Dynamic Strategy:
Reciprocity, Commitment, and Reputation

This note explores strategies in settings where firms or individuals deal with one another repeatedly. There are two problems to prepare for class, on pages 5-7 and 12-13. This note is longer than usual because there are several important concepts and applications here. If you are pressed for time, (1) skim as needed to do the two problems for class, and (2) read this note carefully after class. You can learn a lot about how markets work from this note.

In previous sessions, we have examined managerial decision making in markets characterized by interactive payoffs. When payoffs are interactive, players must anticipate the actions of others in formulating strategies. In this note, we show how an understanding of game theoretic reasoning can improve managerial decision-making.

Many decision-making situations faced by managers resemble repeated games. That is, managers repeatedly find themselves in the same decision-making situation playing against the same set of players, or against "similar" successive players. Think of competing consumer-product firms that update their prices each week, an incumbent airline facing a potential string of upstart entrants into its hub city, or two technology companies deciding which investment projects to pursue.

Three key issues arise when firms interact repeatedly: *commitment, reciprocity,* and *reputation*. The tools of game theory and economic analysis are extremely useful for determining how firms succeed (or fail) in dealing with these types of problems.

1. Commitment Strategies

The first key concept when formulating business strategy in dynamic settings is the value of commitment. The important, and somewhat counter-intuitive, lesson here is that it can be profitable *to publicly limit your options* when you are dealing with others.

As a simple example, suppose that your firm is a potential buyer of a property that your company (privately) values at $250,000. The seller is willing to part with it at any price

above $180,000, but is a good negotiator and will try to get as much as possible for it. If you are the only interested buyer at present, how can you make the seller think that you will walk away rather than pay more than, say, $200,000 for the property?

You need to exercise commitment to do exactly that, in a way that *you cannot back down from*, and that is credible to the seller. Such a strategic move must reduce your flexibility—limit your options—so that you have no choice but to stick by it. For example, your company might issue an authorization letter for you to close the deal at a price up to $200,000, but insist on re-authorization by the Board of Directors for any amount above that, and announce that the board will not meet again for several months. Your willingness to pay no more than $200,000 now becomes a lot more credible. The result is less flexibility—and more bargaining power.

Example: Pre-Emptive Investment[*]

Suppose you manage a firm and face the possibility of entry by a new competitor, Firm X. Suppose that to enter the industry, Firm X will have to pay a (sunk) cost of $80 million to build a plant. Your profit will be higher if you can induce Firm X to stay out of the market: If X stays out, you can continue to charge a high price. Suppose that in this situation you would earn $200 million in profit.

If Firm X does enter the market, you must make a decision. You can "accommodate" the entrant, by maintaining a high price in the hope that X will do the same. In that case, you will earn $100 million because you are now splitting the market. The new entrant X will earn a net profit of only $20 million: $100m less the $80m to build its plant.

Alternatively, you can increase your production capacity, produce more, and lower your price. This will increase your revenue by $20 million if firm X does enter, but the plant expansion has a $50 million cost. Your lower price and output boost will leave Firm X with a net loss of $10 million. However, if Firm X does not enter, then expanding your capacity and lowering your price will cut your $200 million in current profit down to $130 million. All these profit figures are collected in the strategic-form game in Figure 1.

If Firm X believes you will be accommodating and maintain a high price after it has entered, it will find it profitable to enter and will do so. So suppose you threaten to expand output and wage a price war, in order to keep X out. If X takes the threat seriously, it will not enter the market because it can expect to lose $10 million. Your threat, however, is not credible. As Figure 1 shows (and as the potential competitor knows), once entry has occurred, it will be in your best interest to accommodate and maintain a high price. Firm X's rational move is to enter the market.

[*] The examples in this section and the next are based on materials developed by David M. Kreps, and from R. Pyndick and D. Rubinfeld, *Microeconomics* 6th edition. Many thanks to each.

		Firm X: Enter	Firm X: Don't Enter
You	High price, no capacity expansion (*accommodate*)	100, 20	200, 0
	Low price and capacity expansion (challenge)	70, –10	130, 0

FIGURE 1. *Entry and Response Possibilities*

But what if you can make an *irrevocable commitment* that will alter your incentives once entry occurs—a commitment that will give you little choice but to charge a low price if entry occurs? In particular, suppose you invest the $50 million *now,* rather than later, in the extra capacity needed to increase output and wage a price war. Of course, if Firm X does not enter and you continue your high price, the added capacity cost will reduce your total profit. We then have a new payoff matrix, as shown in Figure 2.

		Firm X: Enter	Firm X: Don't Enter
You	High price (accommodate)	50, 20	150, 0
	Low price (challenge)	70, –10	130, 0

FIGURE 2. *Pre-Emptive Investment to Deter Entry.*

As a result of your decision to invest in additional capacity, your threat to engage in price warfare is *completely credible.* Because you already have the additional capacity with which to wage a price war, you will do better in competitive warfare than you would by maintaining a high price and accommodating entry. Because the potential competitor now knows that entry will result in warfare, its best decision is for it to stay out of your market. Meanwhile, having deterred entry, you can maintain a high price and earn a profit of $150 million.

Risks in Commitment Strategies

Commitment strategies are powerful, but not without risk. The risk is that if you mis-understand the game, or the rival's willingness to invest or compete, you can get burned. A real example helps make the point.

Pratt & Whitney and Rolls-Royce. Pratt and Whitney and Rolls-Royce are two of the world's three makers of large commercial jet engines (the third player is GE, but it is not

germane here). Some years ago Rolls-Royce wanted to develop an advanced model of an existing aircraft engine, to be hung on Boeing 757 and 767's. Needing development capital to finance the upgrade, it approached the British government, which was willing to help as long as Roll-Royce could show some orders. To foil Rolls-Royce, Pratt and Whitney decided to try for a knock-out blow: it told all purchasers of a new P&W engine that its engine would be 8% more fuel efficient than any new or existing R-R engine for these aircraft. If P&W's engine was not 8% more fuel efficient than the competition, then the P&W would pay the buyer (an airline) the difference in fuel costs over the life of the product. P&W committed to this in writing when any buyer purchased a P&W engine.

The goal of this commitment strategy was to forestall any airline from ordering R-R's yet-to-be developed new engine—and, by doing so, deter R-R from developing the competing product at all. These efficiency guarantees would not be costly to P&W *if* they deterred R-R's investment, since P&W knew its current engine was 8% more efficient than R-R's older models. And as P&W anticipated, airline orders for P&W engines started racking up.

It was a very clever business strategy, but it had a fatal flaw. P&W analyzed this from the perspective of a game involving two players, P&W and R-R, but in doing so it got the game wrong. There was a third strategic player: The British government. Government agencies and politicians are very strategic (a lesson to remember), and they should be analyzed as such. Fearing a collapse of Rolls-Royce and taking umbrage at P&W's competitive maneuver, the British government went ahead and financed R-R's new engine development anyway—which turned out to be quite fuel efficient in the end. Pratt & Whitney ended up taking a bath on the guarantees it had given, and Rolls-Royce maintained its market share (more or less) in subsequent years.

The point of this is that if you do not analyze the situation you are in right, then a commitment strategy that limits your options may backfire. Carefully assessing the game is important before pursuing a commitment strategy, as the P&W example shows.

Managerial Implications

1. In making decisions where your payoff depends on how others expect you to act, you can sometimes gain a strategic advantage by limiting your options.

2. Limiting your options can have value if it is observed by others, and they know (or believe) you cannot reverse your commitment except at a prohibitive cost.

3. With a commitment strategy, you are aiming to change others' expectations of how you will act. But if you misjudge the willingness of *others* to act, limiting your options can be costly. Assess the situation carefully before you play it.

Problem 1 to Prepare for Class

This is a discussion with a few simple questions at the end. It has a thought-provoking purpose.

The Economics of Price Matching Offers

Best Buy and Circuit City are two consumer electronics retailers. Suppose that, in one particular city, these two firms are the only two sellers of a popular 42" 1080p Sony LCD television model. Each firm's sales of this product depend on both its and its competitor's prices, in similar ways:

$$q_c = 180 - p_c / 10 + p_b / 20 \qquad (\textit{Circuit City's demand})$$

and

$$q_b = 180 - p_b / 10 + p_c / 20 \qquad (\textit{Best Buy's demand})$$

where p_c is Circuit City's price for this model TV, p_b is Best Buy's price, q_c is the number of this model TV's sold by Circuit City each week, and q_b the number sold by Best Buy each week. Each firm's marginal cost (the *cost of goods sold*) for this model TV is $1200.

If you solve the two firms' reaction functions you'll find they cross at a price of $2,000 per set (you can check the math if you wish). If you (separately) solve for the monopoly price, it is $2,400. The dependence of each firm's profit (in thousand $ per week) on prices at these two price points is summarized by the following payoff structure:

		Best Buy	
		$2,000	$2,400
Circuit City	$2,000	64, 64	80, 48
	$2,400	48, 80	72, 72

If this game is played only once, what is the Nash solution? Is a price of $2,400 stable?

Now, let's suppose that each firm decides to offer a *price matching guarantee.* The way this works (in practice) is the following: Circuit City announces publicly that if a customer brings to Circuit City an advertisement, price quote, or sales tag from Best Buy listing a lower price (for this model) than Circuit City's price, then Circuit City will match the competition *and* take (say) 5% off the matched price. You have to bring in an ad or quote to get the "matched minus 5%" deal, though.

It is common for a retailer affected by a rival's price matching guarantee to respond in kind. So let's suppose that, in response, Best Buy immediately offers the same price

matching guarantee: Bring in a quote or ad from Circuit City, and Best Buy will match it minus 5%. Sounds like aggressive competition in a retailing business, right? Intuition suggests a price war of escalating discounts, with effective prices spiraling down to MC.

Game theory actually suggests otherwise. The point of the price matching offers is that they will change the payoffs of the two firms. Let's see how.

First, consider how Circuit City's price match offer affects the payoffs in the bottom-left cell of the game. Circuit City's profit in that cell—where it is the higher-price firm—will go *up* from a few additional sales to the comparison shoppers who ask for a price match (minus 5%) on Best Buy's $2,000 price. Best Buy loses these sales, so its profit in the lower-left cell will go down. But how will this cell's payoffs change quantitatively?

Suppose that, if one firm charges $2,400 and the other charges $2,000, only 12% (roughly 1 in 8) customers will actually bring in an ad or quote to get the set at $1,900 from the firm charging $2,400. Some quick math: If Best Buy charges $2,000 and Circuit City charges $2,400, then the $80k profit for Best Buy (in the lower-left cell here) corresponds to selling 100 sets at a *profit per set* of P – MC = $2,000 – $1,200 = $800 each. If 12% of these customers take their business to Circuit City to get the "match minus 5%", that's 12 fewer sets for Best Buy and $800×12 = $9,600 less profit for it. So Best Buy's payoff in the lower-left cell falls from $80k to $70,400 due to Circuit City's price match. We'll round this to $70 thousand in the table below.

Circuit City picks up these 12 customers, at a profit per set of $1,900 – $1,200 = $700 each, raising its profit in the lower-left cell to $48k + ($700×12) = $56,400. We'll round this to $56 thousand in the table below. Note we're assuming Circuit City still sells 40 sets at $2,400 each, and discounts its price to only the comparison shoppers that come over from Best Buy.[†]

So what happens when Best Buy responds with a price match of its own? This will change the *top-right cell* of the game, when Circuit City prices at $2,400 and Best Buy at $2,000. Since everything is symmetric in this problem (to minimize the math), retracing the logic of the previous two paragraphs will give us the same result, with the players switched: Best Buy's price match changes the two firms' profit entries in the *top-right* cell of the game to (70.4, 56.4), again in '000$ per week.

What about the cells in the top-left and bottom-right, where both firms price the same? In these cells each firm's profit falls by the effect of a 5% price cut on 12% of their sales. Using the demand curves, if both firms price at $2,000 then each firm sells 80 sets. This means 80×12% = 9.6 customers, on average, seek a price match minus 5% from the com-

[†] In principle, if the set can be obtained from Circuit City for $1,900 with a Best Buy price quote, then demand for sets will be higher overall by drawing a few new customers into the market. However, this "new demand" effect is small enough (with a take-up rate of 12% or so) that we can safely ignore it here.

peting firm. Note this will cut both ways: each firm has about 9.6 customers depart for the competitor to get the set for $1,900, but gets about 9.6 coming to it from the competitor to get the set for $1,900. The net effect is that each firm sells about 12% of its sets for $1,900 instead of $2,000. This will cost each firm $100×9.6 = $960 in expected profit, lowering each firm's profit in the top-left cell from $64k to $63,040 per week. We'll round this to $63 thousand in the table below.

Now think through the same set of calculations for the bottom-right cell. The demand curves imply that, if both price at $2,400, each firm sells 60 sets. So 60×12% = 7.2 customers, on average, seek a price match minus 5% from each firm. Since 5% of $2,400 is $120, each firms expected profit in the bottom-right cell will fall by $120×7.2 = $864 to $71,136 per week. We'll round this to $71 thousand in the table below.

Now, let's put the pieces together. If you followed all that (or even if not), what we've found is that when the two firms offer competing price matching guarantees, their pricing game changes from the game before to this one:

		Best Buy	
		$2,000	$2,400
Circuit City	$2,000	63, 63	70, 56
	$2,400	56, 70	71, 71

Questions. Find the Nash solutions to this game now. If Circuit City takes the lead at pricing at $2,400, what will Best Buy do? Is pricing at $2,400 a stable market outcome?

The Key Point. Recall that $2,400 was the monopoly (i.e., collusive outcome) price! If you didn't know game theory, it sure *looks like* "price matching" is aggressive competition. But is it, really? Now you know.

2. Repetition and Reciprocity

Firms in an oligopoly make many different decisions about how to compete: what prices to charge, how to advertise, location of facilities, product characteristics, and on. In practice, the inter-dependence of firms' payoffs with respect to these choices often has the structure of the "prisoners' dilemma" game introduced in the last note. When firms interact repeatedly, it opens up rich possibilities for pricing strategies that maintain prices far above marginal cost.

Consider the pricing problem in Figure 3. The payoffs in this matrix are from the Proctor & Gamble and Unilever pricing example we did during class in session 5. If you re-

call, when both firms price at $1.40, each firm's profit is $72K per month. Figure 3 includes a higher pricing point of $1.50, and the actual profit (in '000 $ per month) the two firms expected at those pricing points (this much you can verify using the spreadsheet from class if you wish, which is on WebCafé).

		Unilever's Price	
		$1.40	$1.50
P&G's Price	$1.40	72, 72	89, 63
	$1.50	63, 89	80, 80

FIGURE 3. *P&G and Unilever's Pricing Problem (payoffs in $000 / month)*

If this game was played only once, then you can quickly verify the only stable prices in this market are the Nash solution: Both firms price at $1.40. This is exactly what we did in class. But now suppose that the two firms will interact repeatedly—and that each can update its price monthly. Can a "cooperative" strategy in which both firms price at $1.50 be sustained? Depending on demand, cost, and interest rate conditions, the answer is often yes. Consider the following strategy for, say, P&G, called a *trigger strategy:*

> *Trigger Strategy:* Begin by cooperating. As long as the game continues and as long as both players have cooperated by pricing at $1.50, cooperate by pricing at $1.50. If any player cuts price, then forevermore price at $1.40.

If Unilever cooperates: What is Unilever's best response to this strategy? Suppose first that Unilever responds by always pricing at $1.50. Since this game is dynamic, we need to consider the time value of money to Unilever's management. Let's suppose they discounts future profits at a rate of r_a = 25% per annum, which corresponds to a monthly rate of approximately r_m = 1.877% (Parenthetically: This relation is $r_a = (1 + r_m)^{12} - 1$.) The present discounted value of cooperatively playing $1.50, holding demand and cost conditions fixed, is the discounted sum of $80K in monthly profit into the indefinite future:

$$80 + 80 / (1 + r_m) + 80 / (1 + r_m)^2 + \ldots = 80 (1 + r_m) / r_m = 4342$$

The right-hand side, where this infinite sum gives the total $80(1+r_m)/r_m$, is just a mathematical formula for the PDV of a sequence of constant cash flows compounded periodically forever (you can check this in Excel, or see your finance notes). Note that Figure 3's profit numbers are in thousands, so that right-hand side is $4.342 million.

If Unilever does not cooperate: Would Unilever be better off *not cooperating* with P&G's gambit of $1.50, and instead play the short-term best response of $1.40? If it did, Unilever would make $89K the first month, when it undercuts P&G's $1.50 price. But P&G's

strategy of then playing $1.40 forever after would make it Unilever's subsequent best response to do $1.40 forever after as well, with a subsequent profit of $72 per month. Run the numbers: If Unilever undercuts P&G's $1.50 price, the PDV of Unilever's future profit stream is

$$\text{PDV} = 89 + 72 / (1 + r_m) + 72 / (1 + r_m)^2 + \ldots$$

If you add 72 to both sides, this becomes

$$\begin{aligned}\text{PDV} + 72 &= 89 + 72 + 72 / (1 + r_m) + 72 / (1 + r_m)^2 + \ldots \\ &= 89 + 72 (1 + r_m) / r_m\end{aligned}$$

where the last step uses the mathematical formula for discounted cash flows again. Rearranging, PDV = 89 − 72 + 72 $(1 + r_m) / r_m$. Plugging in the monthly interest rate above gives the PDV of $3.925 million.

What does this mean? If Unilever and P&G both discount future profit at a rate of 25% per annum (and can update prices monthly), then by individually choosing prices of $1.50 they'll each make a profit stream with a PDV of $4.342, under current demand and cost conditions. This is about $350,000 more, in present-value terms, than if either firm cuts its price to $1.40, provided that the other will return that shot by pricing at $1.40 forever as well. In essence, playing $1.40 forevermore is the punishment that P&G can mete out if Unilever decides to cut price instead of cooperatively playing $1.50 when P&G prices at $1.50. It is a credible threat, because moving to $1.40 is P&G's best response to Unilever's price cut, and pricing at the $1.40 level is stable.

Wait, you say. Why would they punish each other by pricing at $1.40 *forever?* Wouldn't one firm go back to $1.50 at some point, hoping that the other would follow this lead instead of staying at $1.40? Yes, sometimes. This part all depends on what strategies each firm believes the other will play in response to a move back to $1.50. In addition to the trigger strategy, there is a common strategy used in games (and in reality) that will foster cooperation without having to punish each other indefinitely. This is called the *tit-for-tat* strategy:

> *Tit-for-tat Strategy:* Begin by cooperating. After this, do in the current round whatever your opponent did in the previous round.

Tit-for-tat is both simple and practical: P&G starts out with a high price, and maintains it so long as Unilever continues to price cooperatively at $1.50. As soon as Unilever lowers its price, however, P&G follows suit and lowers its price as well. If Unilever later decides to cooperate and raise its price again to $1.50, then P&G raises its price back to $1.50 as well.

In studies, the tit-for-tat strategy tends to work surprisingly well when play involves the same individuals over and over again, even if both of the players are just learning the logic of the previous two pages as they go along. In sum, competition on prices can yield a highly profitable, cooperative outcome that holds together over time, *if* all players understand the situation they are in and expect to face one another repeatedly.

Application: U.S. Steel Corporation[‡]

In its heyday, the U.S. Steel Corporation and its competitors regularly played 'tit-for-tat' to maintain higher steel prices. Here is an example of how it worked.

Facing intensifying price competition among the major steel producers, US Steel's competitors began offering to big buyers secret price discounts off the published "list" prices every producer maintains (the "price book"). Watching its market share slipping, US Steel finally quietly abandoned its policy of not discounting its prices and joined those who had been offering secret price cuts. Bethlehem Steel—another major producer—soon discovered that US Steel had offered one of Bethlehem's largest customers a secret discount. Bethlehem responded by announcing a 22% drop in its *list* price for the steel (hot-rolled sheets), from $113/ton to $89/ton. Bethlehem also publicly announced that "prices should go up, not down" but that Bethlehem "must remain competitive."

Three weeks later, US Steel raised its list price to $125. Nine days later, Bethlehem raised its price to $117. US Steel matched it. A few months later, Bethlehem raised its price to $129, and US Steel again matched it. These price changes tell a fairly obvious story. Bethlehem Steel says, "We're tired of these secret price cuts, and we're not going to take it any more" ($89). US Steel responds, "You're right, we're sorry, what price do you like" ($125)? Bethlehem Steel says "$117." US Steel says, "OK, $117 it is." A few months later, Bethlehem says, "Well if we can agree on $117, how about $129?" Again US Steel says, "OK, $129 it is."

Firms that compete with one another over a long period tend to know the market and each other well. As a result, they can send and respond to subtle cues from each other that allow them to avoid and quickly recover from periods of intense price competition.

Application: Seagate's Price Signaling

In many industries, executives "signal" to direct competitors what they would like one another to do next. To avoid legal tangles and price-fixing allegations, this is typically done with <u>unilateral</u> statements to journalists and the trade press of an industry—which then parrot the one firm's suggestions about future price changes to everyone in the in-

‡ This example is adapted from Saloner, Sheppard, and Podolny, *Strategic Management* (Wiley, 2001); many thanks to Garth Saloner for bringing it to my attention.

dustry. This is often quite overt. See, for instance, the excerpt from an interview with Bill Watkin, CEO of Seagate Technologies (one of the world's largest disk drive manufacturers), attached to this note.

Is this widespread, then?

A couple caveats to this are in order. You might wonder why cooperatively pricing at, say, "collusive" levels isn't more prevalent among competitors. There are several reasons for this.

(a) *Communication.* First and foremost, it can be difficult to reach an implicit understanding about these strategies without communicating about them. Explicit agreement about pricing between competing firms (including agreements about "tit-for-tat" that aim to support higher prices) is illegal.

By contrast, the logic above is based on the firms' managers simply *knowing* these sorts of results—on the basis of being savvy at business strategy, or learning a little game theory in business school (say). Each firm simply prices according to its dynamic profit-maximizing strategy, *given* the strategy of its competitors. Still, the prohibition on communication can make reciprocal pricing and punishment strategies hard to reach.

(b) *Short-term gains are high.* When the goods in question are closer substitutes, the numbers change such that the gains from "defecting"—that is, the payoffs to the price-cutter in the top-right or bottom-left cells in Figure 3—can become quite large relative to the punishment outcome. In that case, it would take implausibly low discount rates to sustain the firms' cooperatively pricing at a high level. In such cases, efforts by one firm to raise price "don't stick": the rest of the market does not find it profitable to follow the leader. The same conclusion follows if the firms apply high discount rates in valuing current versus future profits: If future profit is not valued high enough relative to profit today, then cooperatively pricing above the short-term stable price is unsustainable.

(c) *Too many players.* As the number of firms in the market becomes larger, sustaining the sort of cooperation examined here becomes much harder. The additional profit from pricing high is split among too many firms, and someone tends to cut price to grab the pie instead of just taking his or her share.

(d) *Uncertain market conditions.* Failure to cooperate is often the result of rapidly shifting demand or cost conditions. This makes it difficult for firms to reach an implicit understanding of what cooperative prices should actually be. One firm might believe it means charging $50, while a second thinks demand is lower and should be $40. If the second firm charges $40, the first firm might view that as a

grab for market share and respond in tit-for-tat fashion by pricing at $30. A punishing price war then follows. In sum, the sorts of cooperative strategies illustrated here tend to work when (1) the industry is fairly stable with respect to demand and costs, and the firms know this, and (2) the players expect to deal with one another for a long time.

Managerial Implications. There are three key lessons here:

1. If you and your rivals understand the dynamics of business strategy at this level, then it is possible to sustain prices above the short-term profit-maximizing level. (And that tends to be close to marginal cost if the products are close substitutes.)

2. It may be advantageous for you to keep familiar rivals around rather than driving them out. You want to compete against the same firms over and over again.

3. Cooperative pricing outcomes requires patience and a longer-term profit perspective. An overly short-term managerial focus on making the "quarterly numbers" can destroy cooperation within a market, and lower the present value of your firm (or your investment in it).

Problem 2 to Prepare for Class

Prior to class, please prepare your answers to the problem below. As usual, you may work with others if you wish.

At the intersection of 46th and Chestnut in Philadelphia, two gas stations sit next to one another. Both are independently-owned franchisees (one is a BP, and the other a Hess), which means each station's local owner is (solely) responsible for setting its price. There are no other gas stations for a considerable distance. In this industry, a gas station's demand is highly sensitive to a nearby competitor's prices, but is typically not sensitive to distant stations' prices.

Suppose that each of these two stations is deciding whether to price *high* (e.g., 40 cents per gallon over marginal cost) or price *low* (marginal cost plus a penny or two). Their payoff structure is:

		Hess	
		Price low	Price high
BP	Price low	4, 4	25, 0
	Price high	0, 25	15, 15

The payoffs in this table are each firm's *daily profit* (in hundred $). Each firm can updates its price daily. Assume that the two firms know how each other priced in all *previous* days and weeks, but—for simplicity—suppose that each firm must choose *today's price* at the same time, without yet knowing its rival's price.

(a) Suppose the BP station owner uses the following *one-day punishment strategy:*

> Start by pricing high. Price high until the first day *after* the Hess owner prices low. If that happens, punish the Hess owner by pricing low *for the next day only*; then revert to a high price the following day. Repeat as many times as necessary.

If the BP station followed this one-period punishment strategy *and the Hess stations' owner knew that*, would the Hess station ever price low for realistic discount rates (say, 25% per annum)? *Note: Start with only two days' analysis.*

(b) Now suppose that the BP station owner follows the one-period punishment strategy, but that the Hess station owner initially did not know this (remember they are not legally allowed to communicate such things explicitly). Would you expect the Hess station to figure this out over time? Why or why not?

3. Reputation and Credibility in Markets

The third important class of strategies that firms pursue in dynamic settings involves *reputations.* When there is uncertainty in a strategic situation and play is repeated, then reputation-building behavior becomes important. A reputation is simply the history of past behavior. In situations with incomplete information about what the future will bring, or about the competitive attributes of others, your reputation is an intangible asset that can earn future rents—and make promises or threats credible to competitors.

Using a Reputation to Make a Threat Credible

As usual, an example is helpful for making these ideas concrete. Consider the extensive-form game in Figure 4. In this game, called the *competitive threat game*, Sun Airlines must decide whether or not to challenge American. If there is no challenge, then Sun nets 0 and American gets 2. But, if American is challenged, then it must decide whether to fight or acquiesce. Acquiescence nets 1 for American, while fighting costs it 1, so it seems likely that American would acquiesce if challenged. Knowing this, Sun should challenge American and get a payoff of 1.

Or should it? What if, as Sun decides to enter American's market, American bares its teeth and issues a warning that, even though it will be costly to fight, this market "is the company's heart and soul" and "it will do whatever is needed to maintain its market

presence." If Sun believes this threat, it stays out, and American gets 2. Since it does not hurt to make such a threat—talk is cheap—American can growl away. Precisely because talk is cheap, Sun probably should disregard this threat as mere posturing. Assuming we have the payoffs right, American's threat lacks credibility.

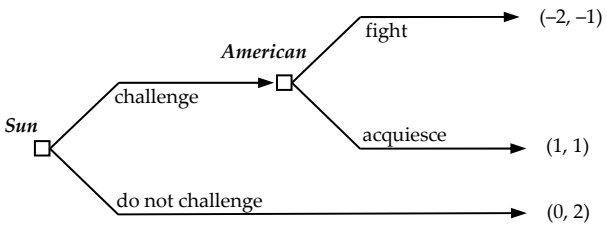


FIGURE 4. *The Competitive Threat Game.*

Now imagine that Sun and American play the threat game *repeatedly*. Let's suppose that, after each round of play, there is a 0.2 chance that the just-completed encounter was their last and a 0.8 chance that they play at least one more time. The payoff from the whole sequence of encounters is the expected sum of the payoffs.

Repeating the encounter, even if you are unsure whether or not your interactions will be repeated, opens up a wide range of possibilities. For instance, consider the following strategies for Sun and American:

> As long as American has a reputation for being tough, Sun will not challenge it. But Sun will challenge American if American's reputation is that it is a wimp.
>
> American will fight any entry that occurs, as long as it has a reputation for being tough. It will acquiesce if its reputation is that it is a wimp.
>
> American's reputation at the outset is that it is tough. It stays that way unless it acquiesces to some entry, after which its reputation is that of a wimp.

These strategies hold together (that is, they are a Nash equilibrium). And they make American's threat to fight Sun credible. To see this, suppose Sun challenges American. If American fights, it loses 1 this round but preserves its reputation. Assuming Sun reverts to the strategy of no entry, this gives a stream of 2 in every subsequent period, the expected value of which is

$$-1 + 2(0.8) + 2(0.8)^2 + 2(0.8)^3 + \ldots = 7 .$$

(You can trust me on the sum, or check it using the earlier PDV formula with $r = 1/4$). If, on the other hand, American acquiesces, it nets 1 immediately but loses its reputation for

toughness and so gets 1 for the rest of the game (however long it lasts). This has an expected payoff of

$$1 + 1(0.8) + 1(0.8)^2 + 1(0.8)^3 + \ldots = 5 .$$

So American is better off protecting its reputation for toughness than acquiescing and losing it. If American is going to fight to protect its reputation, then Sun's best response it not to challenge it.

Wait, you say. After Sun has learned its lesson from tangling with American, won't the next challenger be some other start-up airline other than Sun? Sure. But it is not necessary that American play Sun repeatedly. It suffices that American plays repeatedly, even if American plays a different challenger in each round, as long as the subsequent challenger(s) know and base their entry decision (in part) on American's reputation, and can observe what American did facing entrants in the past.

The point. In sum, reputation provides credibility in a way that legal contracts or explicit agreements cannot. American's threat to fight entry is credible because if it does not fight, it faces a much bleaker future than if it does fight. Acquiescence is relatively more expensive, not in the short run but overall, which is what it takes to make the threat to fight be credible.

Does this sort of thing actually happen in practice? Sure. See the attached *New York Times* article on American Airlines fighting off three competitors in fast succession (Sun, Vanguard, and Western Pacific) that made the miscalculation of entering American's Dallas-Fort Worth hub. No startup airline has entered DFW since.

Managerial Implications

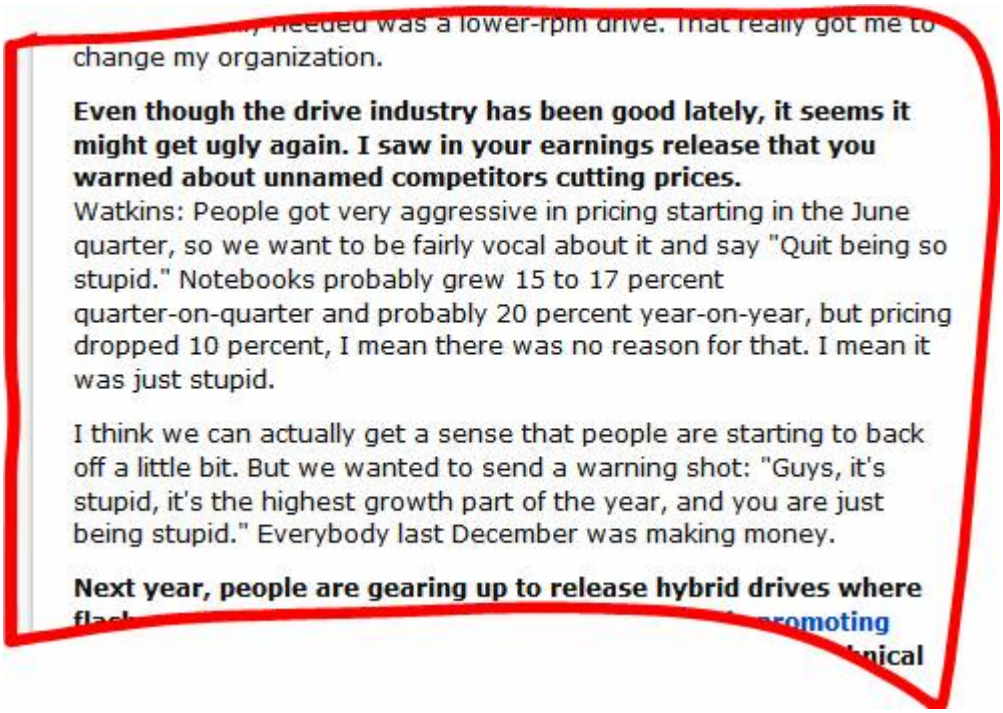
1. Reputations are an asset. They change other players' expectations about how you will behave, and are a substitute for commitment to a particular strategy.

2. Reputations make trust possible, and threats credible, in situations where it is impossible (or prohibitively costly) to contract on future performance. Trust (or threats) are credible *only when others believe you have more to gain by living up to your reputation then by losing it*. You may have to convince others of this.

3. Building a business reputation is a matter worth thinking through strategically. Without a useful reputation, doing business becomes costly: It is harder to convince new consumers you have a quality product, to convince your auditors that you keep clean accounts receivable, to convince the financial sector to loan you capital at a favorable rate, and so on.

Excerpt from an interview with
Bill Watkins, CEO of Seagate Technology

November 2006



needed was a lower-rpm drive. That really got me to change my organization.

Even though the drive industry has been good lately, it seems it might get ugly again. I saw in your earnings release that you warned about unnamed competitors cutting prices.
Watkins: People got very aggressive in pricing starting in the June quarter, so we want to be fairly vocal about it and say "Quit being so stupid." Notebooks probably grew 15 to 17 percent quarter-on-quarter and probably 20 percent year-on-year, but pricing dropped 10 percent, I mean there was no reason for that. I mean it was just stupid.

I think we can actually get a sense that people are starting to back off a little bit. But we wanted to send a warning shot: "Guys, it's stupid, it's the highest growth part of the year, and you are just being stupid." Everybody last December was making money.

Next year, people are gearing up to release hybrid drives where

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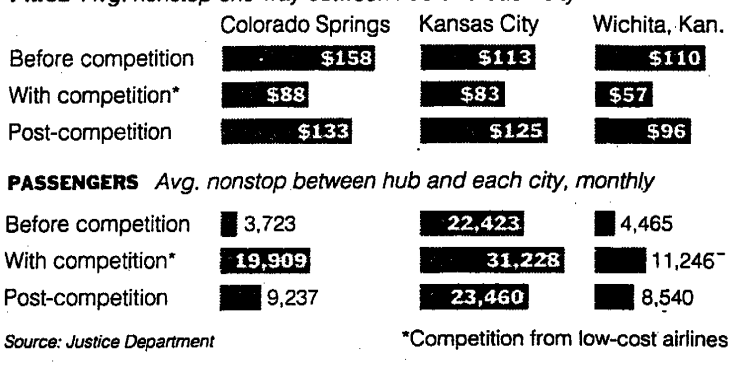
The face of a kinder, gentler Seagate
By Michael Kanellos
http://news.com.com/The+face+of+a+kinder%2C+gentler+Seagate/2008-1015_3-6131978.html
Story last modified Fri Nov 03 06:14:47 PST 2006

American Airlines Accused of Illegal Pricing

Excerpted from New York Times

Priced Out of the Market

An antitrust suit has been filed against American Airlines, accusing it of using predatory tactics during the mid-1990's against three low-cost carriers that tried to compete with American on routes to cities from its Dallas-Fort Worth hub.



The New York Times

Senior officials at the Justice Department said the American case was particularly compelling because company documents showed that American, the nation's second-largest airline, had deliberately embarked on a strategy of selling tickets below cost and incurring significant short-term financial losses in recent years to drive out three low-cost competitors — Vanguard Airlines, Sun Jet International and Western Pacific — from Dallas-Fort Worth International Airport.

Executives and lawyers at American said the airline had not violated any antitrust laws but simply matched the fares of its competitors.

In 1998, American flew 70 percent of the scheduled seats out of Dallas-Fort Worth, up from 60 percent in 1991. The Government presented evidence showing that after Vanguard announced in September 1996 that it was adding service to Dallas-Fort Worth from three cities in addition to Wichita, Kan., American responded by cutting prices and adding flights on nearly all of Vanguard's Dallas routes. Two months later, Vanguard abandoned its expansion plans. By June 1997, American had reduced capacity between Wichita and Dallas by 30 percent and raised the average one-way fare by more than 50 percent to more than $90 from about $60.

"American quickly realized that these new carriers could be a significant competitive threat, estimating that as much as a billion and a half dollars of its annual revenues were at risk if they were to succeed," said Joel I. Klein, the Assistant Attorney General in charge of the antitrust division. "To make sure that this didn't happen, American adopted a predatory responsive strategy, saturating the market in which the start-up carriers had begun service with as much new, low-fare service of its own as was necessary to drive out the start-ups."

Attorney General Janet Reno said American "invested in short-term capacity increases and fare reductions to maintain its monopoly — an investment it was able to recover many times over once its smaller rivals had been driven away."

American Airlines disputed the accusations by the Justice Department that it had priced its fares below cost or flooded the market with flights, and said the lawsuit was little more than sour grapes by smaller airlines, which, unable to compete, had persuaded regulators to bring the case.

"Contrary to the Justice Department's lawsuit, this action today is very potentially anti-consumer," said Chris Chiames, a spokesman for the AMR Corporation, the parent company of American. "It would have a chilling effect on the marketplace if companies felt they could not match prices of competitors. We simply matched the competition."

The Justice Department complaint, filed in Federal court in Wichita, seeks an injunction barring American from cutting prices below cost and increasing flights as part of any effort to stifle competition. The case is being brought under Section 2 of the Sherman Antitrust Act.

Trying to sort out stiff competition from antitrust violations.

Justice Department officials said Federal antitrust law does not permit them to seek any fines or monetary awards, but that smaller airlines that were harmed by American's conduct could file their own civil antitrust lawsuits for money.

The complaint quoted from company papers describing its "Dallas-Ft. Worth Low Cost Carriers Strategy." The Government said the strategy recognized that "it could prove unprofitable in the short run." But, according to a company document, the strategy concluded: "The short-term cost, or impact on revenue can be viewed as the investment necessary to achieve the desired effect on market share."

The Government also quoted from internal American papers that suggested that the carrier intended to add flights to Kansas City to drive Vanguard from the market and that American decided to get Western Pacific out of the Dallas-Colorado Springs route before Western Pacific increased its service there.

Company executives declined to answer questions about the American Airlines documents that the Government has called incriminating but defended them in general terms.

"There is nothing wrong or illegal with tough talk about competition," Mr. Chiames said.

Trey Nicoud, a senior lawyer at American, said, "Looking at aggressive conversations in board rooms is very misleading."

To win against any airline, the Government's evidence would need to be strong because predatory pricing cases are difficult to prove. But Justice Department lawyers have argued that it is relatively easy for a large airline to profit after undercutting a rival and driving it out of a market. In the past, the Government has distinguished between legitimate competition and predatory pricing when an airline cut its fares below its costs and added capacity in a strategy that only made economic sense if the smaller rival were forced to leave the market.

Executives from the smaller rivals portrayed as victims by the Government praised the lawsuit. Of the three, Vanguard has since returned to the Dallas-Fort Worth market, Sun Jet no longer serves that airport, and Western Pacific has filed for bankruptcy protection from its creditors and stopped flying in early 1998.