THE HONORABLE JOHN H. CHUN

UNITED STATES DISTRICT COURT
WESTERN DISTRICT OF WASHINGTON
AT SEATTLE

FEDERAL TRADE COMMISSION, et al.,

Plaintiffs,

v.

AMAZON.COM, INC., a corporation,

Defendant.

Case No. 2:23-cv-01495-JHC

DECLARATION OF MOLLY A. TERWILLIGER IN SUPPORT OF AMAZON'S SUMMARY JUDGMENT AND *DAUBERT* MOTIONS

REDACTED

I, Molly A. Terwilliger, declare as follows:

1. I am a partner at Morgan, Lewis & Bockius LLP, and counsel to Defendant Amazon.com, Inc. ("Amazon") in this action. I am over eighteen years of age and am competent to testify herein. I make the following statements based on my personal knowledge.

2. Pursuant to Local Civil Rule 10(e)(10), certain exhibits attached to this Declaration have been excerpted. Should the Court wish to see any such exhibit in its entirety, Amazon can furnish it to the Court upon request.

3. Attached to this Declaration as **Exhibit 1** is a genuine excerpt of the Expert Report of Elliot Rabinovich, Ph.D., dated March 27, 2026. Pursuant to Local Civil Rule 10(e)(10), the exhibit has been highlighted for ease of reference.

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4. Attached to this Declaration as **Exhibit 2** is a genuine excerpt of the transcript of the deposition of [redacted], dated June 9, 2025. Pursuant to Local Civil Rule 10(e)(10), the exhibit has been highlighted for ease of reference.

5. Attached to this Declaration as **Exhibit 3** is a genuine excerpt of the transcript of the deposition of [redacted], dated September 10, 2025. Pursuant to Local Civil Rule 10(e)(10), the exhibit has been highlighted for ease of reference.

6. Attached to this Declaration as **Exhibit 4** is a genuine excerpt of the transcript of the deposition of [redacted], dated September 11, 2025. Pursuant to Local Civil Rule 10(e)(10), the exhibit has been highlighted for ease of reference.

7. Attached to this Declaration as **Exhibit 5** is a genuine excerpt of the transcript of the deposition of Elliot Rabinovich, Ph.D., dated September 2, 2026. Pursuant to Local Civil Rule 10(e)(10), the exhibit has been highlighted for ease of reference.

8. Attached to this Declaration as **Exhibit 6** is a genuine excerpt of the transcript of the deposition of David Clark, dated August 13, 2025. Pursuant to Local Civil Rule 10(e)(10), the exhibit has been highlighted for ease of reference.

9. Attached to this Declaration as **Exhibit 7** is a genuine excerpt of the transcript of the deposition of Dharmesh Mehta, dated August 8, 2025. Pursuant to Local Civil Rule 10(e)(10), the exhibit has been highlighted for ease of reference.

10. Attached to this Declaration as **Exhibit 8** is a genuine excerpt of the transcript of the deposition of Thomas Taylor, dated June 20, 2025. Pursuant to Local Civil Rule 10(e)(10), the exhibit has been highlighted for ease of reference.

11. Attached to this Declaration as **Exhibit 9** is a genuine copy of a document titled Fulfillment by Amazon: 2007 OP1 S-Team presentation, bearing the Bates stamp AMZN-RTL-FTC-10357948 on its first page.

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12. Attached to this Declaration as **Exhibit 10** is a genuine copy of a document titled Fulfillment by Amazon OP1, dated September 23, 2008, and bearing the Bates stamp AMZN-RTL-FTC-07689442 on its first page.

13. Attached to this Declaration as **Exhibit 11** is a genuine excerpt of the Corrected Expert Report of Justin P. Johnson, Ph.D., dated April 22, 2026. Pursuant to Local Civil Rule 10(e)(10), the exhibit has been highlighted for ease of reference.

14. Attached to this Declaration as **Exhibit 12** is a genuine excerpt of the transcript of the deposition of [redacted], dated December 11, 2024. Pursuant to Local Civil Rule 10(e)(10), the exhibit has been highlighted for ease of reference.

15. Attached to this Declaration as **Exhibit 13** is a genuine excerpt of the transcript of the deposition of [redacted] dated July 9, 2025. Pursuant to Local Civil Rule 10(e)(10), the exhibit has been highlighted for ease of reference.

16. Attached to this Declaration as **Exhibit 14** is a genuine excerpt of the Rebuttal Expert Report of Dr. Nick Vyas, dated June 10, 2026. Pursuant to Local Civil Rule 10(e)(10), the exhibit has been highlighted for ease of reference.

17. Attached to this Declaration as **Exhibit 15** is a genuine excerpt of the Expert Reply Report of Elliot Rabinovich, Ph.D., dated August 19, 2026. Pursuant to Local Civil Rule 10(e)(10), the exhibit has been highlighted for ease of reference.

18. Attached to this Declaration as **Exhibit 16** is a genuine excerpt of the transcript of the deposition of [redacted], dated June 25, 2025. Pursuant to Local Civil Rule 10(e)(10), the exhibit has been highlighted for ease of reference.

19. Attached to this Declaration as **Exhibit 17** is a genuine excerpt of the transcript of the deposition of [redacted], dated June 23, 2025. Pursuant to Local Civil Rule 10(e)(10), the exhibit has been highlighted for ease of reference.

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20. Attached to this Declaration as **Exhibit 18** is a genuine excerpt of the transcript of the deposition of [redacted], dated January 28, 2026. Pursuant to Local Civil Rule 10(e)(10), the exhibit has been highlighted for ease of reference.

21. Attached to this Declaration as **Exhibit 19** is a genuine excerpt of the transcript of the deposition of [redacted], dated December 17, 2025. Pursuant to Local Civil Rule 10(e)(10), the exhibit has been highlighted for ease of reference.

22. Attached to this Declaration as **Exhibit 20** is a genuine excerpt of the transcript of the deposition of Andrew Jassy, dated August 21, 2025. Pursuant to Local Civil Rule 10(e)(10), the exhibit has been highlighted for ease of reference.

23. Attached to this Declaration as **Exhibit 21** is a genuine excerpt of the transcript of the deposition of John Felton, dated May 30, 2025. Pursuant to Local Civil Rule 10(e)(10), the exhibit has been highlighted for ease of reference.

24. Attached to this Declaration as **Exhibit 22** is a genuine excerpt of the transcript of the deposition of [redacted], dated January 20, 2026. Pursuant to Local Civil Rule 10(e)(10), the exhibit has been highlighted for ease of reference.

25. Attached to this Declaration as **Exhibit 23** is a genuine excerpt of the transcript of the deposition of Justin P. Johnson, Ph.D., dated September 9, 2026. Pursuant to Local Civil Rule 10(e)(10), the exhibit has been highlighted for ease of reference.

26. Attached to this Declaration as **Exhibit 24** is a genuine excerpt of the Corrected Expert Reply Report of Justin P. Johnson, Ph.D., dated September 3, 2026. Pursuant to Local Civil Rule 10(e)(10), the exhibit has been highlighted for ease of reference.

27. Attached to this Declaration as **Exhibit 25** is a genuine excerpt of the transcript of the deposition of [redacted], dated January 27, 2025. Pursuant to Local Civil Rule 10(e)(10), the exhibit has been highlighted for ease of reference.

28. Attached to this Declaration as **Exhibit 26** is a genuine copy of Plaintiffs' Supplemental Objections and Responses to Defendant's Interrogatory Nos. 1, 4, 5, 7, 8, 10, 11,

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12, 14, and 15, dated October 13, 2026. Pursuant to Local Civil Rule 10(e)(10), the exhibit has been highlighted for ease of reference.

29. Attached to this Declaration as **Exhibit 27** is a genuine copy of a meeting invitation with attachments from [redacted] to [redacted] and others, dated February 17, 2015, and bearing the Bates stamp AMZN-RTL-FTC-09089370 on its first page. Pursuant to Local Civil Rule 10(e)(10), the exhibit has been highlighted for ease of reference.

30. Attached to this Declaration as **Exhibit 28** is a genuine copy of a document titled Project Nessie Update, dated January 30, 2020, and bearing the Bates stamp Amazon-FTC-CID_07675017 on its first page. Pursuant to Local Civil Rule 10(e)(10), the exhibit has been highlighted for ease of reference.

31. Attached to this Declaration as **Exhibit 29** is a genuine excerpt of the Rebuttal Expert Report of Francine Lafontaine, Ph.D., dated June 10, 2026. Pursuant to Local Civil Rule 10(e)(10), the exhibit has been highlighted for ease of reference.

32. Attached to this Declaration as **Exhibit 30** is a genuine copy of a document titled Amazon Pricing Review – Jan 2017 (Draft Document Prepared for Counsel), bearing the Bates stamp AMZN-RTL-FTC-08632832 on its first page. Pursuant to Local Civil Rule 10(e)(10), the exhibit has been highlighted for ease of reference.

33. Attached to this Declaration as **Exhibit 31** is a genuine excerpt of the Expert Report of Andreas Groehn, Ph.D., dated March 27, 2026. Pursuant to Local Civil Rule 10(e)(10), the exhibit has been highlighted for ease of reference.

34. Attached to this Declaration as **Exhibit 32** is a genuine copy of a document titled WW Consumer Pricing Research – Q2 2019, dated April 4, 2019, and bearing the Bates stamp AMZN-RTL-FTC-13850805 on its first page. Pursuant to Local Civil Rule 10(e)(10), the exhibit has been highlighted for ease of reference.

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35. Attached to this Declaration as **Exhibit 33** is a genuine excerpt of the transcript of the deposition of [redacted], dated August 6, 2025. Pursuant to Local Civil Rule 10(e)(10), the exhibit has been highlighted for ease of reference.

36. Attached to this Declaration as **Exhibit 34** is a genuine excerpt of the transcript of the deposition of [redacted], dated July 23, 2025. Pursuant to Local Civil Rule 10(e)(10), the exhibit has been highlighted for ease of reference.

37. Attached to this Declaration as **Exhibit 35** is a genuine excerpt of the transcript of the deposition of [redacted], dated August 21, 2025. Pursuant to Local Civil Rule 10(e)(10), the exhibit has been highlighted for ease of reference.

38. Attached to this Declaration as **Exhibit 36** is a genuine excerpt of the transcript of the deposition of [redacted], dated July 22, 2025. Pursuant to Local Civil Rule 10(e)(10), the exhibit has been highlighted for ease of reference.

39. Attached to this Declaration as **Exhibit 37** is a genuine copy of an email from [redacted] to Doug Herrington and others, dated January 31, 2022, and bearing the Bates stamp AMZN-RTL-FTC-06805230 on its first page. Pursuant to Local Civil Rule 10(e)(10), the exhibit has been highlighted for ease of reference.

40. Attached to this Declaration as **Exhibit 38** is a genuine excerpt of the Expert Reply Report of David S. Evans, dated August 19, 2026. Pursuant to Local Civil Rule 10(e)(10), the exhibit has been highlighted for ease of reference.

41. Attached to this Declaration as **Exhibit 39** is a genuine excerpt of the transcript of the deposition of [redacted], dated March 31, 2025. Pursuant to Local Civil Rule 10(e)(10), the exhibit has been highlighted for ease of reference.

42. Attached to this Declaration as **Exhibit 40** is a genuine excerpt of the transcript of the deposition of [redacted], dated July 17, 2025. Pursuant to Local Civil Rule 10(e)(10), the exhibit has been highlighted for ease of reference.

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43. Attached to this Declaration as **Exhibit 41** is a genuine excerpt of the Expert Reply Report of Andreas Groehn, Ph.D., dated August 19, 2026. Pursuant to Local Civil Rule 10(e)(10), the exhibit has been highlighted for ease of reference.

44. Attached to this Declaration as **Exhibit 42** is a genuine excerpt of the transcript of the deposition of Andreas Groehn, Ph.D., dated September 10, 2026. Pursuant to Local Civil Rule 10(e)(10), the exhibit has been highlighted for ease of reference.

45. Attached to this Declaration as **Exhibit 43** is a genuine copy of Raymond J. Deneckere & Dan Kovenock, *Price Leadership*, 59 Rev. Econ. Stud. 143 (1992). Pursuant to Local Civil Rule 10(e)(10), the exhibit has been highlighted for ease of reference.

46. Attached to this Declaration as **Exhibit 44** is a genuine excerpt of the Expert Report of David S. Evans, dated March 27, 2026. Pursuant to Local Civil Rule 10(e)(10), the exhibit has been highlighted for ease of reference.

47. Attached to this Declaration as **Exhibit 45** is a genuine excerpt of the Expert Report of Nancy A. Mathiowetz, Ph.D., dated June 10, 2026. Pursuant to Local Civil Rule 10(e)(10), the exhibit has been highlighted for ease of reference.

48. Attached to this Declaration as **Exhibit 46** is a genuine excerpt of the transcript of the deposition of Nancy Mathiowetz, Ph.D., dated September 1, 2026. Pursuant to Local Civil Rule 10(e)(10), the exhibit has been highlighted for ease of reference.

49. Attached to this Declaration as **Exhibit 47** is a genuine excerpt of the transcript of the deposition of David S. Evans, Ph.D., dated September 18, 2026. Pursuant to Local Civil Rule 10(e)(10), the exhibit has been highlighted for ease of reference.

50. Attached to this Declaration as **Exhibit 48** is a genuine excerpt of the Rebuttal Expert Report of Gautam Gowrisankaran, Ph.D., dated June 10, 2026. Pursuant to Local Civil Rule 10(e)(10), the exhibit has been highlighted for ease of reference.

51. Attached to this Declaration as **Exhibit 49** is a genuine copy of Lauren Feiner, *Amazon Starts to Roll Out Free One-Day Delivery for Prime Members*, CNBC (June 3, 2019),

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https://www.cnbc.com/2019/06/03/amazon-starts-to-roll-out-free-one-day-delivery-for-prime-members.html.

52. Attached to this Declaration as **Exhibit 50** is a genuine copy of *Amazon Expands Free Returns with No Shipping Box, Tape, or Label Needed to Over 10,000 U.S. Locations*, Amazon News (July 5, 2019), https://www.aboutamazon.com/news/operations/free-returns-with-no-box-tape-or-label-needed.

53. Attached to this Declaration as **Exhibit 51** is a genuine copy of *CEO Andy Jassy's 2024 Letter to Shareholders*, Amazon News (Apr. 10, 2025), https://www.aboutamazon.com/news/company-news/amazon-ceo-andy-jassy-2024-letter-to-shareholders. Pursuant to Local Civil Rule 10(e)(10), the exhibit has been highlighted for ease of reference.

54. Attached to this Declaration as **Exhibit 52** is a genuine excerpt of the Rebuttal Expert Report of Divya Mathur, Ph.D., dated June 10, 2026. Pursuant to Local Civil Rule 10(e)(10), the exhibit has been highlighted for ease of reference.

55. Attached to this Declaration as **Exhibit 53** is a genuine excerpt of the Rebuttal Expert Report of Lesley Chiou, Ph.D., dated June 10, 2026. Pursuant to Local Civil Rule 10(e)(10), the exhibit has been highlighted for ease of reference.

I declare under penalty of perjury under the laws of the United States of America that the foregoing is true and correct.

Executed on October 16, 2026, at Seattle, Washington.

s/ Molly A. Terwilliger
Molly A. Terwilliger

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EXHIBITS 1-42

Filed Provisionally Under Seal per ECF No. 715

EXHIBIT 43

Review of Economic Studies (1992) 59, 143–162 0034-6527/92/00080143$02.00
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Price Leadership

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and

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First version received March 1988; *final version accepted December* 1990 (*Eds.*)

This paper analyzes duopolistic price-leadership games in which firms have capacity constraints. We provide a complete characterization of price leader equilibria under quite general assumptions on demand and for arbitrary capacities. We show that when capacities are in the range where the simultaneous-move price-setting game (with efficiently rationed demand) yields a mixed-strategy solution the large firm is indifferent between being a leader, a follower, or moving simultaneously. The small firm, while indifferent between being a leader and moving simultaneously, strictly prefers to be a follower. This motivates the discussion of games of timing with ex-post inflexible prices in which the large firm becomes an endogenously determined price leader. We thus provide a game-theoretic model of dominant-firm price leadership.

1. INTRODUCTION

The traditional industrial organization literature is very fond of the dominant-firm model of price leadership. In this model it is generally assumed that there is one large producer and many small producers—no one of which produces a high enough output to affect price. According to Scherer (1970, p. 164), "Dominant firm price leadership occurs when an industry consists of one firm dominant in the customary sense of the word i.e. controlling at least 50% of the total industry output—plus a 'competitive fringe' of firms, each too small to exert a perceptible influence on price through its individual output decisions". With firms in the fringe acting as price takers, the dominant firm is left as the only agent able to set price and does so by maximizing profit subject to its residual demand curve. It, thus, by necessity becomes a "price leader". As Markham (1951, p. 895) concluded, "Price leadership in a dominant firm market is not simply a *modus operandi* designed to circumvent price competition but is instead an inevitable consequence of the industry's structure".

Stigler, in his paper "The Kinky Oligopoly Demand Curve and Rigid Prices" (1947, pp. 444–446), attaches major importance to the dominant-firm model of price leadership. Stigler distinguishes between two types of price leadership: dominant-firm leadership and barometric price leadership. In the former a dominant firm "sets the price, allows the minor firms to sell what they wish at this price . . . , and supplies the remainder of the quantity demanded". Barometric price leadership "refers to the existence of a firm that conventionally first announces price changes that are usually followed by the remainder of the industry, even though this firm may not occupy a dominant position". The latter "commands adherence of rivals to this price only because, and to the extent that, this price reflects market conditions with tolerable promptness". Stigler classifies as industries with dominant-firm price leaders "those in which there is a relatively large firm, producing,

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say, 40% of the output of the industry at a minimum, and more if the second largest firm is large (because otherwise the situation approaches classical duopoly)". Of the nineteen industries Stigler analyzed, seven had dominant-firm price leaders.

Despite its prominence in Stigler's analysis, it is not clear that it is appropriate to use the dominant-firm model of price leadership to describe oligopolistic markets with more than one large firm. Large firms cannot be assumed to act as price takers, taking as given the price set by the leader. They should act strategically in their choice of price.[1] This somewhat limits the applicability of the traditional dominant-firm model. Indeed, as noted by Bain in his critique of the Markham and Stigler papers (1960, p. 197), the dominant-firm model "has scant theoretical interest or practical application". Empirically, there do not appear to be many industries fitting the structure described in the traditional model. Theoretically, if we take the fringe to be non-atomic, so that firms are behaving rationally, the dominant-firm equilibrium coincides with the Cournot equilibrium. Bain went on to describe what he called "oligopolistic price leadership", requiring at least two large firms in the market, which realize their interdependence. There have been many observed cases of price leadership in markets with an oligopolistic structure. Standard examples include episodes in the histories of the automobile, breakfast cereal, cigarette, and steel industries.

In this paper, we construct a model of price leadership in a duopolistic market that maintains the spirit of the traditional model, while not assuming price-taking behaviour by a competitive fringe. We analyze duopolistic price-setting games in which firms have capacity constraints and are allowed to choose the timing of their price announcements. We show that with efficiently rationed demand, and when capacities are in the range where the simultaneous move price-setting game yields a mixed-strategy solution, there are reasonable specifications of games of timing with ex-post inflexible prices in which the high-capacity firm becomes a price leader. We thus provide a game-theoretic model of dominant-firm price leadership.

Our motivation for focusing on price-setting games with capacity constraints is twofold. Clearly, in formulating a model of price leadership, firms should set price as the strategic variable. We incorporate capacity constraints because it is a natural way to model the size of firms. In the traditional literature, size has been viewed as an important determinant of the existence and identity of price leaders. For instance, Markham noted that "in a large number of industries which do not contain a partial monopolist, the price leader is frequently but not always the largest firm". Oxenfeldt (1951, pp. 296–297) stated it more forcefully when he argued, "price leadership probably works best and arises most frequently in industries in which a single firm is outstanding by virtue of large size or recognized high quality of management,"[2] and "The existence of a large firm facilitates price leadership in several ways. First, a large firm's price policy exerts a great influence on the sales of its smaller rivals; consequently the large firm must consider the probable responses of its rivals before setting its own price. In effect, the large firm must think in terms of a price policy for the entire industry".

The basic intuition for the economic forces that drive our results is that small firms, ceteris paribus, stand to lose more from being undercut than large firms. Consequently, small firms have a stronger preference than large firms for assuming a followership role

1. This point is also made in Rotemberg and Saloner (1990).

2. High-quality management might be thought of as being related to informational advantages. For a model incorporating informational asymmetries to explain collusive price leadership, see Rotemberg and Saloner (1990). These authors ignore the potential effect of size in their analysis; an interesting extension would incorporate the effect of both size and informational differences on price leadership.

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in the industry, and choose not to lead or simultaneously set prices. More specifically, in our model, consider the simultaneous-move price-setting game when capacities are in the range where a non-degenerate mixed-strategy equilibrium exists. Recall that the firm with the greatest capacity (firm 2 in our model) receives in equilibrium the same expected profit as it would receive if it chose the best possible price knowing that the low-capacity firm (firm 1) would undercut it. It is not surprising, therefore, that the high-capacity firm makes the same expected payoff in the simultaneous-move game as it would receive if it were an exogenously specified price leader. The low-capacity firm makes a strictly lower expected profit in the simultaneous-move game than if it were an exogenously specified price follower. On the other hand, over the same range of capacities, in the game in which the low-capacity firm is the price leader, both firms obtain the same profit as in the simultaneous-move game (except possibly in one of the two equilibria that exist when capacities are equal).

This fact leads one to expect that it may be possible to specify games of timing in price announcements in which the high-capacity firm becomes an endogenous price leader and the low-capacity firm an endogenous price follower. Since the high-capacity firm is indifferent as to which of the three potential price-setting games it plays, whereas the low-capacity firm strictly prefers to be a price follower, it is reasonable to expect that the small firm would be willing to outwait the large firm in announcing its price (as long as the periods at which the firms can announce prices are not too far apart) and that the large firm, knowing this, would announce price immediately.

Several implications of our model are amazingly consistent with observations made in the traditional literature, even though each firm is large enough to affect price. First, when firms are allowed to choose the timing of their announcements, leadership—when it exists—is an inevitable consequence of industry structure. In our model (in which variable costs are identical) leadership is entirely determined by capacity. Second, the outcome under price leadership is more collusive than the outcome under simultaneous price-setting. The expected profit of the high-capacity firm is the same in each game, but the low-capacity firm benefits strictly from price leadership. Third, to the extent that price leadership leads to a deterministic solution (rather than the mixed-strategy solution from the simultaneous-move game) price leadership appears to induce more stable prices.

The welfare implication of our model, that price leadership leads to higher prices than simultaneous price-setting, addresses a point of some dispute in earlier writings (see Bain's (1960) critique of Stigler and Markham). We demonstrate that price leadership can lead to less competitive outcomes without being either implicitly or explicitly collusive. Even in the absence of exogenous shocks to cost or demand, price leadership can increase price by coordinating the otherwise random actions of the firms.

The remainder of this paper is structured as follows. In Section 2 we present the basic model of price-setting duopoly with capacity constraints and efficiently rationed demand. In Section 3, we review the properties of the simultaneous-move equilibrium with strictly decreasing, concave demand and examine the equilibria obtained both in the case where the large firm is a price leader and where the small firm is a price leader. This extends previous work by Shubik and Levitan (1980).[3] In Section 4, we use the results from the games with exogenously specified leaders to construct games of timing

3. Shubik and Levitan (1980) provide a characterization of price leader equilibria for linear demand and a very restricted range of capacities. Gelman and Salop (1983) provide a characterization of the price leader equilibria when demand is concave, the leader has a higher unit cost of production up to capacity than the follower, and the follower has unlimited capacity. In Section 7 we indicate how our results generalize to the case of different unit costs, and investigate the implications for the Gelman-Salop model of entry.

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in the announcement of price in which the large firm becomes an endogenously determined price leader when capacities are in the range where the simultaneous-move equilibrium is in non-degenerate mixed strategies. Section 5 investigates the relevance of this model by examining two-stage games of capacity choice followed by sequential price-setting. We assume that there is uncertainty about the level of demand at the capacity setting stage, but that all uncertainty is resolved before prices are set. We show that such models can generate the excess capacity needed to make price leadership observable. In Section 6 we compare the results of our analysis to those of the price-setting game with proportional rationing. Section 7 concludes with extensions of the basic model, incorporating both differences in efficiency and product heterogeneity.

2. THE MODEL

Consider a market shielded from entry, in which two firms produce a homogeneous good. Firm i has an (exogenously given) capacity k_i; we assume throughout that $k_2 \geq k_1 > 0$. Each firm may produce up to capacity at the same unit cost, which we will normalize to be zero. The aggregate demand for the output of the firms as a function of price is $d(p): R_+ \to R_+$. We make the following assumptions on demand:

(A1). There exists a $p_0 > 0$ such that $d(p) = 0$ for every $p \geq p_0$ and $d(p) > 0$ for $p < p_0$. Furthermore, $d(p)$ is twice-continuously differentiable, strictly decreasing and concave on $[0, p_0)$.[4]

Let p^m be the unique maximizer of $pd(p)$. Thus, p^m is the (unconstrained) monopoly price on $d(p)$. We assume that price is the strategic variable: i.e. firm i chooses a price $p_i \in [0, \infty)$. If firms charge different prices, customers buy from the cheapest supplier first. When the low-priced supplier cannot satisfy all demand at that price, some customers will be left for the remaining firm. How much this firm will actually sell depends upon how the output of the low-priced firm is rationed. We make the following assumption on the contingent demand of the high-priced firm: it faces the industry demand at its price less the quantity sold by the lower-priced firm. Thus, if $p_i < p_j$, firm j faces a contingent demand of

$$q(p_j) = \max(0, d(p_j) - k_i). \tag{1}$$

The rationing scheme implicit in this formulation of contingent demand, often referred to as *efficient rationing*, was first used by Levitan and Shubik (1972), and has since appeared, inter alia, in Benoit and Krishna (1987), Brock and Scheinkman (1985), Davidson and Deneckere (1990), Kreps and Scheinkman (1983), and Osborne and Pitchik (1986). As noted by Dixon (1987*a*, *b*), such a contingent demand would obtain if there were a single consumer in the market and income effects of low-priced purchases were compensated. With many consumers, each with the same demand curve, it can be obtained from an "equal shares" rationing rule in which each consumer receives an equal share of the output available when excess demand exists. Alternatively, and perhaps most naturally, it can be obtained in a model in which consumers have inelastic demand for one unit of the good, and consumers with the highest reservation prices are served by the low-priced firm, either directly or through resale of the product by consumers with low reservation prices. Given this last interpretation, it appears that our choice of rationing

4. These assumptions are borrowed from Kreps and Scheinkman (1983). We make them to facilitate the proofs. All of our results remain true if we assume that $d'(p) + pd''(p)$ is strictly negative on $(0, p_0)$; see Deneckere and Kovenock (1989*a*) for details.

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rule may be an appropriate description of the working of intermediate product or durable good markets, but may be less appropriate otherwise.[5]

Given the above rationing rule, the profit of firm i as a function of both firms' prices and capacities is given by

$$\pi_i(p_i, p_j | k_i, k_j) = \begin{cases} L_i(p_i) \equiv p_i \min(k_i, d(p_i)) & \text{if } p_i < p_j \\ T_i(p_i) \equiv p_i \min(k_i, \max(0, d(p_i) - I_i^j k_j)) & \text{if } p_i = p_j \\ H_i(p_i) \equiv p_i \min(k_i, \max(0, d(p_i) - k_j)) & \text{if } p_i > p_j \end{cases} \quad (2)$$

where I_i^j is an indicator that takes on the value 1 if i is a leader and 0 if i is a follower. Here $L_i(p_i)$ refers to the profit from being the low-priced seller at p_i, $H_i(p_i)$ the profit from being the high-priced seller at p_i, and $T_i(p_i)$ the profit to firm i when it charges $p_i = p_j$. For leader–follower games we will assume that in the event of a tie the second firm to set price sells its capacity first. We make this assumption for the purely technical reason of avoiding the need to have a follower charge a price arbitrarily close to, but below, the leader's price. In examining the simultaneous-move game we will assume that in the case of a tie, demand is allocated in proportion to capacities, so that $T_i(p_i) = p_i \min(k_i, k_i d(p_i)/(k_1 + k_2))$. However, a wide range of other allocation rules would yield the same results. The functions L_i, T_i and H_i are illustrated in Figure 1.

Let P_i^L be the set of prices that maximize $L_i(p)$ and P_i^H be the set of prices that maximize $H_i(p_i)$. By (A1) there exists a unique $p_i^L \in P_i^L$; p_i^L has the interpretation of a capacity constrained monopoly price (on the demand curve $d(p)$). Note that $L_i(p_i)$ is

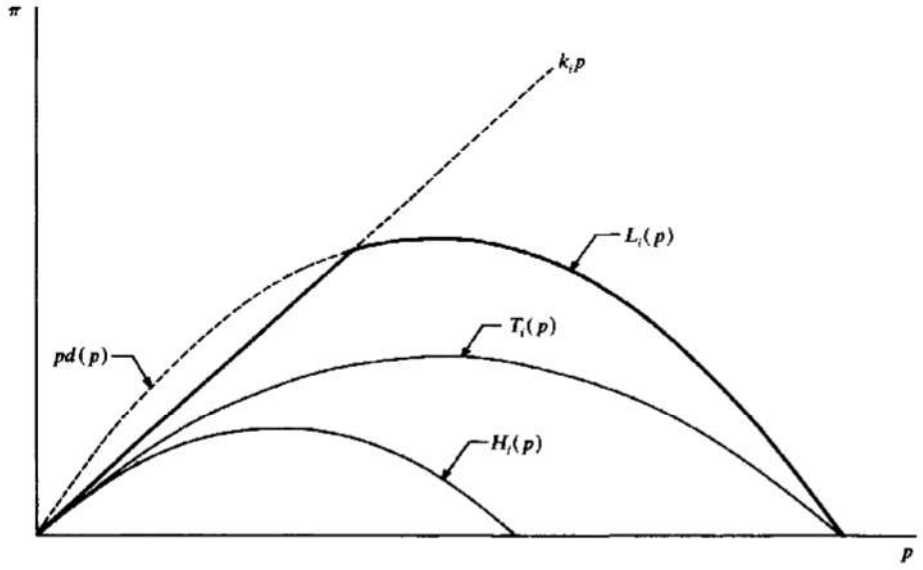

FIGURE 1

Profits to firm i when low priced (L_i), high priced (H_i) and tied (T_i) at the price p

5. Two of the examples we cited above on price leadership, the automobile and the steel industries, seem to fit this description. The two other ones, cigarettes and breakfast foods, concern consumer goods, and for them, the most popular alternative rationing rule, proportional rationing, is perhaps more appropriate. In Section 6 we argue that, while the analysis under proportional rationing is more complicated, there is nevertheless support for our finding that large firms tend to be price leaders. For a further discussion on the relative merits of these rationing schemes, see Davidson and Deneckere (1986).

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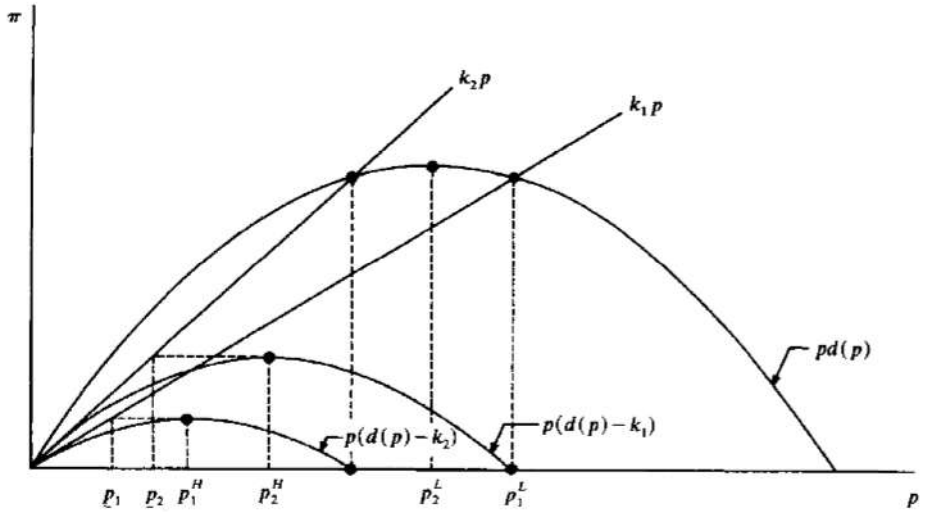

FIGURE 2
The functions H_i and L_i, with the critical prices p_i^H and $\underline{p}_i$ $(i=1,2)$

continuous and strictly increasing in p_i for $p_i < p_i^L$ (see Figure 2). Let $H_i^* = H_i(P_i^H)$. If H_i^* is non-zero, (A1) implies that there is a unique element p_i^H in P_i^H. Again, p_i^H can be interpreted as a capacity-constrained monopoly price, but this time on the residual demand curve $d(p)-k_j$. Note that $H_i(p_i)$ is continuous and strictly increasing in p_i for $p_i < p_i^H$. If $H_i^* = 0$, we define $p_i^H = 0$. Finally, let

$$\underline{p}_i = \min\{p_i : L_i(p_i) \geq H_i^*\}, \qquad i=1,2. \tag{3}$$

$\underline{p}_i$ is the unique price $(<p^m)$ at which firm i is indifferent between being the low-priced firm and being the high-priced firm at p_i^H, earning the best profit knowing that it will be undercut. Observe that $\underline{p}_i \leqq p_i^H < p_i^L$, $i=1,2$, and that $p_1^L \geqq p_2^L$.

In the analysis that follows we shall sometimes write p_i^L, p_i^H and $\underline{p}_i$ as functions of (k_1, k_2) to indicate the dependence of these prices on capacities. Also, it will sometimes be useful to refer to the inverse demand function $P(q)$, defined by: $P(q) = d^{-1}(q)$ for $0 < q \leqq d(0)$, $P(0) = p_0$, and $P(q) = 0$ for $q > d(0)$. An immediate consequence of the above definitions is that $p_i^L \geqq P(k_i)$, $i=1,2$. Also, $P(k_1+k_2) \leqq \underline{p}_i \leqq p_i^H \leqq P(k_j)$, $i=1,2$, $j \neq i$, with equality on the right-hand side if and only if $P(k_j)=0$.

3. EQUILIBRIA WITH EXOGENOUSLY SPECIFIED ROLES

The simultaneous-move price-setting game with capacity constraints has attracted much attention in the literature. It was first analyzed by Levitan and Shubik (1972) for the case of linear demand and equal capacities, and later, in more generality, by Kreps and Scheinkman (1983) and Osborne and Pitchik (1986). We may summarize these authors' results in the following theorem:

Theorem 1. *For each pair (k_1, k_2) with $k_2 \geqq k_1$, the simultaneous-move price-setting game with capacity constraints has a unique Nash equilibrium*:

(a) *If $P(k_1)=0$, the equilibrium is in pure strategies, both firms charge $p=0$ and earn zero profit.*

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(b) *If* $0 < p_2^H(k_1, k_2) = P(k_1 + k_2)$ *then the equilibrium is in pure strategies, both firms charge* $p = P(k_1 + k_2)$, *and profits are given by* $\pi_i = k_i P(k_1 + k_2)$.

(c) *If* $p_2^H(k_1, k_2) > P(k_1 + k_2)$, *the equilibrium is in non-degenerate mixed strategies with common support* $[\underline{p}_2, p_2^H]$, *where* $\underline{p}_2$ *is defined in* (3). *Equilibrium payoffs are* $\pi_i = L_i(\underline{p}_2)$.

Theorem 1 can be interpreted as follows: In case (a) both firms have enough capacity to serve the entire market, and we obtain the standard Bertrand result. Case (b) corresponds to the region below both firms' Cournot reaction functions, i.e. $k_i \leqq r_i(k_j)$ for $i = 1, 2$, and $j \neq i$. Over this region perfect competition, quantity competition and price competition all coincide, since each firm can sell at full capacity. Region (c) is the Edgeworth-cycle case, where no pure-strategy equilibrium in prices exists. Our assumptions on demand nevertheless guarantee the existence of a unique mixed-strategy equilibrium in which firms randomize over a common interval (uniqueness in payoffs is proven in Kreps and Scheinkman (1983), uniqueness in strategies is demonstrated in Osborne and Pitchik (1986)). It is easy to argue that the upper endpoint of this interval must be p_2^H, the monopoly price on the residual demand curve of the large firm. To see this, note that one of the firms must be undercut with certainty at the upper endpoint of the support,[6] so that it has to be one of the p_i^H's. If $k_1 = k_2$ then $p_1^H = p_2^H$ and we are done. So suppose $k_2 > k_1$. Observe that no firm would ever price below its $\underline{p}_i$, since setting p_i^H would yield profits of at least H_i^*, and $H_i^* = L_i(\underline{p}_i) > L_i(p)$ for $p < \underline{p}_i$. But $\underline{p}_2 > \underline{p}_1$ (see Lemma 1, below), so that by pricing at $\underline{p}_2$ the small firm can guarantee itself a profit of $L_1(\underline{p}_2) > L_1(\underline{p}_1) = H_1^*$. Hence it must be that the large firm is undercut with certainty at the upper bound. The lower endpoint of the support is found by equating firm 2's profits across the support. Since firm 2's equilibrium profits are equal to H_2^*, this yields a lower endpoint of $\underline{p}_2$.

Equilibrium in the price-setting game with an exogenously specified leader also has a simple characterization. When the capacities of the two firms are in region (a) of Theorem 1, that is, when both firms have enough capacity to serve the whole market, both leader–follower games have a continuum of equilibria, all of which give the leader zero profit. The simultaneous move equilibrium is, of course, also a leader–follower equilibrium in this case. When the capacities are in the range where both firms sell all capacity in the simultaneous-move equilibrium, i.e. part (b) of Theorem 1, the leader–follower equilibria coincide with the simultaneous-move equilibrium. Since for these ranges of capacity the leader–follower equilibria appear to have no particularly interesting implications, we will ignore them in the remainder of this section (they will become relevant again in the discussion of the two-stage game of capacity choice followed by price setting discussed in Section 5).

In the range of capacities where the simultaneous-move equilibrium is in non-degenerate mixed strategies, i.e. region (c) of Theorem 1, firms charge only two prices in equilibrium, $\underline{p}_2$ or p_2^H. Suppose k_2 strictly exceeds k_1. If firm 2 is a leader it sets p_2^H and firm 1 matches that price (and sells its capacity). If firm 1 is a leader, it sets $\underline{p}_2$ and firm 2 follows with p_2^H. In region c we have $p_2^H > \underline{p}_2$, and so firm 1 sets a strictly lower price as a leader than as a follower. Our model thus predicts that when firm 2, the large firm, is a leader it provides a price umbrella for the small firm, allowing it to undercut (or match) and sell all of its capacity. The small firm, on the other hand, acts aggressively

6. A standard argument rules out a positive probability of ties in region (c).

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as a leader, by setting a low enough price to discourage undercutting or matching by the larger firm.

In the proofs of these assertions the prices $\underline{p}_1$ and $\underline{p}_2$, defined in (3), play an important role. When firm j is a price leader it must charge a price less than or equal to $\underline{p}_i$ to induce firm i to set a higher price as a follower. For prices above $\underline{p}_i$, firm i would prefer to match (or undercut if $p_j > p_i^L$) and, as follower, sell all its capacity.[7] We first provide a lemma ordering $\underline{p}_1$ and $\underline{p}_2$; the proof is relegated to the Appendix.

Lemma 1. *For each pair (k_1, k_2) with $k_2 > k_1$, $\underline{p}_2 \geqq \underline{p}_1$ with equality if and only if there is a pure-strategy equilibrium in the simultaneous-move game.*

Consider now the game where firm 2, the large firm, is an exogenously determined price leader, and suppose that firm 2 sets a price $p_2 \leqq \underline{p}_1$. In response, firm 1 prefers to set its best price given that it is going to be undercut, p_1^H, to undercutting or matching p_2. On the other hand, for $p_2 > \underline{p}_1$, firm 1 prefers to undercut firm 2's price rather than set p_1^H. Therefore, as a leader, firm 2 must decide which it likes best: it can set $\underline{p}_1$ and be the low-priced firm, or it can set its preferred price given that it is going to be undercut, p_2^H. Since $\underline{p}_1 < \underline{p}_2$ (by Lemma 1), and since $L_2(p)$ is increasing over the relevant interval, $L_2(\underline{p}_1) < L_2(\underline{p}_2) = H_2^*$. Thus, firm 2 will set p_2^H. Firm 1 will match this price and, by virtue of the sharing rule specified in the event of a tie, sell all of its capacity first.

In the other leader-follower game, firm 1 faces a similar choice as leader. It can price at $\underline{p}_2$ and be the low priced firm, or price at p_1^H, its best price when undercut. Since $L_1(\underline{p}_2) > L_1(\underline{p}_1) = H_1^*$, firm 1 prefers the former strategy. Firm 2 follows with p_2^H. We summarize these arguments in Theorems 2 and 3.

Theorem 2. *For each pair (k_1, k_2) with $k_2 \geqq k_1$, the price-setting game with capacity constraints and firm 2 as a price leader has the following equilibria:*

(a) *If $P(k_1) = 0$ there is a continuum of equilibria. The set of (pure-strategy) equilibrium prices is given by: $\{(p_1, p_2): p^m \geqq p_2 \geqq 0, p_1 = p_2\} \cup \{(p_1, p_2): p_2 > p^m, p_1 = p^m\} \cup \{(p_1, p_2): p_2 = 0\}$. Furthermore, equilibrium profits for firm 2, π_2, equal zero and equilibrium profits for firm 1, π_1, depend on the particular equilibrium chosen.*[8]

(b) *If $0 < p_2^H(k_1, k_2) = P(k_1 + k_2)$ then both firms set $p = P(k_1 + k_2)$ and profits are given by $\pi_i = k_i P(k_1 + k_2)$, $i = 1, 2$.*

(c) *If $p_2^H(k_1, k_2) > P(k_1 + k_2)$ then $p_2 = p_2^H$, $p_1 = p_2$, $\pi_2 = H_2(p_2^H)$ and $\pi_1 = L_1(p_2^H)$. When, in addition, $k_1 = k_2 = k$, there is another equilibrium (and thus a continuum of mixed-strategy equilibria for firm 2) in which $p_2 = \underline{p}_2$, $p_1 = p_2^H$, and $\pi_1 = \pi_2 = H_2^*$.*

When the small firm is exogenously specified as a leader, we obtain:

Theorem 3. *For each pair (k_1, k_2) with $k_2 \geqq k_1$ the price-setting game with capacity constraints and firm 1 as a price leader has the following equilibria:*

(a) *If $P(k_1) = 0$ there is a continuum of equilibria. The set of (pure-strategy) equilibrium prices is given by: $\{(p_1, p_2): p^m \geqq p_1 \geqq 0, p_2 = p_1\} \cup \{(p_1, p_2): p_1 > p^m, p_2 = p^m\} \cup \{(p_1, p_2): p_1 = 0\}$. In equilibrium, $\pi_1 = 0$ and π_2 depends on the particular equilibrium chosen.*

7. When firm j leads and sets $p_j = \underline{p}_i$, firm i, as follower, is indifferent between setting $\underline{p}_i$ and p_i^H. We assume in this case that (when $p_i^H > \underline{p}_i$) firm i sets p_i^H. This seems reasonable since firm i is indifferent only because of our technical assumption that it need only match price as the follower in order to sell its capacity.

8. Whenever the leader has more than one equilibrium strategy it also has a continuum of mixed equilibrium strategies.

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(b) *If* $0 < p_2^H(k_1, k_2) = P(k_1 + k_2)$ *then both firms set* $p = P(k_1 + k_2)$ *and profits are given by* $\pi_i = k_i P(k_1 + k_2)$, $i = 1, 2$.

(c) *If* $p_2^H(k_1, k_2) > P(k_1 + k_2)$ *then* $p_1 = \underline{p}_2$, $p_2 = p_2^H$, $\pi_1 = L_1(\underline{p}_2)$ *and* $\pi_2 = H_2(p_2^H)$. *When, in addition,* $k_1 = k_2 = k$ *there is another equilibrium (and thus a continuum of mixed-strategy equilibria for firm* 1*) in which* $p_1 = p_1^H$, $p_2 = p_1$, $\pi_1 = H_1(p_1^H)$ *and* $\pi_2 = L_2(p_1^H)$.

These results allow us to compare the returns of the two firms in the simultaneous-move game and the two leader-follower games. Let π_i^S be the payoff to firm i in the simultaneous-move game, π_i^L the payoff to i as a leader, and π_i^F the payoff to i as a follower. Again, taking capacities to be in the range where the simultaneous-move game has an equilibrium in non-degenerate mixed strategies,[9] and when $k_2 > k_1$,

$$\pi_2^S = \pi_2^L = \pi_2^F$$

whereas,

$$\pi_1^S = \pi_1^L < \pi_1^F.$$

The strict inequality follows because $L_1(p)$ is strictly increasing on $[0, p_1^L)$, and $p_1^L \geqq p_2^L > p_2^H > \underline{p}_2$. We conclude that firm 2 is indifferent as to which game it plays, while firm 1 is indifferent between being a leader and moving simultaneously, but strictly prefers to be a follower.[10]

It seems reasonable to conclude from this result that the large firm will become a leader in a model where leadership is endogenized. The standard approach to this problem in the literature to date has been what we call the "choice of roles" approach. Under this approach, at some initial stage, players are assumed to somehow communicate the roles that they would prefer to take. Inconsistent choices (such as leader-leader or follower-follower) are then assumed to lead to the simultaneous-move equilibrium. We find this approach unappealing. First, it appears to require a degree of communication and coordination in the specification of institutions that seems inconsistent with non-cooperative behaviour: a "role" is not usually considered to be an element of one's strategy space. Second, the behaviour following inconsistent choices of roles is *ad hoc*. It is not at all clear to us, for instance, that the struggle for leadership (leader-leader) should result in a simultaneous-move equilibrium. These objections to the choice of roles approach motivate our focus on games of timing of price announcement.

4. GAME FORMS GENERATING AN ENDOGENOUS LEADER

Suppose $k_2 > k_1$ and capacities lie in the range where the simultaneous-move game has an equilibrium in non-degenerate mixed strategies. We now examine several games of timing that yield firm 2 as an endogenous price leader. The first game is chosen for its

9. When capacities are in the range where both firms sell all of their capacity in the simultaneous-move equilibrium it is easily seen that all three games yield the same payoffs to each firm. When $P(k_1) = 0$, then $0 = \pi_i^L = \pi_i^S$, $i = 1, 2$, but π_i^F depends upon the particular equilibrium played. There are equilibria in which this payoff is 0, but in other equilibria it is positive.

10. Anderson (1987), Boyer and Moreaux (1987), Dowrick (1986), Gal-Or (1985), and Ono (1978, 1982) analyze the incentives to be a leader or follower in contexts different from ours. Anderson analyzes the incentive to be a price leader or follower in a Hotelling-type model with endogenous choice of location. Boyer and Moreaux investigate the choice of being a leader or follower in a game where the strategy space is price-quantity pairs. Dowrick and Gal-Or examine the role of the slopes of the firms' best-response functions (in price or quantity space) in determining the desire to lead or follow. Ono examines the incentives to be a leader or follower in a model in which the leader sets price and the follower decides how much to produce at that price.

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simplicity. Let the time period under consideration be the unit interval $[0, 1]$. Divide this interval up into T ($T \geqq 4$, even) periods each of length $\tau = 1/T$, labelled $t = 0, \ldots, T-1$. Assume that firm 1 may announce price at the beginning of intervals having an even index and that firm 2 may do so at the beginning of intervals having an odd index. Suppose also that until *both* firms announce prices, *both* firms earn zero profits, but that the demand remains $d(p)$ independently of the point at which prices are announced.[11] Thus, the profits given in equation (2) remain the relevant profit expressions once both prices are announced. Firms discount this profit at the rate r; we let $\delta = e^{-r\tau}$. To solve for the subgame-perfect equilibrium of the game, suppose that firm 2 is faced with a situation in period t, $t = 1, 3, \ldots, T-3$, where neither firm has set a price. Then it must weigh the return $\delta^{t+1}\pi_2^L$, if it sets a leader price at that time, with either $\delta^{t+j-1}\pi_2^L$ if it is a leader in $t+j$ or $\delta^{t+j}\pi_2^F$ if it is a follower in $t+j$, where $j \geqq 2$. Since $\pi_2^L = \pi_2^F$, firm 2 will move at t. Thus, firm 2 always sets the leader price at the first opportunity. Suppose firm 1 at time t, $t = 0, \ldots, T-4$ is faced with a situation in which neither firm has set a price. It knows that firm 2 will set the leader price in the next period if it does not move first so it must compare the return to leading, $\delta^{t+1}\pi_1^L$, with the return to following at $t+2$, $\delta^{t+2}\pi_1^F$. If $\pi_1^L < \delta\pi_1^F$ firm 1 will wait and follow. Thus, if $\pi_1^L/\pi_1^F < \delta$ firm 1 will not set price in period 0 and firm 2 will set its leader price in period 1. As τ approaches zero the firms will play a game in which firm 2 is a price leader with a delay that converges to zero. If instead firm 2 has the first move in this game it will announce its leader price immediately and no lag occurs. Thus, no matter what the sequencing of moves, as the period between moves becomes shorter we obtain a leader-follower equilibrium with firm 2 as a price leader.

Although the above does not address the question of when, if ever, simultaneous-move games will be played,[12] it illustrates the tendency of endogenous timing to force firm 2 to become a price leader.[13] However, some of its simplifying assumptions may seem unappealing: price is set only once and remains valid until a fixed point in time (rather than for a fixed length of time), and profits do not accrue until both firms have made their price announcements. We now present a more realistic model, which dispenses with these restrictions, but at the same time retains the intuitive structure of the leader-follower equilibria exhibited above. The model is a variant of the alternating move price-setting models studied by Maskin and Tirole (1988). Unlike Maskin and Tirole, however, we allow the time between successive (potential) price-setting periods to be much shorter than the length of time for which the price is committed.

11. We can easily substitute a flow demand and obtain the same qualitative results.

12. Adding the possibility of simultaneous moves leads to complications not arising in the seemingly similar discrete- or continuous-time war-of-attrition. In the war-of-attrition a player chooses an exit time (or a probability distribution over exit times) and the payoffs of both players depend only on which player exits first and at what time. Importantly, a player who "outlasts" her opponent need take no action upon her opponent's exit. In contrast, in the game of timing in price announcements each player has a non-trivial price choice as well as a timing decision. If the players discount time, and if firm 2 were to set a leader price at some time t, firm 1 would want to set the follower price at t as well, rather than waiting until $t+1$. But then, firm 2 would not be playing a best response to firm 1's strategy, and the equilibrium would be disrupted. See Deneckere and Kovenock (1988), for a game of timing in price announcements in which players move at discrete points in time, simultaneous moves are possible, and price leadership arises. In a somewhat different context, Kovenock, Widdows, and Dworkin (1988) provide a continuous-time model exhibiting leader-follower equilibria.

13. If $k_2 = k_1$, and capacities lie in the range where the simultaneous-move game has an equilibrium in non-degenerate mixed strategies, there is a continuum of subgame-perfect equilibria in the game of timing. The leader's price will be either p or p^M although, as long as δ is large enough, the firm that has the first opportunity to move need not become the price leader, and prices may be set with some delay (the upper bound to which depends upon δ).

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More specifically, suppose that the time-horizon is infinite, and that the time line is divided into discrete periods of length τ, labelled $t = 0, \tau, 2\tau, \ldots$. As before, we assume that firm 1 may announce price at the beginning of time intervals indexed by even multiples of τ, and that firm 2 may announce price at the beginning of time intervals indexed by odd multiples of τ. Unlike in the previous model, however, a firm's price, once announced, remains valid for a fixed time-period of length N (chosen so that N/τ is a natural number). Also, once a firm has set a price, its sales start to occur immediately, regardless of whether its opponent has set a price or not. We assume that the demand curve represents a flow demand per unit of time, and that profits are discounted continuously at the rate r. Thus, if firm i has set a price but firm j has not, then i obtains $L_i(p_i)$ per unit of time until j makes his announcement. In the meantime, firm j makes zero profits.

While a general analysis of this game is quite complicated, and beyond the scope of this article, it is easy to show that it has a *unique* Markov perfect equilibrium, provided that the time τ between successive periods is sufficiently short and that the time length N for which a price is committed is sufficiently long. As in the previous game, in equilibrium, the small firm when it is its turn to move and the large firm has not committed yet, gives up its move in the expectation that the large firm will commit to a price p^* next period. Since the large firm knows this price will be matched, we may calculate p^* as:

$$\arg\max_p \{(1-\delta)L_2(p) + \delta(1-\delta^{(N/\tau)-1})H_2(p)\}.$$

Thus, the steady-state price p^* converges to p_2^H as $\tau \to 0$ and $N \to \infty$.

5. PRICE LEADERSHIP AND ENDOGENOUS CAPACITY CHOICE

Price leadership is not always observed in markets. In the context of our model, price leadership can be indistinguishable from simultaneous-move price-setting when capacities are in the range where the latter game has a pure-strategy equilibrium. This raises the question of whether, and when, one is likely to observe capacities in the range where price leadership occurs. Indeed, in the two-stage game of simultaneous capacity choice followed by a stage of endogenous timing in price announcements it is often, but not always, the case that capacities are chosen at the Cournot level.

Figure 3 illustrates the exceptions that may arise. Suppose that the cost of capacity functions $c_i(k_i)$ are twice-differentiable, non-decreasing and convex, so that there is a unique Cournot equilibrium (k_1^c, k_2^c). If this equilibrium lies in region III, then the two-stage game results in the Cournot outcome. Indeed, any deviation by firm i would earn $H_i^*(k_i, k_j^c) - c_i(k_i)$, which is maximized at k_i^c. In contrast, if (k_1^c, k_2^c) lies in region I or II the small firm, by deviating to a capacity above $(r_j)^{-1}(k_j^c)$ and below k_j^c, would earn $L_i(p_j^H(k_i, k_j^c)) - c_i(k_i) > H_i^*(k_i, k_j^c) - c_i(k_i)$ so that a deviation might be profitable.[14] In fact, if the Cournot equilibrium lies on r_j, firm i always has a strict incentive to increase capacity above the Cournot level: with endogenous leadership firm i can anticipate a reduction in firm j's quantity in response to a marginal increase of i's capacity, whereas under Cournot firm j's quantity would remain fixed.[15] More generally, for any given parametrization of the cost of capacity functions, regions I and II can be partitioned into

14. Since $L_i(p_j^H(k_i, k_j^c)) > H_i^*(k_i^c, k_j^c)$, such a decision will be profitable if the resulting increase in capacity cost, $c_i(k_i) - c_i(k_i^c)$, is not too large.

15. More precisely, with endogenous leadership, $\pi_i = P(k_i + r_j(k_i))k_i - c_i(k_i)$ for $k_i \in ((r_j)^{-1}(k_j^c), k_j^c)$, so that $d\pi_i/dk_i = \{P + k_i P' - c_i'\} + k_i(r_j)'P'$ for $dk_i > 0$. But now observe that since firm i is on its Cournot best-response function, the expression in parentheses is zero.

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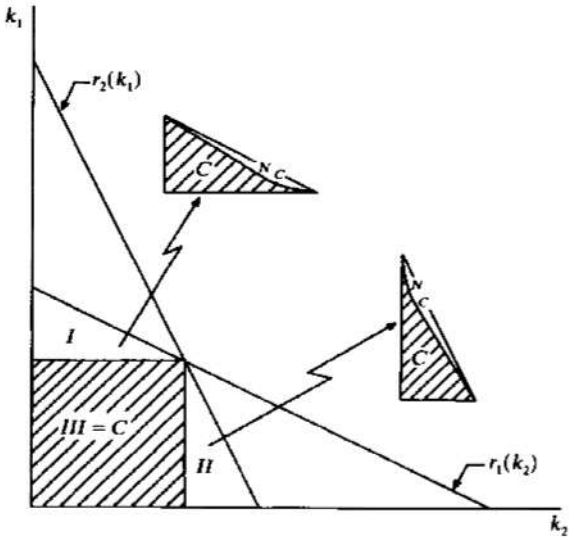

FIGURE 3

Division of the area below the zero-cost-of-capacity reaction functions where Cournot does (C) and does not (NC) obtain as the equilibrium of the two-stage game (as a function of the constant unit costs of capacity, and illustrated for the case of linear demand)

sets where Cournot does and does not obtain; Figure 3 illustrates this for the case of linear demand and constant unit costs of capacity.

Since for a wide range of capacity costs (including symmetric ones) endogenous capacity-setting results in the Cournot outcome, one might ask whether our model of price leadership has any relevance. It is actually quite straightforward to perturb the standard two-stage game of simultaneous capacity choice followed by price-setting in order to obtain empirically plausible models of when leadership is likely to arise. For instance, case studies indicate that in industries where sunk costs like investment in capacity are important, price leadership often occurs after periods of intense price competition due to economic downturns (see Oxenfeldt (1951, p. 296), and Burns (1936, pp. 76–145)). In such situations, we would expect capacities to be high relative to actual demand, i.e. in the range where the simultaneous-move game would yield a non-degenerate mixed-strategy equilibrium. It is easy to alter our model so as to capture the notion that price leadership occurs after negative demand shocks that are not perfectly anticipated. One way to do this would be to assume that firms simultaneously choose capacities at a stage in which demand is uncertain but has a distribution which is common knowledge (for example, the intercept of a linear demand is unknown), and that all uncertainty is resolved before prices are set. If capacity is not too costly, and if the distribution of the relevant parameters of demand is sufficiently diffuse, there will be some realizations of demand for which capacities lie in the range where the simultaneous move game has a non-degenerate mixed-strategy equilibrium. This will generate an endogenous price leader as long as firms do not select identical capacities.[16] Empirically, market asymmetries seem to be the rule rather than the exception; they can be generated in our model in a

16. Even if firms select identical capacities, ex-post differences in other variables such as brand loyalty may generate endogenous leadership. See Section 7 for an example along these lines.

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multitude of ways. Suppose, for instance, that firms do not have equal access to technology (because of patents or imperfect imitation) or differ in their ability to raise capital (for moral hazard reasons). The resulting divergence in the cost of capital would then lead firms to invest at different levels. Furthermore, if demand shocks are autocorrelated, leadership would tend to persist during downturns.

The above "business cycle" justification for the excess capacity needed to generate leadership is just one of many that could be given. For another example, consider a model of (simultaneous) market entry in which firms have heterogeneous expectations about demand, arising from differences in their private signals. One would then expect the conditions for leadership to arise as long as the forecast of at least one of the firms is sufficiently optimistic relative to the actual realization of demand (and the cost of capacity is not prohibitive). In contrast to the model outlined above, leadership would then tend to erode over time, at a rate which depends on the degree of capital depreciation and the extent to which capital is lumpy. Similar empirical implications would be generated by a model of sequential entry, where the asymmetry is temporal rather than informational.

6. PRICE LEADERSHIP WITH PROPORTIONAL RATIONING

This paper has examined price leader equilibria under the assumption of efficient rationing, equation (1). An alternative rationing scheme that has received some attention in recent literature (Allen and Hellwig (1986), Beckman (1965), Davidson and Deneckere (1986)) is the following:

$$q(p_j|p_i) = \max\left\{0,\, d(p_j)\left[1-\frac{k_i}{d(p_i)}\right]\right\}. \tag{4}$$

Such a contingent demand would arise if a subset of (identical) consumers are sold as much as they want (when excess demand exists at the low price, p_i). The high-priced firm will not obtain any residual demand from these consumers, but will attract the fraction of demand, $(1-k_i/d(p_i))$, that remains unserved. For this reason, the scheme in (4) is often referred to as proportional rationing.

The determination of price leader equilibria under proportional rationing requires a different, more complicated analysis than used so far. The complication arises largely from the fact that the high-priced firm now cares about which price it is undercut by, with higher prices leaving a less favourable residual demand. For example, while it is still possible to uniquely determine the upper bound of the support of the equilibrium distributions in the simultaneous-move price game (it is equal to p''', in the range where there are non-degenerate mixed-strategy solutions), this no longer pins down the equilibrium profits of the two firms. Instead, one needs to solve a complicated fixed-point problem. Similar difficulties arise in comparing the outcomes of different leader–follower games.

In Deneckere and Kovenock (1989*b*), we provide a complete ranking of preferences for the case of linear demand. We still find that the small firm—as a leader—prices aggressively, i.e. charges a price that will not be undercut. However, unlike the case of efficient rationing, the large firm—as a leader—does not always choose to form a price umbrella under which the small firm can live. This eliminates the small firm's advantage from following. The reason the large firm may price aggressively is that under proportional rationing a more favourable residual demand is left for the high-priced firm. Thus, a price leader need not set as low a price to deter undercutting as is required under efficient

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rationing. If the follower's capacity is not too low, this is sufficient to induce the large firm to set a price as leader which is low enough not to be undercut. If, on the other hand, the follower is sufficiently small relative to the leader, the latter will again set a passive price.

The preferences over leader-follower roles then fall into three general categories,[17] as illustrated in Figure 4. In the range of capacities where the simultaneous-move game with proportional rationing has a pure-strategy equilibrium,[18] or when capacities are equal, firms are indifferent with respect to the sequencing of moves. When capacities are in the range where the simultaneous-move game has an equilibrium in non-degenerate mixed strategies, and where capacities are not too different, both firms act aggressively as leader. Since the small firm does not need to set as low a price to deter undercutting, both players prefer that it lead. For more asymmetric capacities, the large firm is a passive leader, so that its smaller rival prefers to follow. The large firm also prefers to follow, since it is only slightly undercut when it leads, but undercut by a sizeable margin when it follows. However, in this range the proportional increase in profits (π^F/π^L) derived from following is greater for the firm with the low capacity than for the firm with the high capacity, so that there is an intermediate range of discount factors for which the large firm becomes an endogenous leader. We conclude that the results under proportional rationing, while conflicting with those under efficient rationing when firms are close in size, nevertheless lend support to the theory that firms which are considerably larger than their rivals become price leaders.

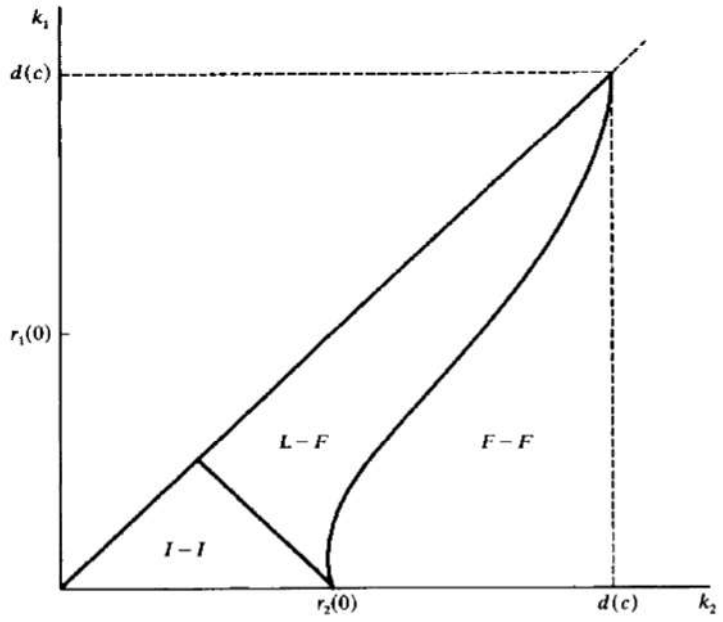

FIGURE 4

Preferences over leader-follower roles when demand is rationed proportionately, with the first index referring to the preferences of firm 1 (illustrated for linear demand)

17. In the discussion which follows, we exclude from consideration the region where $k_1, k_2 \geq d(0)$, when, as before (see case (a) of Theorems 2 and 3), there are multiple equilibria.

18. This range of capacities is smaller than for the efficient rationing rule and consists of all pairs (k_1, k_2) for which $P(k_1 + k_2) > p^m$.

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7. EXTENSIONS AND CONCLUSIONS

The model presented in this paper yields the sharp prediction that when capacities are in the range where the simultaneous-move price-setting game has a non-degenerate mixed-strategy equilibrium, the large firm becomes a price leader. Our model emphasized size as the major determinant of leadership, at the expense of other factors that have received some attention in the empirical literature, such as differences in cost or brand loyalty. Our predictions also differ from the traditional treatment of dominant-firm price leadership, and somewhat less substantially from observed behaviour, in that less of an asymmetry in capacity seems to be needed in order to generate a price leader. We will now present extensions of the basic model that resolve some of these shortcomings.

One extension incorporates differences in unit costs of production up to capacity, denoted by c_i $(i=1,2)$. Without loss of generality, we may assume that $c_2 > c_1$. The equilibrium of the simultaneous-move version of this game has been completely characterized by Deneckere and Kovenock (1989*a*), under demand conditions slightly more general than the ones entertained here. The characterization of the equilibria of the leader–follower games is analogous to the analysis of Section 3, and is illustrated in Figure 5. As in the case where $c_1 = c_2$, there are three regions of capacity with qualitatively distinct simultaneous-move equilibria. When capacities lie in the region below the two Cournot best-response functions, both leader–follower games and the simultaneous-move game yield a pure-strategy equilibrium with $p_1 = p_2 = P(k_1 + k_2)$. When capacities are in the north-east (shaded) region of the quadrant, the high-cost firm is driven out of the market in all three games. In the remaining region, the simultaneous-move game yields a unique equilibrium in non-degenerate mixed strategies. As in the case of identical unit costs, only this region yields interesting conclusions regarding the endogeneity of leadership.

The crucial determinant of the nature of the leader–follower equilibria over this range is the relationship between $\underline{p}_1$ and $\underline{p}_2$ defined in (3) (where c_i now enters into the

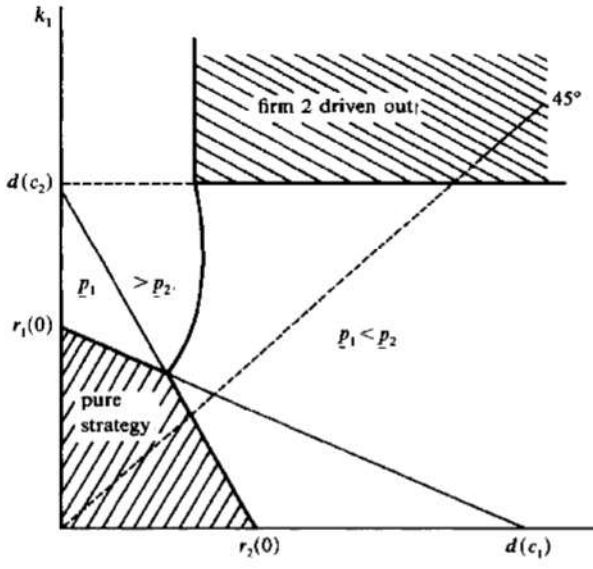

FIGURE 5

The ranking of $\underline{p}_1$ and $\underline{p}_2$ when unit costs of production differ $(c_1 < c_2)$

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definitions of L_i and H_i). As illustrated in Figure 5, and proved in Deneckere and Kovenock (1989*a*), there exists a continuous function $k_2 = \theta(k_1)$ partitioning the region into areas where $\underline{p}_1 > \underline{p}_2$ and $\underline{p}_2 > \underline{p}_1$. When firm i leads, it sets a price high enough to induce firm j to undercut or match if $\underline{p}_i > \underline{p}_j$. If $\underline{p}_i < \underline{p}_j$, firm i sets a price which deters firm j from undercutting or matching. As before, timing considerations then indicate that the firm which acts passively as an exogenously determined leader becomes an endogenous price leader. It can be seen from Figure 5, that when the high-cost firm (firm 2) has a larger capacity than firm 1, it is always the case that $\underline{p}_2 > \underline{p}_1$. The high-cost firm then becomes an endogenous leader. If $k_2 < k_1$, the ranking of $\underline{p}_1$ and $\underline{p}_2$ depends upon the particular capacity levels. If k_2 is not too small (i.e. $k_2 > \theta(k_1)$), $\underline{p}_2$ still exceeds $\underline{p}_1$, and the high-cost firm remains a price leader. However, if k_2 is sufficiently small, the low-cost firm becomes a price leader. We thus find that high costs promote price leadership (for some evidence on this, see Burns (1936, p. 88)), and that when firms have unit costs negatively related to capacities, size may no longer be the prime determinant of leadership.

Our analysis of the model with different unit costs of production up to capacity relates directly to Gelman and Salop's (1983) model of "judo economics". In this paper, which deals with the incentive of a cost-disadvantaged entrant to keep its scale of operation small, the cost-advantaged incumbent is assumed to have enough capacity to serve the entire market. The entrant first decides upon a scale of operation, and a price to charge. The incumbent then follows with its choice of price. Thus, the entrant is a price leader.[19] Gelman and Salop do not provide an explicit solution for the entrant's optimal capacity choice (even for the simple case of linear demand, this turns out to be quite involved). However, they do show that it is optimal to choose a capacity-price pair which will deter the incumbent from undercutting or matching, and which gives the entrant positive profit. In our notation, with firm 1 denoting the incumbent, this requires that $\underline{p}_1 > \underline{p}_2 = c_2 > c_1$.

Contrary to Gelman and Salop's assumption that the inefficient entrant is an (exogenously determined) price leader, our analysis above indicates that at the entrant's optimal capacity, the incumbent would become an endogenous leader. Moreover, if we take endogenous timing into consideration, the entrant's optimal capacity is generally greater than in Gelman–Salop.[20]

A second extension of our model would allow products to be imperfectly substitutable. Such an extension is undertaken in Furth and Kovenock (1990), using linear demand with symmetric product differentiation, and an analogue to the efficient rationing scheme employed here. While the analysis is quite complicated, the results support the basic insights of the present paper. Furth and Kovenock show that in the region of capacity space where the simultaneous-move price-setting game has a non-degenerate mixed-strategy equilibrium, except for neighbourhoods of the diagonal and the analogue to region (a) of Theorem 1, the leader–follower equilibria have properties similar to those found here. First, the large firm is indifferent to the role it takes, whereas the small firm strictly prefers to follow. This conclusion should be contrasted to the case of differentiated

19. In contrast, in a model with both horizontal differentiation and a masspoint of "switchers", Ireland (1988) assumes that the low-cost firm is a price leader.

20. The entrant's optimal capacity choice under endogenous timing takes on a very simple form. Maintaining the assumption that the incumbent can serve the entire market, the optimal scale of entry will be that of a Stackelberg quantity leader, as long as this capacity level is low enough to keep $\underline{p}_1 \geq \underline{p}_2$. If the Stackelberg quantity for the given unit costs exceeds the critical level which equates $\underline{p}_1$ and $\underline{p}_2$, then the entrant will choose a capacity equal to this critical level. For instance, if demand is given by $d(p) = \max(0, 1-p)$, the Stackelberg level arises for $c_1 \leq c_2 < (1+9c_1)/10$, i.e. $k_2 = (1+c_1-2c_2)/2$. For $(1+9c_1)/10 \leq c_2 \leq (1+c_1)/2$ capacity is set to equate $\underline{p}_1$ and $\underline{p}_2$, i.e. $k_2 = 1-c_1-2[(c_2-c_1)(1-c_2)]^{1/2}$. (When $c_2 > (1+c_1)/2$ the small firm will always be underpriced.) Thus, if the cost disadvantage is not too large, the endogenous price-leadership game generates Stackelberg quantity leadership by the entrant.

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products without capacity constraints, where both firms would prefer to follow (see Dowrick (1986)). In addition, Furth and Kovenock find that the small firm is capacity-constrained in each of the leader–follower games. However, in contrast to the homogeneous-goods case, there is now a band of capacity pairs around the diagonal where there is disagreement over roles. Thus, when products are differentiated, endogenous leadership requires some degree of asymmetry.

Of course, differences in size or cost structure no longer remain the sole determinants of leadership once asymmetries in product differentiation are allowed. Even under identical cost conditions, advantages in quality (Anderson and Kovenock (1989)), and brand loyalty (Deneckere, Kovenock and Lee (1991)) yield strong incentives for leadership. One would expect these incentives to remain present and interact with the incentives generated by size and cost asymmetries.

Such interaction effects can perhaps best be illustrated by a generalization of the capacity-constrained homogeneous-product model with efficient rationing that allows for the presence of loyal customer segments. Suppose, for instance, that there are three distinct customer segments. In addition to the usual segment $d(p)$ of price-sensitive consumers (who view the firms' products as perfect substitutes), there are two segments $\lambda_1 d(p)$ and $\lambda_2 d(p)$ of consumers that are captive to firm 1 and firm 2, respectively. Thus, the loyal-customer segments generate demand curves that are scalar multiples of the demand curve for the price-sensitive segment. Suppose also that when setting its price a firm cannot distinguish or discriminate between its loyal-customer base and the switching-prone segment. Efficient rationing in this context means that when $p_i < p_j$ and $k_i < (1+\lambda_i)d(p_i)$, the capacity k_i is allocated to those customers who have the highest reservation values among both the loyal and the price-sensitive segment. More precisely, firm i serves all consumers with reservation values above p^c, where p^c solves $k_i = (1+\lambda_i)d(p^c)$.

Several interesting features differentiate this model from the standard model with perfect substitutes (where $\lambda_1 = \lambda_2 = 0$). First, in determining the best price given that it is undercut, a firm now faces the non-trivial decision whether to ignore the price-sensitive segment of the market altogether and focus entirely on its loyal-customer segment, or whether to set a lower price in order to attract the price-sensitive consumers who are rationed by the unavailability of the competitor's good. Depending on the degree to which the price-sensitive customers are rationed, and depending on the size of its loyal-customer segment, either of these two strategies may yield a global optimum of H_i to firm i. Another interesting feature absent in the standard model is that it is no longer generally true that profit is continuous in own price when both firms set a price which clears aggregate capacity from the market.[21] Since increasing a firm's price above its competitor's level may decrease its residual demand discontinuously, firms will have less of an incentive to deviate from price-matching at or slightly below the capacity-clearing price.

These same features make the analysis of both the simultaneous-move and the leader–follower equilibria somewhat different. The discontinuity in residual demand now creates an extra opportunity for mis-coordination: for capacities at or near the Cournot

21. Indeed, suppose $p_1 = p_2 = \hat{p}$, where $(1+\lambda_1+\lambda_2)d(\hat{p}) = k_1 + k_2$, and suppose each firm's capacity exceeds the demand from its loyal segment (i.e. $\lambda_i d(\hat{p}) < k_i$, for $i = 1, 2$). If one of the firms, say firm 2, raises its price above $\hat{p}$, its profits drop discontinuously. The reason for this is that all of the price-sensitive consumers now prefer to buy from firm 1. This extra demand crowds out some of firm 1's loyal customers who had obtained the good when prices were identical. Prior to the price increase, $\lambda_1 d(\hat{p})$ loyal customers were able to purchase from firm 1; following the price increase only $\lambda_1 d(p^*)$ of these customers find their demands satisfied, where p^* is the solution to $k_1 = (1+\lambda_1)d(p^*)$.

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level, there exist both a continuum of price-matching simultaneous-move equilibria involving prices less than or equal to the capacity clearing price $\hat{p}$ and a mixed-strategy price-setting equilibrium that involves lower profits. This produces leader–follower equilibria which involve price-matching at the capacity-clearing price, in a region of capacity space where we otherwise would predict price leadership and excess capacity. Nevertheless, it is easy to demonstrate that when capacities are not too small relative to demand (so that price-matching equilibria are not present), endogenous price leadership again obtains. Importantly, with asymmetric loyal segments ($\lambda_1 \neq \lambda_2$) endogenous leadership may arise even if capacities are identical, or large enough to allow each firm to serve the entire market.[22] Furthermore, an asymmetry in the size of the loyal-customer segments may dominate an asymmetry in capacities as a determinant of leadership. Finally, and somewhat surprisingly, the existence of large loyal segments, even if identical, may reverse the effect of a large capacity in the determination of an endogenous leader. This reversal arises because with a large loyal segment, a small firm may find it optimal to disregard the switching-prone segment when it is high-priced. A small firm may then, comparatively-speaking, fear less from being undercut, and hence may act passively as a leader, thereby reversing the preferences over leadership roles. When the loyal segments are not too large, however, big firms still have a tendency to lead.

While this model provides only one of the many possible eclectic approaches, it is evident that the endogenous timing framework proposed in this paper provides a useful tool for examining the existence and nature of price leadership.

APPENDIX

Proof of Lemma 1. If there is a pure-strategy equilibrium in the simultaneous-move game, it is clear that $\underline{p}_2 = p_2^H = P(k_1 + k_2) = p_1^H = \underline{p}_1$. Assume, then, that no pure-strategy equilibrium exists in the simultaneous-move game, and thus $P(k_1) > 0$. We first demonstrate that this implies that $\underline{p}_1 < P(k_1)$.

Suppose not. Then $\underline{p}_1 \geq P(k_1)$, implying $\underline{p}_1 > P(k_2)$. The strict inequality follows from the fact that, from our assumption on the equilibrium of the simultaneous-move game, $P(k_1) > 0$. With $\underline{p}_1 > P(k_2)$, $H_1(\underline{p}_1) = 0$, since firm 2 is not capacity constrained at $\underline{p}_1$. Since $\underline{p}_1 \leq p_1^H$, this implies that $\underline{p}_1 = 0$, a contradiction to the fact that $P(k_1) > 0$. Thus, $\underline{p}_1 < P(k_1)$.

The remainder of the proof is divided into two cases, depending on the relationship between $\underline{p}_2$ and $P(k_2)$.

(i) Suppose $\underline{p}_2 < P(k_2)$. Thus, if firm 2 is the low-price firm at $\underline{p}_2$ it is capacity constrained. With $\underline{p}_i < P(k_i)$, $i = 1, 2$, by definition of $\underline{p}_i$,

$$\underline{p}_i k_i = \max_p p \min(k_i, \max(0, d(p) - k_j)) \equiv H_i^*, \qquad i = 1, 2,\ j \neq i. \tag{A.1}$$

Define $r(k) \equiv \operatorname{argmax}_x xP(x + k)$. That is, $r(k)$ is the Cournot best-response function when the rival firm puts output k on the market and firms have zero cost of production. We divide the analysis of this case into two sub-cases, depending upon the relationship of k_1 to $r(k_2)$. Suppose, first, that $k_1 > r(k_2)$. Then $P(k_1 + k_2) < P(k_2 + r(k_2))$, which implies that the price that satisfies the right-hand side of (A.1) for $i = 1$ solves $\max_p p \max(0, d(p) - k_2)$. Thus,

$$\underline{p}_1 = (1/k_1) \max_p \{p \max(0, d(p) - k_2)\}. \tag{A.2}$$

With $k_1 > r(k_2)$ and $k_2 > k_1$ by assumption, Lemma 1 of Kreps and Scheinkman (1983) shows that $k_2 > r(k_1)$, so $\underline{p}_2 k_2 = \max_p p \max(0, d(p) - k_1)$ and

$$\underline{p}_2 = (1/k_2) \max_p \{p \max(0, d(p) - k_1)\}. \tag{A.3}$$

Define $\theta(k_i) \equiv k_i \max_p \{p \max(0, d(p) - k_i)\}$, $i = 1, 2$. From (A.2) and (A.3)

$$\underline{p}_2 > \underline{p}_1 \quad \Leftrightarrow \quad \theta(k_1) > \theta(k_2).$$

The right-hand side inequality is demonstrated in the course of the proof of Kreps and Scheinkman's Lemma 5 (1983, p. 332). Thus, $\underline{p}_2 > \underline{p}_1$.

22. This should be contrasted to the standard model, where Bertrand competition would prevail, and hence no determinate pattern of leadership could be predicted.

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Next, let $k_1 \leqq r(k_2)$; then $\underline{p}_1 = p_1^H = P(k_1 + k_2)$. We know that $\underline{p}_2 \geqq P(k_1 + k_2)$ with equality if and only if there exists a pure-strategy equilibrium (i.e. when $\underline{p}_2 = p_2^H$). So, $\underline{p}_2 > P(k_1 + k_2) = \underline{p}_1$.

(ii) Suppose $\underline{p}_2 \geqq P(k_2)$. Then $H_1(\underline{p}_2) = 0$, which implies that $p_1^H \leqq \underline{p}_2$ with equality only if $\underline{p}_2 = 0$. But then $\underline{p}_1 \leqq \underline{p}_2$, with equality only if $\underline{p}_1 = \underline{p}_2 = 0$, i.e. when a pure-strategy equilibrium exists in the simultaneous-move game. ‖

Acknowledgement. We have greatly benefitted from the comments of the editor and two anonymous referees, and from discussions with seminar participants at the North American Winter Meetings of the Econometric Society (Chicago, December 1987), the Third Annual Congress of the European Economic Association (Bologna, August 1988), and the European Meetings of the Econometric Society (Bologna, August-September 1988). The idea for this paper was conceived while Raymond Deneckere was visiting the University of Bonn and Dan Kovenock was visiting the University of Bielefeld. The first author gratefully acknowledges the hospitality and financial assistance of the University of Bonn, as well as support through National Science Foundation grants IST-86-09128 and SES-86-19012, and the Kellogg Graduate School of Management's Beatrice/Esmark Research Chair. The second author gratefully acknowledges the hospitality of the University of Bielefeld and the financial support of the Purdue Research Foundation, the Krannert Endowment and the Ford Motor Company Fund. The opinions expressed in this paper are those of the authors who bear full responsibility for any errors or omissions.

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EXHIBITS 44-48

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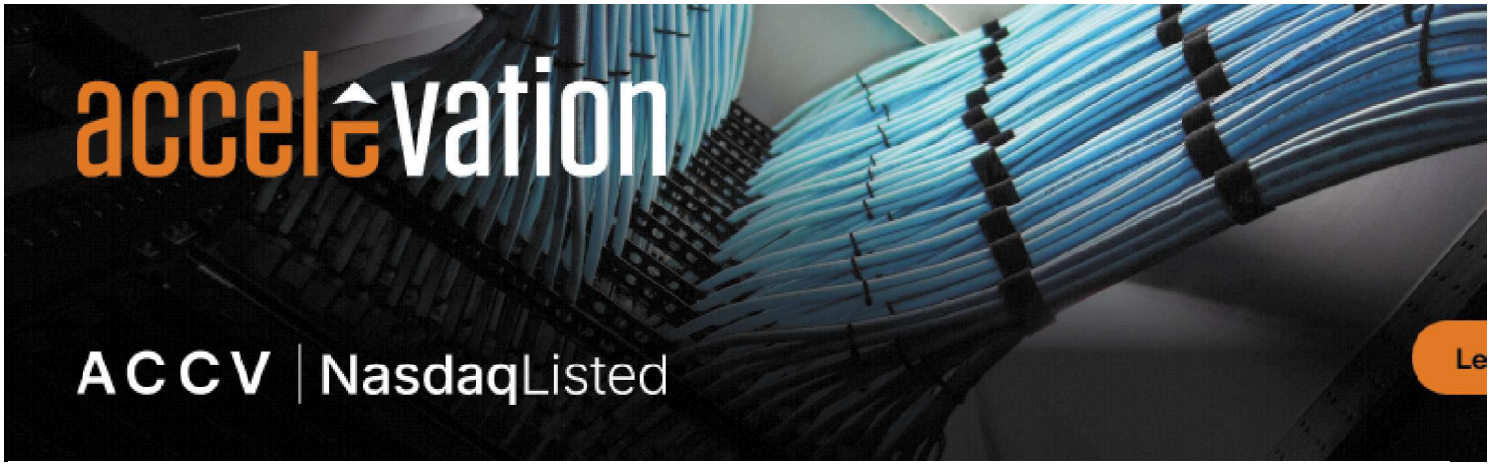
EXHIBIT 49



TECH

Amazon starts to roll out free one-day delivery for Prime members

PUBLISHED MON, JUN 3 2019•9:03 AM EDT UPDATED MON, JUN 3 2019•11:53 AM EDT


Lauren Feiner
@LAUREN_FEINER

WATCH LIVE

KEY POINTS

- Amazon says it has begun to expand its free one-day shipping to Prime members.
- It says the program will begin in North America and then expand globally to other Prime markets.
- Amazon earlier said it would spend $800 million in the quarter to expand free one-day shipping for Prime members.
- Walmart offered its own next-day delivery option about a month after Amazon's announcement.



Amazon.com boxes are shown stacked near a Boeing 767 Amazon "Prime Air" cargo plane on display in a Boeing hangar in Seattle.
Ted S. Warren | AP

Amazon Prime members can now get their packages even faster as the company begins to roll out free one-day shipping on over 10 million products.

Amazon executives said on its last earnings call that it will spend $800 million in the second quarter of 2019 to shorten the standard shipping program for Prime customers from two days to one. The program is launching in North America and will eventually go global, the executives said.

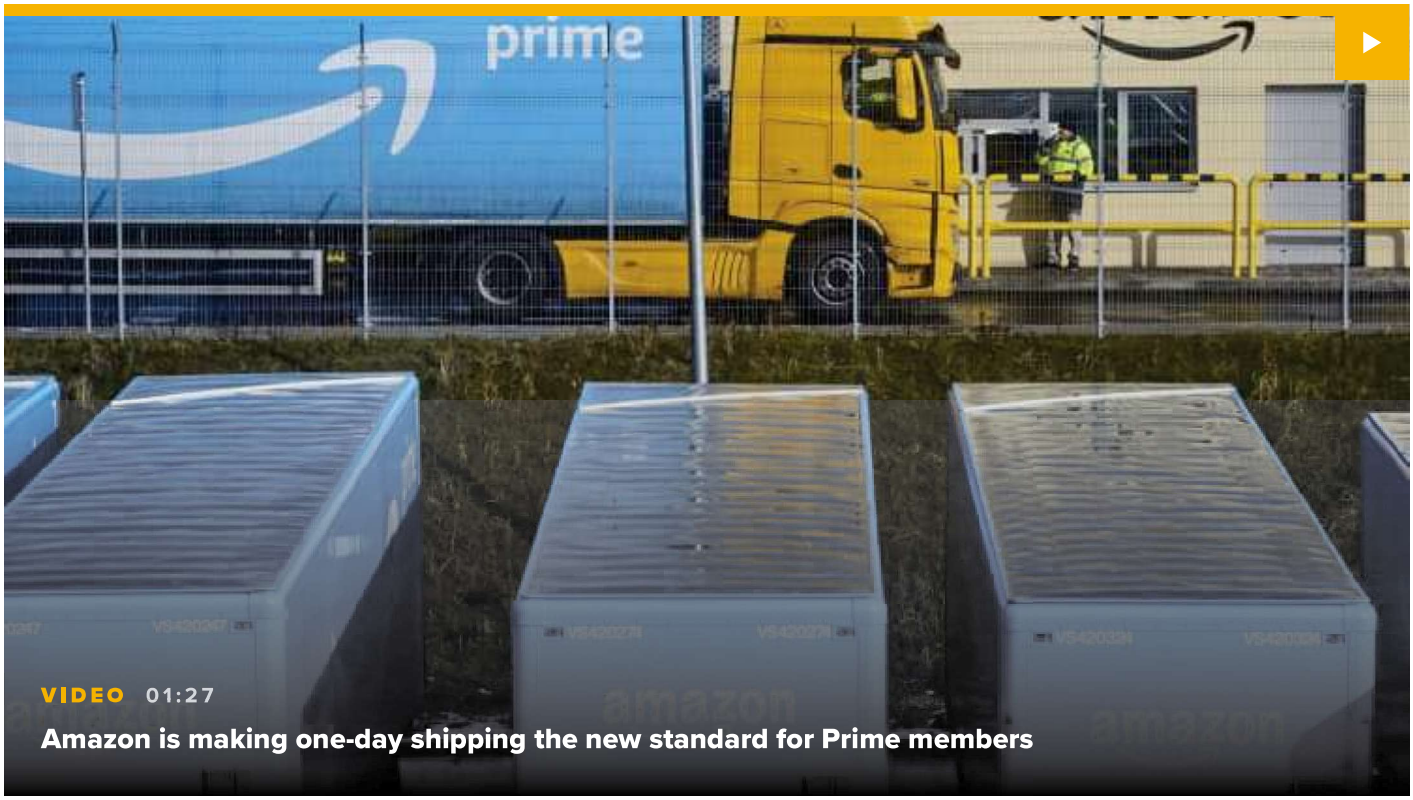
The initial announcement in April sent shares of Walmart and Target tumbling as they will be pressured to keep up with Amazon's delivery speeds. Less than a month later, Walmart announced its own free next-day delivery offering on orders over $35. Amazon's offering requires no minimum purchase.

Amazon's robust logistics network has made it possible to reduce shipping times and costs for customers. A March report from RBC Capital Markets estimated Amazon already had the capacity to offer same-day and next-day delivery to 72% of the total U.S. population. Amazon's heavy investments over the past four years into expanding its fulfillment centers has boosted its

Outside of continental North America, Amazon said it has been speeding up delivery times in Alaska, Hawaii and Puerto Rico over the past year, with shipping speeds ranging from one to five days for Prime members.

Subscribe to CNBC on YouTube.

Watch: Amazon is making one-day shipping the new standard for Prime members



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Memory stocks are getting hammered. China and a 2029 oversupply are the big worries

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EXHIBIT 50

NewsRetail

Amazon expands free returns with no shipping box, tape, or label needed to over 10,000 U.S. locations

Four out of five Amazon customers in the U.S. have access to at least one of our 10,000-plus drop-off locations available within five miles of their home, now including FedEx Office locations nationwide.

Operations Retail Delivery Shopping

Share



Written by Amazon Staff

Published: July 05, 2019
Updated: March 25, 2026

3 min read

Key takeaways

- FedEx Office locations across the U.S. now offer Amazon's free, label-free, shipping box-free return option for eligible items.
- Other convenient drop-off locations include Whole Foods Market, The UPS Store, Kohl's, and Staples, along with regional partners like Winn-Dixie, Save Mart, Goodwill, and more.
- Customers can complete a return without packaging or printing a label—just bring the item and a QR code to a participating location.

Amazon is making returns even easier.

Customers can now make free returns on eligible items with no shipping box, tape, or label needed at more than 10,000 drop-off locations across the United States. Our continued investment in the returns network and expanding partnerships means four out of five customers have a drop-off point within five miles of their home, making it easier than ever to complete a return at a convenient location.



Amazon introduces faster delivery with new 1-hour and 3-hour options

Customers in a growing number of cities and towns can now get over 90,000 products delivered to their doorstep in three hours or less.

Over 1,500 FedEx Office locations nationwide are the latest addition to Amazon's growing network of return drop-off points, joining familiar locations like Whole Foods Market, The UPS Store, Kohl's,

and Staples.

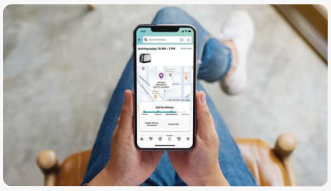
“Convenience doesn’t end once you place your order,” said Gopal Pillai, vice president of Returns and Recommerce at Amazon. “We work hard to help customers find products they’ll love and use, but like any retailer, sometimes a return is needed—and when that happens, we want the experience to be seamless. We’re constantly working to make returns simpler, and bringing FedEx Office locations into our nationwide network is one more way we’re building a return experience that fits naturally into customers’ everyday lives.”

Making returns simple is an important part of the Amazon shopping experience. By expanding convenient drop-off locations, Amazon is helping customers save time and take care of returns as part of their everyday routines—without needing extra packaging or a printer at home.



For eligible items, starting a return is easy. Customers begin the return process in their Amazon account, choose a nearby drop-off location, and receive a QR code. They can then bring their

unpackaged item and QR code to the selected location, where the item is scanned and prepared for shipping—no shipping box or label required.



How to track an Amazon package

Here's how to see when you're getting your next Amazon delivery—and even see its location on a map.

Our free, no shipping box returns are available at the following locations:

FedEx Office

Running errands or shipping a package? FedEx Office locations nationwide now double as convenient drop-off points for eligible Amazon returns, making it easy to take care of a return while you're already out and about.

- Find a FedEx location near you

Whole Foods Market

A trip to the grocery store doesn't have to mean an extra stop for a return. Whole Foods Market stores offer free return drop-offs for eligible items, so customers can take care of a return while picking up groceries. Many locations have dedicated returns counters, and some feature self-service kiosks that let customers complete a return in 60 seconds or less.

- Find a Whole Foods Market near you

The UPS Store

Many UPS Store locations also accept eligible Amazon returns, giving customers another convenient drop-off option. This option is free, unless there is another free option closer to your delivery address. In a small number of cases, customers may see a $1 fee.

- Find The UPS Store near you

Kohl's and Staples locations

Kohl's and Staples stores make it simple to drop off eligible returns during a regular shopping trip. If a participating location is nearby, it will appear as an option when starting a return.

- Find a Kohl's store near you
- Find a Staples store near you



How to know if you qualify for a discounted Prime membership

There are two discounted Prime membership options you may not know about.

Rent-a-Center

With more than 1,700 locations across the U.S., participating Rent-A-Center stores now offer Amazon customers a convenient spot for both label-free, shipping box-free returns and counter order pickups. If a location near you is participating, it will appear as an option when starting a return or checking out.

- Find a Rent-A-Center near you

Save Mart and Winn-Dixie

In select Save Mart stores in California and Nevada and Winn-Dixie stores in Florida, customers can take care of an eligible Amazon return as part of their usual grocery run.

Goodwill

In the greater Seattle area, eligible Amazon returns can also be dropped off at select Evergreen Goodwill locations.

All return options will be clearly shown in the Returns Center to ensure customers can select the available option that best suits their needs.

Prime members have access to free delivery on over 300 million items across 35 categories, all backed by Amazon's A-to-z Guarantee, with tens of millions available for free Same-Day or Next-Day Delivery.

Next, learn how to hide your Amazon orders to keep gift purchases a surprise.

Trending news and stories

- Amazon's Holiday Kids Gift Book is back with 600+ toys, games, and gifts for every age
- Amazon introduces a completely redesigned Kindle family
- Introducing all-new Amazon Alexa Tablets—powerful tablets with Alexa+ built in
- The race our nation can't afford to lose, plus a new commitment from us and a fresh set of community investments

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EXHIBIT 51

NewsCompany news

CEO Andy Jassy's 2024 Letter to Shareholders

Shareholder letter | Andy Jassy

Share





Written by Andy Jassy, CEO of Amazon

Published: April 10, 2025

26 min read

Dear Shareholders:

2024 was a strong year for Amazon.

Our total revenue grew 11% year-over-year ("YoY") from $575B to $638B. By segment, North America revenue increased 10% YoY from $353B to $387B, International revenue grew 9% YoY from $131B to $143B, and AWS revenue increased 19% YoY, from $91B to $108B. For perspective, just 10 years ago, AWS revenue was $4.6B; and in that same year, Amazon's total revenue was $89B.

Amazon's operating income in 2024 improved 86% YoY, from $36.9B (an operating margin of 6.4%) to $68.6B (an operating margin of 10.8%). Free Cash Flow, adjusted for equipment finance leases improved from $35.5B in 2023 to $36.2B.

Apart from the financial results, we made our customers' lives meaningfully better and easier. In our Stores business, we substantially expanded selection, continued lowering prices (independent research firm, Profitero, found Amazon the lowest-priced online U.S. Retailer for the eighth year in a row), and for the second year in a row, we shipped at record speed to our Prime members. AWS launched a slew of new infrastructure and AI services that make it even easier to build remarkable customer experiences, including our latest custom AI silicon (Trainium2), a new set of frontier foundation models in Amazon Nova, and significant expansion of available models and features in our leading Generative AI ("GenAI") services Amazon SageMaker and Amazon Bedrock. Prime Video continued to offer compelling original shows, including new seasons for *Fallout, Reacher, The Boys,* and *The Lord of the Rings: Rings of Power*, movies like *Road House, The Idea of You,* and *Red One*, live sports like *Thursday Night Football* and *UEFA Champions League* in Europe (with the NBA and NASCAR coming in 2025), and new selection, highlighted by Apple TV+ joining Prime Video Channels. We launched a series of new Kindle devices that included a new color version, a larger Scribe option, and our fastest Paperwhites ever (the collection of which drove the highest Kindle unit sales for a single quarter in over a decade). And, we continued to add more selection, price transparency, and same day shipping for Amazon Pharmacy.

These accomplishments are a subset of what the team launched in 2024, but represent a lot of invention, hard work, and thoughtful execution across Amazon. I'm thankful for my teammates and

their delivery this past year (some of which you can see in our 2024 results, others of which won't be visible for the next few years).

A Why Culture

Every year in my annual letter, I try to share insight into what makes Amazon tick. At the highest level, we're aiming to be Earth's most customer-centric company, making customers' lives better and easier every day. This is not easy to do in general, let alone year after year. In fact, it's actually quite hard, especially with the rapid rate of change in technology, customer habits, and new products from large and small companies alike. If we want to have a chance at succeeding in our mission, we have to constantly question everything around us.

We've had this long-held philosophy at Amazon about two-way and one-way door decisions. A two-way door decision is one where if you get the decision wrong, you can walk back through that door, revert to where you were, and there are few (if any) ramifications. You can make these decisions quickly and locally. A one-way door decision is one where it's quite difficult (if not impossible) to walk back through that door if you get the decision wrong, so these decisions are made more methodically. But, both of these constructs assume the door is unlocked. A lot of invention is about trying to open doors that have historically seemed bolted shut. And, over the past 30 years, we've found one of the most important keys to unlock these doors has been a simple question: "Why?"

"Why does this customer experience have to be this way?" "Why can't it be better?" "What are the constraints—why must we accept them?" "Why can't we invent around that?" "Why will it take so long to get to customers?" Why?

My Dad has told me that I was the kind of kid who kept asking why, perhaps to an annoying extent. He's also reminded me how shortly after I joined Amazon in 1997, he tried to persuade me to work somewhere more traditional (and on the east coast closer to family)—only to realize that I'd already found the perfect fit.

That's because Amazon is a Why company. We ask why, and why not, constantly. It helps us deconstruct problems, get to root causes, understand blockers, and unlock doors that might have previously seemed impenetrable. Amazon has an unusually high quotient of this WhyQ (let's call it "YQ"), and it frames the way we think about everything that we do.

Starting in 1995, we asked why can't we offer customers every in-print book?

Then, we asked, why limit ourselves to in-print—why can't we also offer every out-of-print book?

Why not offer every book, ever written, in any language—all available within 60 seconds on a device that's light and fits in the palm of your hand (Kindle)?

When we offer reviews, why must they all come from professional "experts?" Customers are great resources and will be brutally honest. Why not include customer reviews even if they sometimes dissuade a purchase?

Why not offer more than Books? What about Music, Video, Electronics, Tools, Kitchen, Apparel, Home Furnishings?

Why not practically everything?

Why should we be the only sellers of these items? Millions of third-party merchants and small sellers offer similar or unique items. Why not let customers choose the selection, price, and delivery speed they prefer from among these millions of sellers?

After struggling for a couple years to create awareness for sellers' selection, we asked ourselves why not show their selection on the same product detail pages as our first-party selection (where all the traffic was)?

Why not allow our sellers to also store items in our fulfillment network, enable those items to have fast, Prime delivery, and fulfill those items for sellers (a program called Fulfillment by Amazon)?

Why not experiment with relevant advertisements in our store to expose customers to new sellers and items (versus only what our algorithms might surface based on past purchases)?

Why does every company need their own capital-intensive datacenters and infrastructure? Why should every development team keep reinventing services like compute, storage, database, and analytics? Why should builders spend 80% of their time on the undifferentiated heavy lifting vs. their unique customer experience? Why not build a set of services (AWS) to solve that for internal and external builders?

Why do I have to buy a physical video to watch a movie? Why do I need cable or linear TV to watch amazing TV shows (Prime Video)?

Why can't I get my Prime shipping benefits on other websites than just Amazon (Buy with Prime)?

I can go on. But, you get the idea. Every one of these Whys have led to significant invention, and every one of them have made customers' lives better and easier. Some of these seem obvious now. But at the time, these were provocative questions that required curiosity, risk-taking, experimentation, and persistence to make these into success stories.

Enabling a Why Culture

If you believe having high YQ is critical to inventing for customers, how do you enable it? In my opinion, it's not solved with one mechanism. It needs to be built deeply into your culture and leadership team, and has to be fiercely protected over time if you're lucky enough to be successful. Here are a few of the strategies we employ.

Create leadership principles that set the tone. We have 16 Leadership Principles that guide our behavior. They're all integral underpinnings to our YQ, but I'll touch on three in particular:

Are Right a Lot

"Leaders are right a lot. They have strong judgment and good instincts. They seek diverse perspectives and work to disconfirm their beliefs."

When we first instituted this leadership principle, some people incorrectly assumed it meant that the best leaders were the ones whose ideas were chosen (i.e. they were right, a lot). It led to some people overly digging in and fighting for their ideas. There's nothing wrong with pushing for what you believe. But, in my experience, the best leaders want to hear others' views. They don't wilt or bristle when challenged; they're intrigued. Effective leaders change their minds when presented with new compelling information (which makes it ironic how people dismiss politicians as "flip-floppers" when they change their position). Ultimately, leaders are responsible for getting to the best answer for customers, regardless of whose original idea is chosen.

Learn and be Curious

"Leaders are never done learning and always seek to improve themselves. They are curious about new possibilities and act to explore them."

In the nearly 28 years I've been at Amazon, the biggest difference in the relative growth of companies and individuals has been their aptitude to learn. At a certain point, some leaders seem to lose their thirst to learn. It's hard to know the reason in each case, but it's as if some people find it too exhausting, too time-consuming, or too threatening to not have all the answers. Regardless, the day we stop learning at Amazon is the day we risk undermining what we're capable of building in the future. People with high YQ are always curious how they can get better, become wiser, and incorporate their new knowledge into better customer experiences.

Have Backbone; Disagree and Commit

"Leaders are obligated to respectfully challenge decisions when they disagree, even when doing so is uncomfortable or exhausting. Leaders have conviction and are tenacious. They do not compromise for the sake of social cohesion. Once a decision is determined, they commit wholly."

We don't just empower people to challenge one another, we obligate them to do so if they disagree. Questioning, asking the hard questions, forcing the discussion (versus silently thinking a mistake is being made) is necessary to getting to better answers for customers. "I told you so" has no currency at Amazon. It's also important to focus on the second part of this leadership principle: *disagree and commit*. While constructive debate is useful; at some point, teams need to make a decision and take action. From that point on, everybody—even those who advocated for a different solution than the one chosen—must commit to making that decision a success. That means the team goes all in—no pocket-vetoing nor hedging between other options. That's the only way we can preserve speed and confidence that if an issue is heavily debated, the team will ultimately pull together.

Create norms that support the Why. Similar to how our Leadership Principles guide our behavior, we've built norms over the years that guide how we work. Here are a few examples:

Narratives. We stopped presenting information to each other inside the company via powerpoint in 2004. Given how high level powerpoints are, we found that powerpoint was easy for the presenter to prepare, but harder for the audience to understand the substantive issues. Instead, we moved to writing narratives with a maximum of six pages in the body. Narratives are harder for the presenter (it's hard to write a thoughtful six-page document that highlights the key issues in enough detail to be crisp and clear), but much easier for the audience to engage with and ask the right Why questions.

Working backwards documents. When we build services or features, before we start coding, we write Press Release and Frequently Asked Questions ("FAQ") documents. The Press Release is intended to ensure that what we're proposing building is remarkable to customers (so we don't get to launch and

ask “wait, why did we think customers would find this interesting?”). And, the FAQ is designed to force ourselves to ask the hard questions about which customers will use this capability, what they’ll like most, what they’ll be most disappointed with, why are we drawing the launch line where we are, why is it better than current alternatives, how should we think about pricing, what pricing dimensions we recommend, and why have we made the architectural decisions we have. The Press Release and FAQ are how we work backwards from customers, and how we push ourselves to ask questions customers would if they were in these meetings.

Be together whenever possible. There are many paths that can lead to breakthrough innovation. Occasionally, a lone genius comes up with a brilliant idea, and everyone else simply executes it. While that can work, it’s not how we typically operate. Amazon invention is deeply collaborative. It starts with a seed of an idea, then a group of smart, mission-driven people refine, challenge, and build on it together. And, we’ve found that this process is far more effective in person than remote. Of course, you can invent with everybody remote (and some cultures seem to prefer that). However, in my experience, it doesn’t compare to being in the same room. The energy, the pace, the spontaneous brainstorming, the willingness for people to jump in, the way ideas evolve in real time, and the post-meeting iteration is much better when in the same room—and yields better outcomes for our customers and teams. With what’s happening in AI right now, and the likelihood that every customer experience we’ve ever known will be reinvented, there has never been a more important time, in my opinion, to optimize to invent well.

Tolerating messy meetings. It’s hard to “schedule” innovation. You can’t book 60 minutes to invent Amazon Prime, or AWS, or Alexa+, or Fulfillment by Amazon, or Regionalization in our Fulfillment Network, or Project Kuiper. These inventions are borne out of somebody asking why we can’t change what’s possible for customers, and then they take on a life of their own, often meandering down multiple dead ends before getting to a final destination. This might bother some regimented folks. But, when we’re inventing, we accept the process being beautifully imperfect.

Operate like a startup (in our case, the world's largest startup). We strive to operate like the world's largest startup. What does that mean?

First, whatever we're contemplating building has to be focused on solving a real customer problem or meaningfully improving a customer experience. Companies can get off track prioritizing technology because they're excited about the technology. Great startups are on a mission to change what's possible for customers.

Second, we have a disproportionate need for builders. These are inventors. They're people constantly dissecting customer experiences, even ones that seem pretty good today, and asking why they can't be better. They're divinely discontent (maybe annoyingly so for team members proud of what they've previously built), and never feel like the job is done.

Third, we want owners. One of the strengths of Amazon over the first 30 years is that we've hired really smart, motivated, inventive, ambitious people who have been great owners. And, that means that our teammates are constantly asking themselves, "What would I do if this was my own money?" "What would I do if I started this company and I was the majority owner?" "Hey, I know I've only been asked to own a part of this project, but I'm not sure if the other parts are being driven well—should I stick my nose into this and make sure or just trust somebody's got it?" Owners feel accountable. They care deeply about the quality and effectiveness of what they own, and view the company's mission as their mission (we want missionaries, not mercenaries). That's part of what our effort to increase the ratio of individual contributors versus managers is about. We want flatter organizations where our owners doing the work feel like they own the two-way door decisions (which are the vast majority), can move rapidly, and are fully accountable for solving the Whys of their customer experiences.

Fourth, speed disproportionately matters for every business, in every industry, at all times. It's a false binary to argue that you can move fast or deliver high standards. If you want to be fast, you can be

fast, and still be high quality. We've done it for many years (though we can still be faster). Speed is a leadership decision. The leadership team has to believe it's a priority, reinforce it constantly, organize and remove structural barriers, and build in modular ways that enable pace. But, speed does not happen unless the entire company and culture embrace it. We have this persistent feeling, throughout the company and in every business in which we operate, that there are closing windows all around us. We operate in fiercely competitive market segments, with highly talented, well-funded, ambitious companies at every turn. Customers are always looking for something better. We spend a lot of time identifying how to unlock these experiences for them as quickly as possible, and know if we don't, somebody else will.

Another way to gain speed is to eliminate bureaucracy. There is a difference between process and bureaucracy. When you're running something at scale, you need mechanisms to deliver the right experience and constant improvement for customers. However, as companies grow and add more managers, unneeded processes get layered on that add little value. Last fall, I asked teammates across the company to send me bureaucracy examples that they were experiencing. I've received almost 1,000 of these emails, and read every single one. Builders hate bureaucracy. It slows them down, frustrates them, and keeps them from doing what they came here to do. As leaders, we don't always see the red tape buried deep in our organizations, but we can sure as heck eliminate it when we do. We've already made over 375 changes based on this feedback. We need to move fast, and we are committed to rooting out bureaucracy that ties up time and dispirits our teammates.

Fifth, you have to be scrappy. As businesses succeed and get larger, they sometimes forget how things got started. We built Amazon Simple Storage Service (S3) with 13 people; Amazon Elastic Compute Cloud (EC2) with 11 people. Managers can confuse themselves that the way to grow and get ahead is to accumulate large teams. Historically, we've had periods where we've allowed this thinking to hold sway. But, it's not the way we fundamentally think about building teams and

products, and have adjusted to reflect that again. Our best leaders get the most done with the least number of resources required to do the job. They pride themselves on being lean.

Sixth, you have to be willing to take risks. This sounds easier than it is. You need clever enough people to identify worthwhile bets. And if you have these inventive, ambitious builders with high standards, they're not used to failure. They suspect external (and maybe internal) ridicule awaits them if they try something very different that doesn't work out. So, people often play it safe. But, you can't achieve something extraordinary for customers by playing "not to lose." If your Whys take you down an invention path that delivers an experience that doesn't look like what's been done before, let customer obsession be your compass. You rarely, if ever, change the world by doing the same thing as everybody else.

And finally, you have to care most about delivering compelling results for customers. It's not how charismatic you are. It's not whether you're really good at managing up or sideways. What matters is what we actually get done for customers. That's what we want to reward.

Next generation Whys

While the team and I feel quite optimistic about the progress and potential of our existing businesses, we have plenty of new Whys we're asking. Below are a few of them and some quick thoughts.

Why is AI so important? Will it really have as much impact as some claim and when?

Generative AI is going to reinvent virtually every customer experience we know, and enable altogether new ones about which we've only fantasized. The early AI workloads being deployed focus on productivity and cost avoidance (e.g. customer service, business process orchestration, workflow, translation, etc.). This is saving companies a lot of money. Increasingly, you'll see AI change the norms in coding, search, shopping, personal assistants, primary care, cancer and drug research, biology, robotics, space, financial services, neighborhood networks—everything. Some of these areas are already seeing rapid progress; others are still in their infancy. But, if your customer

experiences aren't planning to leverage these intelligent models, their ability to query giant corpuses of data and quickly find your needle in the haystack, their ability to keep getting smarter with more feedback and data, and their future agentic capabilities, you will not be competitive. How soon? It won't all happen in a year or two, but, it won't take ten either. It's moving faster than almost anything technology has ever seen.

OK, I buy AI is big; but why invest this much this quickly?

Fundamentally, if your mission is to make customers' lives better and easier every day, and you believe every customer experience will be reinvented by AI, you're going to invest deeply and broadly in AI. That's why there are more than 1,000 GenAI applications being built across Amazon, aiming to meaningfully change customer experiences in shopping, coding, personal assistants, streaming video and music, advertising, healthcare, reading, and home devices, to name a few. It's also why AWS is quickly developing the key primitives (or building blocks) for AI development, such as custom silicon AI chips in Amazon Trainium to provide better price-performance on training and inference, highly flexible model-building and inference services in Amazon SageMaker and Amazon Bedrock, our own frontier models in Amazon Nova to provide lower cost and latency for customers' applications, and agent creation and management capabilities.

There is also substantial capital investment required. In AWS, the faster demand grows, the more datacenters, chips, and hardware we need to procure (and AI chips are much more expensive than CPU chips). We spend this capital upfront, even though these assets are useful for many years (in the case of datacenters, for at least 15-20 years). We only start monetizing this capital investment many months after we spend the capital, and over many years—which leads to attractive long-term FCF and ROIC (as people have seen in AWS over the last several years). But in periods, like now, of unusually high demand (our AI revenue is growing at triple digit YoY percentages and represents a multi-billion-dollar annual revenue run rate), you're deploying a lot of capital. We continue to believe AI is a once-in-a-lifetime reinvention of everything we know, the demand is unlike anything we've

seen before, and our customers, shareholders, and business will be well-served by our investing aggressively now.

Why do chips and AI have to be this expensive for customers?

AI does not have to be as expensive as it is today, and it won't be in the future. Chips are the biggest culprit. Most AI to date has been built on one chip provider. It's pricey. Trainium should help, as our new Trainium2 chips offer 30-40% better price-performance than the current GPU-powered compute instances generally available today. While model training still accounts for a large amount of the total AI spend, inference (which are the predictions or outputs of the models) will represent the overwhelming majority of future AI cost because customers train their models periodically, but produce inferences constantly in large-scale AI applications. Inference will become another building block service, along with compute, storage, database, and others. We feel strong urgency to make inference less expensive for customers. More price-performant chips will help. But, inference will also get meaningfully more efficient in the next couple of years with improvements in model distillation, prompt caching, computing infrastructure, and model architectures. Reducing the cost per unit in AI will unleash AI being used as expansively as customers desire, and also lead to more overall AI spending. It's like what happened with AWS. Revolutionizing the cost of compute and storage happily led to lower cost per unit, and more invention, better customer experiences, and more absolute infrastructure spend.

Why have personal assistants not yet taken off? How can Alexa help?

A great personal assistant can answer virtually any question and get things done on your behalf. There have been no digital solutions that can do both yet. That is, until Alexa+ arrived. Alexa+ is not only comparably intelligent to the leading chatbots, but can take a plethora of real actions for you. She can play music, play video, move media from one of your devices to another, set alarms and timers, control your smart home, order across hundreds of millions of ecommerce items, make reservations for restaurants or Ubers, order concert tickets, alert you when your favorite artist

announces a tour, find a plumber to fix your sink, and memorize whatever you've done on Amazon. This is pretty game-changing for consumers, and just the start of what Alexa+ will do. We have over 600 million Alexa devices out there today, and expect Alexa+ to play an even more vital role in the lives of these hundreds of millions of customers in the future.

Why can't we get items to customers even faster? Does it matter?

Every year, people ask whether we've reached the law of diminishing returns on speed of delivery. Our data shows this not to be the case. When we promise faster delivery times, customers complete purchases at a meaningfully higher rate and shop with us more frequently. Amazon Prime started with unlimited, free, two-day delivery for a million products; it's now grown to over 300 million items, with tens of millions available in one day (or better). An increasing number of deliveries happen same day. This speed improvement is primarily due to our regionalization redesign of our fulfillment network, our new placement algorithms, and the introduction of our innovative same-day fulfillment centers. Although we've set speed records for two consecutive years, we're still honing these innovations, and have others planned. And, don't forget Prime Air, our drones that will get items to customers inside an hour. We are not done improving speed.

Why can't people in small towns enjoy the same fast delivery speeds as people in cities?

As some other companies are abandoning small-town customers due to cost to serve, we're going the other way—we're investing to serve our rural customers even better. We've already expanded Same-Day and Overnight Delivery to dozens of smaller cities and towns across the U.S., with more coming. This expansion will provide even faster Amazon delivery speeds for many millions of customers, particularly in less densely populated areas, enabling us to deliver over a billion packages each year to customers living in 13,000 zip codes spanning 1.2 million square miles.

Related, why can't we help the hundreds of millions of people without broadband connectivity?

There are about 400-500 million households around the world, most in small, rural towns that don't have access to broadband connectivity. They can't leverage the Internet to learn, shop, do business,

access entertainment, and communicate the same way people take for granted in bigger cities. This digital divide is what Project Kuiper, our low Earth orbit satellite network, aims to solve. We're just launching our first production satellites, and will ultimately have over 3,200 in orbit over the next few years. While capital-intensive to launch, we believe Kuiper will be a meaningful operating income and ROIC business for us.

Why does healthcare have to be so stressful?

Healthcare, especially in the U.S., is quite frustrating. It's hard to get fast appointments with primary care physicians, often harder with specialists. There's a lot of waiting around. Physicians spend only a few minutes with patients. Then, patients have to drive somewhere (often not close) to get their medications. And, when they get to the pharmacy, they're often surprised by the pricing, what's covered by their insurance, and what you can easily access that's not behind a locked shelf. Customers deserve better. It's why you see such positive customer sentiment and growth for Amazon Pharmacy and Amazon One Medical, and we continue to iterate quickly on selection and transparency for Amazon Pharmacy, and physical clinic capacity for One Medical.

These are some of the Why questions we're asking ourselves right now, and I'm excited about the future inventions to come. We're not going to be bored any time soon.

When I first started working, I thought it was unfathomable that my Dad worked at the same place for 45 years. How could that be? That's so long. I used to tell my friends that would never be me. Now, with almost 28 years and counting at Amazon, I have to answer those same friends with their own Why question.

After all these years, why are you still at Amazon?

I'm obviously a Superfan, but there are several compelling parts to working at Amazon. First, I'm not sure that any company prioritizes customers as relentlessly as we do. Lots of companies say they

will; few follow through. Second, it's challenging to find a company where you can make a bigger impact on the world than you can at Amazon. Third, we make significant long-term investments and bets in both inventions and people. This allows our teams to iterate on ideas, and make the right long-term decisions for customers and the company. And, I've never encountered a more intelligent, creative, ambitious, hungry, hard-working, and missionary group of teammates than we have at Amazon. In my opinion, this is a remarkable set of qualities to have at a company. And, for builders who want to change the world, and who have fire in their belly, there's no better place to be than Amazon.

We operate like the world's largest startup in large part because of our culture of Why. We don't always get everything right, and we learn and iterate like crazy. But, we're constantly choosing to prioritize customers, delivery, invention, ownership, speed, scrappiness, curiosity, and building a company that outlasts us all. It remains Day One.

Sincerely,

Andy Jassy
President and Chief Executive Officer
Amazon.com, Inc.

P.S. As we have always done, our original 1997 Shareholder Letter follows. What's written there is as true today as it was in 1997.

amazon.com

1997 LETTER TO SHAREHOLDERS

(Reprinted from the 1997 Annual Report)

To our shareholders:

Amazon.com passed many milestones in 1997: by year-end, we had served more than 1.5 million customers, yielding 838% revenue growth to $147.8 million, and extended our market leadership despite aggressive competitive entry.

But this is Day 1 for the Internet and, if we execute well, for Amazon.com. Today, online commerce saves customers money and precious time. Tomorrow, through personalization, online commerce will accelerate the very process of discovery. Amazon.com uses the Internet to create real value for its customers and, by doing so, hopes to create an enduring franchise, even in established and large markets.

We have a window of opportunity as larger players marshal the resources to pursue the online opportunity and as customers, new to purchasing online, are receptive to forming new relationships. The competitive landscape has continued to evolve at a fast pace. Many large players have moved

online with credible offerings and have devoted substantial energy and resources to building awareness, traffic, and sales. Our goal is to move quickly to solidify and extend our current position while we begin to pursue the online commerce opportunities in other areas. We see substantial opportunity in the large markets we are targeting. This strategy is not without risk: it requires serious investment and crisp execution against established franchise leaders.

It's All About the Long Term

We believe that a fundamental measure of our success will be the shareholder value we create over the *long term*. This value will be a direct result of our ability to extend and solidify our current market leadership position. The stronger our market leadership, the more powerful our economic model. Market leadership can translate directly to higher revenue, higher profitability, greater capital velocity, and correspondingly stronger returns on invested capital.

Our decisions have consistently reflected this focus. We first measure ourselves in terms of the metrics most indicative of our market leadership: customer and revenue growth, the degree to which our customers continue to purchase from us on a repeat basis, and the strength of our brand. We have invested and will continue to invest aggressively to expand and leverage our customer base, brand, and infrastructure as we move to establish an enduring franchise.

Because of our emphasis on the long term, we may make decisions and weigh tradeoffs differently than some companies. Accordingly, we want to share with you our fundamental management and decision-making approach so that you, our shareholders, may confirm that it is consistent with your investment philosophy:

- We will continue to focus relentlessly on our customers.
- We will continue to make investment decisions in light of long-term market leadership considerations rather than short-term profitability considerations or short-term Wall Street

reactions.

- We will continue to measure our programs and the effectiveness of our investments analytically, to jettison those that do not provide acceptable returns, and to step up our investment in those that work best. We will continue to learn from both our successes and our failures.

- We will make bold rather than timid investment decisions where we see a sufficient probability of gaining market leadership advantages. Some of these investments will pay off, others will not, and we will have learned another valuable lesson in either case.

- When forced to choose between optimizing the appearance of our GAAP accounting and maximizing the present value of future cash flows, we'll take the cash flows.

- We will share our strategic thought processes with you when we make bold choices (to the extent competitive pressures allow), so that you may evaluate for yourselves whether we are making rational long-term leadership investments.

- We will work hard to spend wisely and maintain our lean culture. We understand the importance of continually reinforcing a cost-conscious culture, particularly in a business incurring net losses.

- We will balance our focus on growth with emphasis on long-term profitability and capital management. At this stage, we choose to prioritize growth because we believe that scale is central to achieving the potential of our business model.

- We will continue to focus on hiring and retaining versatile and talented employees, and continue to weight their compensation to stock options rather than cash. We know our success will be largely affected by our ability to attract and retain a motivated employee base, each of whom must think like, and therefore must actually be, an owner.

We aren't so bold as to claim that the above is the "right" investment philosophy, but it's ours, and we would be remiss if we weren't clear in the approach we have taken and will continue to take.

With this foundation, we would like to turn to a review of our business focus, our progress in 1997, and our outlook for the future.

Obsess Over Customers

From the beginning, our focus has been on offering our customers compelling value. We realized that the Web was, and still is, the World Wide Wait. Therefore, we set out to offer customers something they simply could not get any other way, and began serving them with books. We brought them much more selection than was possible in a physical store (our store would now occupy 6 football fields), and presented it in a useful, easy- to-search, and easy-to-browse format in a store open 365 days a year, 24 hours a day. We maintained a dogged focus on improving the shopping experience, and in 1997 substantially enhanced our store. We now offer customers gift certificates, 1-Click shopping℠, and vastly more reviews, content, browsing options, and recommendation features. We dramatically lowered prices, further increasing customer value. Word of mouth remains the most powerful customer acquisition tool we have, and we are grateful for the trust our customers have placed in us. Repeat purchases and word of mouth have combined to make Amazon.com the market leader in online bookselling.

By many measures, Amazon.com came a long way in 1997:

- Sales grew from $15.7 million in 1996 to $147.8 million – an 838% increase.
- Cumulative customer accounts grew from 180,000 to 1,510,000 – a 738% increase.
- The percentage of orders from repeat customers grew from over 46% in the fourth quarter of 1996 to over 58% in the same period in 1997.

- In terms of audience reach, per Media Metrix, our Web site went from a rank of 90th to within the top 20.

- We established long-term relationships with many important strategic partners, including America Online, Yahoo!, Excite, Netscape, GeoCities, AltaVista, @Home, and Prodigy.

Infrastructure

During 1997, we worked hard to expand our business infrastructure to support these greatly increased traffic, sales, and service levels:

- Amazon.com's employee base grew from 158 to 614, and we significantly strengthened our management team.

- Distribution center capacity grew from 50,000 to 285,000 square feet, including a 70% expansion of our Seattle facilities and the launch of our second distribution center in Delaware in November.

- Inventories rose to over 200,000 titles at year-end, enabling us to improve availability for our customers.

- Our cash and investment balances at year-end were $125 million, thanks to our initial public offering in May 1997 and our $75 million loan, affording us substantial strategic flexibility.

Our Employees

The past year's success is the product of a talented, smart, hard-working group, and I take great pride in being a part of this team. Setting the bar high in our approach to hiring has been, and will continue to be, the single most important element of Amazon.com's success.

It's not easy to work here (when I interview people I tell them, "You can work long, hard, or smart, but at Amazon.com you can't choose two out of three"), but we are working to build something

important, something that matters to our customers, something that we can all tell our grandchildren about. Such things aren't meant to be easy. We are incredibly fortunate to have this group of dedicated employees whose sacrifices and passion build Amazon.com.

Goals for 1998

We are still in the early stages of learning how to bring new value to our customers through Internet commerce and merchandising. Our goal remains to continue to solidify and extend our brand and customer base. This requires sustained investment in systems and infrastructure to support outstanding customer convenience, selection, and service while we grow. We are planning to add music to our product offering, and over time we believe that other products may be prudent investments. We also believe there are significant opportunities to better serve our customers overseas, such as reducing delivery times and better tailoring the customer experience. To be certain, a big part of the challenge for us will lie not in finding new ways to expand our business, but in prioritizing our investments.

We now know vastly more about online commerce than when Amazon.com was founded, but we still have so much to learn. Though we are optimistic, we must remain vigilant and maintain a sense of urgency. The challenges and hurdles we will face to make our long-term vision for Amazon.com a reality are several: aggressive, capable, well-funded competition; considerable growth challenges and execution risk; the risks of product and geographic expansion; and the need for large continuing investments to meet an expanding market opportunity. However, as we've long said, online bookselling, and online commerce in general, should prove to be a very large market, and it's likely that a number of companies will see significant benefit. We feel good about what we've done, and even more excited about what we want to do.

1997 was indeed an incredible year. We at Amazon.com are grateful to our customers for their business and trust, to each other for our hard work, and to our shareholders for their support and

encouragement.

Jeffrey P. Bezos

Founder and Chief Executive Officer

Amazon.com, Inc.

Stories we think you'll like

CEO Andy Jassy's 2023 Letter to Shareholders

Introducing Alexa+, the next generation of Alexa

Amazon CEO Andy Jassy shares his top tips for a successful career: 'Don't be afraid to fail'

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Filed Provisionally Under Seal per ECF No. 715