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MOTIVES FOR THE INTERNATIONAL LICENSING OF BRANDED FOOD AND RELATED PRODUCTS

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Abstract

Given initial empirical observations of international licensing of food and beer brands, this paper presents a simple game-theoretic model of the motives for licensing. In a situation of complete information, the model suggests that imperfect competition in overseas markets may be an important determinant of a branded product licensing equilibrium, whilst incomplete information about incumbent firms' payoffs and strategies and also repetition of the game may generate a sequence of unsuccessful entry followed by licensing.

Introduction

Casual empiricism suggests that international licensing of the production and marketing of branded food and related products may become an increasingly important aspect of the globalisation of the food industry, particularly in sectors such as soft drinks, brewing and confectionary products. However, much of the recent theoretical literature on licensing has dealt only with the licensing of process technologies, rather than branded products (see Tirole, 1989, for a survey). The purpose of this paper is to consider the possible motives for food manufacturing firms to license their branded products to overseas firms.

Section 1 deals in general with brand licensing in the food processing sector and focusses in some detail on licensing and the brewing industry. Currently major US brewers are both licensees for foreign beers and have recently begun to license their products to foreign firms. Section 2 presents a simple game-theoretic characterisation of a product licensing equilibrium, which takes into account the motives of both the *licensor* and the *licensee*.

1. Branded Food Products and Licensing

As a form of business activity, the licensing of branded food and related products has existed for many years in both the US and other developed countries' food processing sectors. For example, both Coca-Cola and Pepsi-Cola have licensed the domestic canning and distribution of their final products. The activity also crosses national borders. For example, Cadbury-Schweppes and Britvic-Corona own the UK canning and distribution rights to "Coca-Cola" and "Pepsi-Cola" respectively; the chocolate products "Kit-Kat" and "Rolos", both made in the UK by Nestlé-Rowntree, are manufactured under licence in the US by

Hershey; "Yoplait" yoghurts are made under licence in both the US and Canada from the French firm Sodima; and "Knorr" products are licensed by CPC to Ajinmoto in Japan. **Table 1** lists a number of food product licences which are predominantly in the confectionary sector.

Because of recent developments, it is interesting to consider in more detail the case of brewing. Leading US brewers, Anheuser-Busch and Miller, are now licensing the production and marketing of their respective products "Budweiser" (US market share-27 per cent) and "Miller Lite" (US market share-10 per cent) to leading UK brewing companies. US brewers also own the rights to produce foreign beers in the US. For example, "Löwenbrau" (German) and "Killian's Red" (French-owned) are made under licence by Miller and Coors respectively. As **Table 2** indicates, there is also a good deal of inbound licensing into Canada and the UK, suggesting that it is a fairly widespread phenomenon.

In order to set licensing in context, it is relevant to describe briefly the market structures of the US and UK brewing sectors (see Connor *et al*, 1985 and Monopolies and Mergers Commission, 1989 for discussion of the US and UK brewing industries respectively). The US brewing industry is an oligopoly where the three leading firms, each selling a portfolio of branded and heavily advertised beer products, account for an 83 per cent market share (**Table 3**). Whilst many foreign beers are imported into the US, they take only a 5 per cent market share and appear to be sold at a premium over domestically produced beers. Exports account for only 2 percent of US shipments. This market structure is set in the context of a slowdown in the rate of growth of US beer consumption in the 1980s compared to the 1960s and 1970s (Modern Brewery Age, March 1989).

Table 1 : Examples of International Food Product Licences

Licensor/Product	Licensee
Cadbury, UK	
"Cadbury Dairy Milk"	Hershey, US
"Cadbury Fruit and Nut"	Hershey, US
"Caramello"	Hershey, US
"Cadbury Creme Eggs"	Hershey, US
"Roast Almond"	Hershey, US
CPC, US	
"Knorr"	Ajinmoto, Japan
Phillip Morris/Kraft, US	
"Kraft Margarine"	Epic Oil Mills, South Africa
"Kraft Salad Dressing"	Epic Oil Mills, South Africa
Phillip Morris/Jacob Suchard, Switzerland/US	
"Sugus"	Nestlé Produtos Alimentaros, Portugal
	Beacon Sweets and Chocolates, South Africa
	P.T. Super Worldwide Foodstuffs, Indonesia
	Sanborn Hermanos, S.A., Mexico
"Toblerone"	Sanborn Hermanos, S.A., Mexico
"Suchard"	Sanborn Hermanos, S.A., Mexico
	Tong Yang Confectionary, Korea
	Nestlé Produtos Alimentaros, Portugal
"Milka"	Sanborn Hermanos, S.A., Mexico
"Van Houten"	Chocolate Products Manufacturing, Malaysia
	General Food Industries, Indonesia
	Sunshine Allied Investments, Singapore
Nestlé-Rowntree, Switzerland/UK	
"Kit-Kat"	Hershey, US
"Rolos"	Hershey, US

Table 2 : Examples of International Brewing Licences

Licensor/Product	Licensee
Anheuser-Busch	
"Budweiser"	Labatt, Canada
	United Breweries, Denmark
	Guiness, Ireland
	Suntory, Japan
	Oriental Brewery, Korea
	Grand Metropolitan, UK
"Bud Light"	Labatt, Canada
Bond, Australia	
"Castlemaine XXXX"	Allied Lyons, UK
"Swan Premium"	Allied Lyons, UK
Brasserie Artois	
"Stella Artois"	Whitbread, UK
	Molson, Canada
BSN, France	
"Kronenbourg"	Courage, UK
Adolph Coors	
"Coors"	Molson, Canada
Cerveceria Modelo, Mexico	
"Corona"	Molson, Canada
Elders, Australia	
"Fosters"	Beamish and Crawford, Ireland
	Pripps, Sweden
Guiness, Ireland	
"Guiness Stout"	Elders, Australia
Haute Brasserie, France	
"Killian's Red"	Adolph Coors, US
Heineken, Holland[1]	
"Heineken"/"Amstel"	Whitbread, UK
	Kirin, Japan
	Frydenlund Ringes Bryggerier, Norway
	A.B. Wårby Bryggerier, Sweden
Kirin, Japan	
"Kirin"	Molson, Canada
	Sam Miguel, Hong Kong
Labatt, Canada	
"Labatt"	Vaux Brewery, UK
Löwenbrau, Germany	
"Löwenbrau Pils"	Allied Lyons, UK
	Molson, Canada
	Miller, US
	Sam Miguel, Hong Kong
"Löwenbrau Strong"	Allied Lyons, UK
"Löwenbrau Special Export"	Allied Lyons, UK
Miller, US	
"High Life"	Molson, Canada
"Miller Lite"	Molson, Canada
	Courage, UK
United Breweries, Denmark	
"Carlsberg"	Photos Photiades, Cyprus
	Tou, Norway
	Suntory, Japan
"Tuborg"	Frydenlund Ringes Bryggerier, Norway
	Köbányai Sörgyar, Hungary
	Podravka, Yugoslavia
	Unicer, Portugal

1. Heineken's licences to firms in developing countries are not listed here.

Since the late-1960s, the UK brewing industry has been dominated by six firms whose combined market share is 76 per cent (**Table 3**). Again setting this in the context of demand for beer, UK consumption rates as a whole have been declining/stagnating in the 1980s (Monopolies and Mergers Commission, 1989). However, within this static demand there has been an important structural change: at the start of the 1970s, UK beer consumption was dominated by traditional ale products, which are often locally brewed and marketed. Since then there has been a marked shift to the consumption of lager[1], a type of beer similar to that consumed in the US, which tends to be brewed and marketed nationally by the major UK brewers. Consumption of lager increased from about 6 per cent of total beer consumption in 1970 to 44 per cent in 1987 (Monopolies and Mergers Commission, 1989), and since 1970, 340 different lager brands have been introduced into the market (Financial Times, January 1990).

Table 3 : Domestic Market Shares of US and UK Brewers, 1989, %

US		UK	
Anheuser-Busch	- 42.0	Bass	- 22.0
Miller	- 22.0	Allied Lyons	- 13.0
Coors/Stroh	- 19.0	Whitbread	- 11.0
Others	- 12.0	Scottish/ Newcastle	- 11.0
Imports	- 5.0	Courage	- 9.0
		Grand/ Metropolitan	- 9.0
		Others/imports	- 24.0

Source: Modern Brewery Age, March 1989
Monopolies and Mergers Commission, 1989.

[1] Lager is brewed with a top-fermenting yeast whilst bitter, a traditional-style beer in the UK, is brewed using bottom-fermenting yeast.

With respect to technology, brewing is a long established technique in both countries and there is evidence of economies of scale in beer production (see Elzinga, 1977 and Cockerill, 1984 for evidence on the US and UK respectively). There is also evidence that US plants tend to be both larger and more efficiently utilised than those in the UK (see Cockerill, 1984). The critical point about the technology, though, is that whilst it is not particularly sophisticated, different brands of beer are produced, or at least perceived to be produced to different "recipes", e.g. "Budweiser" is "beech-wood aged", "Strohs" is "fire-brewed" and "Miller Genuine Draft" is "cold-filtered".

Given this background, it is important to note that the structural shift in demand for beer in the UK has coincided with the large UK firms acquiring licences to produce and market foreign lager brands. For example, Whitbread brew "Heineken" (Dutch) and "Stella Artois" (Belgian), whilst Courage, prior to their acquisition by Elders, brewed "Fosters" (Australian) under licence, and now they brew "Miller Lite" under licence. The licence to brew "Budweiser" is owned by Grand Metropolitan. It would seem therefore, at least by implication, that some firms find it more profitable to acquire new brands through licensing and may have done so in response to their competitors' strategies.

However, this would explain only one side of any licensing equilibrium. In this respect two additional aspects of the structure of the UK brewing sector need to be noted: **first**, not only do the leading brewers own many brands, they also spend large sums on brand promotion, for example in 1989, Whitbread spent £11 million (≃ $17.5 million) on advertising "Heineken" alone (Monopolies and Mergers Commission, 1989). This suggests a strong degree of pre-commitment on the part of incumbent firms, which is clearly visible

to potential entrants. **Second**, the leading UK brewers, unlike their US counterparts, are highly vertically integrated into beer retailing. The top six firms own over 50 per cent of the licensed "pub" outlets, which are tied to selling their owners' products. They also own a number of the "off-licence" retail outlets[2]. Consequently, firms entering the UK market would have problems securing distribution.

In this context, the 1989 Monopolies and Mergers Commission investigation into the UK brewing industry described it as a "complex monopoly" and indicated that the tie between brewers and retail outlets should be substantially scaled down. However, the Commission's recommendations have not been implemented by the UK government, instead brewers owning more than 2000 retail outlets are now required to sell a "guest"[3] beer as well as their own brand. Therefore, it would appear that direct entry, except by acquisition, would be difficult for US firms and as a result they are attempting to extract rents from imperfectly competitive UK brewers by means of brand licensing. It should be noted that entry by acquisition has occurred in the UK; Elders having acquired Courage from Imperial Tobacco in 1986, however, this appears only to be a viable strategy if conglomerate firms choose to divest themselves of their brewing assets (Financial Times, December 1989) and the Monopolies and Mergers Commission does not rule against specific takeovers[4].

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[2] Stores where sales are for off-premises consumption.

[3] A "guest" beer is a locally brewed, cask-conditioned beer. The rule is designed to provide outlets for small regional brewers and micro-breweries. Beers produced under licence will not meet this definition.

[4] The Monopolies and Mergers Commission ruled against bids by Elders for Allied Lyons and Scottish and Newcastle in 1986 and 1989 respectively and is currently investigating a proposed deal with Grand Metropolitan whereby Elders would exchange some of its retail outlets for breweries.

2. Product Licensing Equilibrium

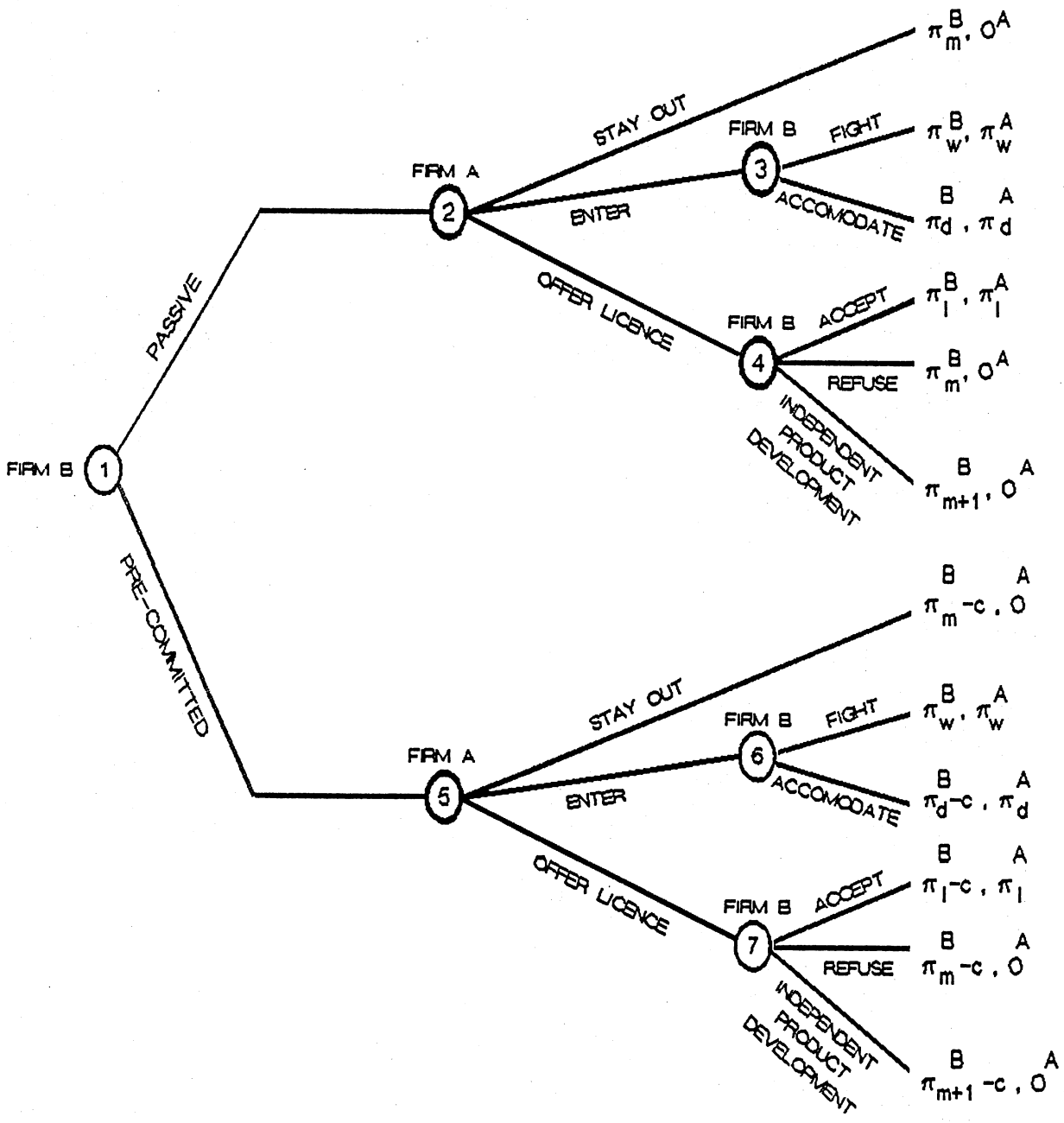
In light of the above discussion, it is useful to consider brand licensing in a theoretical framework. The following licensing equilibrium, based on a stylised market, is modelled in the context of a simple entry game where product licensing enters explicitly into the strategy space of both a potential licensor and licensee (see Gallini, 1984, and Katz and Shapiro, 1985, for applications to technology licensing). Initially it is assumed that the former, firm A, is a monopoly in its own market, producing and selling a single branded food product which it may decide to license in an overseas market. The licence is essentially the right to produce the branded product, for which the licensor has property rights. It also includes basic information on how to produce the product, i.e. the "recipe"; the production technology being treated as relatively unsophisticated.

The potential licensee, firm B, is also a monopoly in its own market, selling a branded product which is differentiated from that sold by firm A. Both firms are assumed to have the same cost structures. However, if firm B adds a second product to its portfolio, its unit costs of production are assumed to fall due to economies of scope. Implicitly, consumers in both markets have an aggregate demand for variety, although this is not modelled here.

The licensing decision by firms A and B is examined in terms of a simple game where licensing is an alternative strategy to direct entry by the licensor and an alternative to independent product development by the incumbent firm. The *extensive* form of the game is depicted in **Figure 1**, where firms move sequentially left to right. Initially, it is assumed that the game is only played once and the payoffs to any particular strategy are known to

both firms. The equilibrium concept invoked is that of *perfect Nash equilibrium* (Selten, 1975). This rules out non-credible threats by firms in the sense that one firm will attach no credibility to an action threatened by another firm for which it has no *ex post* incentive.

Figure 1 Entry/Licensing Game



Equilibrium 1

In this version of the game, the focus is on **node 2** of the game, where firm A moves first. Analysing the entry/no entry sub-game, the following condition is assumed to hold:

(1) $$\pi_m^B > \pi_d^B > 0 > \pi_w^B$$

The outcome of such a game is well-known (see Dixit, 1982); fighting entry by firm A is not a *credible* threat by firm B as the profits from sharing the market in a Nash equilibrium, π_d^B, are greater than those from fighting, π_w^B. Hence the perfect equilibrium is that of entry by firm A and accommodation by firm B.

Focussing now on the strategy of offering a licence at **node 2**, for this to be an equilibrium strategy for firm A, it must also be an equilibrium for firm B to accept a licence at **node 4**. Clearly, if the following condition holds, firm B will be willing to accept the offer of a licence:

(2) $$\pi_l^B > \pi_{m+1}^B > \pi_m^B > \pi_d^B$$

i.e. it is more profitable for the incumbent firm to accept a licence, π_l^B, than either developing its own product, π_{m+1}^B, acting as a monopolist, or sharing the market. If condition 2 holds, then offering a licence will be an equilibrium strategy for firm A if the following holds:

(3) $$\pi_l^A > \pi_d^A$$

where π_1^A are the licensing profits earned by firm A. Assuming (3) holds, (2) must hold, otherwise firm A will simply not offer the licence and will enter the market. It can also be noted that if some informational asymmetry is introduced, i.e. firm A does not know the payoffs to firm B from either accepting or refusing the licence, then it will always be rational for firm A to follow a strategy of direct entry.

Equilibrium 2

Critical to the above equilibrium is the move sequence in the game, i.e. firm A has been allowed *first-mover* advantage. However, it is possible to allow firm B such an advantage in the sense that it can make irrevocable prior commitments, incurring a sunk cost c, in preparation to fight direct entry by firm A. In the context of branded products, Salop (1979) has suggested that product differentiation and advertising represent examples of such prior commitments.

Therefore, at **node 1** of the game, pre-commitment is a rational strategy for firm B if it is optimal to fight entry i.e.:

(4) $$\pi_w^B > (\pi_d^B - c)$$

Assuming firm A can observe this, it will not enter if firm B is pre-committed, but will do if firm B is passive. Firm B, in turn, will pre-commit if the monopoly profits from doing so

exceed the profits from passive market sharing:

(5) $$(\pi_m^B - c) > \pi_d^B$$

Therefore, as long as there is a pre-commitment whose cost satisfies the following condition:

(6) $$(\pi_m^B - \pi_d^B) > c > (\pi_d^B - \pi_w^B)$$

then a credible threat can be employed by firm B such that at **node 5** of the game, entry is no longer an optimal strategy for firm A, i.e. it knows firm B will fight to protect its pre-commitment. Expression (6) is derived by re-arranging (4) and (5) and has the following interpretation. The size of the pre-commitment c must be large enough for firm B to have an incentive to fight entry by firm A, but not so large as to reduce monopoly profits below the profits from market sharing. Essentially, the pre-commitment has to be sufficiently large to be a credible threat against firm A's entry, that is, larger than the opportunity cost to B of fighting entry. If this condition does not hold, the pre-commitment is not credible and it would be more profitable for firm B to accept market sharing.

It is now the case that, at **node 7** of the game, both licensing (π_l^B - c) and developing a new product (π_{m+1}^B - c) are possible outcomes and hence strategies for firm B. Licensing will be an equilibrium if the following conditions hold:

(7) $$(\pi_l^B - c) > (\pi_{m+1}^B - c) > (\pi_m^B - c)$$

(8) $$\pi_l^A > 0$$

Therefore, in this simple model, the motives for licensing are clear: the licensor aims to extract rents from an imperfectly competitive market overseas that it is unable to enter directly, whilst the licensee aims to increase monopoly profits via a less costly route than independent product development. However, this model has been constructed using certain simplifying assumptions which need to be relaxed, specifically a monopolistic structure in firm B's market, no repetition of the game and complete information on the part of firm A about all of firm B's payoffs.

Relaxation of Assumptions

(i) Incumbent Oligopoly

If it is assumed that firm B operates in a small numbers, non-cooperative oligopoly, then the outcomes of the two games outlined above will not alter substantively, although the incentive structure for the incumbent firms may change due to their strategic interaction. In the case of **equilibrium 1**, direct entry by firm A is again likely to be the dominant outcome of the game, i.e. the following condition holds:

(9) $$\pi_o^A > \pi_l^A$$

where π_o^A are the oligopoly profits accruing to firm A. However, it is important to note that the necessary condition for an incumbent firm, say firm B, to accept a licence will now be affected by its conjectures about other firms' licensing decisions, i.e. even though

independent product development is more profitable than licensing for firm B, if either a rival firm(s) finds licensing profitable or firm B is uncertain about the profitability of licensing for rival firms, it may desire to pre-empt its rivals from obtaining the licence because the loss of future profits from not licensing exceeds the difference between independent product development and purchasing the licence:

(10) $$(\pi_o^B - \pi_o^{B'}) > (\pi_{o+1}^B - \pi_l^B)$$

where $\pi_o^{B'}$ are firm B's oligopoly profits if another firm gets a licence and π_{o+1}^B are the next-period profits to firm B of independent product development.

Even if (10) is satisfied, it is not sufficient to ensure a licensing equilibrium. In an auction, firm B will only bid up to what it will lose if another firm gains a licence, whilst firm A's reservation price will be at least π_o^A, the oligopoly profits it could gain through entry. Hence the necessary condition for a licensing equilibrium in this case is:

(11) $$(\pi_o^B - \pi_o^{B'}) > \pi_o^A$$

i.e. the amount bid for the licence must exceed firm A's oligopoly profits if it chooses to enter.

This seems a particularly strong condition for a licensing equilibrium, hence entry is likely to occur. Turning to **equilibrium 2**, where entry is credibly prevented by the incumbent firms, the licensing equilibrium is now only dependent on it being profitable for both firm A and firm B. However, as just noted, pre-emptive behaviour by the incumbent

firms now enters the equilibrium where a rival firm(s) finds licensing profitable or there is uncertainty about its profitability. This strategic interaction between firm B and its rivals would seem, *a priori*,to make licensing a more likely outcome in oligopolistic markets than monopolies.

(ii) Repetition of Game

Retaining a market structure of monopoly for firm B, repetition of the game in **Figure 1** can be allowed for. Specifically, the passive incumbent[5] plays against a number of potential foreign entrants A_i, $i=1,....,n$. In the "*one-shot*" version of this game, it has been shown that entry and accommodation is the perfect equilibrium of the game, however, with repetition the question arises as to whether the incumbent can rationally fight early entrants in order to deter future entry.

In the case of infinite repetition of the game, it is possible for firm B to fight entry early on and then enjoy monopoly profits in perpetuity. If r is the rate of interest, fighting occurs when the following condition holds:

$$(\pi_d^B - \pi_w^B) < (\pi_m^B - \pi_d^B)/r(1+r) \tag{12}$$

i.e. the loss from fighting is outweighed by future gains from not sharing the market. In this case, a licensing equilibrium would emerge for the same reasons as described for **equilibrium 2**, that is conditions (7) and (8) hold. However, as noted by Friedman (1977), infinitely repeated games tend to generate multiple equilibria such that the perfect

[5] Repeating the game with a pre-committed incumbent is not necessary as the pre-commitment is credible by assumption.

equilibrium of the above game could have entry and accommodation at each play, in which case **equilibrium 1** would hold, i.e. there would be entry and no licensing, unless (2) and (3) hold.

If the game is repeated a finite number of times, there is a unique perfect equilibrium, similar to **equilibrium 1.** Given a finite number of entrants, who have complete information about payoffs and strategies, repetition of the game will generate entry and accommodation each time, assuming of course entry remains profitable, $\pi^{Ai}_{o} > 0$. The proof of this result is due to Selten, and is commonly known as the "*chain-store*" paradox. Suppose the last round of the game at time t is considered, A_n being the last potential entrant. As there are no more potential entrants, firm B has no incentive to fight, consequently the Nash equilibrium is to share, i.e. **equilibrium 1.** If accommodation is the equilibrium in period t, then fighting entry in t-1 will not be a credible threat, and likewise in t-2. So by backwards induction, the incumbent firm will never fight entry in a finitely repeated game where players have complete information. Consequently, under these assumptions, repetition of the game is unlikely to generate a licensing equilibrium, unless conditions (2) and (3) hold.

(iii) Incomplete Information

Suppose now that the game in **Figure 1** is repeated a finite number of times, but the potential entrants A_i have incomplete information about the payoffs and strategies of the incumbent firm. The focus is on a situation where the potential entrants do not know whether there is a pre-commitment[6] that satisfies condition (6). Clearly a committed firm

[6] This is probably a reasonable assumption in the case of firms attempting to enter an overseas market.

will always fight entry as sharing will indicate a lack of commitment and hence provoke future entry. However, a passive incumbent may act aggressively in order to be mistaken for a committed firm. As several authors have noted, such incomplete information may be sufficient to allow for reputation-building behaviour by incumbent firms which will deter future entry, or at least delay it (see Kreps and Wilson, 1982a, Milgrom and Roberts, 1982, and Easley, Masson and Reynolds, 1985). In this context, it is interesting to introduce licensing into the strategy space of firms.

Suppose the incumbent firm B is drawn from a sample of four types; type 1 is a pre-committed firm who will always fight entry but, with some positive probability v, will accept a licence if offered ; type 2 is a passive firm who will accommodate entry whilst types 3 and 4 are non-committed firms that will fight current entry in order to delay/deter future entry and also accept a licence(s). Type 3 is an incumbent who fights once and then accommodates and type 4 is an incumbent who fights twice[7] and accepts a licence in the third period. There are a number of potential entrants A_i, $i=1,....,n$, which is sufficient to generate predatory behaviour by the incumbent firm. Entrants do not know the type of firm they face but are able to assign probabilities to types 1 to 4 and update these after observing the incumbent's reaction to entry, i.e. firms act in a Bayesian manner. Also, it is assumed that firms incur sunk entry costs f_i and that for firm A_1, $f_1 < f_i$, $i > 1$, which ensures that firm 1 has an entry advantage[8] over the other potential entrants, although with accommodation

[7] A non-committed incumbent might be prepared to fight for more than two periods, but this is not necessary for deriving the result of fighting and licensing.

[8] This is a device to allow one firm to do the entering and may be regarded as reasonable in the case of attempting to establish a branded product overseas.

by the incumbent, the market can sustain further entry until the following condition is met:

(13) $$(\pi_w^{A_i} - f_i)/r \leq 0, \quad i > 1$$

The equilibrium concept employed is that of *sequential equilibrium* as described by Kreps and Wilson (1982b) and Kreps (1990). Suppose that g is a vector of entrants' and incumbent's strategies and μ is the vector of entrants' expectations about the type of entrant they face. Assuming that all players maximise expected payoffs given the strategies of other players, then an equilibrium to the game can be defined as a set of strategies that satisfy:

(14) $$g \in g*(\mu^{BAY}(g))$$

and a set of beliefs associated with these strategies satisfies the following:

(15) $$\mu \in \mu^{BAY}(g*(\mu))$$

Essentially (14) means that firms' strategies are optimal given beliefs and (15) states that beliefs are obtained from strategies and observed actions using Bayes' rule[9]. A sequential equilibrium then is a set of strategies g and beliefs μ where, at any point in the game, a player plays optimally from then on given what has already occurred and their beliefs about what will happen at later nodes of the game.

As Tirole and Easley *et al* note, finding direct solutions for sequential equilibria can be difficult. However, following a structure suggested by Easley *et al*, an equilibrium for a specific game can be constructed by working backwards, i.e. assume behavioral rules for the

[9] A more formal definition is given in Kreps and Wilson (1982b) and Easley *et al*.

various types of incumbent firm and derive optimal entrant reactions and vice-versa for assumed entry behaviour rules. If there exists a set of parameters that ensure that the incumbent's/entrants' best responses are identical to their assumed behavioral rules, a Nash equilibrium can be derived.

The aim here is to generate an equilibrium where potential entrants are convinced they face a type 1 firm so that they switch strategies to one of offering a licence which has a positive probability of being accepted. The sequence of interest is the following:

t=1, firm A_1 enters the market

t=2, firm A_1 remains in the market even if π_w^{A1} is observed in t=1. If π_d^{A1} is observed in t=1, the other firms, i>1, will enter until $(\pi_o^{Ai} - f_i)/r \leq 0$

t=3, firm A_1 exits the market if π_w^{A1} is observed in t=1 and 2, and any firm in the sample can offer a licence, which the incumbent accepts.

Suppose the initial probability distribution attached to the incumbent firm type is such that, p(type 1)=p_1, p(type 2)=p_2, p(type 3)=p_3, and p(type 4)=p_4, $\Sigma p_i=1$. Given these probabilities, a set of decision rules can be written down for the entrants that will satisfy the above sequence of events:

(16) $$[p_2 \pi_d^{A_i}/r + (1-p_2)\pi_w^{A_i}/r] - f_i < [v\pi_l^{A_i}/r(1+r) + (1-v)0^{A_i}], \quad i>1$$

(17) $$(\pi_w^{A_1} - f_1) + [2(p_3 \pi_d^{A_1}/r + (1-p_3)\pi_w^{A_1}/r) - f_1]/(1+r) > 0$$

$$(18)\quad [3\{\omega\,\pi_d^{A_1}/r + (1-\omega)\pi_w^{A_1}/r\} - f_1] - (2\pi_w^{A_1}/r) < [v\pi_l^{A_1}/r(1+r) + (1-v)0^{A_1}]$$

where ω = p(type 4 | $\Omega_{t=3}$), which defines the conditional probability that A_1 faces a type 4 firm given the information set $\Omega_{t=3}$ available at the start of period 3, i.e. π_d^{A1} has not been observed in periods t=1 and 2. Condition (16) shows that for all firms, bar firm 1, the expected profits from entering are less than the expected profits from offering a licence at some future date. (17) indicates that for firm 1, the expected profits of entry and remaining in the market for two sequential periods are positive, whilst (18) shows that for firm 1, the expected profits from remaining in the market for a third period are outweighed by the profits from exiting and offering a licence, i.e. the odds of the incumbent firm being a type 4 firm are not sufficiently attractive to firm 1 for it remain in the market after period 2.

If the above responses for entrant firms are assumed to be their behavioural rules, a set of optimal reactions can be defined for the incumbent firm that will ensure the sequential equilibrium defined;

Type 1 preys if:

$$(19)\quad n\{\pi_w^B - (\pi_d^B - c)\}/r < [2\{(\pi_m^B - c) - (\pi_d^B - c)\}/r + \{(\pi_l^B - c) - (\pi_d^B - c)\}/r(1+r)]$$

where n is the number of times a committed firm fights in order to deter entry[10]. This condition states that the profits from long-run monopoly, inclusive of returns to accepting

[10] The way the game is structured, the committed firm only has to fight twice.

a licence[11], outweigh the short-run losses from fighting.

Type 2 does not prey if:

(20) $$(\pi_d^B - \pi_w^B) > (\pi_m^B - \pi_d^B)/r(1+r)$$

i.e. the one-period loss from fighting exceeds the difference between monopoly and market sharing in future periods.

Type 3 preys in one period, but not in two if:

(21) $$(\pi_d^B - \pi_w^B) < (\pi_m^B - \pi_d^B)/r(1+r)$$

and

(22) $$2(\pi_d^B - \pi_w^B)/r > (\pi_m^B - \pi_d^B)/r(1+r)$$

Type 4 preys twice and accepts a licence[12] in the third period if:

(23) $$2(\pi_d^B - \pi_w^B)/r < [2(\pi_m^B - \pi_d^B)/r + (\pi_l^B - \pi_d^B)/r(1+r)]$$

Conditions (16)-(23) are sufficient to show that an equilibrium with fighting and licensing exists, i.e. neither entrants nor incumbents can improve their payoffs given the others' behavioural rules.

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[11] Condition (7) is assumed to hold.

[12] This assumes that condition (2) holds.

Necessarily the above result is somewhat restrictive and is only one of a number of equilibria that could arise. In particular, the nature of the strategic outcomes could be made much richer if the game did not end at period t=3, i.e. incumbent firms use licensing as a delaying tactic against future entry and entrant firms regard it as a means of revealing information about incumbent firms. If the bargaining process over the terms of the licence is dealt with explicitly, it might be argued, *a priori*, that an incumbent firm, who is no longer willing to fight after period 2, has an incentive to bargain for a licence with a long time-horizon in order to delay future entry, whilst firm 1, having incurred losses from entry in periods 1 and 2, will require a licence to provide returns over a short time period. In contrast, a pre-committed firm will care less about the length of the licence as future entry will always be fought. Hence the possible asymmetry between the incumbent's and entrant's time-horizons may reveal information about incumbent type. However, expanding the potential equilibria to the game does not undermine the basic point that uncertainty about incumbent firms' behaviour may generate the offer of a licence and a licensing equilibrium.

3. Summary

In summary, this paper has suggested that the licensing of branded food and related products may become an increasingly important feature of international transactions in the food industry. Specifically, in focussing on the characteristics of licensing in the brewing industry, some initial analysis indicates that effectively barricaded entry into the UK market and the expense of independent product development has led leading US firms to licence their brands to UK brewers, the aim being to capture rents in the expanding UK lager

market.

Currently, the economic theory of licensing deals predominantly with the transfer of process technology rather than branded products. Therefore, given the observations on food brand licensing, a conceptual model of a product licensing equilibrium has been presented in order to provide an analytical background to more rigorous empirical work. This analysis suggests that if licensing is considered as an alternative strategy to entry in a simple game-theoretic structure, then in the simplest type of model, licensing is aimed at extracting rents from imperfectly competitive overseas markets. In a more complex model, strategic interaction amongst incumbent firms and imperfect information about their payoffs may also be important factors in the decision to license products internationally.

Clearly more research needs to be conducted in this area both in developing the theory and in establishing the quantitative importance of licensing and its determinants. Also, other licensing issues not addressed in this paper include the notion of an optimal licensing contract, the process of bargaining, the content of brand licensing agreements, and the lifespan of licences.

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