

Inter-divisional Domain Overlap and Product Differentiation

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ABSTRACT

Using data on the U.S. automobile industry between 1979 and 1999, we have investigated the impact of inter-divisional domain overlap on a division's product differentiation vis-à-vis sister divisions. The results show that the higher the level of inter-divisional domain overlap, relative to the focal division's own domain, the higher the chances of locating a new product closer to the existing products of a sister division, thereby decreasing product differentiation vis-à-vis this sister division. We argue that this is due to a high level of similar capabilities between the two divisions and the division with less distinctive capabilities may have little choice but to launch a new product that is close to the products of the other division.

Key words: Product Differentiation, Inter-divisional Domain Overlap, Capabilities

1. INTRODUCTION

Product similarity to or difference from other products is quite important for product competition and consequently firm profits. A high degree of similarity to rival products may increase the demand of a new product but could trigger intense competition, whereas too much difference from rival products may relax potential price competition but could not attract customers who patronize rival products. Industrial organization economists have addressed this issue under the topic of product differentiation: e.g., [30], [43], [53], [55]. They have argued that the degree of product differentiation (i.e., from minimum differentiation to maximum differentiation) varies depending on such factors as the degree of competition, the distribution of demand within the product space, the order of entry, number of firms, and number of product dimensions or characteristics, among others.

It should be noted, however, that the models of product differentiation are generally quite basic (e.g., two-stage games with no repeated interaction, two firms with one or two products) and the results are quite sensitive to assumptions. And the literature on product differentiation has mainly focused on product differentiation between a focal firm and competing firms, but not on product differentiation among the products offered by the same firm. When a division in a firm with multiple divisions introduces a new product, it should consider product differentiation not only vis-à-vis rival products, but also vis-à-vis the existing products of the other divisions of the

same firm. This aspect of product differentiation has not received enough attention and this is what we intend to address.

When two divisions of the same firm offer very similar products, we may expect product cannibalization for the firm as a whole. But this inter-divisional cannibalization does not necessarily mean that both divisions are cannibalizing each other: one division may cannibalize the other division's products, but not vice versa. In this case, the cannibalization would increase the former division's sales and possibly profits, but not necessarily the latter division's sales or profits. Thus, we may expect that these two divisions might develop quite different attitudes or reactions to the same cannibalization. From the viewpoint of resource-based view: [16], [17], inter-divisional cannibalization implies that certain portions of resources and capabilities of these two divisions overlap with each other. We argue that different attitudes and reactions to the same cannibalization, and the way a division's capabilities are overlapped with another division affect this division's new product location decision vis-à-vis the latter division of the same firm.

Specifically, we address the following research question: Does a focal division's divisional domain overlap with another division of the same firm increase or decrease product differentiation vis-à-vis the latter division? We are interested in product differentiation between divisions of the same firm from the standpoint of divisional domain overlap. Using data on the U.S. automobile industry between 1979 and 1999, we tested the hypotheses and found that the level of divisional domain overlap with a sister division would decrease product differentiation vis-à-vis this sister division.

It should be noted that we are interested in firms that produce *differentiated* products. In other words, among different types of M-forms [11], the focus is on pure M-form structure of type D₁ that represents a highly integrated M-form

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enterprise that produces (possibly) differentiated but otherwise common final products or services (e.g., automobile industry, PC industry). This type of M-form is different from the so-called pure M-form of type D_2 that denotes an M-form firm that produces diversified final products or services (e.g., General Electric).

2. PRODUCT DIFFERENTIATION AND DIVISIONAL DOMAIN

2.1 Product Differentiation

The current IO economics literature on product differentiation exhibits several interesting features: [5], [6], [32]. Most of all, the models are very simple. Most studies rely on 2-stage game theoretic models where firms choose product location in the 1st stage and then choose either price or quantity in the 2nd stage. And the majority of models is based on a duopoly situation where each firm is a single-product firm and the product has one-dimensional characteristic. In addition to the simplicity of the model, the results are very sensitive to ad hoc assumptions of the models: simultaneous move vs. sequential move, price competition vs. quantity competition, elastic demand vs. inelastic demand, or linear transportation cost vs. quadratic transportation cost, among others. For example, the assumption of quadratic transportation cost amplifies the effects of price competition compared with the assumption of linear transportation cost. Lastly, when the models incorporate some realities in their specifications, the results are unconventional. These key features have some implications for our current study on inter-divisional product differentiation.

First, in a two-stage duopoly game where each firm produces one product with single characteristic, what matters is whether (1) price is endogenous or exogenous; (2) demand is elastic or inelastic; or (3) price competition is intense or not (i.e., the form of transportation costs). When prices are endogenously decided, equilibrium outcome is hard to gain at least in horizontal differentiation [30], unlike the case where prices are assumed to be quite rigid: [23], [43]. These studies further demonstrate that the (potential) existence of intense price competition would make firms differentiate their product from at least a sufficient degree to maximum degree from competing products to relax intense price competition; [23], [50], [55]. These studies also demonstrate that when the demand is elastic, firms have more incentives to differentiate their products: [50], [56]. Thus, these results basically suggest that when price competition is a concern and demand is elastic, which is usually the case, firms have incentives to differentiate their products from competing products from a sufficient degree to the maximum degree.

Second, the studies on multiple product characteristics suggest that, unlike one-dimensional product characteristic, firms have multiple means to differentiate their products. This implies that depending on what characteristics are included in the equation, we may have quite different results. So we may be better off including characteristics that consumers put equally high importance on [13] and that are expensive to produce [60].

Third, when there are multiple firms with multiple products in the market, equilibrium is either hard to obtain or there may be infinite numbers of equilibrium: [21], [24]. When firms compete with multiple competitors, firms not only consider how much they will differentiate their new products from rival products, but also take into account how close they will locate their new products in comparison with their current products. Thus, in addition to product differentiation relative to rival products, product cannibalization should become an important concern in new product introductions for multiple product firms.

However, what is missing here is that nowadays many firms have multiple divisions and each division is responsible for managing a range of products. Thus, each division has its own competing products, and should interact with other divisions of the same firm in terms of resource allocation and divisional domain changes under the same corporate headquarters. This may pose a new issue in understanding product differentiation compared with the existing literature that exclusively focuses on the firm as a unifying whole.

2.2 Divisionalization and Divisional Domain

Firms set up multiple divisions because, divisionalization could be more profitable than remaining as a unified whole: e.g., [19], [20], [27], [51], [54], [61]. This is because divisionalization allows firms to either deter entry or achieve Stackelberg leadership in the product market.

First of all, firms have incentives to deter entry through divisionalization. In an oligopoly market, incumbent firms set up new divisions to preempt entry. According to [54], divisionalization for preemption always dominates non-innovative entry, which ensures that incumbents in oligopolistic industries forestall all entry by non-innovative potential entrants. This is because independent and competing divisions would perfectly emulate the behaviors of potential entrants and thereby forestall a non-innovative entrant. Extended from [54], [61] argues that creating sufficient numbers of independent divisions or operating centers can deter entry.

Another advantage of divisionalization is that it may allow firms to achieve Stackelberg leadership in the product market. Large firms have incentives to create several independent divisions that compete in the same market as a credible commitment to Stackelberg leadership of the firms [27]. In a two-stage game, setting up autonomous competing units (stage one) that behave independent from profit maximizers allows a parent firm to commit unilaterally to a greater level of output (stage two), thereby mimicking a Stackelberg-type outcome in the product market [20]. Therefore, oligopolistic producers have a unilateral incentive to divisionalize and increase firm profits. In a similar two-stage model, [51] also argues that it is more profitable for the firm to form (completely) independent competing divisions rather than to remain as a unified whole because independent divisions will act independently to each other, which will result in making the firm more aggressive and induce rival firms to be less aggressive when output decisions are made (in stage two).

Unlike the traditional approach of IO economics that typically assumes independent divisions selling homogeneous

products, strategic management has focused on the existence of *distinctive* divisional domain. Through divisionalization each division came to have its divisional domain that refers to “the businesses (i.e., product and market arenas) in which a division actively participate and for which it is responsible within the corporation.” [33]. At a point in time, divisional domains are explicitly fixed and recognized by other divisions and by corporate headquarters, but they change over time due to either the emergence of new business opportunities or growing unfit between divisional domains and relevant divisions’ capabilities, among others: [33], [34]. Or a division can increase or shrink its own domain by introducing new products or eliminating existing products and during the process divisions develop new capabilities or lose existing capabilities. And what is interesting is that all this process is closely related to inter-divisional domain overlap.

3. INTER-DIVISIONAL DOMAIN OVERLAP AND PRODUCT DIFFERENTIATION

Inter-divisional domain overlap implies that there exists internal competition among divisions of the same firm vying for the same customers. Internal competition could help the firm, or at least be tolerated, depending on the intensity and the context of competition. R&D competition between distinct development teams may reduce the development time: [36], [45]; to survive disruptive innovations, firms should set up an small and autonomous organization equipped with disruptive innovations and this autonomous organization compete against a parent company that pursues innovations based on sustaining technology [3]; or a reasonable level of internal competition is good for the firm [49]. Another study shows that internal competition among subgroups in a package delivery company improved quality control, a feature that is critical to company success [46], whereas there is a report that internal competition creates quality problems [52].

Some firms have traditionally allowed internal competition between subunits including divisions. For example, Hewlett-Packard has allowed its laser-jet printer division and ink-jet printer division compete against each other for printer markets. Intense competition among divisions, however, has become a problem, even for a company such as GM that has traditionally tolerated internal competition. Mr. Hoglund, GM’s Executive Vice President points out [28]:

A few years ago GM had four different management systems, four different billing systems, three or four different materials scheduling systems for components – for no good reason. Chevy was trying to screw Pontiac, Olds was trying to screw Buick and Fisher Body was screwing all of us. Under the old system, with all our problems we’d all just be working harder to kill one another. *Now we are trying to convince people in the divisions that they don’t have to fight each other, that they can concentrate on fighting other manufacturers.* We’re making progress, but there’s still a question that our progress is good enough. (Italics are ours)

As can be seen in the above quote, firms have good reasons to avoid, or at least, reduce internal competition. First of all, internal competition among divisions may result in inefficient use of resources from the perspective of the firm. Inefficient use of resources can be approached from factor-market and product-market perspectives. From a factor-market perspective, internal competition makes it hard for a firm to achieve economies of scope. Economies of scope can be achieved when subunits of the same firm share resources in their operations, and achieving economies of scope is one of the primary reasons why firms operate in multiple businesses [58]. However, when internal competition is high, subunits are less likely to share resources or information, thereby increasing the firm’s total cost of operation. And from a product-market perspective, internal competition means redundant products [47].

In addition to potentially inefficient use of resources, internal competition may also foster subunit identification at the expense of organizational identification, which could hurt firm performance in the long run. Organizational identification is a form of psychological attachment such that members identify with the organization they belong to [31]. When a division competes against other divisions in the same firm, this division would be more concerned with obtaining its own division goals, which may encourage the members of the division to identify themselves with their own division. As members identify themselves with their own division, they are more likely to evaluate the alternatives of choice in terms of the consequences for their own division without considering other possibilities or alternatives for the whole corporation [9]. This may create blind spots for divisions and end up creating excessive capacity in a firm [62]. Excessive divisional identification further reinforces already intensified internal competition among divisions [31].

Along with the problem of subunit identification, internal competition could also exacerbate agency problems on the part of division managers. Internal competition may provide incentives for division managers to shirk their optimal behaviors. In compensation incentive design, it is important to match efforts and compensation or performance in the right manner. But internal competition makes it hard for corporate headquarters to link division managers’ efforts to their performance partly because a division manager’s performance is affected by other division managers’ efforts that work against the division manager’s performance, in addition to random factors such as market uncertainty [8].

The above-mentioned concerns would encourage corporate headquarters to check internal competition between divisions before it becomes excessive. Internal competition basically means high chances of inter-divisional product cannibalization. For a division that does cannibalize another division’s products, inter-divisional product cannibalization is not a serious problem; it is rather a source of new revenues. But regardless of who cannibalizes whom, inter-divisional cannibalization could pose a serious problem for the firm as a whole. Therefore corporate headquarters may want to put pressure on divisions involved in inter-divisional cannibalization. And divisions’ product location choices would reflect this pressure from corporate headquarters. Then, who

would be more influenced by the divisional overlap and feel more pressure from the headquarters to lessen internal competition?

We argue that an asymmetric nature of inter-divisional overlap may provide a clue. The literature on niche overlap and competitive dynamics suggests that a focal organization with a higher degree of overlap would feel more competitive pressure than one with a lower degree of overlap with the focal organization: [7], [18], [25], [48]. In analogy, we can expect that a focal division with a higher degree of inter-divisional domain overlap with another division of the same firm would feel more competitive pressure and is more likely to act to take care of this pressure. And the same amount of pressure from corporate headquarters will be more strongly felt for this division. This is because due to the high level of overlap relative to this division's overall domain, this division's performance is more affected by the overlapped portion compared with other sister division.

This competitive pressure from a high degree of inter-divisional overlap would not make a focal division to locate its product closer to the products of another division with which the focal division has domain overlap, thereby increasing domain overlap and competition. The focal division would rather locate its new product farther away from another division's divisional domain as a way to lessen the competitive pressure from inter-divisional domain overlap. For a division, a high degree of inter-divisional domain overlap means that the chances of being cannibalized by another division are very high, which would motivate this division to reduce the chances of being cannibalized, i.e., move farther away from the other division's domain. And for a division, a high degree of inter-divisional overlap means that it would be extremely hard to determine its unique contribution to the overall firm performance, which may jeopardize the rationale of this division's existence as a separate entity. Thus, a focal division with a high degree of inter-divisional overlap has more incentives to locate its new product farther away from the products of the other division with which it has divisional overlap.

Hypothesis 1a. The *higher* the degree of a focal division's divisional overlap with a sister division, proportional to the focal division's domain, the *greater* the distance between the focal division's new product and the sister division's existing products.

Up to now we have mainly focused on the market area aspect of divisional domain. As [10] mentioned, one of the elements of firm domain is products and services rendered to customers. Since divisional domain is a portion of firm domain to which a division is responsible for within the firm, any divisional domain should have their own products and services served to their own customers. From this aspect of divisional domain we have argued that inter-divisional domain overlap works in the way that a division with a high-level of inter-divisional domain overlap has incentives to reduce the level of inter-divisional overlap due to various reasons. Thus, this division may want to launch its new product further away from

the existing products of sister divisions to reduce divisional overlap and internal competition.

In addition to the market area aspect of divisional domain, divisional domain is also characterized with another aspect: resources and capabilities. This aspect also comes from the aspects of firm domain. According to [10], firm domain consists of technology that is needed to produce and sell the products and services. So it is not surprising that divisional domain should also be characterized with the resources and capabilities necessary to render the products and services of the division. And the division is also responsible for these resources and capabilities within the firm. For example, if a division sells low-end products in the product market, this division is responsible for the skills and knowledge to develop and sell low-end products, but is not held accountable for the skills and knowledge required for the success of high-end products.

When divisionalization is implemented, corporate headquarters make an arrangement such that each division would have a distinct divisional domain, which means that inter-divisional domain overlap is deliberately avoided and that, at the same time, the resources and capabilities held by one division is distinct from those held by other divisions. But as time goes on, divisions enter into other divisions' divisional domains pursuing new opportunities and, in doing so, may end up increasing inter-divisional domain overlap. This was the case when GM did divisionalize in the early 1920s [2]. When GM divisionalized, the headquarters did make sure that there were no serious inter-divisional domain overlaps, but since then divisions started to enter other divisions' domains by launching new products there. As divisional domain expands, so do the capabilities and resources of the division over time. But as inter-divisional domain overlap increases due to the expansion of divisions over time, the resources and capabilities that are specific or peculiar to a particular division would decrease. In other words, distinctive resources and capabilities held by a division decrease as this division's domain is getting overlapped by other divisions.

According to resource-based view: [16], [17], product market competition is a function of factor market conditions. If two firms have similar access to factor markets, they may end up producing similar products or services, which will ultimately lead to more competition in the market [35]. In other words, unless you have distinct resources and capabilities, you cannot produce products that are distinct from the existing products of other firms or divisions.

So a division whose overlapped portion is large relative to its domain has less distinct resources and capabilities, and more similar or common capabilities to those of the overlapped sister division. And this division may have fewer distinctive capabilities to experiment new ideas that will lead to new and different products from the existing products of its own or overlapped sister division. This division has less means to maneuver to launch a drastically new product: this division is more likely to be constrained by its capabilities in developing and launching a new product such that this new product may end up being similar to its own and/or the products of the overlapped sister division.

Even though divisions and firms have incentives not to increase inter-divisional product cannibalization by new product introductions, divisions may have no other options but to introduce a new product closer to the existing products of sister divisions due to the constraints imposed by the capabilities. The higher the overlap of divisional domain with a sister division, a focal division has less distinctive capabilities of its own but more similar capabilities to those of the sister division. This phenomenon will be more pronounced, as the overlapped portion of a focal division gets larger relative to the focal division's overall divisional domain. Thus, the more a focal division's domain is overlapped by another sister division relative to the focal division's overall divisional domain, the more chances that this focal division's new product will be launched closer to the existing products of the overlapped sister division.

Hypothesis 1b. The *higher* the degree of a focal division's inter-divisional overlap with a sister division of the same firm, proportional to the focal division's domain, the *shorter* the distance between the focal division's new product and the sister division's existing products.

In sum, we have put forward two rival hypotheses to test the product differentiation aspect of a division's new product launch vis-à-vis sister divisions. The concern for cannibalization and lack of distinctive identity will force a focal division to launch a product further away from those of sister divisions, whereas the constraints imposed by its capabilities may not give the focal division other options but to launch a new product closer to sister divisions.

4. METHODS

4.1 Sample Description

To test the hypotheses, we use data the U.S. automobile industry between 1979 and 1999. The U.S. automobile industry is characterized by large-scale production and/or sales of differentiated products. And many firms have multiple operating divisions to produce and/or sell vehicles to the U.S. customers. The existence of multiple differentiated products and distinct multiple divisions makes the U.S. automobile industry an ideal setting to test the hypotheses.

Since we explicitly test the role of divisions, we only included those car companies with multiple divisions. And we only focus on passenger cars in the traditional sense. So SUVs, vans, and light-duty trucks (e.g., pickup trucks) were excluded from the sample.

4.2 Data

The data were collected from *Ward's Automotive Year Book (AYB)* and *Automotive News Market Data Book (MDB)*. These publications are well-known and reliable yearly publications that have been used by various prior studies on the U.S. automobile industry: [22], [59]. And these publications have information on car sales, model product specifications, car prices, and market class of each car, among others.

Following [22] and [59], we use wheelbase, horsepower, length, width, and MPG (miles per gallon) in calculating product distances of any two car models. Out of all the different versions of the same car model, we focus on base models that are defined as the least expensive version of the model and usually imply a two-door sedan or a car with a hatchback.

Prices of each car model are base prices (i.e., list retail price of the base model) that include the manufacturer's suggested retail price and the destination charge, but do not include state and local taxes, or optional equipment. Base prices were adjusted using the *Consumer Price Index* – all prices are 1983 constant dollars.

The data also include information on sales – the number of units sold for each model – and the division that sold each car model in a given year. And the information on market class is also included. This information is critical in constructing domain overlap measures and car models that belong to the same market class are regarded as direct competitors.

The original data set covers years between 1979 and 1999 and consists of 3,379 observations. Out of these 3,379 observations, those observations of car models that have been offered by single-division firms were excluded, which reduced the number of observations to 2,323. And out of these 2,323 observations, we only used observations with *new* car models. Following [22] and [59], it is assumed that a car model is a new one if it meets one of the two conditions: (1) it bears a new name that didn't appear in previous years; or (2) its horsepower, width, length, and wheelbase has changed more than 10 percent in comparison with a model bearing the same name in the previous year. After this reduction, we have ended up with 163 observations that constitute the base data. The unit of observation for the base data is *model-year*.

Out of this base data, we paired divisions in the same firm and created a new data set to test the hypothesis about product distances vis-à-vis the products of sister divisions (i.e., inter-divisional new product distances). The unit of analysis is *inter-division dyad-model-year*. We could index an observation of this data set as $ijmt$, where ij is a division dyad between focal division i and sister division j of the same firm (ij); m is a *new* car model of focal division i ; and t refers to year. This data set has 297 observations.

4.3 Dependent Variable

Inter-divisional New Product distances (NEWDIST_{ijm})

To calculate the dependent variable, we went through a couple of steps: (1) determine each model's position on a one-dimensional product space; and (2) calculate distances between any two models, including distances between a new model and existing models. First, we calculated the scalar utility index of each car model. To measure the utility, the following equation adapted from [22] was estimated. To calculate the scalar quality index, 3,379 original observations were used.

$$\ln P_{mt} = \alpha + \beta' X_{mt} + \gamma \cdot s_{mt} + t_{mt} + \varepsilon_{mt} \quad (1)$$

$\ln P_{mt}$ is the log-transformed real price of car model m at year t ; X_{mt} is the vector of product attributes of car model m at

year t ; S_{mt} is the market share of car model m in terms of units sold at year t (i.e., units-sold of car model m divided by the total number of units sold in the market); and t_{mt} is a trend variable (calculated by subtracting 1977 from t). (Some issues in estimating the equation (1) will be discussed in the next section on statistical techniques.)

The observable utility of a car model is captured by $U_m = X_m \hat{\beta}$, where the vector includes wheelbase, length, width, horse power, and miles per gallon efficiency of the model. This measure of utility of each model U_m reflects a different magnitude of impact of each product attribute, which is represented by $\hat{\beta}$ in the equation. The distance between car models m and n in a given year is the difference of their respective utility.

$$D_{mn} = |U_m - U_n| \tag{2}$$

We need to calculate the distance between a car model in question and a division. A division usually manages multiple car models, so we should decide specifically how to measure the distance. Here, following [59], the *minimum* distance of all possible pair-wise distances between a car model in question and the models of a sister division was used as the distance between the model and the division.

Finally, inter-divisional distance of a *new* car model (i.e., distance between a *new* car model and a sister division of the same firm) was calculated as follows.

$$D_{ijm} = \min(D_{im,j1}, D_{im,j2}, \dots, D_{im,jp}), \text{ where } m \in i, p \in j; i, j \in f.$$

$$NEWDIST_{ijm} = \begin{cases} D_{ijm}, & \text{if } m \text{ is a new model} \\ \cdot, & \text{otherwise} \end{cases}$$

Here D_{ijm} represents inter-divisional distance of car model m of division i with respect to division j of the same firm f . Note that $D_{im,jp}$ is the pairwise distance between car model m of division i and car model p of division j . Any car model should have this inter-divisional distance with each division of the same firm. $NEWDIST_{ijm}$ is the variable of interest, which captures the product distance between a *new* model m and sister division j . When model m is not a new one, this variable would have no value.

4.4 Independent Variables

Inter-divisional domain overlap (OVERLAP_{ij}) : Inter-divisional overlap (i.e., the degree of divisional overlap between focal division i and sister division j of the same firm) was measured using [57]’s competition coefficient measure as follows.

$$OVERLAP_{ij} = \frac{\sum^n P_{in} \cdot \text{Min}(P_{in}, P_{jn})}{\sum^n P_{in}^2}, \forall P_{in} > 0.$$

where $P_{in} = \sum_{m \in n} (\text{UNITS SOLD})_{im} \cdot (\text{BASE PRICE})_{im}$,
 i = division index
 m = car model
 n = market class/segment.

Here $OVERLAP_{ij}$ represents the degree of divisional overlap that focal division i has with division j of the same firm and captures the level of competitive pressure from the divisional domain overlap with division j and at the same time this measure also captures the level of capabilities and resources that are similar to division j . It should be noted that $OVERLAP_{ij}$ is not symmetric (i.e., $OVERLAP_{ij} \neq OVERLAP_{ji}$): the same amount of overlap may have different implications for the two divisions. And $OVERLAP_{ij}$ takes the value between 0 and 1; the higher the value, the more competitive pressure focal division i receives from the overlap with division j and the higher the level of similarity to division j with respect to capabilities and resources.

4.5 Control Variables

No. of division products (DIVPRODS) : To capture the potential for economies of scope in producing and marketing a new car model, a variable for the total number of car models offered by focal division i was included. The higher the potential for economies of scope, it is expected that (1) divisions are more likely to introduce a new car model in the first place; and (2) in case of new car model introduction, divisions are more likely to locate their products closer to their own products.

No. of other divisions’ products (SISPRODS) : To capture the potential for economies of scope of a division with other divisions of the same firm in producing and marketing a new car model, this study includes the number of models offered by sister divisions of the same firm.

No. of rival products (RIVPRODS) : If there are many rival products from competing firms, this would increase the potential for competition, which may affect a division’s new product location choice.

Trend (TREND) : A trend variable was included to capture any systematic effects of trend. This variable was calculated by subtracting 1977 from the year in the observation.

Density (DENSITY) : This variable captures how dense or sparse among car models in the same division. This variable was calculated by taking average of all pair-wise distances in the same division.

4.6 Statistical Methods

4.6.1 Instrumental variable (IV) estimation : As mentioned in the previous section, the product distance of any two car models was measured by taking the absolute difference between their respective utility. And to create the utility index

for each car model, the following equation was used that was adapted from [22] and [59].

$$\ln P_{mt} = \alpha + \beta_1 wheelbase_{mt} + \beta_2 length_{mt} + \beta_3 width_{mt} + \beta_4 horsepower_{mt} + \beta_5 MPG_{mt} + \gamma_1 share_{mt} + \delta_1 trend_t + \varepsilon_{mt} \quad (3)$$

MPG stands for miles per gallon; and *share* represents market share of a model in terms of units sold. The dependent variable in the equation is log-transformed price. Since the price represents base price, options such as power windows are not included in the equation.

The variable $SHARE_{mt}$ in the equation poses a problem of endogeneity, which would make OLS estimates inconsistent. To address this endogeneity problem, instrumental variable (IV) estimation was conducted to obtain consistent estimates. According to [12], asymptotically we are always better off including more instruments, thus the instruments that had been used either by [22] or [59] were included.

4.6.2 Heckman's two-step estimation : To model a division's new product location choice and test the hypotheses, Heckman's two-step estimation (or Heckit estimator) was conducted. New car models that we observe are there in the first place because they have met certain requirements of the division and the firm. Thus, we could assume that these new models were selected by its offering division and firm out of potential distribution of models. This calls for a correction for a potential sample selection bias.

Following the steps laid out in [37], the following probit equation was estimated to obtain the inverse Mills ratio. This equation is a selection equation for regression equations. Number of products in the market, firm size, and fixed cost were included in the equation along with division size and number of products offered by the focal division. The inverse Mills ratio estimated from the above equation was included in the main equation with other variables.

$$NEWMODEL_{fimt} = \alpha_0 + \alpha_1 mktprods_t + \alpha_2 divprods_{fit} + \alpha_3 divsize_{fit} + \alpha_4 firmsize_{fit} + \alpha_5 fixcost_t + \nu_{fimt} \quad (4)$$

Finally, to model inter-divisional distance (*ij*) and test the hypotheses, the following equation was estimated. The unit of analysis for this equation is *inter-division dyad-model-year*. An observation is indexed as *ijmt*, where *ij* is a division dyad between focal division *i* and sister division *j* of the same firm (*ij*); *m* is a car model of focal division *i*; and *t* refers to year.

$$NEWDIST_{fijmt} = \beta_0 + \beta_1 divprods_{fit} + \beta_2 sisprods_{fit} + \beta_3 rivprods_{fit} + \beta_4 density_{fit} + \beta_5 trend_t + \beta_6 millsratio_{fimt} + \beta_7 overlap_{fij} + \varepsilon_{fijmt} \quad (5)$$

To obtain the estimates, car model-specific random effects GLS estimation was conducted. Since new models are included in multiple times, each in reference to a sister division in question, the observations with the same new model are not independent of each other. So it is necessary to let the residuals

of these observations correlate with each other, which is what car model-specific random-effects GLS estimation is supposed to address.

5. RESULTS

5.1 Instrumental Variable (IV) Estimation and Probit Estimation

The coefficients of each product attribute calculated from estimating the equation (3) were used in constructing the scalar utility index of each car model. The utility indexes of car models were, in turn, used in calculating new product distances.

The estimates from probit analysis were used in calculating the inverse Mills ratio for each *uncensored* observation. The total number of observed observations, i.e., uncensored observations is 163. These observations constitute the base data set for estimating the main equation. (The results of IV estimation and probit estimation are not reported here, which could be obtained upon request.)

5.2 Inter-divisional Domain Overlap and Inter-divisional New Product Distance

Out of these 163 observations, we have constructed 297 observations for testing the main equation. This increase is due to the dyad nature of the test and the the unit of analysis for the equations is *inter-division dyad(ij)-model(m)-year(t)*.

Table 1 reports descriptive statistics and correlation coefficients. The correlation coefficients are pairwise in nature. The dependent variable $NEWDIST_{ijm}$ has the mean value of 0.146. And the descriptive statistics show that the mean value of inter-divisional overlap of a division ($OVERLAP_{ij}$) is 0.345, which means that, on average, 34.5% of a division's domain is overlapped with that of a sister division. The dependent variable $NEWDIST_{ijm}$ has a negative and statistically significant correlation with inter-divisional overlap ($OVERLAP_{ij}$).

Table 2 presents the results of car model-specific random-effects GLS estimation of the main equation on inter-divisional new product location choice. Model 1 is a baseline model for this part of the study and contains control variables. The coefficients of trend variable (TREND) and SISPRODS are statistically significant.

Model 2 introduces the variable $OVERLAP_{ij}^p$ that captures the minimum distance between a new car model of focal division *i* and the car models of division *j* of the same firm. This model tests the hypotheses which posit that division *i* with a higher level of divisional domain overlap with another division *j* of the same firm is more likely to locate its new product (i.e., new car model) farther away from (Hypothesis 1a) or closer to (Hypothesis 1b) the products of division *j*. In other words, Hypothesis 1a predicts more inter-divisional product differentiation, whereas Hypothesis 1b predicts less inter-divisional product differentiation. The coefficient of $OVERLAP_{ij}^p$ is significant ($p < .01$), and the sign is positive, rendering support for Hypothesis 1b. The coefficient suggests that a higher level of inter-divisional overlap would make a

division locate its new model closer to a sister division, i.e., decreasing product differentiation from the models of a sister division in question. Specifically the sign and magnitude of the coefficient (-0.2379) indicate that one standard-deviation increase of inter-divisional domain overlap (which is 0.304) from its average level would result in 49.5% ($0.304 \times -0.2379 / 0.146$) decrease of the average new product distance vis-à-vis a sister division's existing products in question.

The estimates reported in Table 2 were obtained by car model-specific random-effects GLS estimation. To check whether the estimates would have been different if fixed-effects estimation had been used, Hausman specification test was conducted. The test results show that the random-effects estimates are not systematically different from the fixed-effects estimates. And it should be noted that no selection effect was found for any model specification in Table 2, suggesting that sample selection might not be a serious issue for the estimation.

Table 1. Descriptive Statistics and Correlation Coefficients

Variables	Mean	SD	1	2	3	4	5	6	7
1. Inter-divisional New Product Distance ($NEWDIST_{ijm}$)	0.15	0.21							
2. No. of Own Division's Products (DIVPRODS)	8.67	2.94	-0.19 *						
3. No. of Other Divisions' Products (SISPRODS)	22.00	10.88	-0.04	-0.11 *					
4. No. of Rival Divisions' Products (RIVPRODS)	133.35	18.28	0.17 *	-0.13 *	-0.53 *				
5. Density of Division (DENSITY)	-0.33	0.12	-0.14 *	-0.14 *	0.20 *	-0.21 *			
6. Trend (TREND)	11.04	5.75	0.29 *	-0.27 *	-0.10	0.56 *	-0.16 *		
7. Inverse Mills ratio (LAMBDA)	2.21	0.16	0.16 *	0.05	0.14 *	0.00	-0.28 *	0.46 *	
8. Degree of Inter-divisional Domain Overlap ($OVERLAP_{ij}$)	0.35	0.30	-0.37 *	0.20 *	0.10	-0.13 *	0.15 *	-0.10	-0.07

$N=297$, * $p < .05$

Table 2. Results of Car-model Specific Random Effects GLS Estimation

Independent Variables	Model 1	Model 2
DV: $NEWDIST_{ijm}$		
Intercept	0.0105 (0.212)	0.0792 (0.207)
No. of Own Division's Products (DIVPRODS)	-0.0122 (0.005) *	-0.0069 (0.005)
No. of Other Divisions' Products (SISPRODS)	-0.0010 (0.002)	-0.0007 (0.002)
No. of Rival Divisions' Products (RIVPRODS)	-0.0004 (0.001)	-0.0009 (0.001)
Density of Division (DENSITY)	-0.2004 (0.131)	-0.1041 (0.131)
Trend (TREND)	0.0094 (0.004) *	0.0102 (0.004) **
Inverse Mills ratio (LAMBDA)	0.0179 (0.106)	-0.0209 (0.103)
Degree of Inter-divisional Domain Overlap ($OVERLAP_{ij}$) H1a (+) vs. H1b (-)		-0.2379 (0.037) **
Wald χ^2	31.8 **	76.61 **
R²	0.11	0.20

$N=297$

+ $p < .1$; * $p < .05$; ** $p < .01$

6. CONCLUSIONS AND DISCUSSION

6.1 Results Summary and Implications

We hypothesized two rival hypotheses regarding the impact of inter-divisional domain overlap on a focal division's new product location choice and consequently the degree of product differentiation: one for increasing inter-divisional product differentiation and (Hypothesis 1a) the other for decreasing differentiation (Hypothesis 1b). The results support the latter hypothesis that the higher the level of a focal division's domain overlap with a sister division, proportional to its own divisional domain, the closer this focal division would locate its new car model to that sister division's existing models, thereby decreasing product differentiation vis-à-vis the sister division.

This finding is not consistent with some of recent studies that found cooperation among divisions of the same studio in distributing movies [29] and franchisors' efforts to assign outlets to franchisees in such a manner to reduce intra-organizational multimarket contacts [44]. One potential explanation for this inconsistency is that this study is primarily concerned with divisionalization along with product markets, whereas [44] is focused on franchisees (units) that are based on geographic regions and [29] is concerned with divisions that don't have unique divisional charters.

However, the finding is consistent with the arguments of distinctive divisional capabilities. Since divisions with a high level of divisional overlap should have common capabilities which would make them introduce products with similar features, it might not be surprising to find that the level of domain overlap should have a negative effect on new product distances vis-à-vis sister divisions. This finding provides an

empirical support for [61]'s contention that prior investment in division-specific capital can limit the negative impact of inter-divisional cannibalization.

The decreasing inter-divisional new product distance may suggest that divisions are already very broadly defined. That is, even though divisions started with their distinctive divisional domains in the first place, over time they have tended to lose their initial focus. This has increased the potential for inter-divisional product cannibalization that may need corporate headquarters' intervention: [33], [34]. Corporate headquarters may have no option but to take initiative in decreasing inter-divisional product cannibalization due to increasing similarities between divisions of the same firm. Without the active and intentional involvement of the headquarters in rearranging divisional domains to reduce domain overlaps, products between divisions whose divisional domains overlap with others are getting similar and hence the chances of product cannibalization will be increasing accordingly.

We believe that a key contribution of this study is the enrichment of the literature on product differentiation. Up to now the majority of research on product differentiation has been done from IO economics perspectives and most of the research has been theoretical in nature: [4], [24], [30], [43], [53], [55]. By incorporating the perspectives of sociology and strategic management, we have demonstrated that the way a firm splits its product market scope affects the degree of product differentiation within the firm. Distinctive capabilities from distinctive divisional domain or similar capabilities from overlapped divisional domain play a role in explaining a division's product location choice.

By demonstrating the role of divisional domain overlaps in product differentiation, this study also provides a piece of evidence to the hypothesis that strategy follows structure. Unlike the argument that structure follows strategy, the hypothesis that structure affects strategy has not drawn sufficient attention from scholars in the strategic management field. (Notable exceptions are [14] and [42]). Most of the relevant studies have not focused on the impact of structure on firm's strategic behavior, but they rather focused on (1) the direct effect of organizational structure on performance: [15], [38], [41], [58]; or (2) the implications of organizational structure on performance from the perspective of contingency theory: [39], [40].

Contrary to our expectation, the results show that sample selection bias may not pose a serious problem in the current sample. This result is surprising in that the range of the inverse Mills ratio clearly suggests the existence of truncation effects. Regression diagnostics suggest that this result is not due to multicollinearity between the inverse Mills ratio and other explanatory variables in the regression equation. This result might have something to do with the probit model specification in the first place, judging from the low explanatory power of the probit model specification in predicting new car model introductions. This warrants further investigation, which is beyond the scope of the current study.

We argue that the results may also have implications on such industries that don't produce physically differentiated products. For any organizations that rely on multiple divisions in providing differentiated products and services, the results

may have wide ramifications. This may also be true for those firms that produce IT software and hardware, and contents of various types.

A case in point is [29]'s finding of the cooperation among divisions of the same studio in distributing movies. Our results imply that this cooperation may be due to the lack of divisional charters among these divisions. The absence of divisional charters may have created the incentives to cooperate with one another since the divisions don't have any unique or overlapped output to compete with one another in the first place. Another case in point can be found in Sony's decline in recent years. When electronics products, such as computers and personal electronic products, were converging on the basis of information technology, Sony has experienced a deep downfall. Coupled with its culture of internal competition, our results imply that the converging IT technology has eroded the unique divisional charters of its computer, personal electronics, and music divisions. This convergence has ended up with launching similar or competing electronics products from these divisions without successfully competing with other firms such as Apple or Samsung.

We believe that the results may have made some contributions to the literature of strategic management in several important ways. First, the results may enrich the literature on product differentiation. Up to now the majority of research on product differentiation has been done from IO (industrial organization) economics perspectives: [24], [32]. By incorporating the perspectives of sociology and strategic management, we believe the results may have helped deepen our understandings of product differentiation. Second, the results may have provided some evidence regarding the impact of organizational structure on firm behavior, thereby providing a piece of evidence to the hypothesis that strategy follows structure. Unlike the argument that structure follows strategy, this hypothesis has not drawn sufficient attention from scholars in the strategic management field. Third, related to the above, our study has made contributions to the literature on competitive dynamics by exploring another source of competition: divisional domain and inter-divisional domain overlap.

6.2 Limitations and Suggestions for Future Research

The results provide several interesting future research topics. One such direction is about the distribution of divisional status among divisions in the firm and its impact on overall innovation activities of the firm. This would provide another way to look at innovation. If the status distribution is uniform, would this increase radical innovation or incremental innovation? If every division has roughly equal status relative to the others, we could expect that no single division could dominate the other divisions in the process of resource allocation for its own advantage. If resources are equally split, then we may not expect an architectural innovation from the firms with this kind of distribution. But we may expect a series of incremental innovations by each division to gain an edge over other divisions with equal status. Then how about a skewed distribution where one division holds very high status whereas others don't? The distribution of divisional statuses

would dictate resource allocation, which would affect overall firm innovations.

In sum, we have investigated the impact of inter-divisional domain overlap on a division's product differentiation vis-à-vis sister divisions. Using data on the U.S. automobile industry between 1979 and 1999, we tested the hypotheses. The results show that the higher the level of inter-divisional domain overlap, relative to the focal division's own domain, the higher the chances of locating a new product closer to the existing products of a sister division and consequently decreasing product differentiation vis-à-vis this sister division. We argue that this is due to a high level of similar capabilities between the two divisions and the division with less distinctive capabilities may have little choice but to launch a new product that is close to the products of the other division.

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