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ABSTRACT

Location Costs, Product Quality, and Implicit Franchise Contracts

by Justus Haucap, Christian Wey, Jens Barmbold*

In the literature on international trade, very little attention has been given to informational asymmetries between firms and consumers with respect to product quality. The few economic models that analyze the question of how asymmetric information about product quality might affect trade flows treat product quality as exogenous. In contrast, our model takes product quality as an endogenous variable, i.e. firms can choose the quality they wish to produce. In this case, location costs can signal product quality under certain conditions and thereby affect international trade flows. More specifically, intra-industry trade in vertical differentiated experience goods can be determined by information asymmetries about product quality.

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ZUSAMMENFASSUNG

Standortkosten, Produktqualität und implizite Franchiseverträge

In der internationalen Handelstheorie ist der Tatsache, daß die Konsumenten in vielen Fällen nur unvollständige Information über die Produktqualität besitzen, kaum Rechnung getragen worden. Die wenigen Arbeiten, die die Wirkungen asymmetrischer Information zwischen Herstellern und Konsumenten auf den internationalen Handel untersuchen, behandeln die Produktqualität als exogene Variable. Im Gegensatz hierzu wird in diesem Beitrag Produktqualität als eine endogene Variable angesehen, die von den Unternehmen gewählt werden kann. Es wird argumentiert, daß in diesem Fall die Standortkosten zur Signalisierung der Produktqualität eines Unternehmens herangezogen werden können. Es zeigt sich, daß unter bestimmten Bedingungen die geeignete Wahl von standortspezifischen variable Kosten in Verbindung mit Standortaustrittskosten zu einem Trenngleichgewicht führen kann, in dem an einem relativ teuren Standort Hochqualitätsprodukte und an einem relativ billigen Standort Niedrigqualitätsprodukte hergestellt werden. Aus diesen Überlegungen folgt, daß intra-industrieller Handel in vertikal differenzierten Erfahrungsgütern durch Informationsasymmetrien über die Produktqualität und internationalen Unterschieden in den spezifischen Standortkosten erklärt werden kann. Aufgrund der Anreizwirkungen der Standortkostenstrukur auf die Wahl der Produktqualität wird das Verhältnis zwischen Landesregierung und Unternehmen als ein implizites Franchiseverhältnis interpretiert.

1. Introduction

Traditional international trade theory predicts that a country's trading pattern is mainly determined by two factors: (1) the composition of its factor endowments, and (2) the intensity with which factors are required (see Jones and Neary, 1984). While government interventions such as tariffs, quotas, subsidies, etc. have also been argued to affect the volume and the structure of international trade, traditional models usually have assumed markets to be perfect.

In sharp contrast, the literature on strategic trade policy as initiated by Brander and Spencer (1985) and reviewed by Brander (1995) has started to analyze the effects of trade policy under conditions of imperfect competition. As these models demonstrate, government intervention may be beneficial for a country in some situations. What is rather surprising in this context is the fact that potential effects of asymmetric information have only been explored to a very limited extent - although we know at least since the path breaking work of Stigler (1961) and Akerlof (1970) that markets with even small informational asymmetries are qualitatively different from markets with symmetric information. The few models that deal with trade policy under asymmetric information almost exclusively focus on informational asymmetries either between firms and the government (Brainard and Martimort, 1997) or between domestic firms and foreign rivals (Collie and Hviid, 1993). Common to these models is the idea that government intervention may be beneficial for a country as it can make an output expansion of the home firm credible. Moreover, as Qiu (1994) has demonstrated, if neither the domestic government nor a foreign rival can observe the firm's costs, the government can play a second role: By offering a separation inducing menu firms might

eventually be enabled to signal their costs to a foreign rival.

Almost no attention has been given to informational asymmetries between firms and consumers and the question of how these asymmetries may affect international trade. Particular exceptions are the two models of W. Mayer (1984) and Bagwell and Staiger (1989) both of which discuss a country's optimal trade policy when (foreign) consumers are uninformed about domestic product quality. As these models do, we will consider the case of an experience good the quality of which is unknown to consumers.[1] However, our model differs in important respects. First, W. Mayer (1984) and Bagwell and Staiger (1989) take product quality as exogenously given; once consumers know a product's quality any credibility problem is resolved. In contrast, we will treat quality as a choice variable. That means, there is a moral hazard or commitment problem connected with product quality. Second, W. Mayer (1984) assumes that the home country's government is informed about a product's quality. In contrast, we will consider the case in which even the government is uninformed about the firm's type. The government is assumed not to know more than any consumer. Similar to Bagwell and Staiger (1989) and Qiu (1994) we will assume that neither the domestic government nor consumers know firm's production costs, although they know the distribution from which the type is drawn.

Basically, our model extents the recent work by Haucap, Wey & Barmbold (1997) according to which rational consumers can use the „Made-in" label as a signal for

[1] The term „experience good" was coined by Nelson (1970). According to his definition a product is considered an experience good if its quality is not evident on inspection and costly to determine before purchase. In contrast, goods the quality of which can be easily determined on inspection have been labeled „search goods" (see Nelson, 1970).

product quality if countries differ in location specific costs and relocation is costly. In this case, production at a high-cost location can credibly signal high-quality production while production at a low-cost site indicates low product quality. However, while Haucap, Wey & Barmbold (1997) take prices as given and do not account for differences in production costs, our analysis will also derive a monopolist's optimal pricing strategy and allow for differences in production costs. Moreover, the focus of Haucap, Wey & Barmbold (1997) is on the legal protection of „Made-in" labels. In contrast, this paper will concentrate on potential implications for international trade and FDI.

Our model is also related to work by Chiang and Masson (1988) and Chisik (1998) who show that consumers may use country-of-origin labels in situations of adverse selection. However, these models differ from ours in some important respects. Chiang and Masson (1988) analyze a case in which country-of-origin effects are the result of consumers statistically discriminating between goods on basis of the products' country of origin. In this model, consumers only know the average product quality produced by firms in a certain country. Accordingly, consumers form their expectation about product quality based on the product's place of production. In contrast, our model provides a signaling explanation for country-of-origin effects. Similarly, Chisik (1998) analyzes country-of-origin effects in a signaling context. Nevertheless, his model is based on statistical discrimination effects, and country-of-origin labels are only used as signals for product quality when the signaling processing is noisy. In contrast, we consider a signaling process without noise. Furthermore, in Chisik's model high-quality producers have lower signaling costs than low-quality firms. In our model, every firm faces the same signaling costs, but only some firms are able to bear these costs due to their low costs of high-

quality production. Finally, in Chisik (1998) firms have to make long-run quality choices so they are committed to their quality level once its is chosen. In contrast, we allow firms to choose quality in every single period of the game.

The rest of the paper is now organized as follows. The next section will introduce and analyze the model. Then, section 3 will shortly relate the model to empirical findings in the international marketing literature, and section 4 will briefly discuss potential implications for international trade, location choice (or foreign direct investment) and fiscal competition. Section 5 offers concluding remarks.

2. The Model

2.1 Product Quality as a Problem of Moral Hazard

Let us consider a firm that has developed a new quality level, q_H, of some existing product category, and let us assume that it is the sole producer of the new quality level. However, while we assume the firm to have a monopoly position for the new quality level, let there also be a standard product of some lower quality, q_L, the market for which is perfectly competitive.[2] That means, the good under consideration can be produced at two different quality levels, q_L and q_H, with $q_L < q_H$. For simplicity let Δq denote the difference between the two quality levels, i.e. $\Delta q \equiv q_H - q_L$. Let us furthermore assume that the marginal cost of low-quality production is zero, while the marginal cost of high-quality production is given by some constant $c_H > 0$. Since the market for the standard, low-quality product is assumed to be perfectly competitive the

[2] Hence the model can also be interpreted as a new product monopoly in which both consumers and producers have a given outside option.

price is given by $p_L = c_L = 0$.

Consumers are assumed to have unit demand, i.e. consumers do not buy more than one unit of the product. Furthermore, we assume a continuum of consumers which are heterogenous in their taste for quality. More specifically, let consumers' utility function take the form $u(q_j) = \Theta q_j - p$ for $j = L,H$, where p denotes the price paid. The parameter Θ reflects the variation in quality taste and is assumed to be uniformly distributed between 0 and 1.

If the product under consideration is a search good, for which product quality is perfectly observable before purchase, a monopolist producing at a quality level of q_H will face an inverse demand function of $x(p_H) = 1 - (p_H / \Delta q)$, and the monopoly price for the high-quality good is given by:

$$p_H^M = \frac{1}{2}(\Delta q + c_H) \tag{1}$$

Assuming that there are no fixed costs, the monopolist's profits are

$$\Pi^M = \frac{(\Delta q)^2 - 2\Delta q \cdot c_H + c_H^2}{4\Delta q} \tag{2}$$

Next let us consider the case of an experience good in which product quality is not searchable ex ante, but can only be observed after purchase. That means, consumers only learn the product's quality after they have bought the good. Let us furthermore assume

that quality is endogenous: Product quality is not determined once and for all by some technology chosen, but the monopolist can choose between the two quality levels in every single period. In this case, the producer faces an incentive to cheat consumers and offer low quality while charging the price for a high quality good. Hence, the market may possibly fail as Akerlof (1970) has shown in his seminal paper.

However, as is well known from standard game theory (see, e.g., Eichberger, 1993), the problem of market failure due to asymmetric information may be overcome if the game is repeated infinitely often and discount rates are sufficiently close to one: If consumers are willing to pay a price premium for high-quality products and, at the same time, adopt a boycott strategy in case of low-quality production the producer's promise to deliver high-quality might become self-enforcing (Telser, 1980). Let us, for example, consider the case of a pure grim strategy according to which consumers are willing to pay p_H as long as the monopolist has never delivered low quality, but are only willing to offer p_L if the producer has ever delivered low quality. In an infinite horizon model, the monopolist will refrain from producing low quality if the following incentive compatibility constraint (IC) is met where i denotes the discount rate:

$$\frac{p_H - c_H}{i} \geq \frac{p_H}{1+i} \tag{3}$$

The left hand side of this condition represents the present value of the profit made per unit if the producer does not cheat and honestly produces high quality. The right hand side gives us the discounted hold-up profit the producer makes (also per unit) for one single time if he breaks his promise and delivers low quality while charging the price for a

high-quality good. Since consumers will boycott him after a one time deviation, he will be only able to charge p_L in any period following a hold-up so that there are no further profits to be made since $p_L = c_L$.

If now the present value of profits from honest high-quality production as given by the LHS of condition (3) iis greater or equal to the hold-up profit of a one time deviation as given by the RHS, high-quality production is self-enforcing for the monopolist. That means, it is in the monopolist's own self-interest not to break his promise to deliver high quality. While the price premium serves as a carrot, the boycott mechanism can be regarded as the stick, the combination of which makes the promise self-enforcing. For reasons of plasticity, let us rewrite the IC (3) in terms of the quality-assuring price p_H as:

$$p_H \geq c_H(1+i) \tag{3a}$$

If the price charged by the monopolist is lower than this quality guaranteeing price, the IC does not hold and the monopolist's optimal strategy is to offer low quality. However, since payoffs are assumed to be common knowledge, consumers will not believe in the promise of high-quality production for prices that are lower than the quality-assuring price. Hence, consumer demand for the new quality level can now be expressed as:

$$x^H(p_H) = \begin{cases} 1 - \dfrac{p_H}{\Delta q} & \text{for } p_H \geq c_H(1+i) \\ 0 & \text{for } p_H < c_H(1+i) \end{cases} \tag{4}$$

Given consumers' strategy the producer of a high-quality experience good now faces the following constrained maximization problem:

$$\underset{p_H}{\text{Max}} \quad (p_H - c_H)(1 - \frac{p_H}{\Delta q})$$

$$s.t. \quad p_H \geq c_H(1+i)$$

Solving for optimal prices gives us the monopolist's optimal pricing scheme in terms of c_H:

$$p_H^M(c_H) = \begin{cases} c_H(1+i) & for \ c_H \geq \frac{\Delta q}{1+2i} \\ \frac{1}{2}(\Delta q + c_H) & for \ c_H \leq \frac{\Delta q}{1+2i} \end{cases} \tag{5}$$

Accordingly, the inverse demand function can be expressed as a function of the monopoly price p_H^M, and therefore also as a function of c_H. In this case, consumer demand is given by:

$$x^H(c_H) = \begin{cases} \frac{1}{2}(1 - \frac{c_H}{\Delta q}) & for \quad \frac{\Delta q}{1+2i} \geq c_H \geq 0 \\ 1 - \frac{c_H(1+i)}{\Delta q} & for \quad \frac{\Delta q}{1+i} \geq c_H \geq \frac{\Delta q}{1+2i} \\ 0 & for \quad c_H \geq \frac{\Delta q}{1+2i} \end{cases} \tag{6}$$

Hence, the problem of market failure can be overcome if the costs of producing high

quality are sufficiently low, or more exactly, if $c_H \leq \Delta q/(1+i)$. However, if the costs of high-quality production exceed this threshold value, the market will fail to come into existence. In this case, the quality-assuring price exceeds consumers' willingness to pay so that the demand side breaks down. Furthermore, for a price lower than the quality-assuring price consumers will not buy an alleged high-quality product since they know that the producer's incentive to be honest is lower than his incentive to cheat.

2.2 Product Quality as a Problem of Moral Hazard and Adverse Selection

Up to this point we have considered a pure moral hazard problem; payoffs have been assumed to be common knowledge. However, let us now assume that the cost of high-quality production, c_H, is not directly observable for consumers. While consumers can observe prices, lack of knowledge about the costs of high-quality production leaves them uncertain about the monopolist's payoffs, and therefore, his incentives to honestly produce high-quality. For the sake of simplicity let us assume that there are two possible types of monopolists, B and G, which are characterized by their costs of high-quality production, denoted as c_H^B and c_H^G, respectively.

Let us also make the following two assumptions, where π denotes the probability of a monopolist being of type G:

(i) $c_H^B \geq \frac{\Delta q}{1+i} > c_H^G$ and (ii) $c_H^G > \frac{\pi \Delta q}{\pi + i}$.

Due to assumption (i) the quality-assuring price that is incentive compatible for a type-B

producer exceeds consumers' maximum willingness to pay as is shown by the demand function (6). Hence, a type-B producer will not find it optimal to honestly produce high quality since his costs are too high. For a type-G producer costs are sufficiently low so that honest high-quality production is self-enforcing. However, since the quality-guaranteeing price for a producer of type G exceeds zero, a producer of type B will now find it profitable to pretend to be a type-G producer and earn the hold-up profit for one time rather than to reveal his type and earn zero profits in the low-quality segment of the market.

Assumption (ii) now implies that the prior probability distribution over the two possible types, $(\pi, c_H^G; (1-\pi), c_H^B)$, induces sufficiently pessimistic beliefs so that not a single consumer prefers testing a new product at a quality-assuring price of p_H over buying a low-quality good at a price of $p_L = 0$. Put differently, there is not a single price p_H that would make consumers try the new product and at the same time provide producers with sufficiently high incentives to honestly deliver high quality. That means, consumers are sufficiently pessimistic about a new product's quality so that price cannot be used as a signal of product quality and demand breaks down.[3] Hence, under incomplete information about the firm's production costs the problem of market failure may return as we imply by assumption (ii).[4]

[3] This result is explained in Appendix 1.

[4] To overcome this problem various mechanisms have been suggested in the literature. Most prominently, „burning money" in form of introductory advertising (Klein and Leffler, 1981; Rogerson, 1987) or price rebates (Shapiro, 1983) have been argued to be a credible signal for product quality. However, introductory advertising campaigns and price rebates require large amounts of capital which might often not be available to new firms. If firms are not able to borrow against future profits, the signaling mechanisms suggested are no longer availbale to firms. Moreover, we rule out warranties as a quality assuring provision. First of all, warranties might not be available due to problems of incomplete contracting, i.e. it might be too difficult to

2.3 Location Costs as Separation-inducing Means

Now suppose that there are two countries, E and W, which differ with regard to the location costs they impose on firms. More specifically, let us characterize the two countries by the differences in country specific fixed costs which are periodically paid. The country specific fixed costs may take the form of high taxes or wages if labor is a fixed factor of production or if it is difficult to lay off personnel. Alternatively, one might also think of a situation in which firms have to precommit to a fixed capacity level which again induces a certain level of country specific costs per period. For the sake of simplicity let us assume that the low-cost country, E, is characterized by zero fixed costs per period[5] while in the high-cost country, W, firms have to pay country specific fixed costs of w per period. Moreover, we assume that market exit is costly. These market exit costs may result from compulsory layoff plans or from specific investments associated with plant location. That means, industrial locations are subject to site or country specificity. Let us denote these exit costs by R. Furthermore, assume that marginal costs are dependent on the firm's location, S, where $c_{j,S}^{k}$ stands for the constant marginal costs to produce quality level j with $j \in \{L,H\}$ at location S with $S \in \{E,W\}$ for a firm of type k with $k \in \{B,G\}$. Let us assume that conditions (i) and (ii) hold for both countries, E and W. However, note that the figure $c_{j,S}^{k}$ does not

specify all possible contingencies. Secondly, even if contracts can be contingent on any state of the world, warranties might be costly to enforce for consumers, if courts do not work costlessly and states of the world are difficult to verify. And finally, firms might be reluctant to give warranties if there are moral hazard problems on the consumer side. Therefore, we want to focus on another mechanism that can help consumers distinguishing between different types of producers. It is also worth noting that Klein and Leffler (1981), Shapiro (1983) and Rogerson (1987) do not focus on innovating firms. In addition, brand name investments and introductory price rebates also have the major purpose to dissipate any profit in these models as competitive markets are not compatible with positive profits.

[5] This assumption can be viewed as analogous to the standard „laissez-faire assumption" made in the literature on strategic trade policy (see, e.g., Qiu 1994).

include location costs. Hence, the two locations can be fully described by the vectors $(0,c^k_{j,E})$ and $(w,c^k_{j,W})$. To keep the model as simple as possible we take the countries' location costs, 0 and w, as well as any exit costs, R, as given. The process leading to the cost figures is not analyzed. As a first step let us also take firm locations as given, i.e. firms cannot choose their location of production. The case of capital mobility and location choice is analyzed in a second step.

The timing of our model is as follows: First, nature determines an innovator's location, S, and type, k. Then, the innovating firm learns its location and type and decides about market entry. After buyers have observed the innovator's location, S, the firm announces a price for high-quality products, p_H. Now buyers can either accept the price of p_H or reject it and offer $p_L = 0$ instead.[6] This basically implies that consumers compete for the product in Bertrand fashion as it is the case in simple highest-bid auctions: The firm sells to the highest bidders. Once the buyers have made their price offers, the firm decides which quality to produce, q_L or q_H, and finally, the firm decides about market exit. If the firm does not exit, the next period starts with the firm's price announcement.

Let us now denote consumers' beliefs as $\beta(k|S \wedge h_t)$ where h_t is the history of the game. The history of the game h_t is the sequence of tuples $((p_1,Q_1),\ldots,(p_{t-1},Q_{t-1}))$ that describes the moves of all players in periods $1,2,\ldots,t-1$ in terms of the price, p, accepted/offered by consumers and the quality, Q, produced with $Q \in \{q_L,q_H\}$.

[6] That means, that the price announced by the firm is basically a „take-it-or-leave-it" offer for buyers. By this assumption, we rule out complexities raised by bargaining issues.

Furthermore, all players are assumed to have perfect memory. That means, consumers' beliefs about the firm's type, k, are conditional upon the location of the innovating firm and all actions observed in previous rounds of the game. While the seller precisely knows his payoffs, buyers are ignorant about the seller's type, i.e. his costs, and therefore also about the seller's payoffs. For reasons of simplicity let now $p_{H,S}^{GM}$ denote the optimal price for a type-G monopolist as given by the optimal pricing scheme (5).

Then, consider the following pair of strategies where σ_S and σ_B denote the strategy of sellers and buyers, respectively.

σ_S: If the location of production is W and nature has chosen G, always announce $p_{H,W}^{GM}$ and produce high quality for buyers accepting the price. If, however, the location of production is W while nature has chosen B, do not enter the market at all. In all other cases, finally, announce $p_L = 0$ and produce low quality.

σ_B: If a seller is located at the high-cost country, buy the product for $p_{H,W}^{GM}$ if the seller has never sold low quality for $p_{H,W}^{GM}$ and if $\Theta_i \geq p_{H,W}^{GM}/\Delta q$. In any other case, offer $p_L = 0$.

If we now furthermore assume that producers have a lexicographic preference for production over non-production, we can state

Proposition 1: The strategies σ_S and σ_B and the beliefs

$\beta(k = G | S = W \wedge (p^{GM}_{H,W,t-i}, q_{L,t-i}) \notin h_t$ for all $i = 1,\ldots,t-1) = 1$ and

$\beta(k = B | S = E \vee (p^{GM}_{H,W,t-i}, q_{L,t-i}) \in h_t$ for any $i = 1,\ldots,t-1) = 1 - \pi$

form a Perfect Bayesian Equilibrium (PBE) in pure strategies if the following conditions hold:

$$\frac{w}{i} \geq \frac{p^{GM}_{H,W}}{1+i}\left(1 - \frac{p^{GM}_{H,W}}{\Delta q}\right) \tag{7}$$

$$R \geq \frac{w}{i} \tag{8}$$

$$w \leq (p^{GM}_{H,W} - c^{G}_{H,W})\left(1 - \frac{p^{GM}_{H,W}}{\Delta q}\right) \tag{9}$$

The proof is contained in Appendix 2.

The intuition behind this proposition is as follows: Only a firm that can produce high-quality products at low costs can afford paying high taxes or wages. Hence, only monopolists of type G can „survive“ at a high-cost location. Furthermore, for a type-G monopolist profits made by honestly selling high quality are at least as large as the profits he makes by cheating consumers and delivering low quality while charging $p^{GM}_{H,W}$. That means, given consumers' strategy a type-G monopolist will never find it attractive to deviate from its strategy to be honest. For a type-B firm that is located at a high-cost country, however, it is optimal not to enter the market at all since it does not make enough profits to pay the high country specific costs. Hence, on entering the market the

firm would make losses. Since consumers know this by assumption they can conclude that for every active firm at a high-cost location the promise to deliver high-quality products is self-enforcing. In contrast, a type-B monopolist located in a low-cost country will always find it profitable to cheat consumers. While for a type-G monopolist located at a low-cost country the promise to deliver high quality is not less self-enforcing than for one located at a high-cost country, the problem is that consumers are unable to differentiate between type-G and type-B producers located in a low-cost country ex ante. Since consumers' beliefs are sufficiently pessimistic, they will prefer not to believe in anybody located in a low-cost country. Hence, in equilibrium active producers in the high-cost country will honestly deliver high quality while producers in a low-cost country will honestly produce low-quality goods.

At a high-cost location the decision to enter the market serves as a signal for high-quality production. While in the low-cost country both types of firms will enter and produce low quality, in the high-cost country only type-G monopolist starts to produce and deliver high-quality goods. Moreover, if we explicitly assume that consumers do not only form beliefs about cost types, but directly about quality, we can reformulate Proposition 1 to obtain a Separating Perfect Bayesian Equilibrium. Suppose consumer beliefs are given by $b(Q| p \wedge S \wedge h_t)$, i.e. consumer beliefs are not only contingent on location and the game's history, but the price a consumer offers as well. Then, we can state

Proposition 2: The strategies σ_S and σ_B and the beliefs

$$b(Q = q_H \mid p = p^{GM}_{H,W} \wedge S = W \wedge (p^{GM}_{H,W,t-i}, q_{L,t-i}) \notin h_t \text{ for all } i = 1,\ldots,t-1) = 1$$

and

$$b(Q = q_L \mid p \neq p^{GM}_{H,W} \vee S = E \vee (p^{GM}_{H,W,t-i}, q_{L,t-i}) \in h_t \text{ for any } i = 1,\ldots,t-1) = 1$$

form a Separating Perfect Bayesian Equilibrium (PBE) in pure strategies if conditions (7), (8) and (9) hold.

Finally, let us analyze the situation where capital is mobile and firms can choose their location of production before making the market entry decision. As location becomes a choice variable for firms now, we reformulate the sellers' strategy as follows:

$\sigma_{\bar{S}}$: If nature has chosen G, always choose W as the location of production, enter the market, announce $p^{GM}_{H,W}$, and produce high quality for buyers accepting the price. If, however, the nature has chosen B, choose E as the location of production, enter the market, announce $p_L = 0$ and produce low quality.

We can now state

Proposition 3: The strategies $\sigma_{\bar{S}}$ and σ_B and the beliefs

$$\beta(k = G | S = W \wedge (p^{GM}_{H,W,t-i}, q_{L,t-i}) \notin h_t \text{ for all } i = 1,\ldots,t-1) = 1 \text{ and}$$

$$\beta(k = B | S = E \vee (p^{GM}_{H,W,t-i}, q_{L,t-i}) \in h_t \text{ for any } i = 1,\ldots,t-1) = 1$$

form a Perfect Bayesian Equilibrium (PBE) in pure strategies if conditions (7), (8) and (9) hold.

At this point it should be noted, however, that as in most signaling models multiple equilibria may exist. Depending on consumers' belief functions there may be pooling equilibria as well as other separating equilibria. However, our model shows that the location of production *can* be a credible signal of product quality. Furthermore, the separating equilibrium payoff-dominates the market failure equilibrium.

3. A short digression into the marketing literature

Indeed, empirical evidence from the marketing literature shows that a product's country of origin is a cue used extraordinarily often by consumers to judge product quality ex ante. Since the 1960s several marketing studies have been conducted, most of which found that the location of production has a significant influence on buyers' product evaluation. The impact a product's origin has on demand or consumer evaluation is commonly referred to as the country-of-origin effect. As Bilkey (1993, p. xix) has put it, country-of-origin effects reflect „buyers' opinions regarding the relative qualities of goods and services produced in various countries." According to Tan and Farley (1987) these country-of-origin effects represent the „most researched international aspect of consumer behavior." The extensive body of empirical work on country-of-origin effects has been reviewed by Bilkey and Nes (1982), Özsomer and Cavusgil (1991) and, more recently, Peterson and Jolibert (1995). In general, the studies have found that consumers have different perceptions about products made in different countries. The most salient finding is that consumers use a product's location of production to evaluate its quality ex ante. This is also reflected in consumers' willingness to pay. To give an example, in an empirical marketing study Johannson and Nebenzahl (1986) found that consumers in their sample were willing to pay 14 per cent more for a *Buick* built in Germany compared to one manufactured in the US while they were willing to pay 16.4 per cent less for a *Buick* made in Mexico (compared to the US). Similar findings were obtained for other cars as well as VCRs and microwaves (see Nebenzahl and Jaffe, 1993).

4. Possible Implications for International Trade and Location Choice

Concerning international trade flows our model would predict that high-cost countries export high-quality products while importing search (or heavily standardized) goods as well as low-quality experience goods. The opposite should then be true for low-cost countries.[7] Hence, our model can give a new reason for intra-industry trade as trade flows are determined by informational product differentiation.

Moreover, the few models that discuss informational asymmetries between firms and consumers and focus on the question of how these asymmetries may affect international trade, i.e. W. Mayer (1984) and Bagwell and Staiger (1989), treat product quality as exogenous. Therefore, the policy conclusions one might derive from these models are quite different from ours. In W. Mayer's model the optimal trade policy consists in an export subsidy that induces foreign consumers to try the product. Similarly, Bagwell and Staiger (1989) argue that a quality contingent tax/subsidy program might be welfare enhancing on the national level. In contrast, almost the opposite is true for our model: Not subsidies, but high country specific costs such as taxes can indirectly signal product quality.

If capital is mobile and plant locations are endogenous the model might also provide a new rationale for firms' location choice. Firms that have low costs for providing high-quality products might consciously choose a high-cost country for production instead of

[7] Interestingly enough, Vernon (1966) has made a very similar point. As in our model, Vernon addresses the question of where new and where more standardized products are produced. His finding is that new products are usually produced in advanced countries, while more standardized goods are usually produced in less developed countries where labor is cheap. While Vernon bases his finding on a completely different explanation, it is interesting to notice that his results could also be explained by our model assuming that new products rather have experience qualities while standardized products can be regarded as search goods.

a low-cost location - even if there is no difference in the level of public goods or infrastructure provided. To be more precisely, location at a high-cost country might serve as a signal of product quality exactly because of the fact that the high-cost country does not offer any direct productivity benefits. That means, firms may settle at high-cost locations purely for signaling considerations.

A very similar point has been raised by Bagwell and Staiger (1988) who consider a market entry game similar to the models of Milgrom and Roberts (1982) and Bagwell and Ramey (1988). According to their model, multinational firms might locate plants in high-cost countries to signal their production costs to rival firms. To put it differently, in the model of Bagwell and Staiger (1988) location choice can be used strategically to change rivals' perceptions about the firm's production costs. However, the role the location of production may have as a signal for product quality is not explored in their model.

Country-of-origin labels may be especially relevant as a signaling device if firms cannot sink enormous amounts of resources to gain credibility as has been suggested by Klein and Leffler (1981) and Shapiro (1983). Introductory advertising campaigns or price rebates require large amounts of capital which might often not be available to new firms.[8] Hence, in the presence of capital market constraints firms might have to use other signals and might rather use the country-of-origin as a signaling device since it does not require tremendous amounts of start-up capital to be sunken to gain credibility. Instead the firm

[8] Explanations for the presence of capital constraints are beyond the scope of this paper. However, capital constraints have been reported to exist - especially for new firms (see, e.g., C. Mayer, 1988).

leases the country's brand name, „Made in Country XY", and periodically pays a franchise royalty in form of high taxes or wages. In this case, location choice can be interpreted as the conclusion of an implicit franchise contract between the firm and the host country or its representatives, i.e. the government. According to this interpretation host countries (or governments) act as franchisors that rent out their brand name (e.g., „Made in Germany") to firms. Country specific expenditures can now be seen as franchise royalties producers have to pay for using the brand name. In contrast to ordinary franchise contracts, however, there are no initial capital requirements, but a nondissipative exit cost bond which serves as a termination penalty. Quite interestingly, Bagwell and Staiger (1988) report that according to the empirical findings of Swedenborg (1979) Swedish multinationals are in fact more likely to invest in countries characterized by comparatively high wage rates.

In this context, our model might also offer a new perspective on tax competition and location tournaments. Lowering taxes, relaxing environmental standards and granting subsidies to new firms might not necessarily attract new firms if it is the higher costs associated with a country that helps the firm signaling its products' quality. Building upon this rationale location tournaments might not necessarily result in destructive tax competition and subsidy races or social and environmental „dumping". Starting from our model one might think of scenarios in which both high-cost and low-cost locations might coexist. While firms in high-tax countries will then rather produce high-quality experience goods firms in low-tax countries will produce search goods and low-quality experience goods (assumed that all other things are equal and that there is a demand for such goods). In a general equilibrium approach, a country's optimal tax policy will be

dependent on the structure of demand for high- and low-quality experience goods as well as on the demand for search goods (where signaling devices do not play a role). Moreover, an additional factor that determines a country's optimal tax policy consists in the degree of competition for capital between governments, i.e. the structure of the „franchise market". That means, the optimal tax policy is also dependent of the strategies of other countries. To derive hard conclusions about optimal tax policy in this context, however, further research is needed. While we have to leave the questions raised unanswered right now, we hope that they may stimulate further research in this direction.[9]

Finally, it should be noted, however, that the analysis is strictly applicable only to new products whose quality is unknown before purchase. The model says little about the location choice of multinational enterprises which already have an established brand name. In this case, the analysis of Wernerfelt (1988) might apply according to which a monopolist can use umbrella branding to signal product quality. That means, by using the brand name of an established product for a new product a multiproduct monopolist can put its entire reputation at stake. Later sales of other products that wear the same brand as the new product serve as a bond and nondissipative signal of product quality. However, for umbrella branding to work as a signal, one has to assume that the firm already enjoys a reputation which it can post as a bond. In contrast, our analysis might apply to the case in which the firm does not already have a favorable reputation it can put

[9] The works of Bond and Samuelson (1986) and Raff and Srinivasan (1998) are somewhat related as they explore how a country's tax policy might be used to send signals about local production costs to foreign investors. However, they do not explorehow a firm's location choice might affect consumer beliefs and, thereby, demand.

at stake.

5. Conclusion

This paper has endeavored to offer an additional reason for intra-industry trade. If firms can choose the quality they wish to produce, and consumers find it difficult to determine product quality before purchase, the location of production *can* signal product quality under certain conditions, and thereby affect international trade flows. According to the model presented here, intra-industry trade in vertical differentiated experience goods *can* be determined by information asymmetries about product quality.

The model also provides an explanation for the empirically observed, but in economic theory widely neglected phenomenon that consumers judge a product's quality by its location of production. According to the model presented here high country specific costs such as high taxes or wages and compulsory exit costs might serve as a „natural" screening device that enables consumers to differentiate between firms that can produce high-quality goods at low costs and for which the promise to deliver high quality is self-enforcing and those firms that find it profitable to „hold up" consumers. If the „Made-in" label is used as a signal for product quality, trade flows may be determined by country-of-origin effects. According to our theory high-cost countries would now rather export high-quality experience goods while importing low-quality experience goods and search goods while the opposite should hold for low-cost countries.

Furthermore, we have argued that, in contrast to much of the recent trade literature, not a subsidy, but high location costs such as high taxes might help a firm in its endeavors to

signal product quality. Moreover, if capital is at least mobile to some degree and plant locations endogenous, the model also gives a new rationale for location choice and foreign direct investment: Firms that can produce high quality at low costs might consciously chose high-cost locations for production as a means to signal product quality. Location choice can now be seen as analogous to the conclusion of a franchise contract: The country (or its representatives) rent out the country's brand name („Made in Country XY") for which they periodically receive a franchise royalty which is usually called tax in this context. Contrary to standard franchise contracts, however, we have emphasized on the role of exit costs which allow to waive initial capital requirements. Proceeding from this hypothesis we have finally suggested that intergovernmental competition and location tournaments do not necessarily have to result in cut-throat tax competition, subsidy races and the lowering of social and environmental standards as the standard literature on international public finance argues. While we have only explored some possible implications of our model so far, we hope that the questions raised might stimulate further research into this direction.

Appendix 1: Explanation of Assumption (ii)

Assumption (ii) implies that not a single consumer is willing to try a new product of unknown quality. This result can be easily verified by comparing a consumer's payoff from trying a new product with the certain payoff of buying a low-quality product. Due to assumption (i) it is optimal to deliver high quality for a type-G producer while it is a dominant strategy to cheat for a producer of type B. Now given the prior probability distribution, $(\pi, c_H^G; (1-\pi), c_H^B)$, as well as consumers' grim strategy as described above, for any particular p_H a consumer's payoff from trying a new product can be expressed as

$$\pi \frac{\Theta q_H - p_H}{i} + (1-\pi)\left(\frac{\Theta q_L - p_H}{1+i} + \frac{\Theta q_L}{i(1+i)}\right)$$

Compared to the certain payoff from buying low quality, $\Theta q_L / i$, the condition for trying the new product reduces to

$$\Theta \geq \frac{(\pi + i)\, p_H}{\pi \Delta q (1+i)}.$$

As can be seen from this condition, demand will be zero for $p_H \geq (\pi \Delta q(1+i)) / (\pi + i)$. Since we know from condition (3a) that producers only deliver a high-quality product and consumers only buy a product of allegedly high quality if $p_H \geq c_H^G (1+i)$, this can be reduced to $c_H^G \geq (\pi \Delta q) / (\pi + i)$ which is, of course, assumption (ii).

Appendix 2: Proof of the Proposition

First, we must proof that given consumers' strategy, σ_B, and their beliefs, $\beta(k|S \wedge h_t)$, neither an innovator of type B nor one of type G can gain by deviation from his specified strategy, σ_S, at any stage of the game. Second, we have to show that consumers' strategies are optimal given σ_S, and finally, consumer beliefs must be consistent with equilibrium strategies and observed actions.

Ia) Suppose an innovator is located at W and nature has chosen B. As implied by assumption (i) and consumers' utility function, consumers are not willing to pay type B's quality-assuring price, $p_H = c^B_{H,S}(1+i)$. That means, the one-time hold-up profit exceeds type B's gains from honestly providing high quality as implied by condition (3). Since the firm is located at the high-cost country its net profit on entering the market and cheating consumers is given by

$$\frac{p^{GM}_{H,W}}{1+i}\left(1-\frac{p^{GM}_{H,W}}{\Delta q}\right)-\frac{w}{i},$$ if the firm produces low quality and does not exit afterwards, and

$$\frac{p^{GM}_{H,W}}{1+i}\left(1-\frac{p^{GM}_{H,W}}{\Delta q}\right)-\frac{w}{1+i}-\frac{R}{1+i},$$ if the firm produces low quality and exits afterwards.

The first expression cannot be positive because of condition (7) which states that w/i exceeds the maximum profit any producer could make on a one-time deviation.

Furthermore, due to condition (8) the maximum profit from deviating one single time and exiting the market afterwards is zero as well. Thus, the second expression is also non-positive. Therefore, we can conclude that for a type-B producer located at the high-cost country it is optimal not to enter the market.

Ib) Now let us still assume that a firm is located at the high-cost country, but nature has chosen G. By honestly producing high quality the type-G monopolist can earn a profit stream of $(\Pi - w)/i$ with $\Pi = (p_{H,W}^{GM} - c_{H,W}^{G})(1 - p_{H,W}^{GM}/\Delta q)$, which in this case is positive due to condition (9). From (Ia) we already know that cheating consumers while being located at a high-cost country implies losses (which is independent from the firm's type). Hence, a type-G monopolist located at W will find it optimal not to deviate, but to honestly produce high quality.

Ic) Suppose now that an innovator of any type is located at E. Given consumers' strategy and beliefs they will reject any price other than $p_L = 0$ due to assumption (ii). Hence, for firms located at the low-cost country it is optimal to produce low quality.

II) Now, we have shown that for innovators of type B it is only optimal to enter the market and to produce if they are located at the low-cost country. For innovators of type G, however, it is optimal to enter the market in any case. Nevertheless, as has been shown under (I) it is only optimal to produce high quality for the firm if its location is the high-cost country. Obviously, for consumers it is then optimal to accept $p_{H,W}^{GM}$ if the seller is located at W, given sellers' strategies and $\Theta_i \geq p_{H,W}^{GM}/\Delta q$. On the contrary, given the

probability distribution $(\pi, c_H^G; (1-\pi), c_H^B)$ as specified by assumption (ii) no consumers will find it optimal to sample a new product if the firm is located in the low-cost country as has been explained in the text. Since both type-B and type-G producers enter the market if they are located in the low-cost country consumers cannot distinguish between them and will optimally refrain from accepting any price higher than $p_L = 0$.

III) Finally, consumers' beliefs are consistent with equilibrium strategies, since every innovator that is located a the high-cost location and has entered the market will be of type G. Hence, the very fact that a firm located at W takes up production credibly signals consumers that its promise to produce high quality is self-enforcing. In contrast, at the low-cost country every firm will enter the market. Therefore, a proportion $1-\pi$ of the firms located at the low-cost site will be of type B, and accordingly, a proportion π of type G. Thus, consumers beliefs are reinforced by equilibrium outcomes. ■

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