

Vaporware: An Expanded Equilibrium

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Software companies are often accused of using vaporware: a fallacious preemptive announcement of a new product in an attempt to ward off potential competitors. While achieving this end, vaporware has harmful repercussions on consumer demand for the current product. This essay examines the cases in which vaporware can be used successfully by analyzing the balance between costs and benefits of vaporware in a simple two period game. This model is then expanded to include mitigating factors such as the degree to which the announced product renders previous product obsolete, firm size, reputation, and market structure.

Industrial production has had a whole new dimension added to it over the past 40 years. With the invention of the computer, came the creation of the software industry. The software industry has a very different production dynamic than most other companies. There is no verifiable product until production has been completed. Unlike a normal company there are no clearly observable inputs being delivered to the company nor is there obvious assembly being done during production. Only in its final phases does software production even require a corporation. Software is often designed on normal desktop equipment, allowing for production to go basically unseen until the final release (Bayus 4).

The nature of the software industry makes product announcements extremely important. One cannot show a consumer thousands of lines of code as an advertisement. Until the product is actually released, the announcement of the product is all that exists of the product in terms of both consumers and possible competitors. The reliance on announcements as being the only real source of new information has created a difficult

dynamic amongst software companies. There is an ability to be misleading with announcements because the ability to monitor the truth effectively is very limited.

This practice of untruthful product announcements has become so common that the term vaporware has come to be used to describe it. The term “vaporware” was originally coined by Atari users, but became most famous in reference to announcements about Microsoft’s Windows operating system, especially in relation to alleged release dates. Vaporware is the announcement of a product that has not been, and may never be, released. The actual truth about the timetable and existence of the product is private information to the production company. All knowledge competitors have about the product comes through the producer’s announcement or attempts at other communicative actions.

Vaporware is used throughout the software industry as a method of guarding or stealing market share. This preemptive and often untruthful announcement of a new product release creates barriers of entry for possible entrants, as well as hindering current competitors’ potential ability to compete. To best understand the uses of vaporware it is easiest to first look at how it functions in a world of perfect information, initial monopoly, and for a revolutionary product making previously existing products obsolete (these assumptions will be relaxed in the future) (Haan 347).

A test case for the use of vaporware is best seen in a two period game. In period one there exists an incumbent company with a given product, software A. In period two a new company may enter with a product, software B, which can effectively compete with the incumbent’s software A. However, if the incumbent company creates a new

improved product, software C, then the entrant would be unable to compete in period two.

In period one the only information the entrant possesses is what the incumbent announces about its type, a firm either with or without product innovation, software C, for period two. If it claims that it will produce software C in period two then the entrant will have to consider not producing at all in period two. Under normal conditions the truth of the existence of software C is private knowledge and unknown to the entrant, but in this example the existence of perfect information allows the entrant to know the truth about the existence of software C (Bayus 9).

When the game is run to completion, both firms make profit maximizing decisions. In period one the incumbent exists as a monopolist, and in period two either remains a monopolist if it can produce software C or competes in a Cournot duopoly with the entrant firm if the firm does not have the innovation (Matsumoto 296). This game will most likely take on a Cournot competition because the undertaking of vaporware announcements is strictly to discourage competition, so coordination during the following period through interaction like a cartel model is unlikely.

With perfect information both firms know what will happen in period two and must play accordingly. The incumbent firm if it can produce software C will maximize its sales in both periods one and two as a simple monopolist. Maximizing its profits in both periods by selling at the point on the demand curve directly above where marginal cost is equal to marginal revenue as seen in Figure 1. Setting a simple demand curve

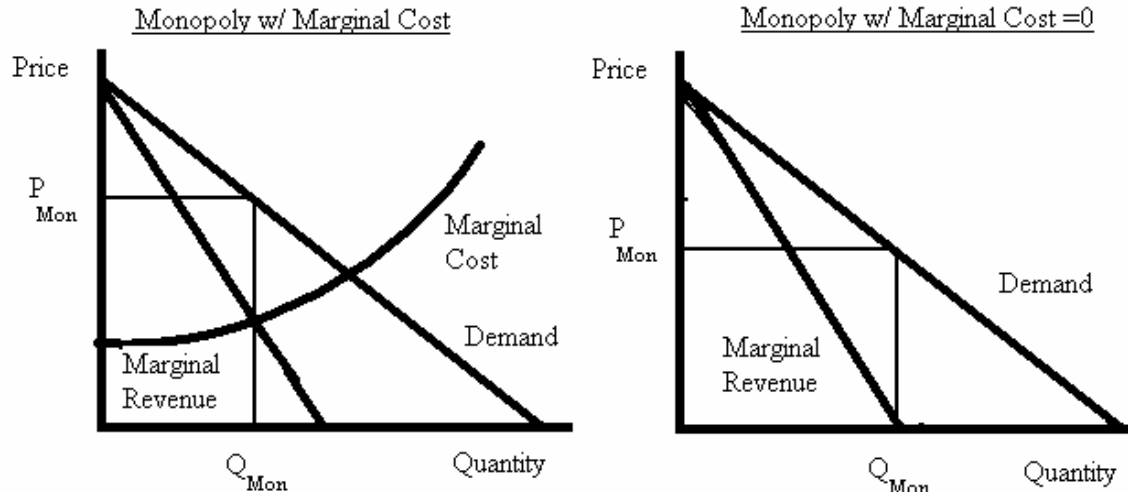


Figure 1: Standard market with a monopoly competitor with marginal cost (left) and with marginal cost equal to zero (right)

where quantity demanded (Q) is equal to a constant (X_1) minus the price (P_1) ($Q = X_1 - P_1$)

and marginal cost equal to zero the profit maximizing quantity is produced where marginal revenue equals zero. (X_1 is the demand constant associated with monopoly demand not necessarily the specific demand of a given period)

$$MR = d(P Q_1) / d Q_1 = d[(X_1 - Q_1)(Q_1)] / d Q_1 = d(X_1 Q_1 - Q_1^2) / d Q_1 = X_1 - 2 Q_1 = MC = 0$$

$$X_1 = 2 Q_1 \quad Q_1 = 2 / X_1$$

$$R_{1,1} = P Q_1 = (X_1 - Q_1)(Q_1) = [X_1 - (X_1/2)](X_1/2) = (X_1^2)/4$$

The monopoly quantity of software A will be sold in period one and monopoly quantity of software C will be sold in period two. The entrant will stay out, knowing it cannot compete against software C and therefore entering would simply have resulted in a loss of fixed costs F with no possibility for any revenue.

However if the incumbent cannot produce software C, the profit maximizing conditions change. Not only will the entrant firm compete with the incumbent in period two as a duopolist, but the incumbent will also change his decisions. Since the incumbent is selling the same product in both periods one and two selling the monopoly

quantity in period one may no longer maximize profit. Some demand must be held over into period two. The incumbent will maximize the number that can be sold over the two periods combined. In the Cournot model both firms are subject to the demand curve for their combined supply. Taking the same simple demand curve for this period, where quantity demanded Q is equally to a constant for period two X_2 minus the price P_2 ($Q = X_2 - P_2$), the total quantity offered Q equals the amount sold by the incumbent q_I plus the amount sold by the entrant q_E in period two. The revenue R for the firms appears as follows:

$$R_{I,2} = P_2 * q_{I,2} = (X_2 - q_{I,2} - q_{E,2}) q_{I,2}$$

$$R_{E,2} = P_2 * q_E = (X_2 - q_{E,2} - q_{I,2}) q_{E,2}$$

Each firm also assumes that the reaction to its output decision will not affect its competitor's output decision, which creates the following reaction functions.

$$d(R_I)/d(q_{I,2}) = X_2 - 2q_{I,2} - q_{E,2} = 0$$

$$d(R_E)/d(q_{E,2}) = X_2 - 2q_{E,2} - q_{I,2} = 0$$

In equilibrium, the reaction functions must be mutually consistent, allowing the two equations to be solved simultaneously.

$$q_I = q_E = X_2/3$$

$$P_2 = X_2 - (q_{I,2} + q_{I,2E}) = X_2 - 2(X_2/3) = X_2/3$$

$$R_{I,2} = R_{E,2} = P_2 q_{I,2} = P q_{I,2} = (X_2/3)(X_2/3) = (X_2^2)/9$$

Under normal circumstances, this equation is easy to maximize however the demand function for software A and B in period two depend on sales of software A in period one.

They only compete over the residual demand. The value of X_2 is partially dependent on

the quantity of software A the incumbent sells in period one. The incumbent firm will sell the amount that maximizes total revenue. For simplicity when competing in period

$$\max (X_1^2/4) + (X_2^2)/9 \quad \text{subject to } X_2 \text{ being some function of } X_1$$

two, period one's profit maximizing quantity for the incumbent will be defined as Z_1 , and period two as Z_2 (Gerlach 190). The entrant's revenue will be $Z_2 - F$ in period two because it splits the demand left over after the incumbent picks its value of Z_1 . The decisions of what quantities to sell at will be obvious because both sides know exactly what will happen as seen in Figure 2. The squares in the game for period two "produce software C and enter"

		Period 1	
		Entrant	
		Enter	Not Enter
Incumbant	Produce C	$(X_1^2)/4, 0$	$(X_1^2)/4, 0$
	Not Produce C	$Z_1, 0$	$Z_1, 0$

		Period 2	
		Entrant	
		Enter	Not Enter
Incumbant	Produce C	Not Possible	$(X_1^2)/4, 0$
	Not Produce C	$Z_2, Z_2 - F$	Not Possible

Figure 2: These cells represent the game played between the incumbent and the entrant and their corresponding payoffs under perfect information

and “not produce software C and do not enter” are not viable options because it is always better for the entrant to correctly respond to the incumbent’s decisions in such a way as to maximize its own profits.

Now the actions taken by each firm are obvious under perfect information, however perfect information rarely exists in the real world, and proves especially lacking in the software industry. This adds a new facet to this game. The entrant, when lacking perfect information could be incorrect on the type of firm the incumbent is. Thus exists a possibility for the entrant to make the wrong decision about how to respond to incumbent in period two. There is a possibility that the entrant may enter even if the incumbent has a new software C, and in that case makes no sales and loses its fixed costs (F). There is also the chance that even though the incumbent cannot produce software C, the entrant believes they can and chooses incorrectly not to enter. The game appears the same in period one however there are new possible outcomes in period two interaction as seen in Figure 3.

		Period 1	
		Entrant	
		Enter	Not Enter
Incumbant	Produce C	$(X_1^2)/4, 0$	$(X_1^2)/4, 0$
	Not Produce C	$Z_1, 0$	$Z_1, 0$

		Period 2	
		Entrant	
		Enter	Not Enter
Incumbant	Produce C	$(X_1^2)/4, -F$	$(X_1^2)/4, 0$
	Not Produce C	$Z_2, Z_2 - F$	$(X_2^2)/4, 0$

Figure 3: These cells represent the game played between the incumbent and the entrant and their corresponding payoffs under imperfect information

The question now arises what strategy is in the best interest of the incumbent. When it has a new software C it does not care what action is taken by the entrant and simply sells its monopoly quantities in both periods. Even if the entrant enters in period two its software B is obsolete compared to software C and therefore has no effect on the demand faced by the incumbent firm. In the case where the incumbent cannot produce software C there is a significant difference whether the entrant chooses to enter or not. If the entrant does enter, the incumbent produces software A to maximize $Z_1 + Z_2$, however if the entrant does not enter the incumbent is allowed to exist as a monopolist in period two and maximizes Z_1 for period one assuming there will be competition in the future and maximizes $(X_2^2)/4$ in period two to fulfill its monopoly position. The preference order for the incumbent is to be able to produce software C, followed by convincing the entrant it can, even when it cannot, and finally competing in the market with the incumbent. This ordering of priorities shows a clear slant in the incumbent's ideal strategy. The

$$2[(X_1^2)/4] > Z_1 + (X_2^2)/4 > Z_1 + Z_2$$

incumbent always wants the other firm to believe that it has the ability to produce software C.

This seems like a relatively simple conclusion with a single strategy for the incumbent: convey oneself as one capable of producing software C. However, the market has two sides and the consumer side greatly complicates this interaction. In the game it is not only the action of the entrant matter, but the actions of the consumers of the products. To simplify the original analysis the interaction between the incumbent and the consumer will be examined without the complication of competition. In period one the incumbent exists as a monopolist, but actual sales will depend on their type. If they are capable of producing software C in period two, making software A obsolete, there will be a much lower demand by consumers for software A in period one. It will only have value for a single period significantly dropping the consumer's willingness to pay (Haan 354). The value of X_1 drops to X_3 lowering the monopoly revenue possible. The incumbent in period two remains capable of selling the full monopoly quantity because the product demand is at full value and there is no competition.

If the incumbent firm is incapable of producing software C then the sales figures remain unchanged. In period one and two the same product is being sold so the demand remains at full values through the two periods. Consumers demand software A equally over the periods, and the incumbent can maximize profits accordingly. The firm acts like a monopoly in both periods distributing sales over the two periods.

Looking at this interaction absent, for the moment, the possibility of entrants creates an interesting conclusion for incumbent's action. Under perfect information the consumers demand is $Q=X_3- P_1$ in period one and $Q=X_1- P_2$ if the incumbent can produce

software C. Since X_3 is less than X_1 the profit levels are lower than originally expected for the two stage monopoly the incumbent holds if it can produce C. The firms can sell the maximum monopoly level subject to those constraints $(X_3^2)/4$ in period one and $(X_1^2)/4$ in period two. If the incumbent cannot produce software C then consumers demand software A equally allowing monopoly profit maximization over both periods $2[(X_1^2)/4]$ as seen in Figure 4.

		Period 1	
		Consumer Believe Product C	Consumer Believe NO Product C
Incumbant	Produce C	$(X_3^2)/4$	Not Possible
	Not Produce C	Not Possible	$(X_1^2)/4$

		Period 2	
		Consumer Believe Product C	Consumer Believe NO Product C
Incumbant	Produce C	$(X_1^2)/4$	Not Possible
	Not Produce C	Not Possible	$(X_1^2)/4$

Figure 4: These cells represent the game played between the incumbent and consumers and their corresponding payoffs under perfect information

If perfect information is relaxed again when dealing with consumers, the chance for consumers to guess incorrectly once again returns. If the producer can produce software C in period two, but the consumers do not believe that to be so a new dynamic is created. The incumbent is able to sell the full monopoly quantity subject to $Q=X_1- P_1$ in period one making revenue of $(X_1^2)/4$, and again can sell the full monopoly quantity in period two, making revenue of $(X_1^2)/4$. However, if the incumbent cannot produce software C and the consumers believe them capable to do so then the incumbent can only sell subject to $Q=X_3- P_1$ in period one, $(X_3^2)/4$, and will sell monopoly quantity in period two $(X_1^2)/4$ as seen in Figure 5.

		Period 1	
		Consumer Beleive Product C	Consumer Beleive NO Product C
Incumbant	Produce C	$(X_3^2)/4$	$(X_1^2)/4$
	Not Produce C	$(X_3^2)/4$	$(X_1^2)/4$

		Period 2	
		Consumer Beleive Product C	Consumer Beleive NO Product C
Incumbant	Produce C	$(X_1^2)/4$	$(X_1^2)/4$
	Not Produce C	$(X_1^2)/4$	$(X_1^2)/4$

Figure 4: These cells represent the game played between the incumbent and consumers and their corresponding payoffs under imperfect information

The incumbent firm has a clear dominant strategy when dealing with the consumer. It wants the consumer to believe it is the type lacking the ability to produce software C in period two. The profit in period two is always the same because the expectations are always correct and the incumbent is a monopolist. However, the consumer's belief in period one can greatly affect the revenues the firm can take in. Consumers believing the firm will produce software C will mean lower demand for software A in period one causing lower profits. If software A is believed to be the best product for both periods one and two then higher profits become possible (Levy 37). If consumers believe no software C will be produced then the incumbent can make $2[(X_1^2)/4]$ instead of being limited to $(X_3^2)/4 + (X_1^2)/4$ revenue whether it can actually produce software C or not ($2[(X_1^2)/4] > (X_3^2)/4 + (X_1^2)/4$). The firm wishes to be always seen as one without a new product.

The interaction with the possible entrant and with the consumer creates a very difficult decision for the incumbent firm. To maximize revenue in relation to possible entrants its focus is to convey itself as one capable of producing software C. However, there is exactly opposite motivation in terms of dealing with the consumer. The ability to extract revenue from the consumer is maximized when the incumbent is believed to be unable to produce software C. The best case for a firm is when it is capable of producing C, but makes people believe that it cannot. Consumers buy the full volume of software A in period one, and in period two the incumbent retains its monopoly by producing software C. When it is capable of producing software C the incumbent does not care what the entrant does as there is no possibility for the entrant to compete. The results

beyond this ideal situation become rather complex. There is a delicate balance between losing period one sales and being forced to lose monopoly in period two.

The equilibrium created by the balance between maximizing profit in terms of consumers and maximizing profit in terms of possible entrants creates a pooling equilibrium (Haan 352). If the revenue associated with maintaining monopoly is greater than the demand losses caused by using vaporware, the vaporware can be used as a viable tool and can be a possible equilibrium. However, if the opposite is true then the opportunity for vaporware does not exist. Lying to the consumer may be useful, however, it would be through pretending to not have a product rather than by having a vaporware product. The specifics of this calculation will be expanded upon later in this paper once more tools are available.

Vaporware possibilities in this game clearly exist with the given assumptions. The next section will go on to relax some of these assumptions and show how it alters the equilibrium. The first major assumption is the existence of a revolutionary software C. Very few products make all previous products truly obsolete. While often new products appear as an enormous improvement there will still be some market, at a lower price, for the past generation's product, and consumers will still be capable of using the old product; it will simply lack the new features. This further blurs the already unclear lines of this equilibrium, but still leads to very similar results (Gerlach 187).

If software A and software B will still have some demand associated with them in period two even if software C is released, the entrant firm will have a new third alternative. The entrant will now be able to enter the market and compete against software A at vastly lower consumer demand when software C is released. This does

however mean that the entrant will not instantly refuse to enter if it believes there is a new product. If there is a new product, the entrant will enter if the demand for both software A and B in period two (X_4) is high enough such that the duopoly profits possible, $(X_4^2)/9 - F$, exceeds the fixed costs faced by the entrant. This creates more cases where the entrant enters, especially if it is facing low fixed costs to get started.

Consumers similarly have a less altered demand for software A in period one when software C is announced. Since it will maintain some value in period two, but less value than software C, demand for software A will be in between the levels $X_1/3$ and $X_3/3$, X_5 . There is still a motivation for the incumbent to make the possible entrant believe there is a new product; lowering the entrance threshold from guaranteed down to the $(X_4^2)/9 - F > 0$ level. Similarly the incumbent still wants consumers to believe there is no product such that they will consume at level $X_1/3$ instead of $X_5/3$. This does remove the ability to effectively use vaporware if the new product leaves open a large market for software B such that the entrant can make profits either way. It also increases the opportunities in some cases because profit loss due to having a new product is lowered, creating more cases where gains due to entry deterrence are greater than losses in current period sales.

One practice many incumbents are able to take advantage of in the software industry is using compatibility to make a product with fewer innovations revolutionary. By connecting other products' ability to be used to the new product it can be transformed into something revolutionary in the eyes of consumers. Consumers will want the new product due to its improvements, but if the new product exclusively allows the use of support products then the demand for software A and B in period two will be zero. This

allows a non revolutionary product to be treated as one by consumers returning the game to the original equilibrium, unlike the case where a similar product that does not alter compatibility and possible usage with other products which exists with the new threshold levels.

Another built-in assumption is that the firms are of relatively equal size and capable of competing on a relatively equal playing field. Firm size varies greatly across the industry and the size of the competing firms alters responses they make in this game. If the incumbent is very large and the entrant is small the incumbent is capable of altering the dynamic of the interaction if the entrant does decide to compete in period two. A Cournot duopoly interaction can be removed by the larger firm by lowering its prices and raising its quantities sold. This lowers the revenue made by both firms; however the larger firm is in a much better position to absorb the loss. Based on the no marginal cost assumption, any revenue the incumbent makes is profit, but the entrant has to compete with its recently invested fixed costs.

The larger firm's ability to alter period twos payouts by undercutting the smaller firm can make the entrant less likely to enter knowing this is a possibility (Bayus 11). The incumbent still wants the entrant to believe its vaporware exists, because driving out a competitor already in the market will drastically increase their profits. However, the greater risk of loss does lower the threshold on the vaporware claims that the entrant is willing to believe.

The game with a small incumbent and a large entrant runs with similar principles, but in the opposite direction. The large entrant has significantly less fear of losing the fixed costs than a normal firm would, because it represents a comparable smaller portion

of total value. This makes the entrant much harder to deter with the threats of loss due to a new software C. The incumbent will still attempt vaporware in the same cases; however the impact will be significantly lower. Claims will require increased legitimacy to be believed making it much harder to succeed in maintaining monopoly with a vaporware product.

Vaporware is not always a good strategy, but if a firm decides to attempt it there are a variety of methods that can be used to enact it. The simplest is what has become known of as “cheap talk”. In general, decisions get made with a significant amount of the real information relevant to the decision left in the dark. Information must be conveyed and gathered in attempts to make more informed decisions. The simplest and cheapest form of information sharing is speech. Free to produce, and usually easy to interpret, speech is the ideal form of information sharing. Simple announcements by the incumbent can work to make it clear to all sides what type of firm the incumbent is; one with or without an innovation (Crawford 134).

There is a problem however when information is conveyed through speech. It is costless for the owner to produce, and therefore does not hold any real credibility. If there is no outside enforcer to impose penalties on untrue speech, it is not clear whether mere words can be trustworthy (Farrell 186). A new and more complex interaction comes into play when there is no truth enforcement. Another level of information gathering becomes important. Besides hearing the announcements incumbents make, there must also be an investigation into the motives of the incumbent, and how they compare to your own.

In cases where both sides have similar motives the answer is simple. If what is best for the announcer is best for the listener, then the statements can be taken at face value, because there is no motivation for the speaker to lie. If the speaker's statements are taken as a lie then both sides are worse off.

However, in the case where motivations diverge, the listener must make a choice about whether to believe the speaker. The speaker's motivation for his statements is to maximize his own benefit which in many cases does not coincide with the listeners benefit(s). The hope of moving away from equilibrium to a better individual result depends on the setup of the interaction. If benefits strictly conflict like in the zero sum game any cheap talk is meaningless and has no hope of changing the outcome. In this case the cheap side of cheap talk is accentuated. It is only if untruthful speech came with a penalty greater than the reward associated with misrepresenting that type of incumbent one would it be believable.

The final and most interesting case is where the speaker and listener have neither completely aligned or completely opposite payoffs from their interaction. This is where vaporware announcements exist. Since all sides know there is no pure strategy that can be played consistently, announcing software C or not, there is no ability to instantly reject or accept the announcements the incumbent makes. The participants can make attempts to shift away from equilibrium by saying what their move will be in period two. Any announcement by the incumbent is cheap talk representing a nonbinding statement, but statements possibly capable of conveying useful information.

The announcement of a new product can gain some validity through advertising. This ties company profits to the new product. Every cent the incumbent spends

advertising software C before it is released is credit towards the validity of the announcement. If significant advertising takes place, and software C never is released, all the money spent on advertising is lost. The hope is for it to be recovered through scaring away entrants, but the risk of loss makes the announcement more credible.

Speech is an extremely easy to use form of vaporware. Being both free to produce and easily understood by all parties makes it easy to use, but this ease also renders its ability to truly alter equilibrium extremely limited. More radical methods can be undertaken by the incumbent. Communicating vaporware through actual product sales is another possible method. This is a much more risky endeavor for the incumbent. Take the case where profits from eliminating possible competitors are larger than losses due to lowered demand by consumers in period one. In this case it is of the firm's interest to convey itself as one capable of producing software C in period two. If the firm is incapable of actually producing software C though it should sell software A at a price and quantity to reach the value Z_1 maximizing profits over the two periods when it is forced to compete in period two. However, selling at that level conveys to the possible entrant what type the incumbent is (Haan 355). Upon observing Z_1 , or the prices and quantities that make it up, the entrant is led to believe that the firm cannot make software C, because if it could it would sell the monopoly quantity to increase profits.

The incumbent can choose a more devious plan. It can choose to sell the monopoly quantity even though it cannot produce software C. When the entrant observes the prices and quantities associated with the monopoly revenue level $(X_1^2)/4$ it is led to believe that the firm can make software C, because if it could not make software C then it is losing money selling the monopoly quantity in period one. If the entrant decides to

enter in period two, and sell software B, a near perfect substitute for software A, that the incumbent is trying to sell, then the incumbent firm loses money for this employed strategy. However, the fact that the incumbent is placing a financial risk by making this move makes the move more credible. The entrant cannot know if the incumbent is actually capable of making software C, and therefore making the entrants entrance into the market disastrous, or if it is a vaporware ploy. With cheap talk making any statements has no costs, but vaporware through product sales can come with penalties. The entrant is much more likely to not test the incumbents bluff knowing that the company has placed sometimes millions of dollars of possible loses on itself if their bluff is called.

The drawbacks of vaporware through product sales are both the time frame and the limited ability to observe. Unlike cheap talk, which can be made at any time, product sales are not a clear defined quantity until the end of a period. The entrant cannot fully know what signal the incumbent is sending until after period one ends and the final quantities sold have been seen. This is often too late for the entrant to react. Upon the end of period one, period two begins and it is at this point that the entrant is planning to possibly compete with the incumbent. The decision to enter cannot be an instant one since all products, especially software, have a long development time. The decision to enter needs to be made usually before or at least during period one for entrants to truly try and compete in period two. There are of course signs of the incumbents selling strategy, but the concrete evidence for a given plan is not clear soon enough in some cases.

The additional difficulty with product sales is simply gathering the information at all. Sale volumes and other necessary numbers are not always observable by competing

firms. Guesses and other crude estimations can be made by possible entrants but if the incumbent strategy changes are subtle between monopoly sales and Z_1 sales then the estimates may not be able to pick that trend up.

Cheap talk and product sales can both be used to create vaporware. The combined use can allow for even greater strategic movement by the incumbent. Up until now it has been assumed that the entrant and consumer have the same ability to observe and rationalize through vaporware signals. However, this is generally untrue. The entrant firms hold two distinct advantages over consumers, money and experience. The entrant firm has much more at stake when deciding on its actions in response to the incumbent. The consumers risk is only the cost of a single item; however the entrant is risking all the fixed costs of the entire business. Since the entrant has much more at risk, it is similarly willing to invest more into research. Analysis of the statements and product signals are done on a much more complete level by possible entrants.

In addition entrants have more experience in the field, allowing them to make sense of the information they are getting. If the incumbent announces an impossible to create new software C , the entrant will be able to realize it as obviously false, where consumers in many cases will not. The actual method used depends on what type of firm the incumbent is and which side it is trying to convince. Expensive advertising campaigns and altered product sales will weigh heavily on entrant's belief of the incumbent's type. The entrant knows that if the product is vaporware and either of these steps is taken, the incumbent is risking significant losses. The more minute the analysis is upon these two methods; the more likely the entrant can make an informed decision.

The consumer, on the other hand, has an insignificant research budget. Ten million sales at five dollars each versus fifteen million at four dollars each are both unobservable for consumers, and would be unlikely to mean anything to them anyway. Advertising may assist in altering demand by consumers of the product, but the cost of the advertising project will not sway the credibility of the statements by the incumbent, because they will be unknown. Consumers are harder to sway because it is harder to lend credibility to the actions they observe. However, any attempts to sway them, primarily cheap talk, can be done at almost no risk to the incumbent.

These factors combine to create an interesting loophole in the uses of vaporware. The firm can use the research intensive indicators of vaporware, and use this to indicate a new product to possible competitors, while simultaneously not scaring away customers, by telling them their current planned purchase will not soon be useless. This extends the number of situations that vaporware can be used in as an equilibrium. In cases where loss of current sales is comparable or slightly greater than gains from removing competition, vaporware may still be used effectively due to this information gap. This cannot be used to fully eliminate the consideration of consumer expectations, because the actions necessary to guarantee no competition require much grander scale moves that will be obvious to all.

Vaporware is a very difficult endeavor for any firm. Executing it incorrectly can be extremely costly, both in the costs associated with failure and the costs taken on in trying to convince the other players it is true. Vaporware is risky in a single interaction game because the methods of gaining credibility are limited. However, if the parties interact many times over the course of history the possibilities for successful vaporware

are far less frequent, but when done correctly they become easier and have the possibility to be more rewarding. In the single interaction game there is no real innate trust or distrust between the parties. Over time though trust can be developed; every action an incumbent has made in the past, while often hard to check at the time, can be seen very clearly after the fact. If a company only announces new products when it has new products, these announcements are extremely believable. This is how reputation begins to play an important role in this interaction.

Reputation for being either truthful or untruthful has an important role in the way entrants and consumers respond to announcements made. The problem with all attempts in vaporware is that whatever effort is undertaken by the company, it is done in an attempt to hurt at least one of the parties. The nature of it being naturally conflicting goals on at least one side means actions bear far less credibility than they would if looked at by an outside observer. This lack of credibility makes it difficult to ever use vaporware effectively. However, reputation has the ability to add credibility. Reputation is an asset that accrues over time and can be spent, but usually only once. Every time a producer tells the truth about its upcoming actions, their next announcement becomes slightly more reliable.. Years and years of truthful announcements either for or against having a new innovation accrue value to the firm's reputation (Sobel 557). Reputation's value is not measured in dollars but in trust. Some companies will be believed no matter how absurd the announcement and others would not be believed if they announced the previous day's sports scores. Those with a complete lack of reputation exist in the game laid out in the single shot interaction. There is no reason to believe them anymore than one should believe an unknown company.

On the other hand, companies with stored up reputation are far more believable than the single interaction companies. Their track record alone shows they should be trusted (Sobel 570). In addition, it is also a known that reputation can only be spent once in a long while. The sting of being betrayed by someone one trusts lingers, so the value of the lie must be immense. Since it is so difficult for a company to spend trust, when they do it they can reap them huge rewards. A completely trustworthy company will have all sides take their words at face value, and read no ulterior motives into them (Levy 40). If an opportunity arises to use reputation to fend off a major competitor or vastly increase sales count there is always the possibility of the reputation stockpile being spent and turned into real assets. Reputation allows vaporware to be more successful if and only if it is done sparingly, and done after a substantial time spent building up a trustworthy reputation. Vaporware actions are given vastly increased validity if a solid reputation is attached to them; increasing success rates.

The other factor that is added in the long run is the value of the successful vaporware. In the long run, eliminating competition can be more valuable than the profits seen in the simple two period game. It can be used as a method of maintaining monopoly for many periods if possible entrants into the market are rare. This does not work in all areas of software, but in areas with expensive or niche software there may only be a few possible competitors. A vaporware move to eliminate them can allow the benefits of monopoly to be seen not only in period two of the single interaction game, but in future periods to come.

The final relaxing assumption for this two period game is the strict definition of the entrant and incumbent that is used. The model assumes complete monopoly by the

incumbent, and no market presence for the entrant. This dynamic does exist in many cases, but not in all. Vaporware can also attempt to steal market share from current competitors. If in period one both firms are in the market the payoff matrixes change, but the impacts of the strategy remain similar, just on a more limited basis. If one of the firms announces a new software C that is vastly superior to the current generation of software A and B, then a similar interaction begins. If software C is produced in period two then the firm lacking the ability to produce it will be driven out of the market, or at least have market share and according market power drastically reduced.

The firm lacking an innovation will not be forced out of the market under the current situation that has been described above, however if a fixed operating cost F_2 is introduced to the game the rules still hold. If software C is produced in period two, the firm incapable of producing software C will have an income of zero and lose its fixed costs of F_2 for its continued existence. If the announced product is vaporware and the competing firm ignores the announcement, then the market is allowed to continue as a competitive market for software A and B. The size of F_2 will help dictate exactly how credible the vaporware claims must be to be successful. If F_2 is small or the announced software C is not very revolutionary the statements about the existence of software C will play an increasingly smaller role in the decision of the other firm. If there is a real chance of loss and a credible announcement is made, then vaporware can still exist as a possible equilibrium in a competitive market.

The problem with the competitive market and vaporware is that vaporware is harder to indicate credibly. Since the market is competitive in period one, there is no quantity the announcing firm can sell of software A in that period that will indicate it is

the type with an innovation. It is unable to risk profits as a method of conveying the existence of software C. It is primarily limited to its ability to use cheap talk. This is also hindered though due to the even stronger knowledge position the other firm finds itself in. As a current competitor in the market, any announcements of new products can be looked at with a more critical eye, making lies more easily detected. Reputation can still be spent to successfully use vaporware and gain market share, but this may be the only method by which it can be believable.

Monopoly control is the ultimate corporate utopia, however, most methods of barring competition are outlawed. While vaporware is being considered by some as something that should be added to anti-trust law, it currently is one of the few legal methods of maintaining a monopoly, and that makes it an incredibly powerful tool. Vaporware impact cannot be seen until after the actual interaction has been completed. So analysis of successful executions of vaporware requires looking back into the past to see how attempted strategies have succeeded.

The defining case of vaporware, and the one that made this term famous, is Microsoft's perpetually mistimed announcements about the release date of its Windows operating system. Microsoft has an infamous history for announcing product dates long before they are ever actually released. As early as Microsoft 1.0, supposed release in 1983 but was not seen until 1985, Microsoft has mistimed effectively every product announcement it has ever made. Windows 95 similarly was released two years after its announced date (Byte 1), and Windows 2000 a full 3 years late (Vaporware Team 2000). How was Microsoft able to maintain monopoly through this period? With every product coming out years late there was a clear opportunity for other firms to enter and compete,

especially when the difference from one Windows released was large, but by no means revolutionary (Levy 35).

There appears to be a clear niche available for competition. The situation in actuality is quite the opposite. Not only remains a PC monopoly, it also has managed to push towards the ultimate vaporware equilibrium, wherein which consumers do not believe its announcements but competitors do. Microsoft's history for announcing incorrectly has been substantially documented such that it is known to all. The reputation stockpile is effectively zero in the eyes of consumers. Any timing announcement is almost laughable. Since consumers make their vaporware decisions primarily on the credibility of the announcements, which are similarly effectively zero, consumers continue to purchase the previous product at basically unaffected levels.

The same limited believability of claims is true for possible entrants as well. However, with Microsoft being one of the largest corporations in the world it is allowed significantly more leeway when dealing with competitors. The ability to hamper possible competitors significantly decreases the truth threshold necessary for competitors. Microsoft could afford huge losses to drive out a small competing firm, making the payoffs even when vaporware is correctly identified not guaranteed. Hesitance to compete is compounded by the fact that, while each Windows version does have only limited changes, Microsoft makes each product revolutionary through compatibility. Other programs are tied to the new released version making the long term niche market for an older version small to non existent.

These risks would be relatively insignificant if Microsoft's announcements were completely untrue. However, possible entrant's decisions are complicated by the

fact that every product announced by Microsoft is eventually released. The time frame necessary to be able to compete, such that it is worthwhile to sink the original fixed costs, is longer than consumer's interests in products. The window for competition may be small if the entrant can only compete with previous versions of Windows. Consumers have a shorter time horizon when considering purchases, allowing Microsoft to have credibility with possible entrants, but not with consumers. The extended delay of products like Windows 2000 may have created a large enough opening for entrants, but the limited credibility built up by shorter previous delays allowed their most egregious vaporware announcement to remain unchallenged and work successfully as planned. However, this did spend much of their credibility; some theorize forcing Windows XP to be released effectively on time, but at a lower quality, knowing delays would be risky.

While Microsoft has rather limited credibility with consumers, the limited credibility and risk associated with being wrong are a significant enough deterrent to allow Microsoft's vaporware announcements to succeed in maintaining monopoly. The statements have limited truth, but if this next time is the one time Microsoft releases the product on time for period two entrants would be destroyed, allowing the vaporware to live on as a useful tool.

Vaporware can and does fail in many cases though. In the case of the computer game Duke Nukem Forever, the sequel to Duke Nukem, the producers were not able to mitigate their dwindling reputation with offsetting factors and therefore maintain their vaporware. Originally announced to be released in 1998, Duke Nukem lovers are still waiting for this title (Kahney 2). The video game portion of the software industry is not a monopoly, but great games are capable of stealing large shares of the market, making

profits of competing firms tenuous. Upon the original announcement, competing firms pushed back production levels slightly knowing the demand this game would create.

However, as its credibility dwindled and this claim became apparently false, competitors filled in market demand and consumers got tired of waiting, shifting demand to other products. The possibility for loss by competitors still existed, and consumers still risked buying a product they wanted less than Duke Nukem Forever, and then being forced to buy that title when it was released, but the announcement became so unbelievable that these factors could be ignored making continued use of vaporware as a market tool impossible. The product is still vaporware whether it succeeds at affecting the market or not, but usefulness can be totally lost as it did in this case.

Vaporware is an extremely interesting classification of products for two reasons. First, it is not an actual product at the time. It exists almost as a figment of the announcer's imagination, the product exists in its announced form only in the words or communicative actions of the incumbent. Second, it cannot be identified until after the fact. Companies use it as a method of entry deterrence by attempting to scare out possible competitors who would be unable to compete with the new product. Companies find it always advantageous to attempt vaporware when only focused on a competitor in the short term. However, altered consumer demand and ruined reputation create a dynamic in which vaporware should not always be tried. Only in the cases where possible market share gains outweigh other losses can it be used intelligently. Imaginary products creating real financial gains is a difficult concept, but one seen clearly through the uses of vaporware.

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