Vertical Boundaries and Endogenous Intensity of Social Comparison

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We study how inter-firm social comparison can alter the choice of two competing manufacturers between vertical integration and vertical separation to independent, status-concerned retailers. Status is determined by the difference in retailers' market shares. The novelty of our paper is that in line with empirical evidence, the intensity of social comparison (i) depends on the distance between retail outlets, and (ii) can be influenced by the manufacturer by adjusting the outlet's location. In contrast to the commonly studied case of a distance-independent intensity of status concern, social comparison with a distance-dependent intensity of status concern predicts different optimal firm boundaries.

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1 Introduction

Social and other-regarding preferences like fairness concerns, inequity aversion, status concerns, or envy crucially affect the decision making of individuals (e.g., Akerlof 1997, Fehr and Schmidt 1999). Social comparisons might alter the choice of firm boundaries and governance structures since they determine the referent group of (envious) individuals and therefore impact the costs of social comparisons (Nickerson and Zenger 2008). Also, a strong reliance on pay-for-performance with its high-powered economic incentives results in psychological costs from social comparison and overconfidence (Larkin et al. 2012, Fredrickson et al. 2010) and causes employee misconduct (Larkin and Pierce 2016). As a response, firms adjust their organizational structures and select flatter, more low-powered incentive schedules. In comparison to markets, firms have an advantage in terms of social motivation (Ramalingan and Rauh 2010).

There is strong evidence that the intensity of social comparison is driven by the 'distance' between economic agents. For example, from an intra-firm perspective Obloj and Zenger (2015) study the change of the incentive system in a multi-branch retail bank and find that envy depends on the proximity within the organization measured by physical, structural and social distance. They conclude that "firms may actively alter distance as a means of managing social comparison costs" (p. 7). To increase the distance of envy's objects, "firms may geographically or, more broadly, spatially separate those with distinct reward structures" (p. 26). Inter-firm social comparisons significantly influence behavior as well. For example, Gartenberg and Wulf (2015) provide empirical evidence that social comparisons have a significant effect in determining pay for executives. In particular, they find that social comparison is stronger for geographically less dispersed firms, that this comparison influences productivity and that it dampens pay-for-performance sensitivity. Further, O'Reilly et al. (1988) argue that compensation committees usually consist of outside directors who are frequently CEOs of other firms. In setting CEO compensation, these outside directors anchor their judgment on their own salaries as well as on compensation of similar other CEOs. Bouwman (2014) provides evidence for the impact of relative status concerns (envy) on the compensation of geographically-close CEOs. Boivie et al. (2015) find empirical evidence that directors' home firms and other interlocked boards serve as salient comparison groups in determining board members' compensations.

In this paper we investigate the influence of distance-dependent social preferences on the manufacturer's choice between vertical separation or integration and the manufacturer's profit. In particular, we consider a standard Hotelling model of two firms each manufacturing a homogeneous product with unrestricted choice of locations (Tabuchi and Thisse 1995). The manufacturers can vertically separate and sell their product through independent (exclusive) retailers (Kopel and Pezzino 2017, Bonanno and Vickers 1988, González-Maestre 2000, Milliou and Petrakis 2007). Manufacturers determine the retailers' locations and the terms of the contract at which they will supply the products (two-part tariff). The retailers determine the market prices for the product. Retailers are assumed to be status-concerned. In

addition to their profit, the relative size of their retail outlet matters. A retailer's utility is higher if the retail outlet's market share is higher than its rival's market share (and lower otherwise). In line with the empirical evidence and in contrast to existing literature, our novel assumptions are that (i) the intensity of the comparison of market shares depends on the distance between retail outlets, and (ii) that this intensity is endogenously determined as the manufacturer adjusts the location of its retailer.

The literature typically neglects the fact that the intensity of social comparison depends on distance and tries to capture the impact of social comparison by a constant parameter. We demonstrate that distance-independent social comparison intensifies competition and unambiguously reduces the manufacturer's profit since the retailers' intrinsic incentive to pursue market share creates a downward pressure on prices. Manufacturers do not have any control since the retailers' status concern enters the manufacturer's decision calculus for selecting the retailer's location and wholesale price as some sort of exogenous fixed cost. Therefore, their retailers' locations and the wholesale prices are identical to the classic case of vertical separation with profit-maximizing retailers. The unambiguous conclusion is that in this case status-concerned retailers have a negative impact on the manufacturer's profit. In contrast, we find that if social comparison depends on the distance between retailers and that manufacturers are able to optimally adjust the proximity of retail outlets, the manufacturers might be able to profit from delegation to status-concerned retailers. Hiring a status-concerned retailer in this case constitutes a strategic commitment device to soften competition by means of a higher retail price and a greater distance between outlets. Even more importantly, a comparison of the profits in these two cases with the profit of a vertically integrated manufacturer shows that our model with endogenous intensity of social comparison makes different predictions about the range of vertical separation (or vertical integration). Overall, our analysis demonstrates that distance-dependent social comparisons not only have a crucial impact on the benefit of vertical separation but also on the optimal decision regarding the firms' boundaries.

Our work is related to recent studies on the impact of social preferences. In an organizational economics context, for example, Bartling and von Siemens (2010) study moral hazard in a two-agents model and demonstrate that envy and social comparison costs lead to flat wages and low-powered incentives. In Miettinen (2011), the principal can exploit the agent's preference for a clear conscience by setting an otherwise suboptimally high target effort level. Although actual effort levels fall short of the target effort level, the combination of wages and targets benefits both the principal and the agent. Grund and Sliwka (2005) show that dislike for disadvantageous inequity (envy) and advantageous inequity (compassion) can reduce the efficiency of tournaments as an incentive device. Similarly, Kragl (2016) finds that in contrast to the situation with selfish agents, relational bonus contracts outperform rank-order tournaments if agents are envious. Bartling (2011) assumes that agents are inequity averse or status-seeking and shows that team incentives rather than relative performance contracts can be optimal (see also Fershtman et al. 2003). Concerning strategic incentives under market competition, Crummenerl et al. (2015) find that envious managers outperform self-interested managers if firms

compete in a homogenous Cournot duopoly. Kou and Zhou (2015) find less than maximum differentiation in a spatial competition model if each firm maximizes an objective which includes the firm's own profit and the difference between its own and the rival's profit (which is akin to envy or status-seeking preferences). In contrast to our paper, the intensity of social comparison in these papers is fixed and does not depend on a measure of distance between the players. Two papers are more in line with our work. Bartling (2012) assumes that the social distance of two agents is smaller if the agent's compensation is based on relative performance (and hence depends on another agent's performance). Grund and Sliwka (2005) study a firm's promotion policy (vertical or horizontal) and assume that envy and compassion are stronger when promotions are vertical. However, in contrast to our paper, "social distance" is not a continuous choice variable but is captured by a binary choice between two scenarios with different, but constant parameter values in the players' utility functions. Finally, Rotemberg (1994), Casadesus-Masanell (2004) and Ramalingam (2014) address the endogenous choice of social preferences. However, in these papers agents (and not principals) are choosing the degree of social preferences.

Our paper contributes to the recent line of research on inter-firm comparisons and the impact of social comparison on a firm's choice of organizational boundaries. In this vein, we follow Nickerson and Zenger's suggestion for theory development about social comparison costs (see Nickerson and Zenger, 2008, p. 1446): " For instance, why is it that some firms locate R&D distantly from manufacturing or locate manufacturing distantly from marketing and sales? Or, why do some firms locate workers distantly from other firms? Our theory suggests that these location choices are strategic choices in the manager's toolkit for shaping salient referents. Knowledge spillover externalities and agglomeration economies provide two approaches for making activity location choices. The consideration of envy provides another explanation for determining these choices."

2 The Model

We consider two single-product firms which manufacture homogeneous products. The product market is characterized by a linear city where consumers are uniformly distributed along the interval $[0, 1]$. Each manufacturer i ($i = 1, 2$) sells its product through an independent retailer [1]. Each retailer chooses the price p_i for the product it sells. The retailer's location x_i is chosen by the manufacturer[2] where we adopt the approach of Lambertini (1994, 1997) and Tabuchi and Thisse (1995) who allow for locations outside the linear city, $x_i \in]-\infty, +\infty[$. Without loss of generality we assume that $x_1 \leq x_2$. Assuming that each consumer buys exactly one product, the

[1] In a two-firms spatial model with restricted location, neither firm would want to choose more than one outlet in order to decrease price competition. See Martinez-Giralt and Neven (1988) and Tabuchi (2012). The same result holds in a divisionalization-delegation game with homogenous products; see Gonzalez-Maestre (2000).

[2] Barcena-Ruiz and Casado-Izaga (2005) show that manufacturers profit from only delegating pricing decisions and retaining the decision authority with regard to locations.

utility of a particular consumer located at $x \in [0,1]$ is

$$u_x = \begin{cases} v - t(x_1 - x)^2 - p_1 & \text{if bought from manufacturer 1,} \\ v - t(x_2 - x)^2 - p_2 & \text{if bought from manufacturer 2,} \end{cases}$$

where $v > 0$ is sufficiently high to ensure full market coverage and t denotes the transportation costs each consumer has to bear for one unit of distance. Note that a higher value of t can be interpreted as capturing a lower degree of competition (and vice versa).[3]

The marginal consumer $\hat{x}$ who is indifferent between buying from manufacturer 1 and buying from manufacturer 2 is given by

$$\hat{x}(p_1, p_2, x_1, x_2) = \frac{x_1 + x_2}{2} + \frac{p_2 - p_1}{2t(x_2 - x_1)}.$$

Therefore, demand for manufacturer 1 and 2 are

$$\begin{aligned} q_1(p_1, p_2, x_1, x_2) &= \min\{\max\{\hat{x}(p_1, p_2, x_1, x_2), 0\}, 1\}, \\ q_2(p_1, p_2, x_1, x_2) &= 1 - q_1(p_1, p_2, x_1, x_2). \end{aligned}$$

Manufacturer i charges its own retailer a two-part tariff covering a (lump sum) fee T_i and a wholesale price w_i for each unit sold. Hence, the payoffs of the manufacturer and its retailer are, respectively, given by

$$\begin{aligned} \pi_{M_i} &= T_i + w_i q_i, \\ \pi_{R_i} &= (p_i - w_i - c)q_i - T_i, \end{aligned}$$

where we have assumed that production costs are normalized to zero and the retailer's costs of distribution are $c > 0$.[4]

[3] Note that our model also allows for a more general interpretation. x_i can not only be seen as the geographical location of a firm but also as the manufacturers' choice of a particular bundle of product attributes which then results in horizontal product differentiation. In the latter case, retailers' intensity of comparison is strong if the products they sell are highly substitutable and therefore address a similar mass of consumers and low if the two products are perceived to be very dissimilar each appeal to a different group of consumers.

[4] Note that this model is akin to a setting of strategic incentives (e.g. Fershtman and Judd 1987, Sklivas 1985, Kopel and Pezzino 2017), where the firm hires a manager for its division and provides (strategic) incentives through a contract based on profits and sales. The results in this paper hold if contracts are based on revenue instead of sales (or market share).

We assume that the retailers are status-concerned, where status is determined by the difference in retailers' market shares (Akerlof 1997). Similar to Fershtman and Weiss (1998), we model the utility of a retailer by

$$U_{R_i} = \pi_{R_i} + \alpha(q_i - q_j), \quad i, j \in \{1, 2\},\ i \neq j,$$
$$\text{where} \qquad \alpha = k - \lambda(x_2 - x_1), \quad \lambda \in \{0, 1\}.$$

The retailer's utility function can be divided into a "material payoff" and a "behavioral payoff" (Rotemberg, 1994). First, utility depends on profit π_{R_i}. Additionally, a retailer is concerned with the relative size of its outlet, where q_i and q_j represent the market shares of the two retailers[5]. A retailer's utility is higher if its market share is higher than its rival's market share (and lower otherwise).

To clearly differentiate our setting from standard models of inequity aversion where agents compare their compensation, we consider status concern where non-monetary aspects are captured by a retail outlet's size or market share.[6] For example, Main et al. (1993, p. 624) argue that "while few would dispute the importance of money, it is the status derived from it that may be most important". Also, the extensive use of job titles, medals and prizes as status awards inspired various papers to study the incentives of such non-monetary, positional goods (Besley and Ghatak 2008, Frey 2007). According to Jensen (1986, p. 323) "Growth increases managers' power by increasing the resources under their control." Therefore, a retailer's status is related to the outlet's size and/or market share.

In our analysis that follows, we study two cases. To capture the commonly considered case of fixed intensity of social comparison, we set $\lambda = 0$. The weight α is then independent of distance, $\alpha = k > 0$, and solely determined by the retailer's intrinsic status concern, k.[7] We will refer to this situation as the benchmark case (F). In contrast, the case where the intensity of comparison depends on the distance between the outlets is obtained by setting $\lambda = 1$. With variable intensity of social comparison (V), the weight α is not only determined by the retailer's intrinsic status concern, k, but also by the distance between outlets, $x_2 - x_1 > 0$. As a result, the weight α is higher the closer the location of the two retailers. In other words, the intensity of social comparison is high if retailer i is in close proximity of retailer j.[8] Each manufacturer can actively manage the intensity of comparison by adjusting its outlet's location. Furthermore, manufacturers can use the lump-sum fee T_i to

[5] In our model, total sales coincide with market shares and are taken as a measure of the retailer's size. One could also assume that one unit of the final product requires one unit of labor and measure size in terms of labor employed. Often, the literature relates similar utility functions to envy. Hence, we could also refer to envious retailers who have a dislike for managing comparatively smaller outlets.

[6] Compared to vertical integration, hiring inequity-averse retailers which compare profits is always beneficial for the manufacturer.

[7] Existing literature refers to similar utility functions with a positive weight on (social) comparisons as competitive, status-seeking (e.g. Neilson and Stowe 2010, Itoh 2004) or ahead-seeking and behindness-averse preferences (e.g. Roels and Su 2014).

[8] Note the similarity to models of R&D spillovers where the spillovers are larger if firms are located more closely; see Piga and Poyago-Theotoky (2005). For simplicity, we assume that k is the same for all retailers and is sufficiently large such that α is always non-negative.

extract downstream profits as long as the retailer's participation constraint is satisfied. We assume that the retailer's reservation utility is $\bar{z} > 0$. In equilibrium, T_i will be set such that the retailers' participation constraint binds ($U_{R_i} = \bar{z}$).

Under vertical separation, the timing of the game is as follows. First, manufacturers simultaneously choose the locations of their retailers. Second, the manufacturers choose the optimal contract parameters, i.e. the fixed fee T_i and the wholesale price w_i. Finally, retailers maximize their utility U_{R_i} with respect to prices p_i. We solve the game by backward induction and use subgame-perfect Nash as an equilibrium concept. In order to ensure that prices and profits are non-negative and that the second-order conditions are fulfilled, we assume

$$t > \frac{1+\sqrt{5}}{2}, \frac{5(1+t)}{2t} < k \leq \frac{5t}{2} - \bar{z}.$$

3 Results

To see how the endogenous adjustment of a retailer's status concern influences the firm's choice between vertical separation or integration, we briefly take a look at the firms' equilibrium locations, market prices and profits (see the table).[9]

Centralization (C) *Tabuchi/Thisse (1995)*	*Vertical Separation/Decentralization* *without Status Concern (D)* *Barcena-Ruiz/Casado-Izaga (2005)* *Vertical Separation/Decentralization with Exogenous Status Concern (F)* *Our Paper*	*Vertical Separation* *with Status Concern (V)* *Our paper*
$x_1 = -\frac{1}{4}, x_2 = \frac{5}{4},$ $p_i = c + \frac{3t}{2}, q_i = \frac{1}{2},$ $\pi_{M_i} = \frac{3t}{4},$ $CS = v - c - \frac{85t}{48},$ $W = v - c - \frac{13t}{48}.$	$x_1 = -\frac{3}{4}, x_2 = \frac{7}{4},$ $p_i = c + 5t - 2k, q_i = \frac{1}{2},$ $w_i = \frac{5t}{2},$ $\pi_{M_i} = \frac{5t}{2} - \bar{z} - k, U_{R_i} = \pi_{R_i} = \bar{z},$ $CS = v - c - \frac{289t}{48} + 2k,$ $W = v - c - \frac{49t}{48}.$	$x_1 = -\frac{3}{4} - \frac{5}{4t}, x_2 = \frac{7}{4} + \frac{5}{4t},$ $p_i = c + 5t - 2(k - 5 - \frac{5}{2t}), q_i = \frac{1}{2},$ $w_i = \frac{5}{2}(1+t),$ $\pi_{M_i} = \frac{5t}{2} - \left(k - 5 - \frac{5}{2t}\right) - \bar{z}, U_{R_i} = \pi_{R_i} = \bar{z},$ $CS = v - c - \frac{289t}{48} + 2(k - \frac{25}{4} - \frac{105}{32t}),$ $W = v - c - \frac{49t}{48} - \frac{5}{2}(1 + \frac{5}{8t}).$

Table 1: Comparison of outcomes in the location games (i) centralization (ii) decentralization with self-interested managers (black font) and with status concerned managers where $\lambda = 0$ and therefore the degree of status concern does not depend on location (black and red font) (iii) vertical separation with status-concerned managers where $\lambda = 1$ and therefore the degree of status concern depends on location.

[9]The Lemma in the Appendix provides a more formal summary of our discussion. More detailed derivations are also given there. The results follow from a straightforward comparison of the corresponding expressions in our table for the four cases discussed below.

For the sake of comparison, column 1 of our table gives the outcomes for the centralized case (C) for unrestricted locations where an integrated manufacturer determines location and prices (see Tabuchi and Thisse 1995). Column 2 of our table shows the outcomes if the manufacturers vertically separate (D, for decentralization), and delegate the price choices to profit-maximizing retailers.[10] It is well-known that under price competition, vertical separation is used as a collusion device (e.g. Bonnano and Vickers, 1988, Kopel and Pezzino 2017). A comparison of the outcomes given in columns 1 and 2 confirms that indeed the difference between locations is increased and manufacturers set the wholesale price above marginal costs. As a result, market prices and profits are increased.

Column 2 of our table also shows how the outcomes change if the manufacturers vertically separate and retailers are status-concerned, but with fixed, i.e. distance-independent, intensity of social comparison (benchmark case F).[11]

The intuition says that status-concerned retailers try to gain market share by undercutting the rival's retail price. Hence, price competition will become fiercer compared to a situation with profit-maximizing retailers. At the same time, with exogenous and fixed intensity of status concerns (benchmark case F), it follows from the retailers' optimal pricing decisions and the retailers' participation constraints that the intensity of social comparison $\alpha = k$ enters as a constant in the manufacturers' maximization problems (see Appendix). In other words, the retailer's intensity of status concern enters as some sort of exogenous fixed cost which the manufacturers cannot influence. Consequently, location and wholesale price decisions remain the same as in the standard case of decentralization with profit-maximizing retailers, $x_i(F) = x_i(D)$. Due to the retailers' intrinsic incentive to pursue market share, market prices are lower, $p_i(F) < p_i(D)$. This, in turn, translates into unambiguously lower manufacturers' profits, $\pi_{M_i}(F) < \pi_{M_i}(D)$.

Column 3 of our table shows the results under variable, i.e. distance-dependent, intensity of social comparison (V). The firm has now two instruments, the wholesale price and the outlet's location, to counter the potentially price-decreasing effect of status concern. Indeed, manufacturers utilize both instruments to soften price competition: they select a higher wholesale price, $w_i(V) > w_i(F)$ and also increase the distance between retail outlets, $x_2(V) - x_1(V) > x_2(F) - x_1(F)$. As a result, status concerns can even be profitable for the manufacturers. More precisely, $\pi_{M_i}(V) > \pi_{M_i}(D)$ if $k < 5/(2t) + 5$. That is, if the degree of competition, $1/t$, is sufficiently high or the intrinsic propensity for status concern, k, is sufficiently small, status-concerned retailers can be used as a profitable commitment device to locate further apart and increase wholesale (and consequently also retail) prices.

The profit expressions in our table can be used to check if either vertical integration

[10] Barcéna-Ruiz and Casado-Izaga (2005) study unrestricted location choice where the price choice is delegated to a manager and the firm chooses the location and the manager's contract terms. Our setting with profit-maximizing retailers is equivalent and, hence, yields identical outcomes.

[11] In our table, the difference in outcomes between vertical separation with profit-maximizing retailers and retailers with distance-independent social comparison is indicated in red color.

(case C) or vertical separation with distance-dependent social preferences (case V) is beneficial for the manufacturer. Finally, a comparison with vertical separation under distance-independent social preferences (case F) illustrates that neglecting the influence of proximity between retailers on the intensity of social comparisons leads to different choices regarding the optimal firm boundaries. The resulting outcomes of these comparisons are summarized in our main Proposition.

Proposition: Depending on the retailers' intrinsic degree of status concern, k, the retailers' reservation utility, $\bar{z}$, and the level of competition in the market, $1/t$, the following ordering of profits of the manufacturer is obtained.

$$\begin{cases} \pi_{M_i}(C) \leq \pi_{M_i}(F) < \pi_{M_i}(V) & \text{if } k + \bar{z} \leq \frac{7t}{4} \\ \pi_{M_i}(F) < \pi_{M_i}(V) \leq \pi_{M_i}(C) & \text{if } k + \bar{z} \geq 5 + \frac{5}{2t} + \frac{7t}{4} \\ \pi_{M_i}(F) < \pi_{M_i}(C) < \pi_{M_i}(V) & \text{otherwise.} \end{cases}$$

First, note that in the case V the manufacturers' profits are always higher than in the case of fixed intensity of status concern, $\pi_{M_i}(F) < \pi_{M_i}(V)$. Most importantly, the two cases can lead to different predictions about the optimal governance choice. The proposition shows that if the sum of a retailer's intrinsic incentive to pursue market share (k) and a retailer's reservation utility ($\bar{z}$) are sufficiently small or sufficiently large, then the predictions of both models coincide. However, if the costs of delegating decision authority to status-concerned retailers, $k + \bar{z}$, are in an intermediate range, the model with fixed intensity predicts vertical integration while the model with variable intensity predicts vertical separation. Our figure illustrates our result in terms of the retailers' intrinsic degree of status concern, k, and the retailers' reservation utility, $\bar{z}$, which can be interpreted as the retailers' bargaining power.

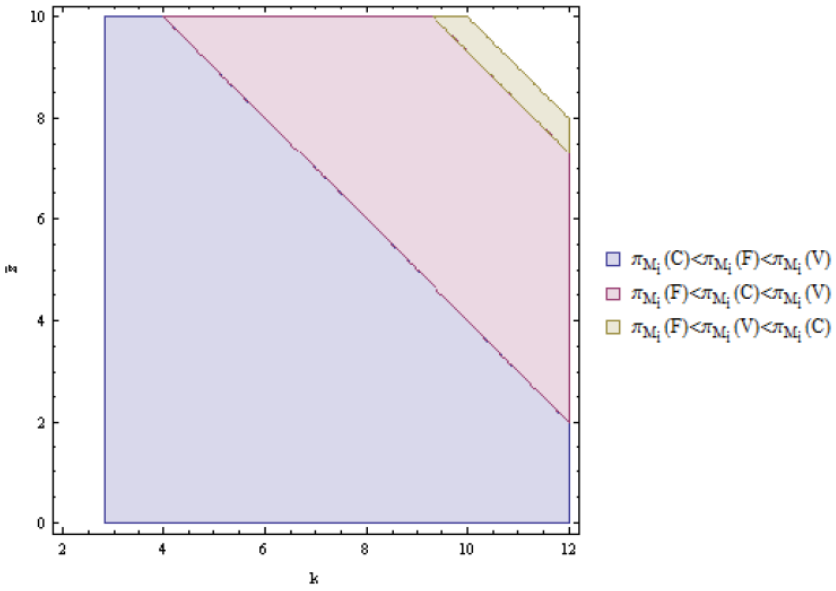

Figure 1: Parameter ranges where the two models with status-concerned retailers yield different firm boundaries ($t = 8$). In the blue region, both the model with exogenous intensity of status-concern (F) and the model with endogenous intensity of status-concern (V) predict vertical separation; in the yellow region both models predict vertical integration; in the purple region, the model (F) predicts vertical integration whereas the model (V) predicts vertical separation.

4 Conclusions

In this paper we demonstrate that social comparison between retail units can crucially influence the manufacturers' benefits of vertical separation and, therefore, the manufacturers' decisions to stay vertically integrated or to separate. In line with empirical research such as Bouwman (2013) and Gartenberg and Wulf (2015), we have assumed that the intensity of social comparison depends on the proximity to a particular reference group. In our model we also incorporate the suggestion of Obloj and Zenger (2015, p. 7) that "firms may actively alter distance as a means of managing social comparison costs". We show that the optimal governance choice strongly depends on distance-dependent social comparisons.

Our results might inspire empirical research on franchising chains where location and proximity of company-owned and franchised outlets is an important topic. The analysis of optimal governance structures is commonly carried out through the lenses of institutional economics or the resource-based view (see Perryman and Combs 2012). In their study, Wilson and Shailer (2015) show that the manufacturer strategically locates company-owned stores in close proximity to the the franchised outlets in order to alleviate agency problems and improve performance measurement and contracting efficiency. However, their analysis does not account for the effects that are associated with social comparison cost. This might be a fruitful line of research.

5 Appendix

In this Appendix, we first show how to derive the subgame-perfect outcomes of the game of vertical separation with status-concerned retailers, where the intensity of social comparisons can be either exogenously fixed (F) or be variable and dependent on distance (V). We will also refer to the solutions in the cases of centralization (C) and vertical separation (or decentralization) with profit-maximizing retailers (D).

The solution of the centralized organizational structure (case C), where the manufacturers determine locations and prices, has been considered for unrestricted location choice, $x_i \in]-\infty, +\infty[$ (see Tabuchi and Thisse, 1995). The derivation of the equilibrium outcomes and payoffs is standard and outcomes are given in column 1 of our table.

Consider now the case of vertical separation where the price choice is delegated to status-concerned retailers and the intensity of social comparison is dependent on the proximity between outlets ($\lambda = 1$, case V).

In the final stage of the game, the retailers determine their optimal pricing decision. Differentiating the retailers' utility U_{R_i} with respect to p_i and solving the system of first-order conditions yields

$$p_1 = c + t\frac{(x_2 - x_1)(2 + x_2 + x_1)}{3} + \frac{2w_1 + w_2}{3} - 2\alpha,$$
$$p_2 = c + t\frac{(x_2 - x_1)(4 - x_2 - x_1)}{3} + \frac{w_1 + 2w_2}{3} - 2\alpha.$$

Observe that the case of profit-maximizing retailers (case D) is obtained as the special case for $\alpha = k - \lambda(x_2 - x_1) = 0$, so that the fourth terms vanish. In the case of status-concerned retailers with an exogenous intensity of social comparison (case F), we have $\lambda = 0$, such that $\alpha = k$.

Taking into account symmetry, it becomes obvious that by charging the retailers positive wholesale prices, market prices are increased. Hence, in comparison to the centralized solution, with symmetric market shares, $x_1 = x_2 = 1/2$, the manufacturers' profits can be increased. The reason simply is that under price competition the manufacturers use their retailers (and their compensation contracts) as commitment devices to keep market prices high and then extract the retailers' profits via their charged lump-sum fees (e.g. Bonanno and Vickers, 1988). On the other hand, if retailers are status-concerned, $\alpha = k - \lambda(x_2 - x_1) > 0$, they have an inclination to lower prices to gain market share. The tendency to lower prices increases as a retailer's intrinsic degree of status-concern increases. However, the manufacturer can actively influence the intensity of status concern and, hence, the pricing decision by adjusting its own wholesale price w_i and the distance between the outlets

by changing x_i. Obviously, a higher wholesale price w_i induces the retailer to curb production and increase the market price. Since market prices are strategic complements, a higher wholesale price c.p. leads to an increase in both prices p_j and p_i, which would increase profits. Likewise, if manufacturers increase the distance between their outlets, then the intensity of social comparison is less severe and the retailers are trying less aggressively to steal business from their competitors by cutting prices.

To understand the full impact of social comparison, we look at stage 2, where each manufacturer chooses the payoff-maximizing lump-sum fee, T_i, and the wholesale price, w_i, given the outlets' locations. The lump-sum fee is used to extract the retailer's profit. In equilibrium, the retailer is paid exactly its reservation utility $\overline{z}$. Substituting the optimal prices into the retailer's utility U_{R_i} and solving the binding participation constraint yields

$$T_1 = t\tfrac{(x_2-x_1)(2+x_1+x_2)^2}{18} + \tfrac{(w_1-w_2)^2}{18t(x_2-x_1)} + \tfrac{(w_2-w_1)(2+x_1+x_2)}{9} - \alpha - \overline{z},$$
$$T_2 = t\tfrac{(x_2-x_1)(4-x_1-x_2)^2}{18} + \tfrac{(w_1-w_2)^2}{18t(x_2-x_1)} + \tfrac{(w_1-w_2)(4-x_1-x_2)}{9} - \alpha - \overline{z},$$

with $\alpha = k - \lambda(x_2 - x_1) > 0$.[12] Using these lump-sum fees, the manufacturers' payoff-maximizing wholesale prices are

$$w_1 = \frac{1}{5}t\,(x_2 - x_1)\,(4 + x_1 + x_2)\,,$$
$$w_2 = \frac{1}{5}t\,(x_2 - x_1)\,(6 - x_1 - x_2)\,.$$

In the first stage, manufacturers determine their outlets' payoff-maximizing locations. Note that if the intensity of social comparison is fixed (case F), status concern enters the manufacturer's maximization problem through the retailer's pricing decision and participation constraint as some sort of fixed cost which it cannot influence. Therefore, in this case location choices (and in turn also wholesale prices) coincide with case D, where manufacturers delegate pricing decisions to profit-maximizing retailers, $x_1 = -3/4$ and $x_2 = 7/4$. The solution if retailers are status-concerned and the intensity of social comparisons depends on distance (case V) is $x_1 = -3/4 - 5/(4t)$ and $x_2 = 7/4 + 5/(4t)$. The outcomes and payoffs are given in column 3 of our table. For comparison, we provide the solutions for the case of exogenous intensity of social comparisons ($\alpha = k$, case F) as well as of profit-maximizing retailers ($\alpha = 0$, case D) in column 2 of our table.

In the Lemma, we compare locations, wholesale prices, and profits under the assumption that the manufacturer vertically separates. We consider the following cases: profit-maximizing retailers (D); status-concerned retailers and distance-independent social comparison (F); status-concerned retailers and distance-dependent social comparison (V).

[12] For $w_i = 0$ and $\alpha = 0$, the lump-sum fees coincide with the integrated manufacturers' profits.

Lemma: If the outlets' locations are unrestricted, then the following holds with status-concerned retailers.

- For locations and wholesale prices with exogenously fixed intensity (F) and with variable intensity of status concern (V), we obtain

$$\begin{aligned} x_1(V) &< x_1(F) = x_1(D), \\ x_2(F) &= x_2(D) < x_2(V), \\ w_i(D) &= w_i(F) < w_i(V). \end{aligned}$$

- If the intensity of status concern is exogenously fixed and independent of distance, then for the ordering of profits we obtain

$$\begin{aligned} p_i(F) &< p_i(D), \\ \pi_{M_i}(F) &< \pi_{M_i}(D). \end{aligned}$$

- If the intensity of status concern is endogenous and dependent on distance, the ordering of profits depends on the retailers' intrinsic degree of status concern, k, and the level of competition, $1/t$, in the market. In particular, we obtain

$$\begin{cases} p_i(D) \leq p_i(V), & \pi_{M_i}(D) \leq \pi_{M_i}(V) & \text{if } k \leq \frac{5}{2t} + 5 \\ p_i(V) < p_i(D), & \pi_{M_i}(V) < \pi_{M_i}(D) & \text{otherwise.} \end{cases}$$

Proof of Lemma: The results follow from a straightforward comparison of the corresponding expressions in our table.

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