offer some advice on how to distinguish between the opposing competitive effects in practice. Hopefully, our analysis will serve to illustrate the sorts of considerations required to separate the competitive consequences of interfirm contracts generally.

II. Exclusionary Effects: Quantity Discounts as a Barrier to Entry

In an earlier and now classic paper, Aghion and Bolton (1987) present a model in which long-term contracts containing early withdrawal penalties (liquidated damages) can simultaneously: (1) be optimal (i.e., profitable) for both parties to the contract; and (2) prevent the entry of more efficient, lower-cost producers.⁶ Here, we extend the Aghion and Bolton model to contracts containing a simple quantity discount. As we show, the solution to this model is related to that of Aghion and Bolton in that we find that a quantity discount contract between the buyer and seller can deter efficient entry. Consequently, such contracts can be socially inefficient, reducing overall social welfare. Moreover, the result obtains even under the assumption that all parties are

³ For example, compare the analyses of tying arrangements in Roger D. Blair and David L. Kaserman, "Vertical Integration, Tying, and Antitrust Policy," American Economic Review, Vol. 68 (June 1978), pp. 266-272; and Michael D. Whinston, "Tying, Foreclosure, and Exclusion," American Economic Review, Vol. 80 (September 1990), pp. 837-859.

⁴ This point is well illustrated by the ongoing controversy surrounding the Kodak case. Compare, for example, Jeffrey K. MacKie-Mason and John Metzler, "Links Between Vertically Related Markets: Kodak (1992)," in John E. Kwoka, Jr. and Lawrence J. White, eds., The Antitrust Revolution: Economics, Competition, and Policy, 3rd ed., Oxford University Press, New York, 1999; and Carl Shapiro, "Aftermarkets and Consumer Welfare: Making Sense of Kodak," Antitrust Law Journal, Vol. 63 (1995), pp. 483-504.

⁵ Multiproduct or bundled discounts, on the other hand, have received considerable attention in the literature. We reference that literature in footnote 14, *infra*.

⁶ P. Aghion and P. Bolton, "Contracts as a Barrier to Entry," American Economic Review, Vol. 77 (June 1987), pp. 388-401.

rational and none are fooled by strategic behavior or false signals. Like Agion and Bolton, we find that the entry-detering contracts are privately profitable but socially inefficient even if all entry is not deterred.

In our model there are three primary participants: (1) the incumbent seller, S; (2) the buyer, B; and (3) the potential entrant, E. We assume that B must purchase one unit of output from S or, if available, one unit from E in order to produce the final product. We have a two-period model, where in the first period a buyer and seller sign a contract or not, and a potential entrant enters or not. In the second period, Bertrand price competition occurs if there is entry.

In order to evaluate the effects of quantity discounts on entry, we consider the case where B has demand for 2 units of the input, with value \$1 each. It is assumed that the buyer can extract all surplus from its downstream customers. The seller S is able to supply all the inputs needed by B and can produce 0, 1, or 2 units at \$0.50 each. For simplicity, we assume that there are no other costs. The entrant E knows its costs, c_e , before its entry decision. The other participants do not know c_e , but they do know that c_e is uniformly distributed on the interval $[0, 1]$. Finally, the entrant E is assumed to have a capacity constraint. As a result, it can only provide 1 of the two units needed by B, so at least one unit is always provided as a monopoly by S.

If there is no contract and no entry, then S sells 2 units to B for \$1 each for a profit of \$1 [= $1 + 1 - 1/2 - 1/2$]. The profits for both B and E are zero. If there is entry, then the price for the contested unit is $P = \max\{1/2, c_e\}$ and the price for the monopoly unit is \$1. If E is more efficient than S ($c_e < 1/2$), then the profit for S is $1/2$, the profit for B is $1/2$, and the profit for E is $1/2 - c_e$. Alternately, if E is less efficient than S ($c_e > 1/2$), then profit for S is c_e , profit for B is $(1 - c_e)$, and profit for E is zero.

If there is some positive level of sunk costs associated with entry, then E enters only if its expected profit is positive ($\pi'_E > 0$). If there is no contract, entry occurs only if $c_e < 1/2$. Thus, probability of entry is given by

$$\phi = \Pr(c_e < 1/2) = 1/2. \quad (1)$$

From the discussion above, it follows that without a contract, the expected profit for S is

$$\pi'_S = (1 - \phi) \cdot 1 + \phi \cdot 1/2 = 3/4, \quad (2)$$

and the expected profit for B is

$$\pi'_B = (1 - \phi) \cdot 0 + \phi \cdot 1/2 = 1/4 \quad (3)$$

Importantly, the buyer will not sign a contract that renders a profit less than $1/4$, because the expected profit without a contract is $1/4$. Similarly, the seller will not sign a contract that will reduce its profit below $3/4$. The task, then, is to show that

the seller and the buyer will voluntarily sign a quantity discount contract that prevents entry, and they will do so only if their expected profits are at least as large as those computed in Eqs. (2) and (3).

Now, consider a simple quantity discount contract $t = (P_1, P_2)$, where P_1 is B's payment to S for one unit and P_2 is B's payment to S for two units. Thus, the marginal price of the second unit is $P_2 - P_1$. The buyer will purchase the second unit from E only if the entrant's price is less than the marginal price of the second unit from S. Call this price \tilde{P} , which must obey the constraint $\tilde{P} \leq P_2 - P_1$.⁷

In the presence of this contract, the entrant enters with probability

$$\phi' = \max\{0, P_2 - P_1\}. \quad (4)$$

The buyer will sign the contract t only if $P_2 \leq 7/4$ (so that B's profit is at least $1/4$). The optimal contract solves

$$\phi' = (P_1 - 1/2) + (1 - \phi')(P_2 - 1) \quad \text{s.t. } P_2 \leq 7/4. \quad (5)$$

The solution to the optimal contract is $(P_2^* = 7/4, P_1^* = 6/4)$, where the marginal price of the second unit, \tilde{P} , is only $1/4$. Note that the price for one unit under the contract substantially exceeds the price without the contract. This price difference $(7/4 - 1)$ represents a penalty on B for defecting to the entrant.

Under the above quantity discount contract, the expected profit to the seller is

$$\pi'_S = 3/4 + 1/16, \quad (6)$$

which is a higher expected profit than that realized in the absence of the contract. The expected profit to the buyer with the contract is

$$\pi'_B = 1/4. \quad (7)$$

Thus, the buyer will be willing to sign the contract, because its expected profit is unchanged.

What is the economic effect of the quantity discount contract t between the buyer and seller? With a marginal price of the second unit being $1/4$ under the contract, the entrant will not enter unless $c_e < 1/4$, which occurs with a probability of only $1/4$. Without the contract, the probability of entry was $1/2$. Thus, the contract reduces substantially -- cuts in half -- the probability of entry. And, importantly, the quantity discount contract deters efficient entry (entrants with cost $1/4 < c_e < 1/2$) and, therefore, reduces social welfare. Consequently, under the

⁷ If the entrant's price does not satisfy this constraint, then B's profit would be less than $1/4$.

conditions postulated here, quantity discount contracts can have exclusionary effects, preventing the entry of a more efficient firm.

III. Efficiency Effects: Quantity Discounts as a Competitive Weapon

The preceding section demonstrates that quantity discounts can retard efficient entry and thereby reduce social welfare. That outcome, however, ultimately derives from the assumptions that underlie the model. In particular, we assumed that a single dominant firm faced a threat of entry by a capacity-constrained potential entrant. It is not necessary, however, that this asymmetric capacity condition be interpreted narrowly. All that is needed is an inability of the entrant to serve all customers otherwise served by the incumbent firm. A limitation of that sort could arise from (i) production capacity constraints; (ii) limited geographical service areas; (iii) legal restrictions arising from contracts or regulation, and so on. Indeed, empirically, observed entrants are generally “small” in multiple dimensions.⁸ Thus, our analysis may be useful in a wide variety of circumstances that allow for the capture of potential rents created by certain sorts of entry.

Because these assumed conditions cannot be expected to hold in all instances in which quantity discounts are observed, however, the question that naturally arises at this point is: What are the competitive effects of quantity discounts likely to be under different market conditions? We briefly address that question here.

To begin, it should be noted that quantity discounts are a form of price discrimination. Specifically, under Pigou’s (1920) seminal classification system, such discounts correspond to second degree price discrimination, in which per-unit prices vary (usually inversely) with the quantity of the good purchased.⁹ Such pricing mechanisms may range from relatively simple two-part tariffs in which each customer pays a fixed “entry fee” which enables them to purchase the product plus a per-unit charge for each unit consumed to more complex multi-part structures.

The more recent literature refers to these pricing structures generally as non-linear prices, due to the non-linearity of the resulting average prices and total outlay schedules. Fortunately, as Philips (1981) points out, despite the wide

⁸ For example, D. Carlton and J. Perloff, Modern Industrial Organization, 3rd ed, Addison Wesley, Reading, MA, 2000, p. 78, write that: “The empirical literature suggests that there is much entry and exit and that entrants tend to be small.” See also, T. Dunne, M. Roberts and L. Samuelson, “Patterns of Firm Entry and Exit in U.S. Manufacturing Industries,” RAND Journal of Economics, Vol. 19 (1988), p. 495-515.

⁹ A.C. Pigou, The Economics of Welfare, 4th ed., Macmillan, London, 1920. For an example of a quantity dependent pricing mechanism in which the per-unit price increases with the amount purchased, see Jean Tirole, The Theory of Industrial Organization, The MIT Press, Cambridge, MA, 1988, p. 158.

variety of specific forms these price structures may take, the basic analytic properties exhibited are independent of the particular form assumed. That is, some general conclusions can be reached that remain valid across the whole class of non-linear prices.¹⁰

Three such conclusions appear relevant to our present discussion. First, while it has been shown that non-linear price structures, including quantity discounts, are generally welfare improving when they are applied to final goods, that conclusion may fail to hold when such structures are applied to intermediate products.¹¹ Indeed, the model we presented in the preceding section illustrates this basic result. As a consequence, it is not possible to draw any general conclusions regarding the social welfare effects of quantity discount contracts when they apply to interfirm transactions. Individual results may differ depending upon the specific market environment.

Second, as others have pointed out, price discrimination in general may provide an attractive avenue for firms participating in a collusive, price-fixing agreement (either overt or tacit) to cheat on the cartel.¹² Specifically, the ability to reduce price selectively to a subset of customers without implementing an across-the-board price cut has two desirable features. First, it is generally more profitable than a uniform price reduction. And second, by reducing the number of customers to whom the price cut is offered, the probability of detection by other parties to the collusive agreement is lowered. Moreover, quantity discounts may provide a particularly attractive form for such cheating via price discrimination to the extent that larger volume buyers may be better informed and more aggressive in negotiating prices. As a result, they may tend to have more price elastic demands. Thus, in industries that are prone to collusion (either overt or tacit), quantity discounts may have procompetitive effects, potentially leading to a breakdown in interfirm coordination.

Finally, and in a related vein, the use of quantity discounts may reduce the likelihood that a collusive agreement will ever arise in the first place. Such discounts complicate the structure of prices upon which participating firms must agree, rendering such agreement less likely.¹³ Moreover, a more complex pricing structure makes it more difficult for a collusive group to make needed adjustments to prices over time as cost and demand conditions change.

¹⁰ Louis Philips, The Economics of Price Discrimination, Cambridge University Press, Cambridge, 1981, pp. 166-167.

¹¹ See Robert D. Willig, "Pareto-Superior Nonlinear Outlay Schedules," Bell Journal of Economics, Vol. 9 (1978), 56-69; and Januz Ordover and John Panzar, "On the Nonexistence of Pareto Superior Outlay Schedules," Bell Journal of Economics, Vol. 11 (1980), pp. 351-354.

¹² See F. M. Scherer and David Ross, Industrial Market Structure and Economic Performance, 3rd ed., Houghton Mifflin Company, Boston, 1990, pp. 449-502.

¹³ See David T. Scheffman and Mary Coleman, "Quantitative Analyses of Potential Competitive Effects from a Merger," George Mason Law Review, Vol. 12 (2003), pp. 319-369.

Therefore, quantity discounts may lower the probability of successful collusion and, thereby, promote more competitive outcomes.

IV. Antitrust Implications - The Literature and Recent Cases

A search of the economics literature revealed very little prior research on the economics of single-product quantity discounts. There exists, however, a large and growing literature dealing with bundled (or package) discounts.¹⁴ Bundled discounts programs, however, raise economic issues of monopoly leveraging through what is, in effect, a price-induced tying arrangement, which single-product discounts do not present.¹⁵ Thus, these two types of discount strategies appear to raise different economic/antitrust questions.

Moreover, examination of the recent case law reveals that these two strategies have been treated quite differently by the courts. Specifically, two recent decisions that have confronted single-product discounts -- Brooke Group and Concord Boats -- have taken a relatively stringent approach that applies the modern, more demanding standards required of plaintiffs in predatory pricing cases.¹⁶ These standards require that plaintiffs be able to demonstrate that: (1) the defendant's prices were below some relevant measure of cost (either marginal cost or average variable cost); and (2) the defendant had a reasonable prospect of recouping its investment in these below - cost prices through (appropriately discounted) monopoly - like returns in the future.

The recent and widely discussed Le Page's decision, which deals with bundled discounts, however, takes a somewhat more plaintiff-friendly stance. In particular, there is no requirement that any of the defendant's discounted prices fall below cost.¹⁷ And, because there are no explicit losses required, there is no recoupment standard imposed.¹⁸ Thus, bundled discount programs are not

¹⁴ This literature dates back to George J. Stigler, "U S v Loew's Inc.: A Note on Block Booking," Supreme Court Review, Vol. ___ (1964), pp. 152-157; and W.J. Adams and Janet L. Yellen, "Commodity Bundling and the Burden of Monopoly" Quarterly Journal of Economics, Vol. 90 (1976), pp. 475-498. For a recent survey, see Bruce H. Kobayashi, "Does Economics Provide a Reliable Guide to Regulating Commodity Bundling by Firms? A Survey of the Economic Literature," Journal of Competition Law & Economics, Vol. 1 (December 2005), pp. 707-746.

¹⁵ See Patrick Greenlee, David Reitman, and David S. Sibley, "An Antitrust Analysis of Bundled Loyalty Discounts," Economic Analysis Group of the Antitrust Division, United States Department of Justice, Discussion Paper EAG 04-13, October, 2004, which argues that bundled discount programs are best viewed as a form of tying arrangements.

¹⁶ Brooke Group Ltd. V. Brown & Williamson Tobacco Corp., 509 U.S. 209, 222 (1993); and Concord Boat Corp. v. Brunswick Corp., 207 F.3d 1039 (8th Cir.), cert. denied, 531 U.S. 979 (2000). See, also, Phillip E. Areeda and Herbert Hovenkamp, Antitrust Law, paragraph 749a, 2006 Supplement.

¹⁷ Le Page's Inc. v. 3M, 324 F.3d 141 (3d Cir. 2003 (en banc), cert. denied, 125 S. Ct. 2932 (2004). For a discussion of this case, see Areeda and Hovenkamp, *supra*, note 16.

¹⁸ Ibid.

treated under the demanding standards required in single-product discount programs and predatory pricing cases. Instead, in *Le Page's*, plaintiff was required to demonstrate only that an equally-efficient single-product competitor could not profitably match the defendant's (3M's) discounted price on that particular product when the sum total of the aggregate discount on all products was applied to that single good. That condition, which was alleged to exclude the equally efficient firm, along with the possession of significant monopoly power, was judged to be sufficient to warrant conviction of unlawful maintenance of monopoly under Section 2.

The question, then, is whether the relatively more stringent treatment of single-product discount claims is justified by the relevant theory. Our results suggest that it is not. In particular, the exclusionary effect we have identified: (1) does not require that average price fall below cost; and (2) is successful against an equally (or even more) efficient firm.¹⁹ As a result, application of the demanding standards used in predatory pricing cases would appear to result in the possibility of under-deterrence -- *viz.*, allowing discounts that are exclusionary.

At the same time, however, we are mindful of the fact that most observed single-product discount programs are likely to be either pro-competitive or competitively innocuous. They are likely to be driven by efficiency considerations, aggressive competition, or price discrimination.²⁰ We also recognize that the courts -- both judges and juries -- have limited abilities to separate the pro- from the anticompetitive cases with complete accuracy. Together, these observations suggest that the likelihood of Type I errors (conviction of an innocent party) may loom large in relatively complex cases. And, as Areeda and Hovenkamp (2006) have argued, the social costs of Type I errors are likely to be much greater than the social costs of Type II errors in antitrust cases due to the chilling effect they are likely to have on aggressive price competition. Therefore, one should proceed with caution in advocating the application of relatively complex economic theories to antitrust jurisprudence.

In the case of the theory we have espoused here, however, there appear to be some relatively simple guidelines that may help to distinguish pro-competitive from anticompetitive single-product quantity discounts. Specifically, in order to

¹⁹ One may argue, of course, that, due to its capacity constraint, the potential entrant is not "equally efficient". A similar argument can be made in the case of a multi-product incumbent using a bundled discount package to prevent entry by a single-product rival. In addition, the "marginal price" of the second unit is $\frac{1}{4}$, which is below cost in our example. See Areeda and Hovenkamp, *supra*, note 16, at p. 322.

²⁰ Areeda and Hovenkamp, *supra*, note 16, at p. 333 writes that "Discounting is very common in most markets and firms compete against each other by offering discounts." See, also, David S. Evans and Michael Salinger, "Why Do Firms Bundle and Tie? Evidence from Competitive Markets and Implications for Tying Law," *Yale Journal on Regulation*, Vol. 22 (2005), pp. ___ - ___.

draw such a distinction successfully, it is useful to examine the assumed market structures that underlie the alternative theories.

For example, the model presented above in Section II, which demonstrates the potential exclusionary effects of single-product quantity discounts, assumes a single, dominant firm with substantial unilateral market power that faces a threat of entry. The discussion in Section III, however, presumes a relatively tight-knit oligopoly in which collusive tendencies are present (or potentially present). Thus, a simple, but effective, approach to the adjudication of cases in which single-product quantity discounts are a significant aspect of the competitive landscape is to segregate them into the appropriate structural categories -- dominant firm versus oligopoly -- and to determine the particular asymmetry that may give rise to the anticompetitive contracts described above. The (rebuttable) presumption, then, is that such discounts are more likely to be anticompetitive in the presence of a dominant firm possessing some sort of asymmetry that provides a competitive advantage over potential entrants.

Obviously, this sort of rule-of-thumb approach is not likely to be fully accurate in all cases. Nonetheless, it seems reasonable to expect that it will serve as a sensible selection criterion for further investigation in many instances. Also, it is attractive, because it is relatively straightforward to implement. And finally, this approach would bring the treatment of single-product quantity discounts much more in line with the post - Le Page's treatment of bundled discounts.

V. Conclusion

From its inception, antitrust policy has struggled with the opposing effects that interfirm contractual agreements can have on the overall vigor of competition. While such contracts are often necessary to support efficient exchange, they also can have exclusionary effects, tending to support the maintenance of monopoly.

Here, we have illustrated this fundamental tension between the potential competitive effects of a specific contractual pricing arrangement -- single-product quantity discounts. Our analysis suggests that such discounts can be used to retard entry in a dominant firm setting. At the same time, however, they can promote more competitive outcomes under oligopoly conditions. As a result, the structural conditions present in the affected industry provide a logical starting point for separating these potential effects in particular cases.