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Decentralized Business Strategies in a Multi-Unit Firm

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Abstract. In a multi-unit firm, such as a retail chain or a multi-plant manufacturer, we compare the business strategies developed by unit managers with the strategies that maximize corporate profit. The setting is one in which units face different markets and where learning spillovers between two units are enhanced if their strategies are more similar. When there is a small number of units, we find a tendency for managers' strategies to be excessively tailored to their local market. When the firm has many units, unit strategies can be either excessively or insufficiently standardized.

1. Introduction

Retail chains typically have stores in diverse markets – rural and urban, affluent and poor, Rust Belt and Sun Belt. This diversity of markets suggests that one business strategy – in terms of such components as merchandising, marketing, and pricing – is unlikely to be best for all stores. Given this diversity of market environment and that store managers are apt to have better information about their local consumers, the case for giving them the authority to develop the store's business strategy would appear quite strong. There is, however, a downside to decentralization that is not well-appreciated. As stores develop business practices that are uniquely suited to their local market conditions, the extent of knowledge sharing among them is likely to diminish because what works for one store is less likely to work for another store. Since this learning spillover is not one that a store manager need necessarily internalize if her compensation schedule induces her to care largely about her own store's profit rather than the chain's, corporate headquarters may wish to mandate a common business strategy across stores in order to improve the efficacy of intra-organizational learning. Given these counteracting forces – heterogeneity in markets argues to decentralization and learning spillovers argue to centralization – the objective of this paper is to sort out these forces to identify when store managers will act in the best interests of the chain and when business strategies may need to be decided upon and mandated from above.

While we consider this problem from the perspective of a retail chain, it is also applicable to a multi-plant manufacturer. A case in point is the global expansion strategy

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pursued by General Motors Corporation, as reported by Blumenstein [6]. This strategy entails building identical plants in four distant countries – Argentina, Poland, China, and Thailand – with widely varying market conditions, all for the purpose of promoting rapid and effective transfer of knowledge among those plants:

> The company has designed the plants to look so much alike that engineers may mistake which country they are in. And the assembly lines are being set up so that a glitch in a robot in Thailand, rather than turning into an expensive engineering problem that requires an expert for each machine at each plant, may well be solved by a quick call to Rosario or to Shanghai, China. [6, A1, A4]

Quite clearly, what GM intends to achieve by imposing such uniformity in its production processes is the positive externality that may arise from the extensive mutual learning among the involved plants.[1] A similar strategy is adopted by Johnson & Johnson in regard to its R&D processes:

> Johnson & Johnson has largely standardized its R&D processes throughout its pharmaceutical business units to encourage them to share people and ideas and to enable all R&D projects to be managed as a single coherent portfolio. [16, p. 115]

With the dramatic rise in recent years in the use of sophisticated information technologies in business operations, the same issue comes up in the context of integration and standardization of data and the adoption of corporate-wide information processing systems. In the context of enterprise systems (ES),[2] Davenport [13] describes the practical importance of achieving "the right balance between commonality and variability" by contrasting the strategies adopted by Monsanto and Hewlett-Packard:

> Monsanto's managers knew that different operating requirements would preclude the complete standardization of data across its agrochemical, biotechnology, and pharmaceuticals businesses. Nevertheless, they placed a high priority on achieving the greatest possible degree of commonality. After studying the data requirements of each business unit, Monsanto's managers were able to standardize fully 85% of the data used in the ES. . . . While customers and factory data have not been fully standardized – differences among the units' customers and manufacturing processes are too great to accommodate common data – Monsanto has achieved a remarkable degree of commonality across a diverse set of global businesses.
>
> At Hewlett-Packard, a company with a strong tradition of business-unit autonomy, management has not pushed for commonality across the several large divisions that are implementing SAP's enterprise system. Except for a small amount of common

[1] In a similar vein, Adler and Cole [1] presents a detailed case study that documents innovation being less when plants are less standardized.

[2] Enterprise systems are commercial software packages that permit integration of all the information relevant to various parts of a business organization, including financial and accounting information, personnel information, supply chain information, as well as customer information. Some well-known providers of these systems include SAP, Oracle, and Peoplesoft.

> financial data necessary to roll up results for corporate reporting, HP's federalist approach gives all the power to the "states" where ES decisions are concerned. This approach fits the HP culture well, but it's very expensive. Each divisional ES has had to be implemented separately, with little sharing of resources. [13, p. 128]

Just as in the case of retail chains discussed in the opening paragraph, all of these examples show that there is a trade-off associated with allowing each plant (unit) manager to develop her own business strategy. Developing the manufacturing process to best meet the needs of one's customers may enhance demand and profit. However, it will also result in plants (units) modifying their production (business) processes in different ways which makes innovative ideas less transferable between them and that can have a deleterious effect on the overall performance of the organization.

The starting point for our research is this empirical observation that learning spillover, as described above, tends to be more when the units pursue uniform strategies. We model a retail chain as a collection of local stores. These stores initially choose the consumer type they wish to target, thereby indirectly determining the extent of spillovers among themselves. We consider two organizational forms under which their decisions are made: centralization (HQ mandate) versus decentralization (store independence). Once the target consumer type is chosen (and, hence, the extent of inter-store spillovers determined), each store independently exerts R&D effort to better satisfy their customers. This modeling framework allows us to analytically examine the above-mentioned trade-off in terms of the organizational characteristics and the conditions of the markets in which the business units operate.

To summarize our findings, there are two possible situations for which decentralized decision-making by store managers may leave room for profit-enhancing intervention by corporate headquarters. First, there may be a unique equilibrium under decentralization that has store managers tailoring their business strategies to their own market but, from the chain's perspective, the result is insufficient uniformity. Achieving the desired uniformity requires that headquarters step in and take control of each store's business strategy. Second, there may be multiple equilibria under decentralization and, due to a coordination failure, store managers settle at an equilibrium that fails to maximize chain profit. This coordination failure could result in either excessive or inadequate uniformity of business strategies across stores. In that situation, headquarters need not mandate but rather just serve to focus expectations on the more desirable equilibrium. We also explore how these difficulties depend on the size of the chain as measured by the number of markets served.

Related work

In several related papers, we have examined how the rate of improvement of store practices depends on the degree of decentralization where a more decentralized structure is one in which store managers have more authority in deciding on their store's practices. These papers develop a computational model of a retail chain so as to explicitly examine how organizational structure impacts a chain's dynamic performance. In Chang and

Harrington [7], there can be a conflict of opinions between store managers and corporate headquarters regarding the value of a new idea.[3] In Chang and Harrington [8,9], as in this paper, the tension comes from stores facing different market environments.[4] Each store manager wants to implement those ideas that maximize her store's profit while corporate headquarters is concerned with chain profit. This can create a conflict of interests. In these papers, the sequence of ideas is exogenous and the adoption decision is modelled. The issue is whether the decision to adopt should be given to store managers or be pushed up the hierarchy. In the current paper, we implicitly model the idea generation process by considering the strategic decision of what type of consumer to target (and, by implication, what types of ideas to generate) and how much effort to exert in generating ideas. By pursuing a static model in this paper, we are able to derive analytical results.

From the vast literature on organizational structure that examines decentralization, let us mention two papers of particular relevance. Though in very different settings, Aghion and Tirole [2] and Van Zandt [22] consider the value to allocating authority to agents at low levels in the hierarchy. In a principal-agent framework, Aghion and Tirole [2] examine the decision of a principal and an agent to exert effort to learn about the value of various projects. More effort implies a more informative signal. An important force in their model is that an agent has a stronger incentive to exert effort if he has the authority to decide in which project to invest. Van Zandt [22] has a structure of the organization in which information processing is given primary attention. Within the organization, it takes real time for information to be processed and to move across agents. Allocating authority to low-level agents results in decisions being based on more partial but also more recent information (as there is less delay in information moving from those who acquire and those who use it in decision-making). Complementary to this paper, Rotemberg and Saloner [19] consider how narrow a firm's business strategy should be. In contrast, we consider how uniform business strategies should be within a multi-unit firm.

2. A model of stores targeting consumers

Consider a single retail chain serving an array of markets. The chain has $n+m$ stores with each store located in a different geographic market. Markets may differ in the characteristics of their dominant consumer. For simplicity, there are just two types of dominant consumer represented by the set $\{I, II\}$. Consumer I might be an upper income household and consumer II a lower middle income household. Let z_i denote the dominant

[3] Though for a different set of organizational forms, Sah and Stiglitz [20] were the first to consider this type of issue.

[4] Chang and Harrington [10] further examine this issue when multiple retail chains are in direct competition with one another in local markets.

consumer in the market served by store $i \in \{1, \ldots, n+m\}$. It is assumed that

$$z_i = \begin{cases} I & \text{if } i \in \{1, 2, \ldots, n\}, \\ II & \text{if } i \in \{n+1, \ldots, n+m\}, \end{cases} \tag{1}$$

where $n \geqslant m$ so that type I markets are at least as numerous as type II markets. Each store decides:

(i) whether to focus its attention on discovering and developing practices to satisfy the wants of consumer I or consumer II; and

(ii) how much effort to exert in discovering and developing new practices.

In that we imagine the choice of a target consumer to be more of a long-run difficult-to-change decision than how much effort to exert, it is assumed that stores first simultaneously choose their target consumer and then, given this outcome is common knowledge, choose how much effort to exert. Note that, in our model, R&D effort is exerted to increase the demand and profit by better satisfying the target consumer type. As such, the chosen sequence of decision-making in the model simply reflects our belief that the target segment of the market has to be determined first before the R&D effort is exerted to satisfy the chosen customer type. A strategy for store i is then a pair $(d_i, e_i(\cdot))$ where $d_i \in \{I, II\}$ is the target consumer and $e_i : \{I, II\}^{n+m} \to R_+$ is a function mapping from the stores' targeting decisions to the space of effort levels.[5]

A store manager's compensation is assumed to be monotonically increasing in the profit of her store. The key implication of this is that a store manager acts so as to maximize store performance. This specification is intended to approximate the actual incentive contracts deployed in the retail trade industry. While some chains do make store managers' bonuses dependent on both store profit and chain profit,[6] it appears more common for bonuses to be disproportionately sensitive to the performance of one's own store. While our objective is to understand the implications of the incentive contracts typically deployed, an important question for future research is the design of optimal incentive contracts. A brief discussion on that topic is provided at the end of section 5.

With d_i denoting the target consumer selected by store i and e_i its effort, define

$$\Phi_j(d_1, \ldots, d_{n+m}) = \left\{ i \in \{1, 2, \ldots, n+m\} \mid d_i = j \right\} \tag{2}$$

[5] A feature of our specification is that equilibrium behavior is the same whether the game involves firms simultaneously choosing their target consumer and effort level or it is done sequentially. This is special, however, to the specification that a store manager's marginal benefit from effort is independent of the effort decisions of other store managers.

[6] For example, store manager bonuses at Sears, Roebuck and Company are based half on store profit and half on chain profit ("Sears, Roebuck and Company (A): Turnaround"). However, in a large chain such as Sears, one would expect a store manager's decisions to have a very small impact on chain profit relative to its impact on store profit. Thus, even there, store manager behavior may be designed to maximize store performance.

as the set of stores targeting consumer $j \in \{I, II\}$. The profit to store i is specified to be:

$$\pi_i\big((d_1, e_1), \ldots, (d_{n+m}, e_{n+m})\big)$$
$$= \begin{cases} \beta\Bigg[e_i + \lambda \displaystyle\sum_{j \in \Phi_{d_i} - \{i\}} e_j + \eta \sum_{j \notin \Phi_{d_i}} e_j\Bigg] - \left(\frac{1}{2}\right)\theta e_i^2 & \text{if } d_i = z_i, \\ \alpha\Bigg[e_i + \lambda \displaystyle\sum_{j \in \Phi_{d_i} - \{i\}} e_j + \eta \sum_{j \notin \Phi_{d_i}} e_j\Bigg] - \left(\frac{1}{2}\right)\theta e_i^2 & \text{if } d_i \neq z_i, \end{cases} \tag{3}$$

where it is assumed that: $\beta > \alpha > 0$, $1 \geqslant \lambda > \eta \geqslant 0$, and $\theta > 0$.

$$e_i + \lambda \sum_{j \in \Phi_{d_i} - \{i\}} e_j + \eta \sum_{j \notin \Phi_{d_i}} e_j \tag{4}$$

represents the change in their expertise and β (or α) multiplied by that expression is the associated gross profit.[7] $\beta - \alpha$ is the profit loss per unit (of expertise) from developing expertise designed to satisfy a consumer type that is not dominant in one's market. For analytical convenience, we let α/β measure the degree of inter-market heterogeneity. When it is close to 1, a store that does not target its dominant consumer loses relatively little. When it is close to 0, consumers *I* and *II* are very different so that a store's practices are quite ineffective when they are not tailored to its dominant consumer. λ and η are spillover parameters associated with learning from other stores who target the same consumer type and who target a different consumer, respectively. It is assumed that a store manager learns more about serving her own target consumers from stores who target the same type of consumer. This is because the spillovers are likely to be more effective between stores targeting similar consumer types than between those targeting heterogeneous consumer types. Finally, $\frac{1}{2}\theta e_i^2$ is the cost associated with exerting effort in developing further expertise.

Note that the marginal benefit (in terms of gross profit) of effort is constant while the marginal cost of effort is increasing. If we redefine effort as $w \equiv e^2$ then w enters the gross profit term in (3) as $\sqrt{w}$. Net profit is then an expression which depends on $\sqrt{w}$ minus w. Hence, the relationship between effort and profit is subject to decreasing returns to scale which is a natural assumption as well as a standard one.[8] However, this profit function also has the property that there are constant returns to scale with respect to spillovers. That is, the marginal benefit from another store's idea (or unit of effort) on a store's profit is the same regardless of how many ideas these two stores have gen-

[7] Suppose a store manager chooses effort to maximize her income less the individual cost of effort. If income includes a share of store profit then that sharing arrangement is implicitly embodied in β and α.

[8] In oligopoly models of R&D (which corresponds to effort in our model), it is common to assume that unit cost is linearly decreasing in the amount of R&D which, after solving for a firm's optimal quantity, results in gross profit being convex in R&D. It is assumed that the cost of R&D is convex as we have specified. Examples of such model include d'Aspremont and Jacquemin [12], De Bondt, Slaets, and Cassiman [15], and Kesteloot and Veugelers [17]. Parametric assumptions are typically made so that R&D is subject to decreasing returns to scale.

erated. This would not be true if, for example, an idea is more likely to have already been thought of when there are more ideas. The virtue of this restrictive formulation is that it greatly simplifies analysis. We feel our results are robust to small changes in this formulation and we discuss this matter at the end of section 5.

These spillovers, while specified in a static model, are given a dynamic interpretation. They are viewed as being generated by intra-organizational knowledge transfer, very much in line with the examples discussed in the Introduction. These spillovers may be achieved via several different mechanisms [3]: direct observations, training, and movement of personnel with the knowledge as well as the technology embodying the necessary information.[9] In the context of retail chains, district managers may also facilitate effective diffusion of knowledge inside the chain:

> "... the real job of a district manager [at J.C. Penney] is to bring information and guidance from the central office to the store manager and to bring to the central office information they gather from the stores; but, more than that, to pollenize all stores in their territories with whatever useful information they gather while visiting them." [5, p. 235]

This model is an adaptation of a common model used to analyze R&D decisions in an industry; see De Bondt [14] for a survey of the literature using this approach. It differs by considering a multi-unit firm as opposed to a set of single-unit firms and, more importantly, in endogenizing the extent of spillovers by having agents choose the target consumer type in addition to how much effort to exert.

3. Equilibrium business strategies

First note that a store's optimal effort level depends only on whether or not it targets its dominant consumer:

$$e_i^*(d_i, z_i) = \begin{cases} \dfrac{\beta}{\theta} & \text{if } d_i = z_i, \\ \dfrac{\alpha}{\theta} & \text{if } d_i \neq z_i. \end{cases} \tag{5}$$

This is obviously a property of our simple structure; in particular, that the effort exerted by other stores' managers do not impact the marginal return to a store manager's own effort. Lemma 1 establishes that all equilibria are symmetric in the sense that stores with the same dominant consumer choose to target the same consumer (and, by (5), exert the same effort).

[9] Empirical testings of the impact of knowledge transfer on productivity are carried out in the context of pizza franchises by Darr, Argote and Epple [11], in the context of hotel chains by Baum and Ingram [4], and R&D alliances by Powell, Koput and Smith-Doerr [18].

Lemma 1. At a Nash equilibrium, $d_1 = \cdots = d_n$ and $d_{n+1} = \cdots = d_{n+m}$.

Proof. For this proof n and m are arbitrary so it will be sufficient to show that $d_1 = \cdots = d_n$ at a Nash equilibrium. For $i \in \{1, \ldots, n\}$, define:

$$\begin{aligned} p_{-i} &\equiv \left|\left\{ j \in \{1, \ldots, n\} - \{i\} \mid d_j = I \right\}\right|, \\ q &\equiv \left|\left\{ j \in \{n+1, \ldots, n+m\} \mid d_j = II \right\}\right|, \end{aligned} \tag{6}$$

p_{-i} is the number of stores (excluding store i) for whom both their target consumer and dominant consumer is I and q is the number of stores for whom both their target consumer and dominant consumer is II. Let $V(d_i, z_i, p_{-i}, q)$ denote the payoff to store i. It follows that:

$$V(I, I, p_{-i}, q) = \left(\frac{\beta}{\theta}\right)\left\{\beta\left[\frac{1}{2} + \lambda p_{-i} + \eta q\right] + \alpha\left[\lambda(m-q) + \eta(n - p_{-i} - 1)\right]\right\} \tag{7}$$

and:

$$V(II, I, p_{-i}, q) = \left(\frac{\alpha}{\theta}\right)\left\{\alpha\left[\frac{1}{2} + \lambda(n - p_{-i} - 1) + \eta(m-q)\right] + \beta[\lambda q + \eta p_{-i}]\right\}. \tag{8}$$

Define $W(p_{-i}, q) \equiv V(I, I, p_{-i}, q) - V(II, I, p_{-i}, q)$ and note that:[10]

$$\frac{\partial W(p_{-i}, q)}{\partial p_{-i}} = \left(\frac{\beta}{\theta}\right)(\beta\lambda - \alpha\eta) - \left(\frac{\alpha}{\theta}\right)(\beta\eta - \alpha\lambda) > 0 \tag{9}$$

since $\beta > \alpha$ and $\beta\lambda - \alpha\eta > \beta\eta - \alpha\lambda$.

Consider a strategy profile such that $d_i = I$, $d_j = II$, $i \neq j$, $i, j \in \{1, \ldots, n\}$, and $x \equiv |\{k \in \{1, \ldots, n\} \mid d_k = I\}|$. $d_i = I$ is optimal for firm i iff $W(x - 1, q_{-i}) \geqslant 0$. By (9), it follows that $W(x, q_{-j}) > 0$ and thus $d_j = II$ is not optimal for firm j. We conclude that, at a Nash equilibrium, if $d_i = I$ is optimal for some $i \in \{1, \ldots, n\}$ then $d_j = I$ is optimal $\forall j \in \{1, \ldots, n\}$. This proves lemma 1. $\square$

By lemma 1, there are four candidates for equilibrium – all stores target I, all stores target II, all stores target their dominant consumer, and all stores target their non-dominant consumer. The latter can be shown not to be an equilibrium because the value to targeting a particular consumer type is, *ceteris paribus*, always higher for a store for which that type is its dominant consumer. Theorems 2 and 3 derive necessary and sufficient conditions for the other three candidate profiles to be equilibria. Recall that α/β measures the degree of inter-market heterogeneity. Theorem 2 shows that a necessary and sufficient condition for there to be an equilibrium in which each store targets its dominant consumer is that α/β is sufficiently small; that is, there is sufficient inter-market heterogeneity.

[10] Assume $p_{-i} \in \mathbb{R}_+$ rather than the natural numbers.

Theorem 2. There exists a subgame perfect equilibrium such that $(d_1, \ldots, d_{n+m}) = (z_1, \ldots, z_{n+m})$ (non-uniform business strategies) iff

$$\frac{\alpha}{\beta} \leqslant \left\{\left[\lambda n + \eta(m-1)\right]^2 + 2\lambda(m-1) + 2\eta n + 1\right\}^{1/2} - \left[\lambda n + \eta(m-1)\right] \equiv \Gamma(n, m), \quad (10)$$

where $\Gamma(n, m) \in (0, 1)$.

Proof. Given (5), the only candidate strategy profile for which $(d_1, \ldots, d_{n+m}) = (z_1, \ldots, z_{n+m})$ is $(d_i, e_i) = (I, \beta/\theta)$ for $i \in \{1, \ldots, n\}$ and $(d_i, e_i) = (II, \beta/\theta)$ for $i \in \{n+1, \ldots, n+m\}$. This strategy profile yields the following payoff to a store with a type *II* market:

$$\left(\frac{\beta}{\theta}\right)\beta\left[\frac{1}{2} + \lambda(m-1) + \eta n\right]. \quad (11)$$

Setting $d_i \neq z_i$, along with the optimal effort level of α/θ, yields a payoff of:

$$\left(\frac{\alpha}{\theta}\right)\left\{\alpha\left(\frac{1}{2}\right) + \beta\left[\lambda n + \eta(m-1)\right]\right\}. \quad (12)$$

Equilibrium requires (11) $\geqslant$ (12). This inequality is equivalent to:

$$-\left(\frac{\alpha}{\beta}\right)^2 - 2\left(\frac{\alpha}{\beta}\right)\left[\lambda n + \eta(m-1)\right] + \left[1 + 2\lambda(m-1) + 2\eta n\right] \geqslant 0. \quad (13)$$

Solving for the roots to this expression, one finds that it has a unique positive root which is $\Gamma(n, m)$. Thus, (13) holds iff $\alpha/\beta \leqslant \Gamma(n, m)$.

Now consider a store with a type *I* market. One can similarly show that its strategy of targeting a type *I* consumer is optimal iff:

$$-\left(\frac{\alpha}{\beta}\right)^2 - 2\left(\frac{\alpha}{\beta}\right)\left[\lambda m + \eta(n-1)\right] + \left[1 + 2\lambda(n-1) + 2\eta m\right] \geqslant 0 \quad (14)$$

It is straightforward to show that the expression in (14) is at least as great as that in (13) iff $(\lambda - \eta)(n - m) \geqslant 0$. Since this latter condition holds, we conclude that if a store with a type *II* market finds it optimal to target a type *II* consumer then a store with a type *I* market finds it optimal to target a type *I* consumer. Therefore, $\alpha/\beta \leqslant \Gamma(n, m)$ is a necessary and sufficient condition for non-uniform business strategies to be a subgame perfect equilibrium.

Let us now establish that $\Gamma(n, m) \in (0, 1)$. $\Gamma(n, m) > 0$ is obvious upon inspection. One can show that $\Gamma(n, m) < 1$ is equivalent to $\lambda > \eta$ which is true by assumption. □

Theorem 3 shows that a necessary and sufficient condition for all stores to target the same consumer, and thereby have uniform business strategies, is that inter-market heterogeneity is sufficiently small.

Theorem 3. There exists a subgame perfect equilibrium such that:

(i) $d_1 = \cdots = d_{n+m} = I$ (uniform business strategies targeting the type I consumer) iff

$$\frac{\alpha}{\beta} \geqslant \frac{\{[\lambda n - \eta(m-1)]^2 + [1+2\lambda(m-1)](1+2\eta n)\}^{1/2} - [\lambda n - \eta(m-1)]}{1+2\lambda(m-1)} \equiv \Omega_I(n,m), \tag{15}$$

where $\Omega_I(n,m) \in (0,1)$; and

(ii) $d_1 = \cdots = d_{n+m} = II$ (uniform business strategies targeting the type II consumer) iff

$$\frac{\alpha}{\beta} \geqslant \frac{\{[\lambda m - \eta(n-1)]^2 + [1+2\lambda(n-1)](1+2\eta m)\}^{1/2} - [\lambda m - \eta(n-1)]}{1+2\lambda(n-1)} \equiv \Omega_{II}(n,m), \tag{16}$$

where $\Omega_{II}(n,m) \in (0,1)$.

Proof. To prove part (i), first note that the only candidate strategy profile is: $(d_i, e_i) = (I, \beta/\theta)$ for $i \in \{1,\ldots,n\}$ and $(d_i, e_i) = (I, \alpha/\theta)$ for $i \in \{n+1,\ldots,n+m\}$. If $i \in \{1,\ldots,n\}$ then it is obvious that store i's strategy is optimal as targeting consumer II results in lower revenue per unit of expertise (the expression in (4)) and, since all of the other stores are targeting consumer I and $\lambda > \eta$, its expertise is diminished. The problematic case is when $i \in \{n+1,\ldots,n+m\}$. The payoff to one of those stores for this strategy profile is:

$$\left(\frac{\alpha}{\theta}\right)\left\{\alpha\left[\frac{1}{2} + \lambda(m-1)\right] + \beta\lambda n\right\} \tag{17}$$

while the payoff from targeting consumer II is:

$$\left(\frac{\beta}{\theta}\right)\left\{\beta\left[\frac{1}{2} + \eta n\right] + \alpha\eta(m-1)\right\}. \tag{18}$$

(17) $\geqslant$ (18) is equivalent to:

$$\left(\frac{\alpha}{\beta}\right)^2\left[1+2\lambda(m-1)\right] + 2\left(\frac{\alpha}{\beta}\right)\left[\lambda n - \eta(m-1)\right] - [1+2\eta n] \geqslant 0. \tag{19}$$

Solving for the roots to this expression, one finds that it has a unique positive root which is $\Omega_I(n,m)$. Hence, (19) is true iff $\alpha/\beta \geqslant \Omega_I(n,m)$.

To establish that $\Omega_I(n,m) \in (0,1)$, first note that $\Omega_I(n,m) > 0$ is obvious upon inspection. Proposition 5 shows that $\Gamma(n,m) \geqslant \Omega_I(n,m)\ \forall m$ which, given $\Gamma(n,m) < 1$ by theorem 2, implies $\Omega_I(n,m) < 1$.

Turning to the proof of part (ii), analogous methods can be used to show that $d_1 = \cdots = d_{n+m} = II$ is part of a subgame perfect equilibrium outcome iff $\alpha/\beta \geqslant$

$\Omega_{II}(n, m)$. $\Omega_{II}(n, m) > 0$ is immediate. All that remains is to show that $\Omega_{II}(n, m) < 1$. From (16), this is equivalent to:

$$1+2\lambda(n-1)+\big[\lambda m-\eta(n-1)\big] > \Big\{\big[\lambda m-\eta(n-1)\big]^2+\big[1+2\lambda(n-1)\big](1+2\eta m)\Big\}^{1/2}. \quad (20)$$

Since $\lambda(n-1) > \eta(n-1)$ then the rhs is positive. Hence, (20) is equivalent to the inequality derived from squaring both sides. Doing that and cancelling common terms, one finds that (20) holds iff $\lambda > \eta$ which is true by assumption. □

Depending on the parameter values, two equilibria with uniform strategies can exist – one with all stores targeting the type I consumer and one with the targeting of the type II consumer. If $n = m$ then these two equilibria are indistinguishable. However, if $n > m$, so that there are more type I markets as type II markets, the equilibrium involving the targeting of the type I consumer results in more stores targeting their dominant consumer type. Since the amount of spillovers is the same for both equilibria, chain profit is higher. The next result shows that the equilibrium conditions for the more profitable equilibrium are weaker. That is, if an equilibrium exists with all stores targeting the consumer type which is dominant in a minority of markets then there exists an equilibrium with all stores targeting the consumer type which is dominant in a majority of markets.

Proposition 4. $\Omega_{II}(n, m) > \Omega_I(n, m)\ \forall m \in \{1, 2, \ldots, n-1\}, \forall n \in \{1, 2, \ldots\}$.

Proof. From (19), define

$$W_I\left(\frac{\alpha}{\beta}\right) \equiv \left(\frac{\alpha}{\beta}\right)^2\big[1+2\lambda(m-1)\big]+2\left(\frac{\alpha}{\beta}\right)\big[\lambda n-\eta(m-1)\big]-[1+2\eta n]. \quad (21)$$

Thus, $\Omega_I(n, m)$ is defined as the positive root to $W_I(\alpha/\beta) = 0$. Analogously, we can define:

$$W_{II}\left(\frac{\alpha}{\beta}\right) \equiv \left(\frac{\alpha}{\beta}\right)^2\big[1+2\lambda(n-1)\big]+2\left(\frac{\alpha}{\beta}\right)\big[\lambda m-\eta(n-1)\big]-[1+2\eta m] \quad (22)$$

so that $\Omega_{II}(n, m)$ is defined as the positive root to $W_{II}(\alpha/\beta) = 0$. If $W_I(\Omega_{II}(n, m)) > 0$ then $W_I(\alpha/\beta) > 0\ \forall\alpha/\beta \geqslant \Omega_{II}(n, m)$. It follows that $\Omega_I(n, m) < \Omega_{II}(n, m)$. To prove the proposition, we must then only show that $W_I(\Omega_{II}(n, m)) > 0$.

Some algebraic manipulation reveals that, if $n > m$ then:

$$W_I\left(\frac{\alpha}{\beta}\right) > W_{II}\left(\frac{\alpha}{\beta}\right) \quad \text{iff} \quad \frac{\alpha}{\beta} > \frac{\eta}{\lambda}. \quad (23)$$

Thus, if $\Omega_{II}(n, m) > \frac{\eta}{\lambda}$ then $W_I(\Omega_{II}(n, m)) > 0 = W_{II}(\Omega_{II}(n, m))$ and we are done. Using the expression for $\Omega_{II}(n, m)$, simple manipulation reveals that $\Omega_{II}(n, m) > \eta/\lambda$ iff $\lambda > \eta$ which is true by assumption. □

The next result is useful in characterizing the set of equilibria.

Proposition 5. $\Gamma(n,1) = \Omega_I(n,1)$ and $\Gamma(n,m) > \Omega_I(n,m)$ $\forall m \in \{2,3,\ldots,n\}$, $\forall n \in \{1,2,\ldots\}$.

Proof. By re-arranging terms, it is straightforward to establish that:

$$\begin{aligned}&\big[\lambda n - \eta(m-1)\big]^2 + \big[1 + 2\lambda(m-1)\big](1 + 2\eta n)\\ &\quad = \big[\lambda n + \eta(m-1)\big]^2 + 2\lambda(m-1) + 2\eta n + 1,\end{aligned} \tag{24}$$

where the left-hand side expression is from the numerator of $\Omega_I(n,m)$ and the right-hand side expression is the first term of $\Gamma(n,m)$. Defining

$$A \equiv \big[\lambda n + \eta(m-1)\big]^2 + 2\lambda(m-1) + 2\eta n + 1 \tag{25}$$

then $\Gamma(n,m) \gtreqqless \Omega_I(n,m)$ can be stated as

$$A^{1/2} - \big[\lambda n + \eta(m-1)\big] \gtreqqless \frac{A^{1/2} - [\lambda n - \eta(m-1)]}{1 + 2\lambda(m-1)}. \tag{26}$$

Multiplying both sides of (26) by $1 + 2\lambda(m-1)$ and cancelling terms, one derives

$$(m-1)\lambda A^{1/2} \gtreqqless (m-1)\big\{\lambda\big[\lambda n + \eta(m-1)\big] + \eta\big\}. \tag{27}$$

This holds with equality when $m = 1$ which proves $\Gamma(n,1) = \Omega_I(n,1)$. Now suppose $m > 1$. Squaring both sides of (27), cancelling terms, and re-arranging, (27) holds with strict inequality iff:

$$\big(\lambda^2 - \eta^2\big)\big[1 + 2\lambda(m-1)\big] > 0. \tag{28}$$

Since $\lambda > \eta$ then this proves $\Gamma(n,m) > \Omega_I(n,m)$ when $m > 1$. □

To keep the discussion of equilibria focused, let us restrict attention to the equilibrium in which firms have non-uniform strategies and the equilibrium in which stores deploy uniform strategies that target the more numerous type *I* consumer. All of our discussion can be adapted to handle the equilibrium with uniform strategies targeting the type *II* consumer.

Using the preceding theorems, the set of equilibria is depicted in figure 1 for when m is allowed to vary and $n = \upsilon m$, $\upsilon \in \{1,2,\ldots\}$.[11] When inter-market heterogeneity is sufficiently great ($\alpha/\beta < \Omega_I(\upsilon m, m)$), the unique equilibrium outcome is for stores to tailor their practices to their dominant consumer so that the chain has non-uniform business strategies. When inter-market heterogeneity is sufficiently small

[11] Thus, as m increases, the size of the chain rises though the ratio of the two market types remains fixed. While the three regions identified in figure 1 follow from the preceding results, the exact properties of $\Gamma(\upsilon m, m)$ and $\Omega_1(\upsilon m, m)$ depend on the values for $(\lambda, \eta, \upsilon)$. Numerical analysis was conducted for

$$(\lambda, \eta, \upsilon) \in \{0.4, 0.8\} \times \{0, 0.25\lambda, 0.75\lambda\} \times \{1, 2, 4, 16\}.$$

$\Gamma(\upsilon m, m)$ is generally an increasing concave function though, when λ is low and υ is high, it is a decreasing convex function. $\Omega_1(\upsilon m, m)$ was always found to be a decreasing convex function.

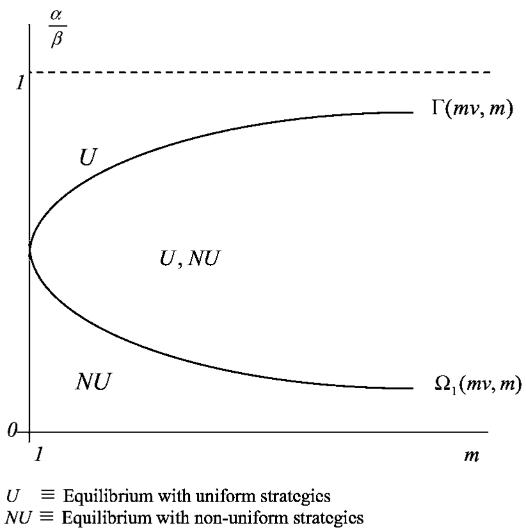

Figure 1.

($\alpha/\beta > \Gamma(vm, m)$), all equilibria involve stores targeting the same consumer so that there is a uniformity of business strategies within the chain. When inter-market heterogeneity is moderate, so that $\alpha/\beta \in [\Omega_I(vm, m), \Gamma(vm, m)]$, multiple equilibria exist in which case the chain may have either uniform or non-uniform practices. Based upon numerical analysis, the range over which multiple equilibria occurs is increasing in the size of chain, as reflected in figure 1.[12]

When α/β is sufficiently low then a store's business strategy is quite ineffective when it does not target its dominant consumer. As a result, equilibrium entails non-uniform business strategies. When α/β is sufficiently large then there is not much disparity between tailoring practices to either consumer type. As a result, the prevailing force is how much a store manager can learn from other stores. This leads her to target the consumer which is targeted by most other stores in the chain so as to maximize spillovers and results in all stores targeting the same consumer with a standardized business strategy emerging. Multiple equilibria can also easily occur, however. If all other stores are targeting the same consumer then it can be advantageous for a store to target that same consumer even if it is not its dominant consumer and inter-market heterogeneity is not small. The larger is the chain, the more advantageous it becomes to go along with all other stores when they are deploying the same business strategy. Of course, crucial to this issue is the degree of spillover. Whether the amount of learning from other stores is sensitive to whether you target the same consumer as they do depends on the differential in the spillover parameters, $\lambda - \eta$. The greater is that differential, the more important it is to target the same consumer that most other stores target.

[12] See footnote 11 for the parameter values used in the numerical analysis.

4. Chain-optimal business strategies

In this section, we characterize the targeting decisions that maximize chain profit. For this purpose, let x denote the number of type I stores that target a type I consumer and y denote the number of type II stores that target a type II consumer. Chain profit is then:

$$\begin{aligned}
&\Pi(x, y) \\
&\quad = x\left(\frac{\beta}{\theta}\right)\left\{\beta\left[\frac{1}{2} + \lambda \max\{x-1, 0\} + \eta y\right] + \alpha\left[\eta(n-x) + \lambda(m-y)\right]\right\} \\
&\qquad + (n-x)\left(\frac{\alpha}{\theta}\right)\left\{\alpha\left[\frac{1}{2} + \lambda \max\{n-x-1, 0\} + \eta(m-y)\right] + \beta[\eta x + \lambda y]\right\} \\
&\qquad + y\left(\frac{\beta}{\theta}\right)\left\{\beta\left[\frac{1}{2} + \lambda \max\{y-1, 0\} + \eta x\right] + \alpha\left[\eta(m-y) + \lambda(n-x)\right]\right\} \\
&\qquad + (m-y)\left(\frac{\alpha}{\theta}\right)\left\{\alpha\left[\frac{1}{2} + \lambda \max\{m-y-1, 0\} + \eta(n-x)\right] + \beta[\lambda x + \eta y]\right\}. \quad (29)
\end{aligned}$$

The first term is the profit earned by the x stores for whom consumer I is their dominant consumer and they target that consumer. The second term is the profit earned by the $n-x$ stores for whom consumer I is their dominant consumer and they instead target consumer II. The third and fourth terms apply to those stores for whom consumer II is their dominant consumer.

Theorem 6. Define

$$\Delta(n, m) \equiv \frac{\{(2\lambda n)^2 + [1 + 2\lambda(m-1) + 4\eta n][1 + 2\lambda(m-1)]\}^{1/2} - 2\lambda n}{1 + 2\lambda(m-1)}. \quad (30)$$

If $\alpha/\beta > \Delta(n, m)$ then the chain optimum is $(x, y) = (n, 0)$ or $(d_1, \ldots, d_{n+m}) = (I, \ldots, I)$ (uniform business strategies).[13] If $\alpha/\beta < \Delta(n, m)$ then the chain optimum is $(x, y) = (n, m)$ or $(d_1, \ldots, d_{n+m}) = (z_1, \ldots, z_{n+m})$ (non-uniform business strategies). If $\alpha/\beta = \Delta(n, m)$ then the set of chain optima is $(x, y) \in \{(n, 0), (n, m)\}$. Finally, $\Delta(n, m) \in (0, 1)$.

Proof. Taking the second derivatives of $\Pi(x, y)$ with respect to x and y, one derives:[14]

$$\frac{\partial^2 \Pi(x, y)}{\partial x^2} = \frac{\partial^2 \Pi(x, y)}{\partial y^2} = 2\left(\frac{\beta}{\theta}\right)(\lambda\beta - \eta\alpha) - 2\left(\frac{\alpha}{\theta}\right)(\eta\beta - \lambda\alpha) > 0 \quad (31)$$

as $\beta > \alpha$ and $\lambda > \eta$. It follows from (31) that an optimum is a corner solution so it lies in $\{(0, 0), (n, 0), (0, m), (n, m)\}$.

It is obvious (and straightforward to show) that $\Pi(n, 0) > \Pi(0, 0)$; that is, profit is higher by having all stores target consumer I than to have all stores not targeting

[13] If $n = m$ then there is also an optimum with $(d_1, \ldots, d_{n+m}) = (II, \ldots, II)$.

[14] Assume $x, y \in \mathbb{R}_+$ rather than the natural numbers.

their dominant consumer. Simple manipulation also shows that $\Pi(n, 0) \geqslant \Pi(0, m)$ is equivalent to:

$$(n - m)\big(\beta^2 - \alpha^2\big)\big[1 + 2\lambda(n + m - 1)\big] \geqslant 0. \tag{32}$$

If $n = m$ then $\Pi(n, 0) = \Pi(0, m)$ while if $n > m$ then $\Pi(n, 0) > \Pi(0, m)$. It then follows that the optimum lies in $\{(n, 0), (n, m)\}$ (noting that $(n, 0)$ and $(0, m)$ yield equal payoffs when $n = m$).

Using (29), we have:

$$\begin{aligned}&\Pi(n, 0) - \Pi(n, m)\\ &\quad= \left(\frac{m\beta^2}{2\theta}\right)\left\{\left(\frac{\alpha}{\beta}\right)^2\big[1 + 2\lambda(m - 1)\big] + \left(\frac{\alpha}{\beta}\right)4\lambda n - \big[1 + 2\lambda(m - 1) + 4\eta n\big]\right\}.\end{aligned} \tag{33}$$

One can show that (33) has a unique positive root that is $\Delta(m)$. Hence, $\Pi(n, 0) \geqslant \Pi(n, m)$ iff $\alpha/\beta \geqslant \Delta(m)$.

To establish that $\Delta(m) \in (0, 1)$, first note that $\Delta(m) > 0$ is obvious by inspection. Through straightforward manipulation, one can show that $\Delta(m) < 1$ iff $\lambda > \eta$ which is true by assumption. □

When markets are sufficiently similar, chain profit is maximized by having all stores target the same consumer so that there is a uniformity of business strategies. Such a strategy enhances spillovers across stores. When inter-market heterogeneity is sufficiently great, the knowledge gained from all stores being able to learn from one another is overwhelmed by the reduced efficacy of practices for those stores who are not targeting their dominant consumer. In that case, chain profit is maximized by having each store tailor its business strategy to its market.

5. Comparison of equilibrium and chain-optimal business strategies

To what extent is there a conflict between what store managers would do and what is desired by chain headquarters? To provide for cleaner results, we will ignore the equilibrium with uniform strategies that focus on the type *II* consumer. Thus, when business strategies are decentralized, stores are presumed to either target their dominant consumer (that is, the equilibrium with non-uniform strategies) or target the consumer type that is most frequently dominant (that is, the equilibrium with uniform strategies targeting the type *I* consumer). We do not believe this affects our qualitative findings.[15]

[15] Recall that if the type *II* uniform equilibrium exists then the type *I* uniform equilibrium exists. Hence, in some cases only the type *I* uniform equilibrium exists so that ignoring the other uniform equilibrium is without any loss of generality. When both equilibria exist then, by focusing on the type *I* equilibrium, we might be assigning higher profit under equilibrium than would occur. If, for example, stores engage in excessive uniformity (that is, settling on the type *I* equilibrium when non-uniform strategies maximize chain profit) then allowing them to settle on the type *II* equilibrium would only exacerbate that problem and the same qualitative result would prevail. If instead stores engage in insufficient uniformity (that is,

Define $\Gamma(m) \equiv \Gamma(vm, m)$, $\Omega(m) \equiv \Omega_I(mv, m)$, and $\Delta(m) \equiv \Delta(mv, m)$ where $v \in \{1, 2, \ldots\}$. Results are derived depending on the size of the chain, as measured by m, while holding fixed the ratio of market types, which is controlled by v.

Theorem 7. There exists $\underline{m} \geqslant 1$ such that if $m \leqslant \underline{m}$ then $\Gamma(m) \geqslant \Omega(m) > \Delta(m)$.

Proof. Since $\Gamma(m) \geqslant \Omega(m)\ \forall m$ by proposition 5, we need only show that $\exists \underline{m} \geqslant 1$ such that if $m \leqslant \underline{m}$ then $\Omega(m) > \Delta(m)$. For $m = 1$, it is straightforward to show that $\Omega(1) > \Delta(1)$ iff $\Phi(\lambda, \eta) > 0$ where

$$\Phi(\lambda, \eta) \equiv \left[(\lambda v)^2 + 2v\eta + 1\right]^{1/2} - \left[(2\lambda v)^2 + 4v\eta + 1\right]^{1/2} + \lambda v. \tag{34}$$

Let us first show that $\partial\Phi(\lambda, \eta)/\partial\eta < 0$. Since

$$\frac{\partial\Phi(\lambda, \eta)}{\partial\eta} = v\left[(\lambda v)^2 + 2v\eta + 1\right]^{-1/2} - 2v\left[(2\lambda v)^2 + 4v\eta + 1\right]^{-1/2} \tag{35}$$

then $\partial\Phi(\lambda, \eta)/\partial\eta < 0$ is equivalent to

$$2\left[(\lambda v)^2 + 2v\eta + 1\right]^{1/2} > \left[(2\lambda v)^2 + 4v\eta + 1\right]^{1/2}.$$

Squaring and multiplying out these expressions, one derives $4v\eta + 3 > 0$ which is indeed true. Next note that $\Phi(\lambda, \lambda) = 0$. $\Phi(\lambda, \lambda) = 0$ and $\partial\Phi(\lambda, \eta)/\partial\eta < 0$ imply $\Phi(\lambda, \eta) > 0\ \forall \eta < \lambda$. As it is assumed $\eta \in [0, \lambda)$, we conclude that $\Omega(1) > \Delta(1)$. Therefore, $\Gamma(1) \geqslant \Omega(1) > \Delta(1)$ so that the theorem is proven. □

Figure 2 visually depicts the properties characterized in theorem 7.[16] When the chain is sufficiently small – so that $\Gamma(m) \geqslant \Omega(m) > \Delta(m)$ – there are two sources of disparity between what stores achieve by pursuing their individual interests and what is in the best interests of the chain. To begin, there is no such disparity when markets are either sufficiently similar (region A in figure 2) or sufficiently diverse (region E). Problems arise when inter-market heterogeneity is moderate. When $\alpha/\beta \in (\Delta(m), \Omega(m))$ (region C), equilibrium targeting decisions have each store manager tailoring her business strategy to the dominant consumer in her market even though chain profit is maximized by having stores adopt uniform business strategies. The externality at work is that a store, in deciding which consumer to target, ignores the spillovers it creates for other stores who target that same consumer. As a result, there is too much focusing of practices on one's market and not enough uniformity to promote inter-store dissemination of new practices.

settling on non-uniform strategies when the type *I* equilibrium maximizes chain profit) then allowing them to settle on the type *II* equilibrium would alter the conclusion in that store managers' strategies may be appropriately uniform but they are targeting the wrong consumer type.

[16] Numerical analysis shows that the properties of these functions, as depicted in figure 2, hold for some parameter values. Footnote 11 discusses $\Gamma(m)$ and $\Omega(m)$. For those same parameter values, we found that $\Delta(m)$ is either a decreasing convex function, as shown in figure 2, or an increasing concave function.

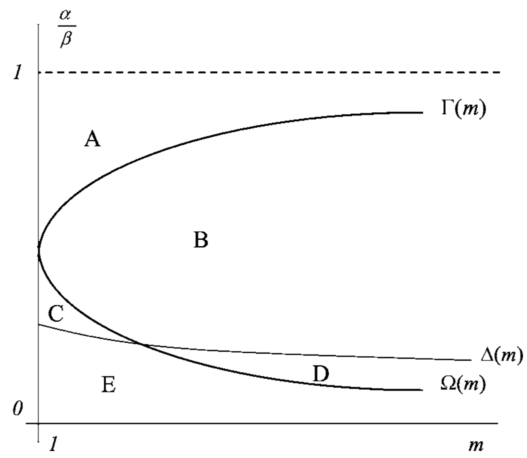

Figure 2.

There is a second source of excessive diversity of business strategies though it is due to a coordination failure. When $\alpha/\beta \in (\Omega(m), \Gamma(m))$ (region B), uniform business strategies maximize chain profit but both non-uniform and uniform business strategies are consistent with equilibrium. Thus, stores may settle upon non-uniform strategies and fail to maximize chain profit. Of course, there is a clear role for chain headquarters which is to coordinate expectations so that stores gravitate to the equilibrium with uniform strategies. This is to be contrasted to the problem when α/β lies in region C as then chain headquarters will have to impose uniformity by removing the discretion of store managers to develop their own business strategy.

Theorem 8. There exists finite $\overline{m}$ such that if $m \geqslant \overline{m}$ then $\Gamma(m) > \Delta(m) > \Omega(m)$.

Proof. Through a series of lemmata, we show that $\Gamma(m) > \Delta(m) > \Omega(m)$ as $m \to \infty$.

Lemma 9. $\lim_{m\to\infty} \Gamma(m) = (\lambda + \eta v)/(\lambda v + \eta)$.

Proof. Using the expression on the left-hand side of (13), $\Gamma(m)$ is defined as the positive root to

$$-\Gamma(m)^2 - 2\Gamma(m)\big[\lambda v m + \eta(m-1)\big] + \big[1 + 2\lambda(m-1) + 2\eta v m\big] = 0. \tag{36}$$

Dividing each side by m and letting $m \to \infty$, we have

$$-2\Gamma(m)(\lambda v + \eta) + 2\lambda + 2\eta v = 0. \tag{37}$$

Solving (37) for $\Gamma(m)$, we conclude that $\lim_{m\to\infty} \Gamma(m) = (\lambda + \eta v)/(\lambda v + \eta)$. □

Lemma 10. $\lim_{m\to\infty} \Omega(m) = \eta/\lambda$.

Proof. Using the expression on the left-hand side of (19), $\Omega(m)$ is defined as the positive root to

$$\Omega(m)^2\big[1 + 2\lambda(m-1)\big] + 2\Omega(m)\big[\lambda v m - \eta(m-1)\big] - [1 + 2\eta v m] = 0. \tag{38}$$

Dividing each side by m and letting $m \to \infty$, we have

$$2\lambda\Omega(m)^2 + 2(\lambda v - \eta)\Omega(m) - 2\eta = 0. \tag{39}$$

Solving (39) for $\Omega(m)$, we conclude that $\lim_{m\to\infty} \Omega(m) = \eta/\lambda$. □

As a comment, let us note that $\lim_{m\to\infty} \Omega_{II}(mv, m) = \eta/\lambda$ so that this theorem holds regardless of which equilibrium with uniform strategies is selected.

Lemma 11. $\lim_{m\to\infty} \Delta(m) = [(\lambda(1 + v^2) + 2\eta v)/\lambda]^{1/2} - v$.

Proof. Using the expression on the left-hand side of (33), $\Delta(m)$ is defined as the positive root to:

$$\Delta(m)^2\big[1 + 2\lambda(m-1)\big] + \Delta(m)4\lambda v m - \big[1 + 2\lambda(m-1) + 4\eta v m\big] = 0. \tag{40}$$

Dividing each side by m and letting $m \to \infty$, we have

$$2\lambda\Delta(m)^2 + 4\lambda v\Delta(m) - 2(\lambda + 2\eta v) = 0. \tag{41}$$

Solving (41) for $\Delta(m)$, we conclude that

$$\lim_{m\to\infty} \Delta(m) = \left[\frac{\lambda(1 + v^2) + 2\eta v}{\lambda}\right]^{1/2} - v. \qquad \square \tag{42}$$

It is straightforward to show that if $\lambda > \eta$ then

$$\frac{\lambda + \eta v}{\lambda v + \eta} > \left[\frac{\lambda(1 + v^2) + 2\eta v}{\lambda}\right]^{1/2} - v > \frac{\eta}{\lambda} \tag{43}$$

from which it follows that $\Gamma(m) > \Delta(m) > \Omega(m)$ as $m \to \infty$. □

As was found for when the chain is small, the decentralized behavior of store managers can fail to maximize chain profit when the chain is large. However, two notable differences emerge. First, when the chain is large, the only source of disparity between store manager behavior and chain profit-maximizing behavior is as a result of coordination failure. When $\alpha/\beta \in (\Delta(m), \Gamma(m))$ (region in B figure 2) both uniform business strategies and non-uniform business strategies are equilibrium outcomes but only uniform business strategies maximize chain profit. If $\alpha/\beta \in (\Omega(m), \Delta(m))$ (region D in figure 2) then both uniform business strategies and non-uniform business strategies are equilibrium outcomes but only non-uniform business strategies maximize chain profit. Second, when the chain is large, store managers may engage in too much uniformity as well as too little, in contrast to when the chain is small.

Let us consider why qualitative results depend on the size of the chain. From the chain's perspective, there are two issues. First, a store manager ignores the learning spillovers that her effort provides to other stores. This tends to result in insufficient uniformity as store managers tailor their practices to their own market rather to the consumer type that most other stores are targeting. Second, a store manager may try to free-ride on the effort of other stores by targeting the consumer type that most other stores target. This tends to result in excessive uniformity. When the chain is small, the first effect tends to be strong since how much one learns from one's own effort is sizable compared to what one learns from the efforts of others. This implies that it can be a unique equilibrium for all stores to tailor their practices. The bias is then towards excessive diversity of business strategies. When instead the chain is large, the second factor can be quite powerful. If there are many stores and they are all targeting the same consumer type, this can dominate the loss in efficacy from not targeting one's dominant consumer even when α/β is moderately low. Hence, excessive uniformity can emerge. If instead all other stores target their dominant consumer, the enhanced spillovers by targeting the consumer type that most other stores target may not be large so that non-uniform strategies can emerge even when α/β is moderately high. This is easiest seen when $\upsilon = 1$ so that $n = m$.[17] Suppose all other stores target their dominant consumer type. By targeting the type *II* consumer, a store manager in a type *II* market learns at a rate λ from $m - 1$ stores and a rate η from m stores (all of them exerting effort of β/θ). Targeting the type *I* consumer allows it to learn at a rate η from $m - 1$ stores and a rate λ from m stores. The difference in spillovers goes to zero as the chain grows so that a store prefers to target its dominant consumer irrespective of α/β. Hence, one can end up with insufficient uniformity.

Here it is important to discuss the robustness of this result with respect to the assumption that the marginal benefit associated with spillovers is constant (see the discussion in section 2). That is, the gross profit to a store associated with another store's idea (or unit of effort) is the same regardless of how much ideas have been generated. This assumption has the implication that more stores linearly increases the amount of spillovers as measured in terms of gross profit, holding the amount of R&D per store fixed. If instead there were decreasing returns to spillovers then the relationship would be concave rather than linear. While this would weaken the relative advantage of uniform practices, we do not believe our qualitative conclusions would change. The above intuition does not depend on linearity in the relationship between the number of stores and the amount of spillovers but rather that the marginal benefit from spillovers is strictly positive so that more stores means more spillovers. Of course, quantitatively, we would expect decentralized strategies to be preferred for a wider array of parameter values.

Having identified an externality that may prevent chain profit from being maximized, it is natural to consider the use of properly designed incentive contracts to solve this dilemma. To induce a store manager to internalize the effect of her targeting decision on other stores' profits, a contract could be designed to make store manager compensa-

[17] When $\upsilon > 1$, the analysis is a bit different though the same qualitative conclusions apply.

tion sufficiently sensitive to chain profit. Though it solves the problem associated with a store's business strategy, it has the undesirable side effect of weakening the incentive to exert effort. Since a store manager's effort has a much smaller effect on chain profit then store profit, her incentive to work hard could be quite weak if her compensation is largely driven by chain profit. There is then a tension between inducing adequate effort – which would argue to making store manager compensation highly sensitive to her own store's performance – and inducing the proper business strategy – which would argue to making store manager compensation highly sensitive to the chain's performance. An obvious next step in this line of research is to characterize optimal incentive contracts while taking into account these two effects.

6. Concluding remarks

In sum, we find that the interests of unit managers and the corporate staff can indeed diverge on the issue of designing business strategies at the unit level. When the firm has few units, giving discretion to managers may necessarily imply insufficient standardization of local business strategies because unit managers fail to internalize the spillovers that their choice of strategy creates for other units. When the firm has many units, decentralization of strategy choice can result in either excessive or insufficient standardization, depending on parameter values. In this case, however, the optimal design of local strategies from the perspective of the firm is always an equilibrium for unit managers. Heavy-handed intervention by corporate headquarters may not be necessary for the right strategies to emerge but rather careful instruction and information dissemination so that unit managers choose for themselves what is best for the firm.

While this model is static, one can use it to derive some tentative insight regarding the evolution of a retail chain. If a chain starts small then our theory suggests that stores will tend to tailor their practices to their market, perhaps excessively so. Of course, a chain can avoid excessive specialization and thereby enhance inter-store learning by imposing a uniformity in business strategies or by entering local markets that are sufficiently similar and thereby inducing store managers to adopt the same business strategy. Our theory suggests that there can be a later downside to such a policy. As the chain grows, it may be desirable to encourage stores to tailor their practices as, with enough markets of each type, there will be adequate inter-store learning. If store managers have private information about who their dominant consumer is then the appropriate method for accomplishing that goal is to decentralize and give store managers the authority as to whom to target. However, if many existing stores are targeting the same type of consumer then new stores will probably choose to act likewise so as to free-ride on what other stores have learned. In this manner, earlier uniformity may make later diversity quite difficult to materialize. This suggests a strong path-dependence to the evolution of a chain's practices.[18] An interesting topic for future research is to characterize the

[18] While merely changing the structure of a given organization from centralization to decentralization may not bring about the desired diversity over time, there exists an alternative approach that is more direct:

optimal dynamic plan that might avoid the problem of excessive uniformity while, at the same time, promoting standardization where and when it is appropriate.

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corporate HQ, if in possession of appropriate information about the markets, may influence the degree of inter-store diversity by either actively repositioning the existing stores or placing new stores in those markets that are sufficiently different from the current ones. If successful, this will negate the free-riding incentive of the individual stores and set them on the path to long-term diversity.

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