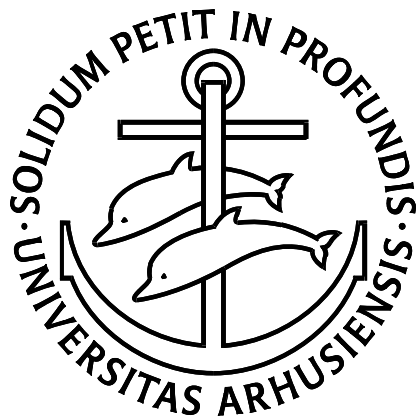


SCHOOL OF ECONOMICS AND MANAGEMENT

ECONOMICS WORKING PAPER 2008-11

Brand popularity, endogenous leadership, and product introduction in industries with word of mouth communication

Christian Dahl Winther



UNIVERSITY OF AARHUS

BUILDING 1322 - 8000 AARHUS C - DENMARK ☎ +45 8942 1133fa

Brand popularity, endogenous leadership, and product introduction in industries with word of mouth communication

Christian Dahl Winther*

Abstract: This paper considers the impact of popularity on duopolists' entry strategies into an emerging industry, where each consumer holds a preference for one of two competing brands. Brand popularity is influenced by word of mouth communication, as early adopters recommend the brand they have bought to later buyers. Early introduction is, however, a costly strategy. The timing of product introduction is therefore of strategic importance to firms. I investigate the equilibria of the game when firms choose their time to market strategies sequentially, and observe how they relate to the popularity of the Stackelberg leader's brand. This analysis reveals firms' individual incentives for leader and follower roles, and the market structure that would result in this noncooperative game. As von Stackelberg showed a leader's commitment to a strategy can preempt the follower. The present model shows that this situation, where both firms prefer the leader role, most likely occurs when brands hold equal levels of popularity. On the other hand it is interesting to observe that in certain markets, in particular where popularity is highly asymmetric, it is optimal for the dominant firm to become follower, and for the inferior firm to lead, because this facilitates soft competition. Still, the market structure may be insensitive to the order of moves. This warrants investigation of the connection between leadership and brand popularity, and the effect on market structure.

JEL classification: D83, L11, O33

Keywords: Endogenous leadership, product differentiation, product introduction, technological change, word of mouth communication.

*School of Economics and Management, University of Aarhus, Universitetsparken, Building 1322, DK - 8000 Aarhus C. E-mail: cwinther@econ.au.dk.

1 Introduction

Branding creates images in consumers' minds by appealing to a certain lifestyle, personality, and values. Firms use branding to target particular consumer groups, the young, the mature, the intellectuals etc. This practice shifts consumers' focus away from a consideration of sheer intrinsic value of a product onto something more intangible. If the message and wrapping is just right, consumers will take the product to heart, and once the brand is firmly entrenched in a buyer's brain, a competitor will have a hard time dislodging this image again. The successful company will benefit from a loyal segment of customers and is in a good place for earning high markups on its product. The Cola war between Coca Cola and Pepsi illustrates how products that are fairly close substitutes have used branding to create strong differences in consumer sentiment. Without branding the firms would be forced to sell on price.

This model considers how competition between two brands is influenced by popularity. Popularity refers to the proportion of buyers holding an affinity towards that particular brand. Equivalently, the asymmetry between firms can be interpreted as the result of brands' market shares or market powers in another industry. Firms are otherwise symmetric in every way. As Coke Classic roughly outsells Pepsi-Cola 3:2 in the US,¹ it seems reasonable that this has an impact on the market shares of derived products such as low-calorie cola. The data confirms that Diet Coke does in fact outsell Diet Pepsi.²

Word of mouth communication, or buzz, is an integral part of branding. If you can have consumers not only buying your product, but also talking about it you are truly fortunate (and clever). Many surveys have shown that consumers often rely on the experiences and knowledge of their peers in deciding what products to buy.³ According to a study by Dye (2000) the entertainment industry, toys, and fashion are highly influenced by word of mouth. Further, electronics, hotels, and pharmaceuticals are driven by buzz only to a lesser extent. At the other end of the scale, such goods as

¹See Beverage Digest at http://www.beverage-digest.com/pdf/top-10_2008.pdf

²The development process is assumed to be stochastic, making the final qualities of new introductions unknown when the entry strategy is chosen. It is therefore not inconsistent with the model to observe Pepsi outselling Coca-Cola in some submarket, as the realized quantity of Pepsi's product can turn out to be of a sufficiently higher quality.

³Says David McCallum, Nielsen's global managing director for Customized Research Services: *"...the recommendation of someone else remains the most trusted sources of information when consumers decide which products and services to buy."* (See the press release from October 1, 2007, in its entirety on http://www.nielsen.com/media/2007/pr_071001.html)

utilities, chemicals, and insurance are more or less immune to word of mouth effects. To model word of mouth effects I assume that an early buyer will recommend the product she has tried to a later adopter increasing that brand's popularity, shifting the distribution of preferences from which the latecomer type is drawn. Under these circumstances there is clearly an incentive to be early to market. On the downside, however, fast product introduction can well be a costly strategy to follow. To put it in the words of Scherer:

“Accelerating the pace of development is costly for three reasons. First, errors are made when one overlaps development steps instead of waiting for the information early experiments supply. Second, it may be necessary to support parallel experimental approaches to hedge against uncertainty. Third, there are conventional diminishing returns in the application of additional scientific and engineering manpower to a given technical assignment.” (Scherer 1980, pp. 426-427)

This model aims at capturing the tension created by these countervailing incentives, and investigates the effect on firms' strategic choices of product introduction. Dye reports that more than two thirds of the US economy involves word of mouth communication, emphasizing the need for companies to thoroughly understand the connection between these effects and their behavior in the particular industry they are part of. This paper is intended as a theoretical guideline to firms in this regard, and I hope that this will give business leaders more than a gut feeling to go on when choosing time to market strategies.

The economics literature has investigated issues like herding and network effects to model dependencies in consumer choice. Herding is a term often used to describe how consumers will take the choice of their fellow consumers as an indication of the private information they possess, and use this as a signal of value. Banerjee (1992) and Bikhchandani *et al.* (1992) both have good discussions of the origin of herd behavior as well as interesting applications; an agent may choose to vote for the political party that is ahead in opinion polls as this (may) indicate that the majority of voters think that this is the better party. Herding differs from word of mouth communication as the former concerns the diffusion of private information between economic agents when there is incomplete information about the true value of different choices, while the latter has more character of a fashion effect influencing the preference of buyers,

or buyer types, directly.

One consumer recommending a brand she has tried to another consumer gives the externality in buyer preferences from word of mouth communication a one-way nature. In contrast, models of network externalities are of a two-way character; as compatibility with other users is a valuable asset in network economies, the utility that buyer X can derive from a given technology is dependent on the adoption choice of Y, and the utility of Y is likewise dependent on the adoption choice of X, as is the case in Farrell and Saloner (1985) and Katz and Shapiro (1986). This interdependency in adoption choices departs from this treatment of word of mouth communication as the latter does not influence the consumption value of a given product as such but does influence the way it is valued.

Ellison and Fudenberg (1995) study how word of mouth communication helps buyers with bounded rationality learn about the quality of other products than the one they current use, modeling word of mouth effects as a form of social learning. The authors investigate whether consumers will end up on a single product in the long run. In the present model I look at word of mouth communication in the same way as the marketing literature does where focus is on buyers telling friends and family about the products they have come to like, and the effect this has on their preferences. The marketing literature contains many empirical studies of word of mouth communication but lacks satisfactory, formalized treatments of the connection between the demand and supply sides. The present model attempts to fill this gap in the literature by considering how word of mouth effects on the demand side affect the strategic choices of timing of product introduction on the supply side.

The value of commitment is one of the most important notions in game theory. The simplest way to commit to a strategy is probably to move before a competitor, an ability that goes to the leader of the industry. As von Stackelberg (1934) showed, a leader can benefit from its ability to commit to a strategy, as it forces the competitor to react in a favorable way. Moreover Schelling (1960) is littered with ways that commitment and reduced flexibility can benefit a leader. Yet, as this paper illustrates, this may not always be the case. When brands differ greatly in popularity the dominant firm has only little to gain from word of mouth communication for being first in the market. On the other hand it has much to loose. In this case, the firm is interested in imitating whatever strategy its inferior rival has for product introduction, and to do so it must retain its flexibility in the development phase, that is it must become

the follower of the game, and only commit to a strategy after learning the play by the opponent. As I will show, firms can exploit this incentive to facilitate soft competition in a noncooperative way where the inferior firm prefers the role of leader and the dominant firm prefers the role of follower. For this reason there may not always be a conflict in the assignment of roles. This warrants investigation of the connection between leadership and popularity as this affects the performance of markets, industrial structure, and ultimately the growth of the economy.

The paper imposes pre-determined roles to answer the question: *If some firm were to be the Stackelberg leader, how would this affect competition in turn the equilibrium of the game?* These results establish when leadership is an advantage, a disadvantage, and when is it irrelevant to the outcome of the game as a function of the firm's popularity. The conclusions help identify in what sort of industries, what sort of firms seek leadership.

In a companion paper, Winther (2008), I consider the impact of word of mouth communication on the outcome of product introduction when firms choose entry strategies simultaneously. Simultaneity in the decision making process is descriptive of industries where a firm have limited information on its opponent's options, or if there is not a single, obvious strategy to be played by one of the firms. When new product development originates from an underlying technology that becomes freely available to all players, for instance the Internet, decisions are likely to be made simultaneously. For example this could be online book stores choosing when to enter the market. On the other hand, a sequential structure will be more appropriate in industries characterized by a great level of observability in the strategies available to firms and/or when they have the ability to communicate the strategies played in a credible way. Sequentially should be expected when innovation is something that is pioneered by a single firm. The reader may want to think of the development of new pharmaceuticals which are usually build from the bottom up by one firm alone. Between this model and its companion the reader can choose the most appropriate framework depending on how the particular industry in question functions.

2 The model

Two competing firms, A and B, each sponsor a branded product line. Each brand is targeted towards one of two consumer types. Consumers are therefore either A-fans or

B-fans, and so one can speak of a buyer as being either a ‘fan’ or a ‘nonfan’ of a brand. The central question is to find the optimal time to market strategy for a product line extension into an emerging market.

The timing of the model is as follows. In the first of three stages, stage 0, firms sequentially choose a time to market strategy. A firm is said to play an *early to market* strategy if it enters at stage 1, whereas entry at stage 2 is referred to as being a *late to market* strategy.⁴ The leader’s strategy is perfectly observed by the follower before choosing its own strategy. For easy reference, I reserve the terms (Stackelberg) ‘leader’ and ‘follower’ to denote the order of firms’ decisions at stage 0. Figure 1 illustrates the timing of decisions in the reduced form game.

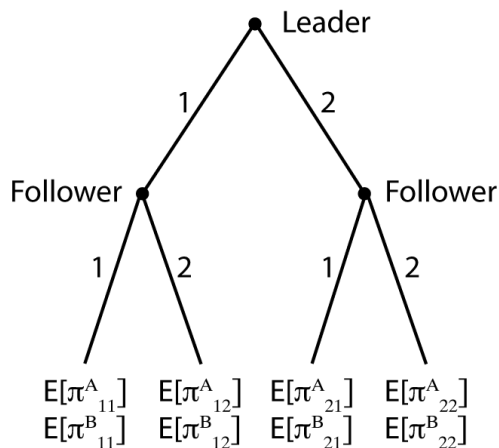


Figure 1

Expected payoff levels are reported in figure 2. As an example, $E[\pi_{21}^B]$ denotes the expected profit of firm B when firm A enters at stage 2 and firm B enters at stage 1.

A new consumer arrives in both stage 1 and stage 2, and is referred to as the earlycomer and the latecomer respectively. At stage 1 the earlycomer has the option to adopt an available technology, if any, or postpone adoption to stage 2. At stage 2 all uncommitted consumers adopt one of the two products, even though different types may not choose the same good. The quantity bought by the latecomer is normalized to 1, and the earlycomer buys a fraction ϕ hereof. Buyers may be interpreted as being either single users buying different quantities, or as generations of buyers of different size with identical preferences. Consumers’ types are observable to firms.

The development process is stochastic as firms are unable to accurately predict the final product quality when time to market strategies are chosen at stage 0. Let

⁴The outside option of not entering the market is never exercised in equilibrium as it is dominated by playing the late to market strategy.

qualities be a random draw from a distribution $G(-)$ with support $[0; 1]$. Denote realized product qualities of brands A and B as a and b respectively, and assume that they are uncorrelated with the choice of timing of introduction. Further, as firms produce at zero marginal cost, one can regard a and b as being product values net of production costs.

As products are imperfectly substitutable, a consumer will have a higher willingness to pay for his preferred brand. Let z denote the level of heterogeneity in consumer tastes, with $z \in [0; 1]$. Alternatively z can be interpreted as the degree of product differentiation between the two brands. If $z = 0$ a nonfan derives no utility from consumption of his least preferred brand, while brands are perfectly substitutable if $z = 1$. A consumer may optimally adopt his nonpreferred brand if the quality of his preferred brand turns out to be relatively low. For example a B-fan values product A higher than B if and only if $az > b$.

The two brands differ in their popularity in the population according to the parameter λ , where $\lambda \in [0; 1]$. The greater the popularity of a firm the more frequently does it meet a fan. Let λ be the popularity of firm A and $(1 - \lambda)$ the popularity of firm B. Without loss of generality assume that $\lambda \geq \frac{1}{2}$ such that player A is the more popular firm *ex ante*.

As discussed in the introduction, word of mouth communication increases the popularity of a brand adopted at stage 1 as an early user will recommend the product to a late user. To get a functional form for the impact of word of mouth communication I assume that it follows a modified version of the Polya urn as described in Winther (2008). The stronger the word of mouth effect, the greater is the winning firm's chance of facing a fan at stage 2. If the earlycomer does not adopt one of the products, if for example there is no product available for adoption, the distribution from which the consumer types are drawn remains unchanged between stages 1 and 2.

It is a predominant assumption in the marketing literature that word of mouth communication is purely beneficial for a firm. Following this thinking there can be no negative effects from being early to market. Naturally one can think of many situations in which a bad experience will lead to a reduction in popularity, such as a negative review in Zagat's restaurant guide. However, to conform to standard practice, I have chosen a formulation that preserves this assumption.

A company that chooses to enter the market quickly incurs development costs of C . Scherer phrases it beautifully: "*As scientific and technological knowledge advances,*

what may be impossible today will be feasible but costly tomorrow and easy the day after tomorrow." (Scherer, 1980, p. 429). This highlights not only the negative relationship between entry time and the costliness of innovation, but also the emergence of a market. In general, C should be interpreted as a time to market cost, which among other things includes research and development expenses and diminishing returns to effort for making the product available more quickly.

To focus on firms' strategic choices of timing of product introduction it is assumed that the earlycomer only derives a single period of product use. Multi-period usage would make firms more inclined towards fast introduction as the earlycomer's willingness to pay would increase. Switching costs are 'high' in that a customer does not switch from one product to another following initial adoption. In particular, this applies to the earlycomer who may adopt one product before the quality of the other is known. For simplicity there is no discounting in the model, so think of time periods as being relatively short.

Firms are able to solve the game and choose the strategy that yields the highest level of expected payoff. Consumers rationally anticipate expected utility levels resulting from the different options they face. The outside option (no adoption) yields zero utility. Competition is in prices. The paper considers pure strategies only, and the equilibrium concept is that of subgame perfection.

3 Analysis

The game is solved by the two firms. For each combination of strategies played there is an associated payoff. Figure 2 shows the expected profit levels connected to the different entry combinations, net of the expected profits from combination (2,2) for easier comparison. Brand A's payoffs are reported in the top left hand corner, and brand B's payoffs are reported in the lower right hand corner of each cell.

A \ B	1	2
1	$-\Omega^B - C$ $-\Omega^A - C$	$\Omega^A - C$ $-\Psi^B - \Omega^A$
2	$-\Psi^A - \Omega^B$ $\Omega^B - C$	0 0

Figure 2

All expected profits are derived in Winther (2008). For a discussion of pricing behavior the reader is referred to that paper also. Here I would like to offer a little intuition behind the payoff levels.

A fan's willingness to pay for a good is always at least as high as that of a nonfan. Let F denote expected profits made by a producer facing a fan, and let N denote expected nonfan profits, where $F \geq N$ for all $z \leq 1$. Fan (nonfan) profits can be shown to be decreasing (increasing) in z .

Taking the opponent's action as given, comparison of expected payoffs resulting from the firm's two available time to market strategies either shows what the firm can gain from being first-mover (competitor enters at stage 2) or its loss from being second-mover (competitor enters at stage 1). These differences in relation to the time to market cost C show the optimal (re)action of the player, and serve as a key component of the analysis below. Let first-mover gains and second-mover losses be denoted Ω^i and Ψ^i respectively, with $i = A, B$.

The model implies that a first-mover always wins the earlycomer in equilibrium, and therefore will experience increased popularity through word of mouth effects and in turn higher expected profits. This result hinges on a second-mover's inability to make a credible promise to the earlycomer of tendering her to a utility level that is higher than what otherwise can be derived from her best alternative. For this reason there always exists a nonnegative price for which the earlycomer joins the first-mover.⁵ This holds disregarding the consumer's type, and even in the absence of word of mouth effects. For the same reason, a second-mover will never be able to do business with the earlycomer and so forgoes any profits that otherwise could be expected had it entered alongside its opponent at stage 1.

The more popular firm has a smaller scope of further increases to its fan base, and one can therefore rank first-mover gains as $\Omega^A \leq \Omega^B$. On the other hand, as A is defined to be the more popular brand it suffers a greater second-mover loss than brand B, because the earlycomer is more likely an A-fan than B-fan. Second-mover losses can therefore be ranked as $\Psi^A \geq \Psi^B$. Figure 3 contains the analytical expressions for the gains and losses.

⁵As a first-mover always benefits from greater popularity at stage 2, it appropriates a larger share of the surplus derived from the latecomer. In network industries a similar result known as the *weakened-rival effect* shows that firms will enter the market sooner than otherwise optimal in order to secure themselves a relatively bigger network. By doing so the firm is able to command a greater part of the latecomer's surplus.

$$\begin{aligned}
\Omega^A &= (1 - \lambda) \left(\frac{\eta}{1 + \eta} \right) (F - N) \\
\Omega^B &= \lambda \left(\frac{\eta}{1 + \eta} \right) (F - N) \\
\Psi^A &= \lambda \phi F + (1 - \lambda) \phi N \\
\Psi^B &= (1 - \lambda) \phi F + \lambda \phi N
\end{aligned}$$

Figure 3

The time to market cost relative to a firm's first-mover gain and second-mover loss plays an integral part of its choice of time to market strategy.

Best-response functions

To find the equilibria of the game, start from the back by deriving the Stackelberg follower's best-response contingent on the Stackelberg leader's choice of action. The optimal strategy played by a follower of type j given the strategy chosen by the leading firm i , with $i, j = A, B$ and $i \neq j$, is

$$\text{Best-response of firm } j = \begin{cases} \text{Entry at stage 1} & \text{for } C < \Omega^j \wedge C < \Psi^j \\ \text{Entry at stage 2} & \text{for } C > \Omega^j \wedge C > \Psi^j \\ \text{Imitation of } i & \text{for } C > \Omega^j \wedge C < \Psi^j \\ \text{Differentiation from } i & \text{for } C < \Omega^j \wedge C > \Psi^j \end{cases}$$

The best-response functions follow directly from comparison of the relevant expected payoff levels as given in figure 2.

Cabral (2002) notes that the leading boat in match racing has an incentive to imitate its competitor's route closely to achieve high correlation of results, as opposed to sailing another route with a lower correlation of outcomes. Correspondingly, the boat that is behind in the competition seeks a strategy of differentiation in order to rock the current standing in the race.

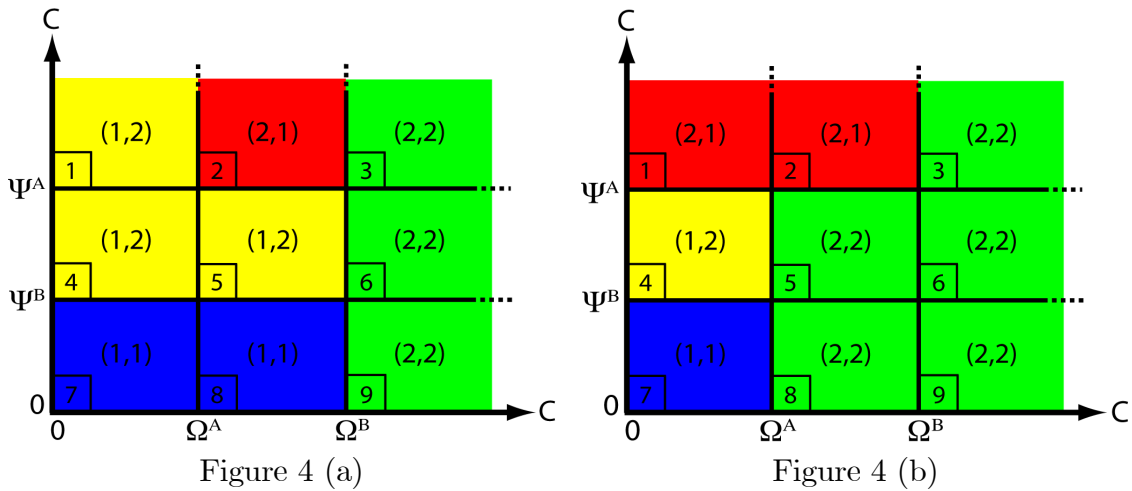
In the same way as a firm with insufficient incentives to become first-mover, yet unwilling to accept a role as second-mover, seeks a high correlation in the time to market strategies that is played by imitating its opponent. Weak word of mouth effects and strong demands from the earlycomer tend to reinforce this incentive. Likewise, when a firm would like to reap the benefits of word of mouth communication of being first-mover, but is not prepared to waste the time to market cost in order to avoid becoming second-mover. Clearly this is most likely to happen in a market where early demands are relatively weak and word of mouth communication strong.

Proposition 1. Higher (lower) popularity increases the firm’s incentive for imitation (differentiation).

The proposition is easily verified by taking partial derivatives of the relevant terms with respect to λ . The proposition is two-fold. First, the dominant brand A is generally more prone to imitation than brand B as it sees less of an opportunity for further increases to popularity for being first-mover, while it at the same time stands to lose the most for being second-mover. Second, these incentives get stronger as the duopoly becomes more asymmetric.

Equilibrium outcomes of the game

The Stackelberg leader anticipates the follower’s optimal reaction and knows the outcome of its own actions. Figure 4 (a) and (b) illustrate the unique subgame perfect equilibria of the model with brand A and brand B being leaders respectively. The equilibria are reported in parentheses with the action taken by brand A first and brand B second. For example (2,1) indicates that brand A enters at stage 2 and brand B enters at stage 1. Further, the numbered labels running from 1 through 9 refer to particular industries for easy reference.



I will now analyze the incentives that drive equilibrium in the different areas. As can be seen from these figures, the identity of the Stackelberg leader may or may not matter for the outcome in this strategic game of product introduction. I begin the analysis by considering those markets where leadership *does not* play a role in the outcome, and return to the reverse case later.

■

Proposition 2.

$$\text{Leadership insensitive outcomes} = \begin{cases} (1, 2) & \text{for } C < \Omega^A & \wedge & \Psi^B < C < \Psi^A \\ (2, 1) & \text{for } \Omega^A < C < \Omega^B & \wedge & \Psi^A < C \\ (1, 1) & \text{for } C < \Omega^A & \wedge & C < \Psi^B \\ (2, 2) & \text{for } \Omega^B < C \end{cases}$$

This proposition and the ones to follow result from the equilibria of the game. Proving the propositions are straightforward and, as a consequence, omitted. The insensitive outcomes are unified by firms playing by the same strategy as Stackelberg leader as their best-response as Stackelberg follower to the opponent's strategy. As a result of the insensitivity to leadership, it is unlikely that firms will spend any energy maneuvering themselves into a certain role, for example by building a reputation for being on the forefront of innovation, or investing in high-end research facilities that can make opponents regard it as the leader of the industry due to the speed at which it can develop a new product.

□ Figure 4 shows that (1,2) is the unique subgame perfect equilibrium in area 4 irrespective of leadership in the industry. Knowing that the best-response of brand B is differentiation, brand A must essentially choose whether to get (1,2) or (2,1) as outcome. Because the first-mover gain of brand A is higher than the time to market cost, the firm optimally chooses a strategy of fast product introduction. When brand B is Stackelberg leader it anticipates that brand A plays early to market as a dominant strategy, and since C exceeds B's loss for being second-mover, it is best to play late to market. This situation is likely to arise in markets where word of mouth effects are strong and/or the substitutability between brands is low. Some degree of asymmetry in popularity of brands should also be expected.

The introduction of new drugs is most often pioneered by Big Pharma. Eli Lilly for example introduced Prozac, the first antidepressant of its kind, and Pfizer brought us the erectile dysfunction treatment Viagra. To enjoy the monopoly status granted by a patent, Big Pharma spends huge amounts of money to be first to market. But when patents expire there is usually an influx of generic equivalents most often introduced by small, less known medical companies. A firm inventing around the original patent can likewise be regarded as second-mover.

The model predicts a tendency for the dominant firm to consolidate its position, which seems to be consistent with observations from the medical industry.

□ The opposite situation arises in area 2 where (2,1) is the unique subgame perfect equilibrium outcome no matter who is Stackelberg leader. Area 2 is characterized by a time to market cost that is higher than the second-mover losses of both firms, and only the inferior firm having a first-mover gain in excess of this cost.

Anticipating that brand B plays by a best-response strategy of differentiation, brand A is faced with a choice between (1,2) and (2,1) and prefers the latter outcome for all parameter combinations satisfying area 2. Brand A's reaction to the leadership of B is simply to enter at stage 2, and B chooses to become first-mover in the industry. In either case, the inferior firm is able to secure first-mover status irrespective of how the timing of decision making is organized. This market is distinguished by the earlycomer consuming a relatively small quantity in comparison to the latecomer. This would be the case if the new good is of such a character that consumers must get used to it before they fully embrace it, as was arguable the case with the Internet.

Similar behavior is found in general classification bicycle racing, such as Tour de France, where the rider with the fastest total time across multiple stages wins the competition. To win an individual stage of the overall race, riders will try to escape the peloton. Teams with prominent classification riders often try to control the race from the peloton by keeping breakaways on a leash. In the interest of conserving energy, however, low-ranking riders are often allowed to break away from the peloton without hefty pursuit because they only pose little threat in the general classification, while focus is kept on riders posing more imminent threats. In the same manner, a dominant firm will allow a sufficiently small rival to become first-mover.

□ In area 7 both firms have first-mover gains and second-mover loss greater than the time to market cost. This implies that each firm, whether leader or follower, chooses to be early to market, making (1,1) emerge as the unique subgame perfect equilibrium no matter which firm is Stackelberg leader. This will typically be the case in industries where firms are relatively even competitors and where the time to market cost is low. Moreover, low substitutability between brands increases firms' incentives to win first-mover status as the difference in expected profit earned on fans over nonfans increases. Low substitutability will also raise second-mover losses, provided the reduction in z increases the weighted component of profits from fans more than the loss incurred on nonfans. Under such circumstances one should expect to observe firms racing into a new market as soon as the opportunity arises.

□ Lastly, no firm will seek first-mover status in industries where early entry is very expensive, brands highly substitutable, or where word of mouth effects are small. As a result (2,2) arises as the unique subgame perfect equilibrium in areas 3, 6, and 9.

■ Now, consider those equilibria that *are sensitive* to the sequence of moves.

□ Industries with strong word of mouth effects make it attractive for producers to become first-mover. However, when losses incurred for being second-mover are small relative to the time to market cost, differentiation is an industry-wide best-response strategy, and competition will resemble the game of chicken: Each firm would like to be early to market but only if their opponent has not done so. Consequently, the Stackelberg leader will seize the opportunity to become first-mover demoting the follower to second-mover. The model predicts (1,2) as the outcome when the dominant firm leads the market, and (2,1) is likewise the predicted outcome when the inferior firm is leader.

Proposition 3. In markets where both firms have high first-mover gains and low second-mover losses, the Stackelberg leader chooses to be early to market, essentially forcing the follower to be late to market. Hence, the leader becomes first-mover and the follower second-mover.

Formally this market satisfies the conditions $\Psi^A < C < \Omega^A$ equal to area 1. This behavior is particularly likely in industries where brands hold fairly even popularities, as this makes it more likely that the two firms hold the same incentives for a given level of C .

The result is comparable to the Stackelberg leader-follower model in which the leader exploits its advantage by boosting its own production on the follower's expense. This owns to the fact that quantities are strategic substitutes. The present model shares this element of strategic substitutability in players' actions: An early to market strategy played by the leader convinces the follower to postpone the date of its own introduction, since competition for the earlycomer's affection drives down prices, and thus profits, offsetting the expected gain from word of mouth communication.

□ A high degree of asymmetry in the popularity of brands gives firms very different incentives in the game. For certain levels of the time to market cost the game has a structure resembling Matching pennies, because one firm is interested in coordination of strategies and the other prefers strategies to be different. In particular let the time

to market cost satisfy the following conditions $\Omega^A < C < \Omega^B$ and $\Psi^B < C < \Psi^A$. This corresponds to area 5.

Proposition 4. If brands differ greatly with respect to popularity, the dominant brand prefers a strategy of imitation while the inferior brand covets a strategy of differentiation. When the dominant brand has leadership in the market (1,2) is the unique subgame perfect equilibrium, whereas (2,2) is equilibrium when the inferior brand is assigned the role of leader.

In this market there is only little to gain for the dominant brand as first-mover, while the loss it suffers for being second-mover is high. By proposition 2 it is therefore optimal for brand A to imitate brand B's strategy when it is the follower of the game, and for this reason brand B essentially faces a choice between outcomes (2,2) and (1,1). It is then only natural that B chooses to play the late to market strategy thereby softening competition. As Stackelberg leader brand A essentially chooses between (1,2) or (2,1) as the outcome of the game, knowing that brand B plays by a strategy of differentiation. Brand A therefore chooses to enter at stage 1 and (1,2) emerges as the subgame perfect equilibrium of the game. Scherer captures the intuition behind this equilibrium nicely:

“Dominant firms are not likely to be vigorous innovators. But if their market position is threatened by the intrusion of a smaller innovator, they have a great deal to lose from running a poor second: the larger share they would otherwise enjoy. The theory predicts then that profit-maximizing dominant firms will be potent imitators when their market shares are endangered. They may even accelerate their development efforts so strongly in response to a challenge that they induce the challenger to relax its development pace and settle for the smaller market share associated with being second.” (Scherer 1980, p. 428).

This equilibrium is interesting as it demonstrates how the order of moves in the development stage has far-reaching consequences for the firms' choices of development strategies. Although the dominant brand has insufficient incentives to pursue an early to market strategy via its own first-mover benefits, pressure from its smaller opponent necessitates intensive R&D at stage 0, as it otherwise forgoes sales to the earlycomer. So brand A ends up playing the early to market strategy in a market where it really

would prefer playing late to market, and brand B ends up playing the late to market strategy even though it is the one most interested in being first-mover. One can see this unfortunate situation arising out of the dominant brand's own success, because high popularity makes for high second-mover losses. Brand B faces the opposite problem; it would like to be early to market as it has a lot to gain, but knowing that it will be imitated by brand A, late to market is the more profitable choice.

□ The last situation in which leadership plays a role in the outcome arises when the time to market cost is low enough for no firm to accept being second-mover, in combination with the dominant brand being sufficiently popular not to desire first-mover status on its own. Formally this market is characterized by the inequalities $\Omega^A < C < \Omega^B$ and $C < \Psi^B$ corresponding to area 8. Proposition 5 summarizes the outcome emerging from these incentives.

Proposition 5. In area 8, brands race into the market when the dominant firm is Stackelberg leader. Leadership by the inferior firm results in slow introduction of both brands.

Knowing that the best-response of brand B is to enter at stage 1, brand A is forced into a strategy of fast product introduction as Stackelberg leader. Being early to market helps player A secure (1,1) as the outcome rather than (2,1). When brand B leads the industry, it takes into account that brand A plays by a best-response strategy of imitation. As B's payoff under (2,2) is higher than under (1,1), firm B chooses the late to market strategy. Again, the firm least interested in early entry does in fact become first-mover in this game.

The next section considers the strategic aspects associated with leadership.

4 To lead or not to lead

Proposition 2 demonstrated that competition in some markets yields the same outcome irrespective of how leadership is organized. In such instances one should not expect leadership to play an important strategic role in competition, as it is of no consequence for the expected payoffs.

Things change when the identity of the leader does have an impact on the equilibrium, and the timing of decision making naturally becomes of interest for firms as well as the public. The Chicken game structure of competition shown in proposition

3, allows the Stackelberg leader to position itself in a more favorable position than the follower, in the same way as predicted by Stackelberg's original model (von Stackelberg 1934). A lack of information or no organization of the timing of moves can potentially lead to Stackelberg warfare, as identified by Schelling (1960, p.39): Both players act as though they are the leader of the game, but ultimately regret their action after learning the competitor's strategy.

Several papers have investigated a corresponding situation of endogenous timing of moves in a duopoly with mutually conflicting incentives in assignment of leadership. van Damme and Hurkens consider both quantity competition (van Damme and Hurkens 1999⁶) and price competition (van Damme and Hurkens 2004) in a market where one firm is more efficient than the other in terms of marginal production costs. The results draw upon a consideration of which of the two competitors will tolerate more risk in the assignment of roles. The authors show that the more efficient firm being leader is a fairly robust result, even though this is not the same as the efficient firm retaining the more attractive role under price competition. Amir and Stepanova (2006) use a supermodular game to generalize this result further.

In a similar way one could compare the difference in profits each of the two brands receive in an economy described by area 1 for having the preferred role as leader rather than being follower, and noting that firms' actions are strategic substitutes as is the case in van Damme and Hurkens (1999). Brand A compares (1,2) to (2,1) and brand B compares (2,1) to (1,2). It is easy to verify that brand A gains the most from leadership. Now, if one is willing to equate a more efficient firm, that is a firm that is somehow ahead of its rival, to a firm holding a greater level of popularity among consumers, then I reach the same conclusion as van Damme and Hurkens.

Yet, there need not be a conflict of interest over how roles are assigned even though leadership influences the outcome of the game. Propositions 4 and 5 demonstrated that competitive pressure forces brand A into early product introduction when it leads the game. The propositions yield the equilibria (1,2) and (1,1) respectively. Comparing these outcomes to those arising when brand B plays the role of Stackelberg leader, namely (2,2) in both cases, shows that both firms will benefit from B's leadership.

Proposition 6. Consider a market where the dominant brand optimally imitates the strategy of the inferior brand, and where the inferior brand

⁶This paper also contains a nice review of the literature on endogenous leadership, and I refer the reader hereto for a thorough discussion.

would like to become first-mover. This industry makes collusive behavior arise endogenously by the inferior brand choosing the roles as leader, and the dominant brand accepting follower status, as this alleviates a race for the market.

Proposition 6 applies to all C satisfying $\Omega^A < C < \Omega^B$ and $C < \Psi^A$ corresponding to areas 5 and 8. The driving force behind the collusive behavior is that brand A has a best-response of imitating brand B's action. This effectively keeps B in check realizing that it will not be able to achieve first-mover status alone, thus prompting it to play an unaggressive strategy. Brand A is therefore able to soften competition by surrendering leadership of the industry. This situation most likely occurs in markets where the two brands hold very different levels of popularity, and where word of mouth communication in the population is strong. Yet one should be careful what to wish for: While word of mouth does make this collusive outcome likely to occur in terms of the range of parameters leading to such a market, it is existence of word of mouth effects itself that gives firms the incentive to fast product introduction in the first place.

In a similar fashion Dowrick (1986) shows that firms' choice of roles can be determined by the slope of their reaction functions. A firm with a positively sloped reaction function that is sufficiently steep can be used to deter an aggressive action by the opponent due to the threat of severe retaliation, and the latter firm should therefore want to become leader and choose a nonaggressive action to facilitate a soft state of competition. This benefits both players, who will therefore be able to agree on the allocation roles. This behavior is basically the same as identified in proposition 6 even though the models are as different as they are.

Identifying a desired outcome is one thing, reaching it is another. An obvious way to achieve coordination is for firms to communicate directly or in industrial committees to arrange leadership in the optimal way. If for some reason this is not possible, I look into some possible ways for the wanted timing structure to arise endogenously in the noncooperative game.

Hamilton and Slutsky (1990) suggest an elaborated pre-play stage in which players decide when to move without committing to the strategy to be played.⁷ The idea of the pre-play stage is to allow firms to work around pre-determined leader-follower roles (or a simultaneous move structure), and be able to choose the timing of moves

⁷The authors extended this analysis to a bi-matrix game in their 1993 paper.

endogenously. As noted by Hamilton and Slutsky, the structure of pre-play is generally unobserved by the economist, while only the outcome remains observable. Hamilton and Slutsky (1993) conclude that provided that the extended game can produce payoffs that are higher than those of the game without pre-play communication, then pre-play communication can change the equilibrium of the game, and therefore help firms reach an outcome which was not previously possible. Hamilton and Slutsky's model implies that Stackelberg leadership emerges endogenously, which, however, is rejected by Huck, Müller, and Normann (2002) on the basis of experimental data.

Whether Hamilton and Slutsky's pre-play stage is applicable or not, one should not expect a dominant player to be interested in 'setting the tone' in industries pertaining to proposition 6; both firms are better off if the dominant player takes a backseat to decision making and simply reacts to its rival's action. In this case the dominant firm would be wise to play a 'fast second' strategy, as described by Markides and Geroski (2005) in the following way:

“A fast-second strategy differs from both a first-mover and (more important) a second-mover strategy. A first-mover strategy would involve getting into the market quickly and producing your own product variants, hoping that your product emerges as the dominant design. A second-mover strategy would involve waiting for the dominant design to be completely established and accepted in the market and then producing a me-too product under that standard. A fast-second strategy would involve waiting for the dominant design to begin to emerge and then moving in to *be part of that* (that is, helping to create it).”

Markides and Geroski point to IBM having played a fast second strategy in the early days of mainframe computers. The players that participated in the industry at the time were IBM and a handful of smaller companies, in addition to governmental agencies. While IBM kept in touch by supporting the early development of the industry, IBM itself did not try to pioneer the industry on its own. Only in 1953, as the market started to take shape and products became more productive did IBM enter the market with its own mainframe.

5 Conclusions

This paper has followed two main ideas. First, it studies the strategic competition between two brands in their choice of time to market strategies into an emerging market. Popularity differences give brands asymmetric incentives to be first or second-mover, and in connection with the time to market cost, the equilibrium in product introduction strategies shows the industrial structure that results from the game when leader and follower roles are exogenously assigned. Under such circumstances the paper derives the optimal product introduction strategy for a business manager.

Second, comparing these equilibria as a function of the identity of the leader reveals each brand's incentive to be Stackelberg leader or follower in an industry. This tells us what goes on behind the scenes in firms with regards to the allocation of roles in the product development stage, which largely remains unobserved to economists. This paper therefore serves as a guideline for building economic models by deriving the order of moves that would arise endogenously. It can help the modeler choose between competing specifications of leadership, in turn avoid an overly complex model and keep focus on other issues.

An intense product development phase to be able to enter the market more quickly is associated with wasteful development costs. Moreover, there is a potential inefficiency associated with the equilibria involving sequential entry, as the earlycomer may adopt a brand at stage 1 that *ex post* turns out to be of lower value than the competing brand entering at stage 2. From a social perspective a market is efficient only if both brands play the late to market strategy, yet firms' private incentives may result in early introduction due to the effect of word of mouth communication.

The model has some policy relevant implications as asymmetries in brand popularity help facilitate collusive behavior. Firms are shown to be mutually better off when the inferior firm takes leadership, and the dominant firm accepts follower status, to soften competition. A sequential order of moves can therefore arise endogenously in this game, rather than being the result of artificially imposed asymmetries in the psychology of firms' managements or from differences in information. Even though firms do exercise collusive behavior it does in fact benefit the economy as a whole. Antitrust authorities should smile at asymmetries in brand popularity, or market power, as this can lead to improved efficiency with respect to product line extensions. Careful consideration should be given to this effect before making regulatory intervention.

References

- Amir, R. and A. Stepanova, 2006, "Second-mover advantage and price leadership in Bertrand duopoly", *Games and Economic Behavior*, 55, 1-20.
- Banerjee, A.V., 1992, "A simple model of herd behavior", *Quarterly Journal of Economics*, 107, 797-817.
- Bikhchandani, S., D. Hirshleifer, and I. Welch, 1992, "A theory of fads, fashion, custom, and cultural change as information cascades", *Journal of Political Economy*, 100, 992-1026.
- Cabral, L.M.B., 2002, "Increasing dominance with no efficiency effect", *Journal of Economic Theory*, 102, 471-479.
- van Damme, E. and S. Hurkens, 1999, "Endogenous Stackelberg leadership", *Games and Economic Behavior*, 28, 105-129.
- van Damme, E. and S. Hurkens, 2004, "Endogenous price leadership", *Games and Economic Behavior*, 47, 404-420.
- Dowrick, S., 1986, "von Stackelberg and Cournot duopoly: choosing roles", *RAND Journal of Economics*, 17, 251-260.
- Dye, R., 2000, "The buzz on buzz", *Harvard Business Review*, November-December, 139-146.
- Ellison, G. and D. Fudenberg, 1995, "Word-of-mouth communication and social learning", *Quarterly Journal of Economics*, 110, 93-125.
- Farrell, J. and G. Saloner, 1985, "Standardization, compatibility, and innovation", *RAND Journal of Economics*, 16, 70-83.
- Hamilton, J.H. and S.M. Slutsky, 1990, "Endogenous timing in duopoly games: Stackelberg or cournot equilibria", *Games and Economic Behavior*, 2, 29-46.
- Hamilton, J.H. and S.M. Slutsky, 1993, "Endogenizing the order of moves in matrix games", *Theory and Decision*, 34, 47-62.
- Huck, S., W. Müller, and H.-T. Normann, 2002, "To commit or not to commit: Endogenous timing in experimental duopoly markets", *Games and Economic Behavior*, 38, 240-264.
- Katz, M.L. and C. Shapiro, 1986, "Technology adoption in the presence of network externalities", *Journal of Political Economy*, 94, 822-841.
- Markides, C.C. and P.A. Geroski, *Fast second - How smart companies bypass radical innovation to enter and dominate new markets*, San Francisco: Jossey-Bass.
- Schelling, T.C., 1960, *The strategy of conflict*, 1980-edition, Cambridge, MA: Harvard University Press.

- Scherer, F.M., 1980, Industrial market structure and economic performance, 2nd ed., Chicago: Rand McNally & Co.
- von Stackelberg, H., 1934, Marktform und Gleichgewicht, Vienna: Springer-Verlag.
- Winther, C.D., 2008, "Popularity and debut", Working paper no. 2008-2, School of Economics and Management, University of Aarhus.
http://www.econ.au.dk/AfN/working_papers/working_papers.htm

Legend

Figure 1: Reduced form game.

Figure 2: Expected profits of the game.

Figure 3: First-mover gains and second-mover losses.

Figure 4 (a): Outcomes of the game with brand A as leader.

Figure 4 (b): Outcomes of the game with brand B as leader.

Economics Working Paper

- 2007-16 Michael Rosholm, Jonas Staghøj and Michael Svarer: A Statistical Programme Assignment Model
- 2007-17 Nabanita Datta Gupta and Marianne Simonsen: Non-cognitive Child Outcomes and Universal High Quality Child Care
- 2007-18 Agne Lauzadyte: Unemployment, Employment and Inactivity in Denmark: An Analysis of Event History Data
- 2007-19: Christian Dahl Winther: Timing of product introduction in network economies under heterogeneous demand
- 2008-01: Richard Barnett, Joydeep Bhattacharya and Helle Bunzel: Choosing to keep up with the Joneses
- 2008-02: Christian Dahl Winther: Popularity and Debut
- 2008-03: Knud Jørgen Munk: Welfare Effects of Tax and Price Changes Revisited
- 2008-04: Erich Gundlach and Martin Paldam: A farewell to critical junctures: Sorting out long-run causality of income and democracy
- 2008-05: Torben M. Andersen and Michael Svarer: The role of workfare in striking a balance between incentives and insurance in the labour market
- 2008-06: Michael Svarer: Crime and Partnerships
- 2008-07: Marianne Simonsen and Lars Skipper: The Incidence and Intensity of Formal Lifelong Learning
- 2008-08: Torben M. Andersen and Allan Sørensen: Globalisation squeezes the public sector - is it so obvious?
- 2008-09: Kristin Kleinjans: Do Gender Differences in Preferences for Competition Matter for Occupational Expectations?
- 2008-10: Martin Paldam: Development and foreign debt: The stylized facts 1970-2006
- 2008-11: Christian Dahl Winther: Brand popularity, endogenous leadership, and product introduction in industries with word of mouth communication