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ADOPTION, TRANSFERS, AND INCENTIVES IN A FRANCHISE NETWORK WITH POSITIVE EXTERNALITIES

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We study franchise arrangements that allow franchisees with exclusive territories to own their customers. This permits franchisees to benefit from positive externalities in the franchise network through interfranchise transfers based on the purchases by their customers at other franchises on the network. Using the structure of a single franchisor and many franchisees, we show that, in general, interfranchise transfers between franchisees and incentives for franchisee investment in the expansion of their customer base are critical both to the size and to the benefits derived from the franchise network. Specifically, we find that when individual franchisees make investments in marketing effort to increase their customer base, the franchisor's setting of the interfranchise transfer trades off the positive effects on network size with the negative effects of removing franchisee incentive for investment. This result is due to the fact that interfranchise transfers encourage adoption, but discourage full investment in marketing effort. As compared to first-best franchisee investment, use of the royalty and the inter-franchise transfer directly dissipates franchisee profits, and indirectly dissipates franchisee profits through less than universal adoption, thereby causing franchisees to underinvest. As compared to traditional franchise systems, however, use of the interfranchise transfer results in franchises making greater investments than they otherwise would.
(Channels of Distribution; Pricing Research)

1. Overview

This paper examines a recent development in channels of distribution: electronically linked franchise networks. Franchisees with exclusive territories "own" their customers. The franchisor perfectly tracks market transactions of customers throughout the franchise network. Perfect tracking allows the franchisor to redistribute payments in the form of interfranchise transfers between franchisees on the basis of ownership of customers and location of purchase. Similar to other franchise arrangements, this franchise network exhibits positive externalities; however, royalty payments for network services and interfranchise transfers differentiate this case from traditional franchise environments. Our objective is to compare the impact of these royalities and interfranchise transfers on franchisee investment in marketing effort to recruit customers. The following example illustrates this network.

Pacific Pride Commercial Fueling System is a network of independently owned franchises covering several regions of the U.S., and serving customers who own vehicle fleets. The franchisees own fuel stations that are connected through an electronic network,

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called a Cardlock network, run by the franchisor, Pacific Pride. Customers adopt the network through signing an agreement with any one of the franchisees. In this way, franchisees "own" particular customers, and customers direct their fuel purchases to fuel stations on the network. Each franchisee benefits from customers of other franchisees being directed to its fuel station. The commercial fueling franchises are automated and unattended: a vehicle enters any franchise on the network, the driver inserts a card into the fuel station card reader, enters a security code and possibly the vehicle odometer reading, and is allowed access to the fuel pumps. The network records the vehicle/driver information, the time, location, and amount of fuel purchased. The customer is billed biweekly for all fuel purchased at all locations on the network by all vehicles in its fleet, and is provided with the detailed information gathered during the fuel purchases.

Because of the full reporting feature and the restricted access to fuel, customers have superior control over their vehicle fleet. Control is the critical feature for customers, eliminating the agency problem between fleet owners and their drivers. Previously, use of a standard credit card placed the fleet owners at risk, because the drivers could divert funds for fuel to personal use. Forced use of Pacific Pride's franchise network removes the fueling decision from drivers. Customers also gain from fuel availability throughout the network 24 hours a day, 7 days a week, and have credit terms similar to most major credit cards. Credit is extended because purchases throughout the franchise network are guaranteed by the owning franchisee, eliminating the moral hazard of serving foreign customers. These significant enhancements in control, convenience, and credit, throughout a much-expanded geographic region relative to the home territory, lead customers to pay a premium for fuel above the price charged at retail fuel stations (HBS Case Services 1988, Nault and Dexter 1992).

Franchisees have exclusive territories in which to locate their fuel station, and maintain exclusive customer bases, that is, by contract, franchisees cannot solicit each other's customers. The Cardlock price premium is a function of retail prices, and is therefore determined by the market. Bulk fuel prices are determined by the spot market. Because customers draw fuel from any franchise on the network, and franchisees own individual customers, the distinction between own and foreign purchases is important. Pacific Pride maintains a database matching customers to their *owning* franchisees. Pacific Pride's electronic network perfectly tracks fuel purchase transactions. When one franchisee's customer purchases from another franchisee the *owning* franchisee makes the sale (i.e., invoices the customer) and the *foreign* franchisee where the purchase was made receives a transfer payment from the *owning* franchisee. Pacific Pride profits by charging a royalty for each foreign purchase to the *owning* franchisee. These foreign purchases are referred to as *foreign* demand, meaning demand at *foreign* franchises from customers which are *owned* by other franchisees.

This example is not unique. The general case is defined by any network provider that collects a royalty for services and can monitor transactions over its network, and where franchisee ownership of customers allows for interfranchise transfers. While novel today, this arrangement portends to be an emerging channel structure, with electronic transaction monitoring offering new advantages to both franchisor and franchisees.

We build a model of a single franchisor and multiple franchisees. The franchise network provides positive adoption and investment externalities to franchisees. The franchisor charges a royalty based on network transactions and sets an interfranchise transfer price to distribute benefits from the between-franchisee transactions amongst the franchisees. We examine two main issues. The first is the effect of the royalty and the interfranchise transfer on franchise network size through adoption. The second issue is the additional impact the royalty and interfranchise transfer have on franchise network size and the volume of customer transactions through individual franchisee investments in customer recruitment. We study the relationship between each price, the royalty and the interfranchise transfer, and marketing investment by franchisees. We abstract from the issues of franchise fees and other franchisee or customer adoption costs, as we do not examine price discrimination schemes by the franchisor. We discuss franchisor investment in the Summary.

In marketing there are two streams of complementary research. In the first Coughlan (1985), McGuire and Staelin (1986), and Moorthy (1988) concentrate on issues of vertical integration versus complete decentralization of channels. In the second Jeuland and Shugan (1983), Shugan (1985), and Moorthy (1987) concentrate on incentive mechanisms and learning to improve channel coordination. Most recently Lal (1990) focused on the structure of royalty payments and the cost of monitoring in principal-agent scenarios. This paper continues in the spirit of this latter stream. In a model of multiple franchisees and a single franchisor, Lal (1990) found separation between royalties charged by the franchisor and service provided by the franchisee, essentially through the level of service being determined by franchisor monitoring of franchisees. In a single franchisor and single franchisee model, however, royalties were necessary for appropriate franchisor investment and franchisee service levels.

As part of a seminal article on vertical restraints, Mathewson and Winter (1984) showed that, because individual territories do not receive the full benefits of their advertising expenditures, advertising levels below those which would be optimal for an integrated firm obtain. We extend this case with one fundamental addition: an inter-franchise transfer which has the potential to return dissipated benefits back to the franchisees that make the investments. Using an application of the revelation principle, Mathewson and Winter (1985) found that profit sharing between franchisor and franchisee, along the lines of our royalties, could be achieved with an incentive compatible contract where the agent declares the state of the world. Their model, however, included the ability of the franchisor to monitor the franchisee and that franchise-specific contracts could be written, two features we do not assume. Not surprisingly, empirical results suggest that franchise arrangements, as organizational forms, are favored when monitoring costs are high, for example when there is high labor intensity or geographical dispersion (Brickley and Dark 1987, Norton 1988). That is, franchise arrangements are favored when agency problems are acute.

Section 2 follows by outlining the franchise network structure, franchise demands and assumptions that we employ in our model. Section 3 models marketing investment as a franchisee decision. We derive relationships between each price and network size, network volume, and franchisee investments, and compare franchisee investments from our model to first-best and investments that result from traditional franchisee systems. Section 4 summarizes the previous sections.

2. Franchise Network Structure

We consider the market for a single good. A set of franchisees form a franchise network that spans all or part of a set of territories. Customers are owned by a single franchisee, but may make purchases from any franchisee on the network. Franchisees on the network have exclusive territories for purchases, and exclusively own potential customers in their territories. A franchisee from each territory can adopt the network, and customers in its territory can enter into an agreement with that franchisee, effectively subscribing to the franchise network. A franchisee may make investments in marketing effort to recruit customers within its territory. The franchisee knows the relationship between its investments and demands.

Because services are enhanced by the franchise network, customers are willing to pay a premium price for goods from the franchisees. The good prices and factor input prices for the franchisee are exogenous. All of our results, however, extend to the case where the price of the good being sold by franchisees is increasing in the size of the network.

These prices are equal across the network; thus, similar to Mathewson and Winter (1985), there is no agency issue on price. This is not a case of resale price maintenance because in our model the franchisor is not setting price.

The franchisor knows the distribution of franchisee characteristics, can identify franchisee types, and can perfectly monitor transactions on the network. The franchisor, however, cannot determine the effect of investment in marketing effort for new customer recruitment made by the franchisees, and thus does not know the specific relationships between franchisee investments and demands. This is the information asymmetry. As control instruments, the franchisor sets a unit royalty on all network demands and a unit transfer price for network demand from customers away from their home territory. The royalty is paid by franchisees to the franchisor and the transfer is an interfranchise transfer between franchisees.[1]

There are both positive adoption and investment externalities between franchisees. The adoption externality has two sources. First, more franchisees adopting directly increases the volume of foreign purchases on the franchise network. Second, a larger franchise network makes the network subscription with a given franchisee more attractive to customers, inducing greater market penetration, reinforcing the increase in the volume of foreign purchases. The investment externality occurs because a given franchisee's investment in marketing effort to recruit customers benefits other franchisees through the increased foreign purchases generated by those additional customers.

If a franchisee has adopted the network it faces three positive demands:

(1) Demand from own customers at own franchise, D_0;

(2) Demand from own customers at foreign franchises, D_1;

(3) Demand from foreign customers at own franchise, D_2.

Franchisees are heterogeneous in territory population. The demands are $D_i(x, y, e)$, where x identifies franchisee size, representing increasing size of the territory population, y is the proportion of franchises which have adopted the network or network size, and e represents the vector of franchisee investment over the support of x, that is, $e = (e_x, e_{\setminus x})$ where e_x is investment by franchisee x and $e_{\setminus x}$ is a vector of investments made by other franchisees. $x \in [\underline{x}, \bar{x}]$, where x is distributed with the density $f(x)$. $f(x) > 0$ over $[\underline{x}, \bar{x}]$ and is zero elsewhere, that is, there may be many franchisees for a given $x \in [\underline{x}, \bar{x}]$. The franchisor knows the density $f(x)$ and can identify individual franchisees.

We assume foreign demands, D_1 and D_2, for a given franchise territory population, network size, and level of franchisee investment, do not depend on other factors. Our case example involves fuel purchases by customers that own vehicle fleets, whose routes often cross franchise territory boundaries. Once in a foreign franchise territory, should the vehicle need refueling, demand for the fuel is inelastic. A customer based in one territory creates foreign demand by making purchases from a franchise in another territory. The key is that this customer is directed to another franchise on the network when making purchases outside of its home territory, because of the advantages the network affords. Exogeneity of foreign demand results from the inelastic nature of the purchase location. Generically, what is critical in our model is that the distribution of spillovers between franchise territories are unaffected by franchisee and franchisor actions.

We make two groups of assumptions: demand assumptions (D1 through D6), and model assumptions (M1 through M6). We make the general assumption that the functions we employ are continuously differentiable where necessary.

D1. *Demands from own customers are increasing in territory population and network size.*

[1] Our results extend to the Pacific Pride case where the royalty is only charged on foreign demands.

Using partial derivatives, Assumption D1 can be described by

$$\frac{\partial D_i(x, y, e)}{\partial x} > 0 \quad \text{and} \quad \frac{\partial D_i(x, y, e)}{\partial y} > 0, \quad i \in \{0, 1\}.$$

$D_0(x, y, e)$ is increasing in x because, ceteris paribus, a larger territory population yields a larger realized customer base. This demand is increasing in y because as the size of the franchise network increases, the network, and therefore the franchisee, becomes more attractive to own customers—the positive adoption externality. This rationale applies equally to $D_1(x, y, e)$.

D2. *Demands from foreign customers at own franchise are unaffected by territory population and are increasing in network size.*

Assumption D2 can be described by

$$\frac{\partial D_2(x, y, e)}{\partial x} = 0, \quad \text{and} \quad \frac{\partial D_2(x, y, e)}{\partial y} > 0.$$

Because a franchise x is defined only by the size of its territory population, having a larger territory population has no impact on the demand from foreign customers at own franchise. Similar to the other demands, $D_2(x, y, e)$ is increasing in y as a larger franchise network yields a larger number of customers and, therefore, greater foreign demand at own franchise.

While we expect the adoption externality to be positive, $\partial D_i(x, y, e)/\partial y > 0$, we acknowledge that there may be additional competition from other franchisees adopting the network. The Pacific Pride case, however, suggests the negative externality is dominated by the positive benefits.

D3. *Demands from own customers are increasing in own investment at a decreasing rate, demands from foreign customers at own franchise are unaffected by own investment.*

Using partial derivatives, Assumption D3 can be described by

$$\frac{\partial D_i(x, y, e)}{\partial e_x} > 0, \quad \frac{\partial^2 D_i(x, y, e)}{\partial e_x^2} < 0, \quad i \in \{0, 1\}; \quad \text{and} \quad \frac{\partial D_2(x, y, e)}{\partial e_x} = 0.$$

The first two partial derivatives reflect positive, but diminishing, returns to marketing investment. The third partial derivative reflects the fact that rather than being a function of own effort, demand from foreign customers at own franchise is a function of investments made by foreign franchisees.

D4. *Demands from own customers are unaffected by foreign investment and demands from foreign customers at own franchise are increasing in foreign investment.*

The effects of Assumption D4 can be described by

$$\frac{\partial D_i(x, y, e)}{\partial e_{\backslash x}} = 0, \quad i \in \{0, 1\}; \quad \text{and} \quad \frac{\partial D_2(x, y, e)}{\partial e_{\backslash x}} > 0.$$

Foreign investment has no direct effect on demands from own customers. Investment by foreign franchisees, however, increases their realized customer bases, and thereby generates larger demand from foreign customers at own franchise.

D5. *The marginal increase in demands from own customers resulting from investment are greater for franchises with larger territory populations and are greater for franchises that are part of a larger franchise network.*

Assumption D5 can be described by the cross-partial derivatives

$$\frac{\partial^2 D_i(x, y, e)}{\partial e_x \partial x} > 0 \quad \text{and} \quad \frac{\partial^2 D_i(x, y, e)}{\partial e_x \partial y} > 0, \quad i \in \{0, 1\}.$$

D6. *For the franchise on the network with the smallest territory population, demand from foreign customers at own franchise is greater than demand from own customers at foreign franchises.*

Assumption D6 is satisfied by any reasonable assumption on the distribution of foreign demand. Those franchisees that are contributing the least to franchise network volume by virtue of their lesser size are benefiting the most from the demand from foreign customers at own franchise.

M1. *Franchisees know the relationship between their investments and demands. The franchisor does not know the relationship between franchisee investments and demands.*

Assumption M1 defines the information asymmetry between the franchisor and the franchisees. This precludes franchisee-specific contracting based on any function of franchisee investment, which, as we later show, prevents attainment of a first-best contract.

M2. *Franchisee investment costs are increasing at an increasing rate and are not franchise-specific.*

Using derivatives, Assumption M2 is

$$\frac{dC(e_x)}{de_x} > 0 \qquad \text{and} \qquad \frac{d^2C(e_x)}{de_x^2} > 0.$$

M3. *Franchisee profits are increasing in franchise territory population.*

M4. *Marginal franchisee profits from own investment are increasing in franchise territory population.*

M5. *Franchisee profits are concave in own investment.*

Assumptions M3 to M5 are not severe: a sufficient condition for them to be satisfied is that the franchise margin is greater than the transfer.[2] Assumption M4 is a logical extension to Assumption M3: not only are franchises with larger populations more profitable, they are more profitable at the margin. Assumption M5 is a sufficient condition for optimal franchisee investment.

M6. *For the franchise on the network with the smallest territory population the total effect of having a larger territory population is positive.*

Both the marginal effect through population and the marginal effect through network size are positive, the former directly and the latter indirectly from Assumption M3.

3. Royalties, Transfers, and Investment

The franchisee's profit function is

$$\Pi(x, y, e) = [p - r]D_0(x, y, e) + [p - r - t]D_1(x, y, e) + tD_2(x, y, e) - C(e_x),$$

where marginal cost is normalized to zero, $p > 0$ is the network premium price for the good, r is the royalty on demand from own customers, and investment costs are as defined above. The interfranchise transfer, t, is paid on $D_1(x, y, e)$ and received on $D_2(x, y, e)$. Individual franchisees maximize profits by choice of own investment, e_x. The necessary first-order condition for franchisee x is

$$[p - r]\frac{\partial D_0(x, y, e)}{\partial e_x} + [p - r - t]\frac{\partial D_1(x, y, e)}{\partial e_x} - \frac{dC(e_x)}{de_x} = 0, \qquad (1)$$

[2] The necessary conditions for Assumptions M3 to M6 are available upon request.

noting from Assumption D3 the term representing demand from foreign customers at own franchise vanishes. The sufficient second derivative condition is satisfied from Assumption M5.

All franchisees that adopt select their optimal level of e_x. Therefore, (1) implicitly defines e_x as an optimal value function of r and t for each x that adopts, that is, $e_x(r, t)$. The simultaneous set of first-order conditions, (1) for $x \in [\underline{x}, \bar{x}]$, defines a Nash equilibrium in franchisee investment.[3].

Lemma 1 describes the effects of having a larger franchise territory population, of changes in the royalty and the interfranchise transfer, on equilibrium individual franchisee investment.

LEMMA 1. *Individual franchisee investment is increasing in the size of the franchise territory population, and is decreasing in the royalty and in the interfranchise transfer:*

$$\frac{\partial e_x(r, t)}{\partial x} > 0, \quad \frac{\partial e_x(r, t)}{\partial r} < 0, \quad \text{and} \quad \frac{\partial e_x(r, t)}{\partial t} < 0.$$

Franchisees with larger territory populations invest more in marketing effort because they receive higher marginal returns per dollar of investment. In addition, for a given level of franchisee investment, an increase in the royalty or in the interfranchise transfer reduces returns from marketing investment, where returns from franchise investment are gains from growth of the realized customer base—the investment externality.

Using Assumption M3, we can define franchise network size, y, as a function of the franchisee on the network with the smallest territory population, $\tilde{x}$, where $y(\tilde{x}) = \int_{\tilde{x}}^{\bar{x}} f(x)dx$. We assume the network reaches its maximum possible size, given prices. We can define the adopting franchisee with the smallest territory population as a function of the royalty, the interfranchise transfer and the vector of equilibrium franchisee investments,

$$\tilde{x}(r, t, e(r, t)) = \min\{x \mid \Pi(x, y(x), e(r, t)) = 0\}.$$

Thus, this indifferent franchisee satisfies the equation

$$\Phi(r, t, e(r, t), \tilde{x}) = [p - r]D_0(\tilde{x}, y(\tilde{x}), e(r, t)) + [p - r - t]\, D_1(\tilde{x}, y(\tilde{x}), e(r, t)) + tD_2(\tilde{x}, y(\tilde{x}), e(r, t)) - C(e_{\tilde{x}}(r, t)) = 0.$$

Lemma 2 shows the impact of changes in the royalty and the interfranchise transfer and changes in franchisee investment on the indifferent franchise.

LEMMA 2.

$$\frac{\partial \tilde{x}(r, t, e(r, t))}{\partial r} > 0, \quad \frac{\partial \tilde{x}(r, t, e(r, t))}{\partial t} < 0, \quad \frac{\partial \tilde{x}(r, t, e(r, t))}{\partial e_{\tilde{x}}} = 0, \quad \text{and} \quad \frac{\partial \tilde{x}(r, t, e(r, t))}{\partial e_{\backslash \tilde{x}}} < 0.$$

Letting $\tilde{x}(\cdot) = \tilde{x}(r, t, e(r, t))$ for economy of notation, we can define franchise network size as a function of prices and investment,

$$y(\tilde{x}(\cdot)) = \int_{\tilde{x}(\cdot)}^{\bar{x}} f(x)dx,$$

observing that all x, and in particular $\tilde{x}(\cdot)$, are optimizing their individual franchisee profits by choice of the level of marketing investment. Proposition 1 describes the change in franchise network size resulting from a change in the royalty.

[3] In what follows lemmas and propositions are stated without proofs. The proofs are available upon request.

PROPOSITION 1. *Franchise network size is decreasing in the royalty*: $dy(\tilde{x}(\cdot))/dr < 0$.

The effect of an increase (decrease) in the royalty is to decrease (increase) the proportion of franchisees that adopt. Thus, an increase in the royalty reduces franchise network size.

The impact of a change in the interfranchise transfer on the proportion of franchisees,

$$\frac{dy(\tilde{x}(\cdot))}{dt} = \frac{dy(\tilde{x}(\cdot))}{d\tilde{x}}\left[\frac{\partial\tilde{x}(\cdot)}{\partial t} + \frac{\partial\tilde{x}(\cdot)}{\partial e_{\tilde{x}}}\frac{\partial e_{\tilde{x}}(r,t)}{\partial t} + \frac{\partial\tilde{x}(\cdot)}{\partial e_{\setminus\tilde{x}}}\frac{\partial e_{\setminus\tilde{x}}(r,t)}{\partial t}\right], \tag{2}$$

is not monotonic. This is due to the two opposing effects of the interfranchise transfer on the adoption and investment externalities captured by the first and last terms in brackets of (2). Because franchisees receive a greater share of the profits from the demand from foreign customers at own franchise, an increase in the inter-franchise transfer will directly increase franchise network size by inducing franchisees with smaller territory populations to adopt—the adoption externality. This increase in the interfranchise transfer, however, expropriates some of the profits resulting from the demand from own customers at foreign franchises away from franchisees with larger territory populations, giving them a lower return on investment, and thereby causing them to underinvest. This underinvestment reduces their realized customer base and makes network adoption less attractive to franchisees in general. Thus, the investment externality is reduced.

Franchise network volume is

$$Q(\tilde{x}(\cdot), e(r,t)) = Q_0(\tilde{x}(\cdot), e(r,t)) + Q_1(\tilde{x}(\cdot), e(r,t)),$$

where the components are

$$Q_i(\tilde{x}(\cdot), e(r,t)) = \int_{\tilde{x}(\cdot)}^{\bar{x}} D_i(x, y(\tilde{x}(\cdot)), e(r,t))f(x)dx, \qquad i \in \{0, 1\}.$$

Proposition 2 describes the effect of a change in the royalty on franchise network volume.

PROPOSITION 2. *Franchise network volume is decreasing in the royalty*: $dQ(\tilde{x}(\cdot), e(r,t))/dr < 0$.

An increase in the royalty reduces the attractiveness of adoption directly through a reduction in profit and indirectly through a reduction in incentives for franchisees investing in, and increasing, their realized customer base. The combined effect is lower franchise network volume from lower franchise network size because fewer franchisees adopt, and additionally from lower individual franchise volume because adopting franchisees invest less. Thus, the royalty negatively affects both the adoption externality and the investment externality.

The impact of a change in the interfranchise transfer on each component of franchise network volume can be written as

$$\begin{aligned}\frac{dQ_i(\tilde{x}(\cdot), e(r,t))}{dt} &= \Bigg[-D_i(\tilde{x}(\cdot), y(\tilde{x}(\cdot)), e(r,t))f(\tilde{x}(\cdot)) \\ &\quad + \left[\int_{\tilde{x}(\cdot)}^{\bar{x}} \frac{\partial D_i(\tilde{x}(\cdot), y(\tilde{x}(\cdot)), e(r,t))}{\partial y}\frac{\partial y(\tilde{x}(\cdot))}{\partial\tilde{x}} f(x)dx\right]\Bigg]\frac{\partial\tilde{x}(\cdot)}{\partial t} \\ &\quad - D_i(\tilde{x}(\cdot), y(\tilde{x}(\cdot)), e(r,t))f(\tilde{x}(\cdot))\frac{\partial\tilde{x}(\cdot)}{\partial e_{\setminus\tilde{x}}}\frac{\partial e_{\setminus\tilde{x}}(r,t)}{\partial t}\end{aligned}$$

$$
\begin{aligned}
&+\left[\int_{\tilde{x}(\cdot)}^{\bar{x}} \frac{\partial D_i(\tilde{x}(\cdot), y(\tilde{x}(\cdot)), e(r, t))}{\partial y} \frac{\partial y(\tilde{x}(\cdot))}{\partial \tilde{x}} f(x)dx\right] \frac{\partial \tilde{x}(\cdot)}{\partial e_{\setminus \tilde{x}}} \frac{\partial e_{\setminus \tilde{x}}(r, t)}{\partial t} \\
&+\left[\int_{\tilde{x}(\cdot)}^{\bar{x}} \frac{\partial D_i(\tilde{x}(\cdot), y(\tilde{x}(\cdot)), e(r, t))}{\partial e_x} f(x)dx\right] \frac{\partial e_x(r, t)}{\partial t} \qquad (3) \\
&+\left[\int_{\tilde{x}(\cdot)}^{\bar{x}} \frac{\partial D_i(\tilde{x}(\cdot), Y(\tilde{x}(\cdot)), e(r, t))}{\partial e_{\setminus x}} f(x)dx\right] \frac{\partial e_{\setminus x}(r, t)}{\partial t}
\end{aligned}
$$

for $i \in \{0, 1\}$. (3) captures two forces. The first contained in the first line, is the positive impact of the interfranchise transfer increasing franchise network size through franchisees with smaller territory populations obtaining a larger contribution from the demand from foreign customers at their own franchises, making network adoption more profitable. The second, captured in the remaining terms, is the negative impact from reduced incentives for franchisee investment in customer recruitment. These reduced investment incentives are caused by the transfer of margin away from the franchisee that owns the customer to the franchise of the foreign purchase. Thus, the interfranchise transfer works in favor of the adoption externality, but against the investment externality.

For the franchisor, there are two mechanisms affecting franchise network volume. The first is franchise network size, where the greater the proportion of franchisees on the network, the greater is franchise network volume. The second is individual franchisee investment, where the greater the franchisee investment, the greater is the size of the franchisee's realized customer base, which results in greater franchise network volume. Use of the interfranchise transfer by the franchisor, however, affects these mechanisms in opposite directions. While an increase (decrease) in the interfranchise transfer causes more (less) franchisees to adopt the network, it reduces (increases) incentives for franchisee investment which lowers (raises) franchise network volume.

The franchisor's profit maximization problem is

$$\max_{r,t} \Psi(r, t) = \max_{r,t}[rQ(\tilde{x}(\cdot), e(r, t))].$$

The necessary first-order conditions are

$$\frac{\partial \Psi(r, t)}{\partial r} = r\frac{dQ(\tilde{x}(\cdot), e(r, t))}{dr} + Q(\tilde{x}(\cdot), e(r, t)) = 0,$$

$$\frac{\partial \Psi(r, t)}{\partial t} = r\frac{dQ(\tilde{x}(\cdot), e(r, t))}{dt} = 0.$$

Because $r > 0$ for the franchisor to make positive profits, from the second first-order condition, $dQ(\tilde{x}(\cdot), e(r, t))/dt$ must equal zero at the optimum price pair. The optimal prices perfectly trade off the changes in the adoption and investment externalities resulting from changes in the interfranchise transfer. Thus, the vertical agency problem of the franchisor being unable to enforce first-best investments by franchisees causes the franchisor not to be able to use the interfranchise transfer to secure adoption by all franchisees. If the second-order conditions hold, it is optimal for the franchsior to have less than universal adoption. The main result from this section is as follows.

RESULT 1. *With franchisee investment, the franchisor's optimal profits may occur without universal adoption because of the trade off between the adoption and investment externalities resulting from the use of the interfranchise transfer.*

Following the spirit of Mathewson and Winter (1985), a first-best contract would elicit franchisee investment decisions that are optimal for the franchisor in the sense of maximizing franchisor profits.[4] In our model first-best can be achieved by a perfectly discriminating lump-sum franchise fee and universal adoption. At the individual franchise level, first-best can be described as the investment that results from maximizing the following profit function:

$$\Pi^{\text{fb}}(x, 1, e) = p[D_0(x, 1, e) + D_1(x, 1, e)] - C(e_x) - L(x)$$

where the franchisee receives the full price premium on all demands from own customers but now pays a franchise-specific lump-sum franchise fee, $L(x)$, set so that universal adoption is obtained, $y = 1$. Franchisee investments can be described by the necessary first-order conditions

$$p\left[\frac{\partial D_0(x, 1, e)}{\partial e_z} + \frac{\partial D_1(x, 1, e)}{\partial e_x}\right] - \frac{dC(e_x)}{de_x} = 0,$$

one for each franchisee x, yielding the vector of first-best investments e^{fb}. The sufficient second-derivative conditions are satisfied from Assumptions D3 and M2.

In our problem first-best cannot be achieved by any contract. We have four potentially contractable variables: (a) individual franchisee investments, (b) individual franchise demands, (c) network size, and (d) franchise territory population (or identity). Our information asymmetry, Assumption M1, is that the franchisor does not know the specific relationship between franchisee investments and demands. The franchisor therefore cannot determine the appropriate levels of franchise investment upon which to contract (a). Moreover, individual franchise demands and network size depend on individual franchisee investments. Therefore, the optimal levels of (b), and (c) are also not known by the franchisor for inclusion in a contract. Because knowledge of franchise identity does not include knowledge of the relationship between franchisee investment and demands, (d) is not a useful variable on which the franchisor may contract.

The contract we propose in this paper uses a linear royalty and interfranchise transfer. Individual franchisee investments that result from this contract are $e(r, t)$, and are determined by the first derivative conditions (1). Proposition 3 determines the relative magnitudes of individual franchisee investments resulting from the first-best and our linear (r, t) contract.

PROPOSITION 3. *The linear royalty and interfranchise transfer contract yield franchisee underinvestment relative to first-best franchisee investments*: $e^{\text{fb}} > e(r, t)$.

Franchisee underinvestment in our model, relative to first-best, occurs for two reasons. Firstly, the royalty dissipates franchisee profits from demands from own customers to the franchisor. In addition, the interfranchise transfer dissipates franchisee profits from demands from own customers at foreign franchises to other franchises. Thus, franchisees receive a lower return on investment for each investment expenditure and hence underinvest. Secondly, under first-best, universal adoption is obtained, which does not necessarily result from our linear (r, t) contract. The franchise which is member of a larger network is more attractive to customers and therefore, from Assumption D5, returns to investment are higher.

In a traditional franchise system the franchisee profits are the margin on demands from customers at own franchise:

$$\Pi^{\text{trad}}(x, y, e) = [p - r][D_0(x, y, e) + D_2(x, y, e)] - C(e_x).$$

Franchisee investments result from the set of necessary first-order conditions

[4] We would like to thank the area editor and the reviewers for encouraging us to pursue comparisons with first-best.

$$[p - r]\frac{\partial D_0(x, y, e)}{\partial e_x} - \frac{dC(e_x)}{de_x} = 0$$

one for each franchisee x, yielding the vector of investments as a function of the royalty only, $e(r)$. The sufficient second derivative conditions are satisfied from Assumptions D3 and M2. Proposition 4 compares the investments obtained in a traditional franchise system and our linear (r, t) contract.

PROPOSITION 4. *The linear royalty and interfranchise transfer contract yield franchisee investments greater than franchisee investments from a traditional franchise system*: $e(r, t) > e(r)$.

This increased investment results from rewarding franchisees for demands by own customers at foreign franchises through the interfranchise transfer. Under our linear (r, t) contract and in traditional franchise systems universal adoption does not obtain. It is not possible to determine which of these two structures yields the larger network. The traditional franchise system is the linear (r, t) contract with $t = p - r$. A change in the interfranchise transfer has a direct effect of transferring profits between franchises and an indirect opposite effect through franchisee investment.

4. Summary

In the absence of franchisee investment, the franchisor employs the royalty and the interfranchise transfer for separate functions. The royalty is used to take network profits, and the interfranchise transfer is used to control franchise network size. This separation is complicated by individual franchisee investment in customer recruitment. The confounding effect is due to the fact that individual franchisee investment affects, in addition to franchise network size, the number of customers owned by each franchisee in the franchise network. Thus, individual franchisees have additional control over the proportion of their potential customer base (territory population) which is realized. Therefore, while the royalty's effect on investment indirectly reinforces the royalty's direct effect on franchise network size and volume (the adoption externality), the indirect effect of the interfranchise transfer through investment runs contrary to its direct effect on network size and volume. In fact, the profit maximizing franchisor sets the optimal royalty and interfranchise transfer so that the effects on franchise network volume of any changes in the interfranchise transfer perfectly trade off the effects of the adoption externality and the investment externality. Hence, universal adoption is usually not optimal for the franchisor.

Compared to first-best, the trade off between the adoption and investment externalities results in franchisee underinvestment. This franchisee underinvestment occurs because franchisee profits are dissipated by the royalty and by the interfranchise transfer, and because the benefits of maximum network size, universal adoption, are not necessarily obtained. Compared to traditional franchise systems, our linear royalty and interfranchise transfer contract results in higher levels of franchisee investment because franchisees are more fully rewarded for their investments at the margin. Because of the investment incentives, these results hold over more general nonlinear transfer schemes where the total interfranchise transfers depend on the volume of foreign purchases.

The main limitation of the model is that in practice franchisors typically do not try to maximize the size of their network instantaneously, even when there are positive externalities—because there is a positive cost to the franchisor of adding franchise units. This likely curtails adoption, that is, network size, at least for the period in which the network grows. Another limitation of the model is that we do not consider investment by the franchisor. In practice, franchisees often pay an advertising royalty to the franchisor which invests on their behalf. From our analysis we know that an increase in the royalty results in lower franchisee investment and smaller network size. Thus, an analysis of franchisor investment would examine whether this investment can overcome the negative effects of the increased royalty.[5]

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