DETERMINANTS OF THE PROFITABILITY OF SHARED-CUSTOMER VERSUS SHARED-RESOURCE SCOPE ADVANTAGES

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Abstract (105 words)

Scope-based competitive advantages are among the central explanations of firms’ choice of scope, yet differences in the performance implications of different types of scope advantages have remained under-theorized. We develop economic models to compare the profitability of shared-resource versus shared-customer scope advantages, and find three key differences. Unlike the shared-resource case, the profitability of deploying a shared-customer scope advantage: (1) depends on whether customers in the market are intrinsically loyal or disloyal to companies across their products, (2) differs according to whether the advantage is cost-decreasing or increasing customer willingness-to-pay, and (3) can sometimes be negative due to provoking a highly aggressive response from rivals.
INTRODUCTION

'There are two ways that companies can extend what they're doing. One is they can take an inventory of their skills and competencies, and then they can say, "OK, with this set of skills and competencies, what else can we do?" And that's a very useful technique that all companies should use. But there's a second method, which takes a longer-term orientation. It is to say, rather than ask what are we good at and what else can we do with that skill, you ask, who are our customers? What do they need? And then you say we're going to give that to them regardless of whether we currently have the skills to do so, and we will learn those skills no matter how long it takes’

– Jeff Bezos, founder and chairman of Amazon.com, interview in Newsweek, January 4th, 2010

How do competitive advantages span across product markets? Extensive research has examined the links between a firm’s competitive advantage and the scope of its outputs, but most of this research relies exclusively on the familiar logic of shared-resource scope advantages. Under this shared-resource logic, when a firm gains competitive advantage in one market from a proprietary resource, and that resource has excess capacity that cannot be sold due to market failure, it will be profitable for the firm to expand into other markets where it can gain a similar advantage by redeploying the resource’s excess capacity (Montgomery & Wernerfelt, 1988; Teece, 1982).

Research in this tradition has explored the types of resources that can be profitably shared in this way (Chatterjee & Wernerfelt, 1991; Farjoun, 1994; Robins & Wiersema, 1995), as well as mechanisms that either enhance or limit the extent to which the shared resource may lead to additional performance (Gary, 2005; Levinthal & Wu, 2010; Tanriverdi & Venkatraman, 2005).

However, there is also a second, much less developed logic, originating with Lemelin (1982), which argues that a firm may gain an advantage by extending the scope of its activities in order to better serve or exploit its existing customers. Research has focused on identifying the sources of such shared-customer scope advantages, such as reduced information asymmetry (Nayyar, 1990, 1993), lock-in due to customers’ knowledge (Cottrell & Nault, 2004; Priem, 2007), or superior knowledge about customer needs (Chatain, 2011; Zander & Zander, 2005).

Research on these two types of scope advantages has largely overlooked the fact that they differ dramatically in terms of: (1) how they create superior value, (2) how expanding output across
markets affects the amount of superior economic value created, (3) how a firm manages the trade-off between competing for marginal customers who are on the cusp in deciding between rival firms versus exploiting its existing ‘safe’ customers who will not depart, (4) whether a firm is more motivated to compete for some marginal customers than others, and (5) whether a firm can selectively attract the specific marginal customers that it is most motivated to compete for. In the shared-resource advantage case, when a resource that creates superior value on one market is used in another market, it can create the same incremental value by winning a marginal sale from any marginal customer in that other market, in which case rival firms are equally motivated to compete for all marginal sales to marginal customers. Consequently, in the shared-resource case, firms make the trade-off between competing for marginal customers and exploiting safe customers in a way that is independent across product markets. Thus, in the case of shared-resource advantage, increasing sales across markets has an additive effect on the amount of superior economic value the firm creates, due to cumulative sharing of the resource across markets.\(^1\) In contrast, for the case of a shared-customer scope advantage, superior economic value is only created when the firm serves the same customers in different markets, in which case no superior economic value is created if the firm serves only one market. A firm with a shared-customer scope advantage is thus more interested in some marginal customers than others. In particular, it is much more motivated to sell a product to a customer who already buys a different product from it, and less motivated to sell products to a marginal customer who does not yet buy any products from it. So, in the shared-customer case, the trade-off that a firm makes in one market between competing for marginal customers and exploiting safe customers is inextricably linked to the corresponding trade-off that it makes in its other markets. In the shared-customer case, increasing sales across markets thus has a multiplicative, rather than additive, effect on the amount of superior economic value the firm creates. These

\(^1\) Here we assume resource fungibility and no opportunity cost (Levinthal & Wu, 2010). If fungibility were low and opportunity costs were positive, the additive effect would be reduced, but it would still be additive.
differences between these two types of scope advantages lead to big differences in how they affect profit. We use a series of economic models to develop a theory of the profitability of different types of scope advantages. We take the conventional shared-resource advantage as a baseline, in order to distinguish the distinctive factors that affect the profitability of shared-customer scope advantages.

Specifically, we study two key moderating factors: The first moderating factor is whether the scope advantage creates superior economic value (as in Brandenburger & Stuart, 1996) by reducing the firm’s costs below those of competitors (i.e., a cost-leadership advantage), or by raising buyers’ willingness to pay (WTP) for the firm’s product above that of competitors’ products (i.e., a quality advantage or differentiation advantage). In our model, this distinction is very important in the shared-customer advantage cases, where the advantaged firm is more motivated to compete for some marginal customers than others, because a shared-customer differentiation advantage allows the advantaged firm to selectively attract those customers that it is most motivated to compete for, whereas a shared-customer cost advantage does not allow for this kind of targeted expansion.

The second moderating factor is whether customers tend to be intrinsically loyal or disloyal to companies across their different products – i.e., whether the cross-market preference correlation is positive or negative. In our model, this factor turns out to be very important in the shared-customer advantage cases, where the advantaged firm is more motivated to compete for some marginal customers than others, because it shifts the relative concentration of marginal customers that the firms are most motivated to compete for versus marginal customers that they are less motivated to compete for. When there are more marginal customers that the firms are highly motivated to compete for, price competition can become much more aggressive.

Our models show that, although neither of these two moderating factors has any effect on the profitability of shared-resource scope advantages, they both have strong and somewhat complicated effects on the profitability of shared-customer scope advantages. Perhaps more importantly, our
models also show that, in the case of a shared-customer (but not shared-resource) scope advantage, the advantaged firm does not always benefit from strengthening its advantage, due to a potential increase in rivalry induced by this strengthening. In extreme cases, this increased rivalry may even ‘backfire’ and leave the advantaged firm with a lower profit than it would have had if it had not strengthened the advantage, which is similar to a result obtained by Costa, Cool, and Dierickx (2012) in a single market context. However, unlike in their model, the backfiring in our model arises as a result of how customers are distributed in preference space. So, our results suggest a more fine-grained view of how scope advantages may, or may not, boost profit.

Our study makes several contributions. First, we extend prior competitive advantage-based theories of firm scope by distinguishing multiple types of scope advantages and showing that they have starkly different performance implications. Second, we contribute to an emerging literature challenging the conventional assumption that increasing competitive advantage always improves performance (Costa, Cool, & Dierickx, 2012); our results add fuel to the argument that competitive advantage based explanations of superior performance should be tempered by an understanding of how the deployment of advantages affects product market competition. Third, by showing how the cross-market correlation of customer preferences influences the value of scope advantages, we add to a growing stream of studies about the impact that demand-side factors, such as customer heterogeneity, have on the optimality of firm strategies (e.g., Adner & Snow, 2010; Adner & Zemsky, 2006; Chatain & Zemsky, 2007; Makadok & Ross, 2013; Schmidt & Keil, 2013).

COMPETITIVE ADVANTAGE, TYPES OF SCOPE ADVANTAGE, AND PROFIT

Competitive advantage is defined as a firm’s ability to create more economic value than rivals, where ‘economic value’ is the difference between customers’ willingness to pay for a product or

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2 In the Costa, Cool, and Dierickx (2012) model, backfiring arises under a very narrow set of conditions, where both firms have diseconomies of scale, there is high substitutability between the rival firms’ products, and the degree of competitive advantage is very high. In our model, backfiring occurs under a much wider range of parameters.
service and the company’s cost to provide that product or service (Brandenburger & Stuart, 1996). Researchers often rely on this concept to explain inter-firm profit differences, under the assumption that firms with competitive advantage reap superior profit (Barney, 1991; Peteraf, 1993; Porter, 1985). The underlying logic is that even under competition, superior value creation guarantees value capture (MacDonald & Ryall, 2004). A prominent example of this logic is the resource-based view, which argues that control of proprietary resources confers competitive advantage, which in turn leads to superior profit, both in individual markets (e.g., Barney, 1991; Peteraf, 1993) and through sharing resources across markets (Robins & Wiersema, 1995; Wan et al., 2011; Wernerfelt & Montgomery, 1988). This logic, however, has been critiqued in two main ways: First, Coff (1997, 1999) contends that possession of an advantage is not a sufficient condition for attaining superior profitability due to other stakeholders, such as employees, possibly appropriating the resulting rents, in whole or in part. A second, more fundamental critique has recently been made by Costa, Cool, and Dierickx (2012), who argue that this logic ignores the indirect effect that competitive advantage can have on profit via product-market rivalry as a mediator. In particular, it presumes that intensity of rivalry is unaffected by the deployment of the advantage. Relaxing this assumption, they theorize that deployment of a competitive advantage may provoke an aggressive response from rivals that reduces the value captured by the firm, and may even backfire by leading to a reduction in profit for the advantaged firm, so that it would be better off by refraining from deploying its advantage. We draw upon this latter critique in examining the effects of scope advantages under competition.

Building on the above definition of competitive advantage, we define a scope advantage as a firm’s ability to increase its superiority over competitors in its creation of economic value by participating in a combination of product markets instead of a single market. Thus, a scope advantage is a special case of a competitive advantage – one that is maximized by serving the right combination of markets in the right way. A key premise of research on firm scope is that firms may
enjoy scope advantages as a result of sharing proprietary resources across product markets (Montgomery & Wernerfelt, 1988; Teece, 1982), and that such shared-resource scope advantages can drive the profit of multi-product firms (Palich, Cardinal, & Miller, 2000; Seth, 1990; Wan et al., 2011). The theoretical logic of this literature, whether applied to diversification across different industries (e.g., Markides & Williamson, 1994; Robins & Wiersema, 1995; Tanriverdi & Venkatraman, 2005) or to different segments within the same industry (e.g., de Figueiredo & Silverman, 2007; Li & Greenwood, 2004; Stern & Henderson, 2004), is that resource sharing leads to reduced cost due to the exploitation of economies of scope (Panzar & Willig, 1981; Teece, 1980) or that it leads to the ability to better differentiate the products of the firm (Hill, 1988; Hill & Hoskisson, 1987; Markides & Williamson, 1996; Prahalad & Hamel, 1990).

Although this familiar shared-resource logic has dominated most research on firm scope, some research, starting with Lemelin (1982), has focused on scope advantages arising from a firm serving the same customers, rather than from deploying the same resources, across product markets. Such shared-customer scope advantages have been described as ‘client-specific economies of scope’ (Chatain, 2011; Chatain & Zemsky, 2007) or ‘economies of scope in consumption’ (Cottrell & Nault, 2004). While it is widely understood that shared-resource scope advantages may create value through either decreasing the costs incurred by a firm or by increasing the willingness to pay of its customers, it may not be widely recognized that the same distinction can also be applied to shared-customer scope advantages. A shared-customer scope advantage may foster cost leadership by reducing customer acquisition cost (Nayyar, 1990, 1993) or customer retention cost (Chatain, 2011), or by exploiting superior customer-specific knowledge (Akcura & Srinivasan, 2005). Alternatively, a shared-customer scope advantage may generate superior customer willingness to pay due to cross-product compatibility (Cottrell & Nault, 2004), customer bundling (Stremersch & Tellis, 2002) or customers’ prior knowledge and familiarity with products (Cottrell & Nault, 2004;
Priem, 2007; Tanriverdi & Lee, 2008). This leads us to the 2x2 typology shown in Table 1, with four different scope advantages that, as we will see later, exhibit different effects on profit.

******** Insert Table 1 about here. *******

In the shared-resource column of Table 1, familiar old examples from the strategy literature abound. Southwest became the most profitable U.S. airline by developing a capability for low-cost hub-bypass operations on three original routes and then deploying it to hundreds of others. Retailers Aldi (in groceries) and Ikea (in furniture, home décor, and housewares) both profited by expanding their scope to include a wide range of products that benefit from their underlying core capability for using low-cost labor-saving store designs to sell good quality but low-cost private-label products to price-sensitive customers. Honda’s capability to produce highly reliable small engines is deployed to increase customers’ WTP across a range of products, including generators, pumps, lawnmowers, snow blowers, tillers, trimmers, motorboats, ATV’s, scooters, motorcycles, and cars.3 Examples in the shared-customer column of Table 1 are newer and less familiar. Companies may use superior knowledge of customer preferences to reduce the cost of cross-selling several products to the same customer. Apparel retailer Nordstrom’s Personal Book database, an on-line upgrade of its previous paper-based system, gives all of its salespeople detailed knowledge of each customer’s preferences and prior purchases, thereby enabling them, at little or no cost, to suggest complementary products that would match his/her existing wardrobe or gifts that would suit the tastes of his/her family members. Netflix’s proprietary CineMatch algorithm identifies a set of other customers who have similar tastes in movies and then suggests renting other movies that those customers liked, thereby enabling Netflix to keep circulating its large library of older, low-demand movies.4

Customer-specific scope advantages in the WTP row of Table 1 arise from two main sources –

3 Disney similarly boosts WTP across a wide range of products and services (e.g., entertainment, tourism, toys, clothing, and other merchandise) by leveraging the intellectual property from its animated characters.

4 Amazon.com’s proprietary recommendation engine uses similar cross-selling techniques on a broader product line.
either superior compatibility across products, or superior customization of product bundles. An example of superior compatibility is the seamless linkage between Apple’s media players (iPod, iPad, iPhone, Apple TV) and its iTunes Store, a linkage enforced (for the first six years in the case of music, and indefinitely in the case of video and books) by Apple’s use of its proprietary FairPlay digital rights management (DRM) system; FairPlay is the only DRM that Apple media players can decrypt, and the only source of FairPlay-encrypted media is Apple’s iTunes Store. Likewise, superior compatibility between products underlies Monsanto’s agricultural weed control system; its Roundup brand broad-spectrum herbicide kills every plant except for the company’s six species of Roundup Ready crop seeds, which are genetically engineered to tolerate Roundup herbicide. The resulting convenience, and reduction in labor and fuel consumption for tillage, boosts farmers’ WTP for both the herbicide and the seeds. An example of superior customization of product bundles is Dell Computer’s patented mass-customization system, which allows a customer to choose any combination of specific components (e.g., processor, memory, storage, connectivity, display, software) in his/her computer. Likewise, MyMuesli lets customers choose from over 566 quadrillion possible custom-mixed breakfast cereals by combining over eighty ingredients, and the Coca-Cola Freestyle fountain dispenser lets customers combine over twenty basic soft drinks with seven different flavors like vanilla, lime, or cherry, to create over 100 unique beverages.

THE MODEL AND ITS PARAMETERS

We examine how scope advantages translate into profit via a series of analytical models, which gives our argument precision, logical consistency, reproducibility, and a clear audit trail (Adner et al., 2009). As a benchmark for comparison, we first present our baseline model with symmetric

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5 Similarly, Airbus uses its digital fly-by-wire system to boost airlines’ WTP by maximizing cockpit compatibility across its broad line of 10 aircraft models, thereby giving airlines maximum flexibility when assigning pilots to flights.

6 Pro-Paks offers a similar benefit to surgeons by allowing them to customize sterile surgical procedure trays to include their preferred combination of particular types, sizes, and quantities of surgical tools and supplies for each type of surgery, as well as specifying the exact spatial arrangement of items on the tray. Similarly, Movie Tavern uses its in-cinema dining system to combine a customer’s choice of first-run movies with her choice of chef-prepared meals.
firms and no competitive advantage. We extend this baseline by developing four versions, each of which operationalizes one of the four types of scope advantages discussed in the previous section.

**Baseline Symmetric Model**

Our model uses a two-dimensional extension of the classic linear Hotelling model of horizontal differentiation (D'Aspremont, Gabszewicz, & Thisse, 1979; Hotelling, 1929). We assume there are two firms $k \in \{A, D\}$ that each produce one version of the same two products $i \in \{1, 2\}$. The firms compete for buyers who are distributed inside a unit-size ‘Hotelling square’\(^7\), with firm A located at the square’s lower-left corner ($X_1 = 0, X_2 = 0$) and firm D at its upper-right corner ($X_1 = 1, X_2 = 1$), as shown in Figure 1. In each product market, some buyers prefer firm A’s version of the product, while others prefer firm D’s version. These preferences are represented by the individual buyer’s location within the Hotelling square. A buyer’s position on the horizontal dimension ($X_1$) represents her preference for the type of product 1, and her position on the vertical dimension ($X_2$) represents her preference for the type of product 2. Buyers who prefer firm A’s version of product 1 are closer to the left edge of the square, while those who prefer firm D’s version of product 1 are closer to the right edge. Buyers who prefer firm A’s version of product 2 are closer to the bottom edge of the square, while those who prefer firm D’s version of product 2 are closer to the top edge. By using the Hotelling square, we assume that every buyer purchases both products. Although shared-resource scope advantages do not require buyers on both markets to be the same, we make this assumption because it allows us to directly compare shared-customer scope advantages with shared-resource scope advantages in an ‘apples-to-apples’ way.\(^8\)

\(^7\) Hotelling square models have been used in economics to assess the desirability of standardization for sellers of complementary products (Matutes & Regibeau, 1988; 1992) or the use of bundling and tying to deter entry (Nalebuff, 2004), as well as more recently in strategy research on platform bundling (Eisenmann, Parker, & Van Alstyne, 2011).

\(^8\) As a robustness check, to verify that Hotelling square results for shared-resource advantages generalize to cases where buyers differ across markets, we developed models of such advantages where each market has its own separate buyers. The results are qualitatively similar to the results given here, and are available from the authors upon request.
Each customer purchases exactly one indivisible unit of each product, either from the same firm or from different firms, which leaves her four options labeled as follows: buying both from firm A (option AA), buying both from firm D (option DD), buying product 1 from firm A and product 2 from firm D (option AD), or buying product 1 from firm D and product 2 from firm A (option DA). For each product, a buyer must pay the price charged for that product by the firm that he/she buys it from. In addition, a buyer must also pay (to a third party) a separate linear ‘transport cost’ for each product. For product 1, this transport cost is $\alpha$ per unit of horizontal distance from the buyer’s horizontal position and the horizontal position of the firm selling product 1 to the buyer. Likewise, for product 2, this transport cost is also $\alpha$ per unit of vertical distance from the buyer’s vertical position and the vertical position of the firm selling product 2 to the buyer. Each buyer chooses whichever option (AA, AD, DA, or DD) gives him/her the lowest total consumption cost, which is the sum of the prices and transport costs for both products, as follows: $t_{AA} = p_{1A} + p_{2A} + \alpha X_1 + \alpha X_2$; $t_{AD} = p_{1A} + p_{2D} + \alpha X_1 + \alpha (1 - X_2)$; $t_{DA} = p_{1D} + p_{2A} + \alpha (1 - X_1) + \alpha X_2$; and $t_{DD} = p_{1D} + p_{2D} + \alpha (1 - X_1) + \alpha (1 - X_2)$. Later, we will change the transport costs, and hence the total consumption costs, in order to boost WTP for versions of the model with differentiation advantages.

Research has shown that competitive advantages may be sensitive to the characteristics of product markets (Adner & Zemsky, 2006; Schmidt & Keil, 2013) and to the structure of preferences of customers therein, which may affect the intensity of rivalry between firms (Makadok, 2010; Makadok & Ross, 2013). Cross-market preference correlation is perhaps the single most important feature of demand when several markets are linked by sharing the same customers. For example, correlation may be high when customers have an intrinsic preference for purchasing products from a single supplier. This may be the case when one-stop shopping can significantly reduce search costs, or when there are no standardized interfaces for combining products from different firms, or

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9 These transport costs can be interpreted as either a cost of tailoring products to adjust their characteristics to the buyer’s ideal preference, or as a disutility from consuming products that do not exactly match his/her ideal preference.
when customers have little knowledge about how to combine products, so that they must rely on sellers to assemble bundles (Spiller & Zelner, 1997). The correlation may also be high in industries where all competitors offer customer-loyalty incentives (e.g., the nearly ubiquitous airline frequent-flyer program), thereby artificially inducing a preference for one-stop shopping. On the other hand, cross-market preference correlation would be low when customers are knowledgeable about combining different firms’ products, or when well-established interfaces and standards help them to do so (Matutes & Regibeau, 1988; 1992). It could even be negative in factor markets where businesses are more vulnerable to ‘hold-up’ problems from their suppliers, in which case those businesses might prefer to reduce suppliers’ bargaining power by sourcing different inputs from different suppliers (Williamson, 1979). Likewise, there may be some consumer markets, perhaps in entertainment or fashion, where customers have an intrinsic preference for variety and change, which would also imply a negative correlation (Simonson & Winer, 1992).

So, our model includes a parameter for cross-market preference correlation, to capture the extent to which customers tend to prefer buying several products from the same firm or from different firms. Mathematically, we use the method of Morgenstern (1956) to generate the following bivariate family of joint probability density functions with uniform marginal distributions:

\[ f(X_1, X_2; \lambda) = 1 + 4\lambda(0.5 - X_1)(0.5 - X_2), \]

where \( \lambda \in [-1,1] \) is the cross-market preference correlation multiplied by 3, and \((X_1, X_2)\) must lie within the Hotelling square. At the upper extreme of \( \lambda = 1 \), buyers are very loyal to firms across products, or strongly prefer one-stop shopping, or prefer to avoid combining products from different firms, either because they lack knowledge about how to do so or because a lack of established standardized interfaces makes it difficult to do so. In that case, as shown on the right side of Figure 2, buyers are disproportionately concentrated in the main diagonal quadrants between firm A’s corner of the square and firm D’s corner. Conversely, at
the lower extreme of \( \lambda = -1 \), buyers are very disloyal to firms across markets, or are averse to one-stop shopping, or have a preference for combining products from different firms, due to being disproportionately concentrated in the off-diagonal quadrants between the two corners of the square that do not have firms, as shown on the left side of Figure 2. In the intermediate case of \( \lambda = 0 \), preferences for the two products are independent and buyers are uniformly distributed in the square.

The joint probability density function above is integrated over each of the regions of the Hotelling square where buyers choose each of the four options, i.e., AA, AD, DA, and DD, to calculate the corresponding total quantities demanded, which we denote, respectively, as \( q_{AA}, q_{AD}, q_{DA}, q_{DD} \).

Our baseline assumption (to be altered later, when we introduce scope advantages) is that both firms have constant marginal costs of \( \gamma \) per unit of either product sold, and no fixed costs. Later, we will change the marginal cost for versions of the model with cost advantages. We also assume that firms compete on price and that they cannot price discriminate. We further rule out any form of collusion between the two firms, including, but not limited to, any quid pro quo arrangements where each firm monopolizes one of the two markets. The solution to the model is thus the Nash equilibrium where each firm \( i \in \{A, D\} \) chooses its own prices for the two products, denoted as \( p_{1i}, p_{2i} \), to maximize its own profit function under the assumption that its rival does the same.

Those profit functions are given by \( \pi_A = (p_{1A} - \gamma)(q_{AA} + q_{AD}) + (p_{2A} - \gamma)(q_{AA} + q_{DA}) \) and \( \pi_D = (p_{1D} - \gamma)(q_{DA} + q_{DD}) + (p_{2D} - \gamma)(q_{AD} + q_{DD}) \) for firms A and D, respectively.

As one might expect from the symmetric assumptions of this baseline model, the solution derived in the Appendix is also symmetric. As shown in Figure 1, both markets are split evenly, with equilibrium prices, outputs, and profits of \( p_{1A}^* = p_{2A}^* = p_{1D}^* = p_{2D}^* = \alpha + \gamma, \quad q_{AA}^* = q_{AD}^* = \frac{q_{DA}^* = q_{DD}^* = \frac{1}{4}}, \) and \( \pi_A^* = \pi_D^* = \alpha \), where the asterisk denotes Nash equilibrium.

**Modeling Scope Advantages**

In each of the four scope-advantage versions of the model, without loss of generality, firm A is
the advantaged firm, and firm D is the disadvantaged firm. Relative to the baseline symmetric model, firm A gains an advantage of magnitude \( \delta \geq 0 \), either via reducing its marginal cost in the two cost-leadership advantage models, or via increasing its customers’ WTP by subsidizing their transport costs to A in the two differentiation advantage models. The difference between shared-resource and shared-customer advantages lies in what percentage of this advantage of size \( \delta \) gets applied to each of the three sets of customers served by firm A – i.e., those who choose options AA, AD, and DA. For shared-resource advantages, the advantage is applied separately to each product market, where it is spread equally across all customers purchasing that product from firm A. For shared-customer advantages, the advantage is applied only for those customers who purchase both products from firm A. Table 2 shows, for each of the four scope-advantage versions of the model, how the advantage \( \delta \) changes buyers’ total-consumption cost functions and firms’ profit functions.\(^{10}\)

***** Insert Table 2 about here. *****

THE PROFITABILITY OF DIFFERENT TYPES OF SCOPE ADVANTAGES

Differences in margin and output trade-offs across types of scope advantage

Under all four scope advantages, firm A gains customers from firm D as the magnitude of its advantage \( \delta \) increases. As this happens, both firms face a trade-off in deciding how aggressively to compete for the marginal customers who are indifferent, or nearly indifferent, between the two firms. Because a firm cannot price-discriminate between customers, the more aggressively it

\(^{10}\) Ideally, in order to maintain comparability across models, we would like to parameterize the models in a way that guarantees that, for any given value of \( \delta \), the advantage creates the same total amount of economic value (i.e., totaled across the entire market for both products) in all four versions of the model. However, this is not possible. If we maintain comparability across models in the total amount of economic value created when \( \delta \) is relatively small and the market shares of both firms are close to equal, then the comparability between the shared-resource and shared-customer cases breaks down when \( \delta \) gets large and firm A dominates the vast majority of the market. Conversely, if we maintain the comparability between the shared-resource and shared-customer cases for large values of \( \delta \), then it breaks down for small values. We have opted to parameterize the models so that comparability is maintained for small values of \( \delta \), since that scenario is probably more interesting anyway. So, in interpreting the model, we avoid drawing conclusions based on directly comparing between shared-resource and shared-customer versions of the model in their specific levels of output, margins, and profits generated at a given value of \( \delta \). Nevertheless, despite this limitation, we are still able to make many interpretations and draw many conclusions from other types of comparisons between the four models.
reduces its price to compete for marginal customers, the less effectively it can exploit its ‘safe’ customers who will not depart. Our scope advantage scenarios differ in terms of how the firms handle this trade-off. Specifically, the scenarios differ in: (1) which particular marginal customers firm A would most like to take from firm D, and (2) whether firm A has the ability to selectively attract those specific marginal customers. To illustrate this point, consider how firm A would ideally like to move the four borders between the four regions in Figure 1 as the magnitude of its advantage $\delta$ increases. Under the two shared-resource scope advantage scenarios, economic value would then be added in proportion to the number of customers who buy product 1 from firm A, regardless of which firm they buy product 2 from, and would also be added in proportion to the number of customers who buy product 2 from firm A, regardless of which firm they buy product 1 from. So, firm A would then have the same incentive to push upward on the right-side horizontal border between regions AA and AD as it does to push upward on the left-side horizontal border between regions DA and DD, and would like these two borders to move upward together at the same rate as $\delta$ increases – and analogously for the two vertical borders as well (the AD/DD border and the AA/DA border). This outcome also suits the buyers’ interests, since each buyer’s optimal decision about where to buy each market depends solely on the price of that product and is therefore independent of his/her choice about where to buy the other product. So, when $\delta$ increases under either of the shared-resource scenarios, the borders shift together, as shown in Figure 3b.

******* Insert Figure 3 about here. ******

However, firm A’s incentives are different under the shared-customer scope advantage scenarios. If $\delta$ were to increase in those scenarios, then all of the economic value would get added in the AA region, with none added to the AD or DA regions. This would give firm A an incentive to expand only the AA region, without any incentive to expand the AD or DA regions. Whether firm A could accomplish this selective expansion of only the AA region would depend upon whether the shared-
customer advantage were cost-based (lowering A’s cost of serving buyers in the AA region) or differentiation-based (raising the WTP of buyers in the AA region). If it were differentiation-based, firm A could accomplish this goal because buyers all around the periphery of the AA region would have an incentive to choose AA in order to gain the resulting WTP boost (i.e., transportation-cost subsidy), in which case the borders would shift separately, as shown in Figure 3a, with the two horizontal borders separating, the two vertical borders separating, and the AA region alone selectively expanding in both dimensions. From a buyer’s perspective, the WTP boost (i.e., transportation-cost subsidy) from choosing AA creates a linkage between the purchase decisions in the two markets, so that those two decisions are no longer independent, and this linkage separates the AA/AD and DA/DD horizontal borders, as well as separating the AD/DD and AA/DA vertical borders, as shown in the Figure 3a. In other words, under the WTP version of the shared-customer scope advantage, buyers cooperate with firm A’s desire to selectively expand the AA region by self-selecting into that region. On the other hand, if the customer-specific advantage were cost-based, then buyers would have no such incentive to cooperate with firm A’s desire to selectively expand the AA region, and since price discrimination was assumed to be impossible, firm A would have no lever that it could use to induce them to do so. Buyers would then behave as they do in the shared-resource scenarios, making each product’s purchase decision independently, on the basis of that product’s price alone, so that the borders would shift together, as shown in Figure 3b, even though firm A would prefer them to shift separately, as shown in Figure 3a.

Equilibrium solution for shared-resource advantage cases

In the shared-resource advantage cases, we derive a closed-form analytical solution, as described in the Appendix. This solution is illustrated graphically in Figure 4, which shows firm A’s output (for one product), normalized margin, and normalized profit as a function of the normalized magnitude of the advantage (all normalizations are scaled by dividing by the transport-cost
parameter $\alpha$). Here, margin is just the difference between the per-unit price that the firm charges and the per-unit marginal cost that it pays – a cost that differs between firms in the cost-advantage case. The equilibrium solution yields identical outputs, margins, and profits for both the cost advantage and differentiation advantage versions of the shared-resource model. The cross-market preference correlation parameter $\lambda$ does not affect any of these equilibrium outcomes. As one might expect, and as shown in Figure 4, equilibrium output and margin are both monotonically increasing functions of the magnitude of the advantage. So profit, which is just the product of output and margin, is also an increasing function of the magnitude of the advantage.

****** Insert Figure 4 about here. ******

**Equilibrium solution for shared-customer cases**

The shared-customer cases are much less tractable than in the shared-resource cases, so simple closed-form analytical solutions could not be found. So, we constructed the approximate solutions which are shown in Figures 5 (for cost advantage) and 7 (for differentiation advantage) by using numerical methods explained in the Appendix, and calculated derivatives of these approximate solutions for the purpose of doing comparative-statics analysis.\textsuperscript{11}

Two stark differences are immediately visible when comparing the shared-resource results from Figure 4 with the shared-customer results in Figures 5 and 6: First, the cross-market preference correlation parameter $\lambda$ has a strong and complicated effect on equilibrium outcomes in the shared-customer case, especially on equilibrium margin\textsuperscript{12} and profit, whereas it had no effect on any

\textsuperscript{11} In the shared-customer differentiation advantage case shown in Figure 6, the solutions have a visible discontinuity in the approximate vicinity of $\delta = 1.5$ because this is where $\delta$ has grown to the point where the AA region is large enough to squeeze the AD and DA regions out of existence. As $\delta$ increases, slightly before the AD and DA regions have collapsed completely, there is a point where both firms prefer to switch to a higher-margin equilibrium in which the AD and DA regions do not exist. The fact that this point is reached slightly before the AD and DA regions have completely collapsed is what causes the discontinuity in the equilibrium solutions. Interestingly, the disappearance of the AD and DA regions at high values of $\delta$ enables the firms to reduce their rivalry with each other, thereby boosting their margins and dramatically decreasing the aggressiveness of firm D’s response to any further increases in $\delta$.

\textsuperscript{12} Again, margin here is just the difference between the per-unit price that the firm charges and the per-unit marginal cost that it pays – a cost that differs between firms in the cost-advantage case. Also, in the shared-customer cost-
outcomes in the shared-resource case. Second, there are big differences between the cost-advantage and differentiation-advantage results (Figures 5 and 6) in the shared-customer case, but no such differences between the shared-resource cases. Hence, we propose:

**Proposition 1:** Unlike a shared-resource scope advantage, the profitability of a shared-customer scope advantage is sensitive to variation in cross-market preference correlation.

**Proposition 2:** Unlike a shared-resource scope advantage, the profitability of a shared-customer scope advantage is sensitive to whether the advantage is cost-based or differentiation-based.

****** Insert Figures 5, 6, 7, and 8 about here. ******

A third difference is that a firm with a shared-customer advantage, unlike those with shared-resource scope advantages, does not always have an incentive to strengthen its advantage. For all four types of scope advantage, a marginal increase in $\delta$ leads to an increase in output (see Figures 5a-A and 6a-A). In so expanding its output, the advantaged firm sets its prices to trade off the margin earned from attracting new customers against the margin earned from existing customers who would continue to buy even in the absence of increased advantage. The resulting margins are typically decreasing in $\delta$, as shown in Figures 5b-A and 6b-A. Although profit typically goes up as $\delta$ increases, there is a range of parameters for which increasing $\delta$ decreases profit, as seen in Figures 7a and 8a. This happens when, as in the model of Costa et al. (2012), increases in $\delta$ provoke such a highly aggressive response by the disadvantaged firm that the resulting increased rivalry overwhelms the advantaged firm’s increased superiority in value creation. Comparing Figure 7b with Figure 7a, and Figure 8b with Figure 8a, shows that the region of parameter space where the disadvantaged rival’s response to increased $\delta$ is most aggressive (i.e., where the derivative of its equilibrium margin with respect to $\delta$ is most negative) roughly corresponds to the region where

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advantage case, firm A actually has two margins – its margin for output sold to customers in the AA region, and a lower margin for output sold to customers in the AD and DA regions. In this case, the margin shown in Figure 5b-A is actually the weighted average of these two margins, weighted by the quantities of output sold in the respective regions.
increased $\delta$ reduces firm A’s profit. However, the motivation for this aggressive response in our models is very different than in the model of Costa et al. (2012). It occurs here because firm A is more motivated to compete aggressively for those customers who buy one product from each firm, since it can create more economic value by inducing these customers to switch their purchases of just a single product. For strongly negative levels of cross-market preference correlation, there is a higher concentration of such fought-over customers, as shown in Figures 7c and 8c. For the case of a shared-customer differentiation advantage, Figure 8c shows the region of parameter space with the highest percentage (>40%) of total equilibrium demand from customers who buy one product from each firm, which corresponds roughly to the region where marginally increasing the advantage backfires (in Figure 8a). For the case of a shared-customer cost advantage, Figure 7c shows the region of parameter space where the equilibrium density of customers on the AA/DA border (or the AA/AD border) increases most rapidly when the magnitude of the advantage increases, and this region corresponds roughly to the region where marginally increasing the advantage backfires (in Figure 7a). Thus, based on the regions illustrated in Figures 7 and 8, we propose:

**Proposition 3:** The profitability of incrementally strengthening a cost-based shared-customer scope advantage is positive when the magnitude of the advantage is low, or when the magnitude of the advantage is high and cross-market preference correlation is strongly negative. Between these two extremes, the profitability of incrementally strengthening a cost-based shared-customer scope advantage may be negative due to highly aggressive response from rivals.

**Proposition 4:** The profitability of incrementally strengthening a differentiation-based shared-customer scope advantage is positive when the magnitude of the advantage is high or when the cross-market preference correlation is high. Otherwise, when the magnitude of the advantage and the cross-market preference correlation are both low, the profitability of incrementally strengthening a differentiation-based shared-customer scope advantage may be negative due to
highly aggressive response from rivals.

When there is negative marginal profitability of improving a customer-specific scope advantage, these negative effects can sometimes accumulate to the point where it becomes unprofitable for the firm to deploy its advantage at all (i.e., where the firm’s profit when deploying the advantage is actually lower than it would have been if the firm had no advantage at all). The regions of parameter space where this occurs are illustrated in Figure 9. Based on these regions, we propose:

**Proposition 5:** The total profitability of deploying a shared-customer cost advantage is negative when its magnitude is high and cross-market preference correlation is strongly negative.

**Proposition 6:** The total profitability of deploying a shared-customer differentiation advantage is negative when its magnitude is high and the cross-market preference correlation is low.

****** Insert Figures 9 and 10 about here. *****

Figure 10 shows a direct comparison of the profit levels of the two types of shared-customer scope advantages. When the advantage magnitude parameter $\delta$ is low, the profitability of a shared-customer cost advantage exceeds that of a comparable-magnitude shared-customer differentiation advantage. Conversely, when $\delta$ is high, the profitability of a shared-customer differentiation advantage exceeds that of a comparable-magnitude shared-customer cost advantage. Thus:

**Proposition 7:** The profitability of a cost-based shared-customer scope advantage is higher than that of a similar-strength differentiation-based shared-customer scope advantage when the strength of the advantage is small, but lower than that of a similar-strength differentiation-based shared-customer scope advantage when the strength of the advantage is large.

**DISCUSSION**

Our results have implications for theories of firm scope, theories of competitive advantage, and demand-based theories of strategy, which we discuss in this section. We also acknowledge limitations of this study and suggest opportunities for future resarch implied by our findings.
Implications for theories of firm scope

Scope-based competitive advantages continue to be among the most important explanations of firm scope and its performance implications (e.g., Chatterjee & Wernerfelt, 1991; Markides & Williamson, 1994; 1996; Montgomery & Wernerfelt, 1988; Palich, Cardinal, & Miller, 2000; Wan et al., 2011). Yet despite their prevalence as an explanation, the concept of scope advantages has been surprisingly under-theorized. Following Teece (1980) and Panzar and Willig (1981), resource-based theory (Barney, 1991; Markides & Williamson, 1994; 1996) has narrowly conceived of scope advantages as arising from a firm’s unique resources that are in excess supply and subject to market failure. Only recently has this view been complemented by a second perspective that sees scope advantages as arising from exploiting existing customers (Chatain, 2011; Cottrell & Nault, 2004; Priem, 2007; Ye, Priem, & Alshwer, 2011; Zander & Zander, 2005). Our systematic comparison of different scope advantages under different customer preference structures begins to connect these two viewpoints, thereby adding theoretical detail to the conceptualization of scope advantages and to understanding the effects of a firm’s scope decisions, such as diversification, product-line extension, or other market entry or exit. Our models suggest that the profitability of broadening or narrowing a firm’s scope is a function of both its type of scope advantage and the characteristics of market demand. Since different firms may have different types of scope advantage, these scope decisions depend on whether the firm is able to match its advantage with market characteristics and customer preferences, and our results suggest that this may be a more complex problem for managers than previously thought. Our models suggest that in some cases deploying a scope advantage leads to a negative expected performance effect, in which case the firm is better off by refraining from deploying its advantage.13 Also, the conduct of a firm on a market it enters may depend on the degree of rivalry induced by its decision to enter and deploy its scope advantage.

13 Indeed, the class of scope advantages that hurt performance may be even bigger than suggested by our analysis, since our model ignores the cost of building or acquiring the advantage.
which in turn may be a function of the cross-market structure of buyer preferences.

Our study also complements empirical work on the relationship between scope advantages and performance. A small number of empirical studies have investigated both shared-resource and shared-customer scope advantages in a single study (Cottrell & Nault, 2004; Nayyar, 1993; Tanriverdi & Lee, 2008). Although these studies have been limited in their theoretical grounding and by the choice of idiosyncratic industries to conduct their empirical work, their results are in line with our argument that shared-resource and shared-customer scope advantages differ substantially in their performance implications (Cottrell & Nault, 2004; Nayyar, 1993; Tanriverdi & Lee, 2008). Our study therefore provides a stronger theoretical rationale for these prior empirical studies.

**Implications for theories of competitive advantage**

Several authors have described factors that limit the extent to which competitive advantages translate into superior performance due to possible rent dissipation to others, such as suppliers of inputs like employees (Coff, 1997, 1999), or competing firms which imitate the resources underlying competitive advantage (Grahovac & Miller, 2009; Pacheco-de-Almeida & Zemsky, 2007). These upstream explanations for rent dissipation have recently been complemented by a downstream explanation by Costa et al. (2012), who argue in a single-market context that competition and rivalry induced by deploying a competitive advantage may limit the extent to which the advantage generates superior profit, and that in the extreme case, deploying the advantage may lead to decreased profit. In this case, rents are dissipated to customers via lower prices.

We extend this ‘backfiring’ insight from Costa et al. (2012) to scope advantages and especially to shared-customer scope advantages. However, we also find that the mechanism that causes this aggressive pricing is different in our model. In the numerical example provided by Costa et al. (2012), extreme rivalry was induced by a combination of diseconomies of scale and high inter-firm substitutability. But in our models of shared-customer scope advantage, the cross-market preference
structure induces extreme rivalry in situations where firms compete for a large concentration of customers who split their purchases of different products between those firms.

**Implications for demand-based theories of strategic management**

A growing stream of research now explores the impact of demand-side factors, and especially the structure of customer preferences, on strategic choice and performance outcomes (Priem & Butler, 2001; Priem, Li, & Carr, 2012). Researchers have examined the role of demand in topics as diverse as technology development (Adner, 2002; Adner & Levinthal, 2001), firm positioning (Makadok & Ross, 2013), resource repositioning (Adner & Snow, 2010), sustainability of competitive advantage (Adner & Zemsky, 2006), and knowledge embedded in customer relationships (Chatain, 2011). Our results add to these studies by providing a more fine-grained view of how customer preferences influence strategic choices and performance outcomes, as well as by demonstrating when and how firms may leverage their existing customer relationships to profitably enter new product markets.

Our study not only shows that customer preferences affect the extent to which a firm may benefit from deploying a scope advantage, and in turn how valuable that advantage is to the firm (Priem & Butler, 2001; Schmidt & Keil, 2013), but it also expands the set of mechanisms by which those preferences affect the profitability of the advantage – namely, by inducing product-market rivalry. Our analyses suggest that customer preferences may have not only a direct effect on the profitability of a competitive advantage (and thereby the value of the underlying resource, as in Schmidt & Keil, 2013), but also an indirect effect through inducing product market rivalry.

We also shed new light on the question of when and how firms can exploit existing customer relationships when extending firm scope and entering new markets (Chatain, 2011; Lemelin, 1982). Specifically, we show that the mere existence of a scope advantage is not a sufficient condition for reaping additional profits when entering new markets that share the same customers. We find that the benefits of such a decision need to be weighed against the increased rivalry, which is a function
of the structure of customer preferences across markets. Interestingly, it is not the negative attitude of customers against buying several products from the same firm per se, but the increased rivalry it induces, that limits the extent to which a firm may benefit from a scope advantage.

**Limitations, extensions, and opportunities for future research**

An obvious extension of this research would be to conduct empirical tests of the ideas explored here. For instance, our study points to important new factors that should be taken into consideration when testing the relationship between scope advantages and performance. Our models suggest that if a firm enters a new market, its performance is subject to the type and magnitude of any scope advantage it has, the structure of cross-market preferences, and any increased rivalry its entry may induce. For future empirical work, this suggests that more fine-grained empirical tests are needed that differentiate between types of scope advantages, especially different types of shared-customer scope advantages. Our results further suggest that it is important to control for the structure of cross-market preferences and for the degree of rivalry before and after a firm enters a market.

In addition, other opportunities for future research can be identified by acknowledging and examining some of the limitations of the present study. For example, our analysis presumed that customer preferences are exogenous and stable. However, we might expect preferences to change over longer periods of time, and in particular over the life-cycle of an industry. Cross-market preference correlation may initially increase when more and more firms enter an industry during its early growth stage, thereby reducing the bargaining power of individual suppliers. Later in the life cycle, it may decrease when customers become increasingly familiar about its products and more knowledgeable about how to combine them, and when firms in the industry develop more standardized interfaces for combining products. In light of our results, this suggests that different firms with different types of scope advantages will enter an industry at different stages in its lifecycle. Our theory may thus help explain early- versus late-mover advantages and patterns of
entry into industries (e.g., see Franco et al., 2009). Customer preferences may also be endogenous and, for example, driven by the decisions of firms that seek to exploit their scope advantages. The existence of an increasing number of firms that are present in the same two industries leads to these two industries becoming more related over time (Li & Greenwood, 2004). Therefore, if a firm with a shared-customer scope advantage enters an industry in order to exploit its advantage and others follow suit, the two markets may eventually converge (Han, Chung, & Sohn, 2009). A key driver of inter-industry convergence may thus be the pursuit of a firm-level competitive advantage in the form of a demand-side scope advantage, and subsequent attempts at imitation by competitors. So, our findings may also provide a basis for explaining how industries develop, based on an interaction between firm-level scope advantages and industry-level variables such as industry boundaries. Further research is needed to discern the factors that contribute to changes in customer preference structures and the conditions under which firms can take advantage of them.

Our model is also restricted in that we take total demand as fixed. However, demand expands as markets grow and mature. As our model does not take into account the possibility that increases in market share may have additional benefits in growing markets due to an increase in total market demand over time, it may underestimate the performance effect of some types of scope advantage. In particular, it may underestimate some of the potential long run benefits of gaining market share in a growing market through aggressive pricing, which we observe for shared-customer scope advantage. Such behavior may suppress performance in the short run, but it may still be beneficial for an advantaged firm to pursue its scope advantage no matter the degree of rivalry induced if it expects to earn higher profits in the long run. Future research therefore should explore dynamic models that can take market growth into consideration. Other dynamic effects ignored in our model include entry and exit, which could significantly alter our model’s results if treated as endogenous.

Some aspects of our model were parameterized very restrictively, and the results could change if
these restrictions were relaxed. For example, we assumed a very high degree of symmetry between the two products in our model. The results might change if the two markets were allowed to differ in their sizes, production costs, transport costs, or other aspects. Likewise, our model allowed variation in only one parameter of the customer preference distribution – namely, its correlation across markets. Additional results, or boundary conditions on the current results, might be obtained by allowing variation in other parameters of the customer preference distribution, such as its mean, variance, or skewness, or by allowing it to be asymmetric across products.

Our model does not consider opportunity costs, fungibility, or slack, which are all factors that have been argued to influence the profitability of scope advantages (Gary, 2005; Levinthal & Wu, 2010; Tanriverdi & Venkatraman, 2005). One could easily imagine that opportunity costs and low fungibility are more pronounced for shared-resource advantages, which may explain any empirical findings where shared-customer advantages outperform shared-resource advantages, since shared-customer advantages by definition imply high fungibility. More research is needed to examine the differential effect on each of these factors on the different types of advantages we have identified.

Yet another limitation of our model is that we considered the distinction between shared-resource and shared-customer scope advantages to be a black-and-white dichotomy, when some real-world scope advantages may appear as blends of the two, bearing characteristics of both shared-resource and shared-customer types. Indeed, we acknowledge that some of our examples of shared-customer scope advantages (e.g., automated cross-selling by Netflix and Amazon.com) could be interpreted as combining both types. An extension of our model could examine such intermediate cases.

A final limitation of our model is that we have only considered price competition in our model. Our results may be sensitive to the type of competition, since quantity competition is usually associated with less rivalry than price competition. While this limits the applicability of our findings to certain types of markets, our choice of modeling price competition serves to demonstrate an
effect in circumstances when rivalry is expected to be strong. The examination of how scope advantages translate into performance under quantity competition is left for future research.

**APPENDIX**

In each of the four models, each buyer in the Hotelling square chooses whichever one of the four purchase options \( k \in \{AA, AD, DA, DD\} \) gives her the lowest total consumption cost function \( t_k \) among the four listed in that model’s cell in Table 2. By taking the differences between each pair of cost functions in that model’s cell in Table 2, setting those differences equal to zero, and solving the resulting equation for either \( X_1 \) or \( X_2 \), we find the locus of buyers who are indifferent between the corresponding pair of purchase options, which forms the border between the corresponding regions in Figure 3. Calculated in this way, these borders are shown in that model’s cell in Table 3.\(^{14}\) These borders are used as bounds for integrating the buyer density function \( f(X_1,X_2;\lambda) = 1 + 4\lambda(0.5 - X_1)(0.5 - X_2) \) over each of the four regions shown in Figure 3. The results of these four definite integrals are the quantities \( q_k \) demanded for each of the four purchase options. Calculated in this way, these quantities are shown in that model’s cell in Table 3. Next, we substitute these quantities into the two firms’ profit functions from the corresponding cell in Table 2, and then differentiate each firm’s profit functions with respect to the price that it charges for each of the two products. Calculated in this way, the resulting derivatives are then set equal to zero to obtain the first-order necessary conditions for price equilibrium, as shown in the corresponding cell in Table 4.

\(^{14}\) In the shared-customer differentiation advantage model, large values of \( \delta \) make the AD and DA regions disappear, leaving only the AA and DD regions, so that model’s cell in Tables 3 and 4 is split into separate parts for each of these two regimes. We determine the threshold between the low \( \delta \) and high \( \delta \) regimes as the lowest value of \( \delta \) for which both firms earn higher profit under the high \( \delta \) regime’s equilibrium than under the low \( \delta \) regime’s equilibrium. Because this threshold occurs at a value of \( \delta \) where the AD and DA regions have not yet completely disappeared under the low \( \delta \) regime’s equilibrium, the transition to the high \( \delta \) regime is a discontinuous jump, as shown in Figure 6.
other product. So, in the shared-resource advantage models, the firms treat the two product markets as independent of each other, with their pricing decisions in each product market having no impact on their pricing decisions in the other product market. In contrast, Table 4 also shows that this is not true for the shared-customer advantage models. Each of the two first-order conditions in each cell of Table 4 actually represents two first-order conditions, i.e., one for each of the two products indexed by \( i, j \in \{1,2\} \) for \( i \neq j \), for a total of four first-order conditions for each model. Each model’s price equilibrium is a set of four prices (both firm’s prices for both products) that must satisfy all four of these first-order necessary conditions. The two shared-resource models’ first-order conditions are linear functions of the prices, so exact closed-form solutions for these models’ price equilibria are calculated directly, as shown in those models’ cells in Table 4.\(^{\text{15}}\) Although the two shared-resource advantage models have different equilibrium prices, they also make different assumptions about the advantaged firm’s production costs, and these two differences exactly counterbalance each other, so that the two models share the same equilibrium margins, outputs, and profits, as shown in Figure 4.

Solving the first-order conditions is a much more intractable problem in the shared-customer advantage models, with the exception of the special case of \( \lambda = 0 \) (i.e., uniform distribution of customers) where exact closed-form equilibrium solutions can be calculated as a function of \( \delta/\alpha \). So, for each of the two shared-customer models, we use the Newton’s method algorithm (Wolfram, 1991: 694) to calculate numerical solutions to the first-order conditions for at least 1300 different sets of parameter values\(^{\text{16}}\) across the entire parameter space, using the exact solution of the \( \lambda = 0 \) special case as the algorithm’s starting point in its search for numerical solutions of nonzero \( \lambda \) cases (sharing the same value of \( \delta/\alpha \)). Plots of the equilibrium margins, outputs, and profits implied by

\(^{\text{15}}\) The solution to the baseline symmetric case shown in Figure 1 is found by substituting \( \delta = 0 \) into either of the two shared-resource cases in Tables 2, 3, and 4.

\(^{\text{16}}\) Every possible pairing of at least 36 different values of \( \lambda \) with at least 36 different values of \( \delta/\alpha \).
these numerical solutions are shown in Figures 5 and 6.\textsuperscript{17}

In order to conduct comparative-statics analysis (e.g., Figures 7a, 7b, 8a, and 8b) in the absence of exact closed-form equilibrium solutions for the shared-customer models, we use the numerical solutions as data to estimate a least-squares approximation for the equilibrium as a multivariate polynomial function of $\lambda$ and $\delta/\alpha$. We experimented with different specifications in order to find approximations that have a strong fit to the numerical solutions (R-squared $> 0.98$) and that also closely track the curvature of those numerical solutions across the entire parameter space.\textsuperscript{18} We then substitute the resulting approximate equilibrium for each model back into that model’s profit function in order to obtain an approximate equilibrium profit function. We conduct comparative-statics analysis by differentiating this approximate equilibrium profit function with respect to the parameters of the model. Some of the resulting derivatives are plotted in Figures 7a, 7b, 8a, and 8b.

\textsuperscript{17} We confirmed that second-order conditions for local optima were satisfied at the equilibria. In the case of the shared-customer advantage models, this confirmation was done numerically, at each of the numerically-calculated equilibrium solution points. In the shared-customer cost advantage model, there was only one tiny sliver of parameter space where the second-order conditions were not satisfied, near the corner where $\delta$ and $\lambda$ are both at their maximum possible values. Accordingly, we removed this sliver of parameter space from our plots of the results of the shared-customer cost advantage model, as can be most clearly seen in the top-right corner of Figure 5a-A. None of the other three models had any violations of the second-order conditions in any part of the parameter space. Details of our confirmation of the second-order conditions are available from the authors upon request.

\textsuperscript{18} For the shared-customer differentiation advantage model’s approximation, we settled on a fourth-order multivariate polynomial specification, including every possible term of the form $\lambda^g (\delta/\alpha)^h$ with nonnegative integer exponents $g$ and $h$ whose sum is between 0 and 4 inclusive (a total of 17 polynomial terms). For the shared-customer cost advantage model’s approximation, we settled on a fifth-order multivariate polynomial specification, including every possible term of the form $\lambda^g (\delta/\alpha)^h$ with nonnegative integer exponents $g$ and $h$ whose sum is between 0 and 5 inclusive (a total of 23 polynomial terms), but we also added a term for $e^{-(1+\lambda+2(\delta/\alpha))}$ in order to correct some divergence from the curvature of the numerical solutions in the region of parameter space near the corner where $\lambda = -1$ and $\delta = 0$. All of our approximations are visually indistinguishable from the numerical solutions that they are approximating when they are plotted together on the same axes. Every bit of curvature in the numerical solutions, across the entire parameter space, is matched exactly in its corresponding approximation. In short, these are very close approximations to the numerical solutions.
Table 1. Mechanisms and Examples of Scope Advantages

<table>
<thead>
<tr>
<th>Cost advantage</th>
<th>Shared-resource advantage</th>
<th>Shared-customer advantage</th>
</tr>
</thead>
<tbody>
<tr>
<td> Similarity of expertise lowers cost of applying same skills in other markets (Farjoun, 1994)</td>
<td> Existing client relationship (Nayyar, 1993) leads to lower cost of customer acquisition</td>
<td> Common interface across products boosts WTP due to lock-in (Cottrell &amp; Nault, 2004)</td>
</tr>
<tr>
<td> Shared sales force (Capron &amp; Hulland, 1999)</td>
<td> Client-specific knowledge leads to lower costs of both retaining customers (Chatain, 2011) and cross-selling to them (Akcura &amp; Srinivasan, 2005)</td>
<td> Integrating products for a superior seamless experience (Stremersch &amp; Tellis, 2002)</td>
</tr>
<tr>
<td> Sharing product development resources across different markets (Tanriverdi &amp; Lee, 2008)</td>
<td> Examples…</td>
<td> Customizable product due to unique value chain boosts WTP (Rivkin &amp; Porter, 1999)</td>
</tr>
<tr>
<td> Examples…</td>
<td> Examples…</td>
<td> Examples…</td>
</tr>
<tr>
<td>➢ Southwest: Lean hub-bypass operations</td>
<td>➢ Nordstrom: Personal Book database</td>
<td>➢ Apple: iPod/iTunes Store integration, enforced via FairPlay DRM</td>
</tr>
<tr>
<td>➢ Ikea &amp; Aldi: Labor-saving store designs with quality private-label products for price-sensitive customers</td>
<td>➢ Disney: intellectual property for animated characters &amp; their stories</td>
<td>➢ Airbus: Fly-by-wire common cockpit</td>
</tr>
<tr>
<td> Examples…</td>
<td>➢ Amazon: Recommendations database</td>
<td>➢ Dell, Coca-Cola Freestyle, Movie Tavern, Pro-Paks, MyMuesli: Custom bundling</td>
</tr>
</tbody>
</table>

Table 2. Total Consumption Cost Functions and Profit Functions

<table>
<thead>
<tr>
<th>Cost advantage</th>
<th>Shared-resource advantage</th>
<th>Shared-customer advantage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cost advantage</td>
<td>Cut A’s marginal cost on output sold to all customers for either product.</td>
<td>Cut A’s marginal cost on output sold to customers who buy both products from A.</td>
</tr>
<tr>
<td>$t_{AA} = p_{1A} + p_{2A} + \alpha X_1 + \alpha X_2$</td>
<td>$t_{AA} = p_{1A} + p_{2A} + \alpha X_1 + \alpha X_2$</td>
<td>$t_{AA} = p_{1A} + p_{2A} + (\alpha X_1 - \delta /4) + (\alpha X_2 - \delta /4)$</td>
</tr>
<tr>
<td>$t_{AD} = p_{1A} + p_{2D} + \alpha X_1 + \alpha(1 - X_2)$</td>
<td>$t_{AD} = p_{1A} + p_{2D} + \alpha X_1 + \alpha(1 - X_2)$</td>
<td>$t_{AD} = p_{1A} + p_{2D} + (\alpha X_1 - \delta /4) + \alpha(1 - X_2)$</td>
</tr>
<tr>
<td>$t_{DA} = p_{1D} + p_{2A} + \alpha(1 - X_1) + \alpha X_2$</td>
<td>$t_{DA} = p_{1D} + p_{2A} + \alpha(1 - X_1) + \alpha X_2$</td>
<td>$t_{DA} = p_{1D} + p_{2A} + \alpha(1 - X_1) + \alpha X_2$</td>
</tr>
<tr>
<td>$t_{DD} = p_{1D} + p_{2D} + \alpha(1 - X_1) + \alpha(1 - X_2)$</td>
<td>$t_{DD} = p_{1D} + p_{2D} + \alpha(1 - X_1) + \alpha(1 - X_2)$</td>
<td>$t_{DD} = p_{1D} + p_{2D} + \alpha(1 - X_1) + \alpha(1 - X_2)$</td>
</tr>
<tr>
<td>$\pi_A = [p_{1A} - (\gamma - \delta /4)](q_{AA} + q_{AD})$</td>
<td>$\pi_A = (p_{1A} - \gamma)q_{AD} + (p_{2A} - \gamma)q_{DA}$</td>
<td>$\pi_A = (p_{1A} - \gamma)q_{DA} + (p_{2A} - \gamma)q_{DD}$</td>
</tr>
<tr>
<td>$\pi_D = (p_{1D} - \gamma)(q_{DA} + q_{DD})$</td>
<td>+$$[p_{2A} - (\gamma - \delta /4)](q_{AA} + q_{DA})$$</td>
<td>+$$[p_{2A} - (\gamma - \delta /4)]q_{AA}$$</td>
</tr>
<tr>
<td></td>
<td>+$$(p_{2D} - \gamma)(q_{AD} + q_{DD})$$</td>
<td>+$$(p_{2D} - \gamma)(q_{AD} + q_{DD})$$</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Differentiation (WTP) advantage</th>
<th>Subsidize transport costs to A for all of A’s customers for either product.</th>
<th>Subsidize transport costs to A for customers who buy both products from A.</th>
</tr>
</thead>
<tbody>
<tr>
<td>$t_{AA} = p_{1A} + p_{2A} + (\alpha X_1 - \delta /4) + (\alpha X_2 - \delta /4)$</td>
<td>$t_{AA} = p_{1A} + p_{2A} + (\alpha X_1 - \delta /2) + (\alpha X_2 - \delta /2)$</td>
<td>$t_{AA} = p_{1A} + p_{2A} + (\alpha X_1 - \delta /4) + (\alpha X_2 - \delta /4)$</td>
</tr>
<tr>
<td>$t_{AD} = p_{1A} + p_{2D} + (\alpha X_1 - \delta /4) + \alpha(1 - X_2)$</td>
<td>$t_{AD} = p_{1A} + p_{2D} + \alpha X_1 + \alpha(1 - X_2)$</td>
<td>$t_{AD} = p_{1A} + p_{2D} + \alpha X_1 + \alpha(1 - X_2)$</td>
</tr>
<tr>
<td>$t_{DA} = p_{1D} + p_{2A} + \alpha(1 - X_1) + (\alpha X_2 - \delta /4)$</td>
<td>$t_{DA} = p_{1D} + p_{2A} + \alpha(1 - X_1) + \alpha X_2$</td>
<td>$t_{DA} = p_{1D} + p_{2A} + \alpha(1 - X_1) + \alpha X_2$</td>
</tr>
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<tr>
<td>$\pi_A = (p_{1A} - \gamma)(q_{AA} + q_{AD})$</td>
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</tr>
<tr>
<td>$\pi_D = (p_{1D} - \gamma)(q_{DA} + q_{DD})$</td>
<td>+$$[p_{2A} - \gamma)(q_{AA} + q_{DA})$$</td>
<td>+$$[p_{2A} - \gamma)(q_{AA} + q_{DA})$$</td>
</tr>
<tr>
<td></td>
<td>+$$[p_{2D} - \gamma)(q_{AD} + q_{DD})$$</td>
<td>+$$[p_{2D} - \gamma)(q_{AD} + q_{DD})$$</td>
</tr>
</tbody>
</table>
### Table 3. AA/AD/DA/DD Region Borders and Quantities Demanded

<table>
<thead>
<tr>
<th>Cost advantage</th>
<th>Shared-resource advantage</th>
<th>Shared-customer advantage</th>
</tr>
</thead>
<tbody>
<tr>
<td>AA/AD border: ( x_2 = (a - (p_{2A} - p_{2D})) / 2a )</td>
<td>[ q_{AA} = \frac{a^2(4 + \delta + \lambda(p_{1A} - p_{1D}))}{16a^4[(a - (p_{1A} - p_{1D}))]^{-1}[(a - (p_{2A} - p_{2D}))]^{-1}} ]</td>
<td>[ q_{AA} = \frac{a^2(4 + \delta + \lambda(p_{1A} - p_{1D}))}{16a^4[(a - (p_{1A} - p_{1D}))]^{-1}[(a - (p_{2A} - p_{2D}))]^{-1}} ]</td>
</tr>
<tr>
<td>AA/DA border: ( x_3 = (a - (p_{1A} - p_{1D})) / 2a )</td>
<td>[ q_{AD} = \frac{a^2(4 - \delta + \lambda(p_{1A} - p_{1D}))}{16a^4[(a - (p_{1A} - p_{1D}))]^{-1}[(a - (p_{2A} - p_{2D}))]^{-1}} ]</td>
<td>[ q_{AD} = \frac{a^2(4 - \delta + \lambda(p_{1A} - p_{1D}))}{16a^4[(a - (p_{1A} - p_{1D}))]^{-1}[(a + p_{2A} - p_{2D}))]^{-1}} ]</td>
</tr>
<tr>
<td>DD/AD border: ( x_3 = (a - (p_{1A} - p_{1D})) / 2a )</td>
<td>[ q_{DA} = \frac{a^2(4 - \delta + \lambda(p_{1A} - p_{1D}))}{16a^4[(a + (p_{1A} - p_{1D}))]^{-1}[(a - (p_{2A} - p_{2D}))]^{-1}} ]</td>
<td>[ q_{DA} = \frac{a^2(4 - \delta + \lambda(p_{1A} - p_{1D}))}{16a^4[(a + (p_{1A} - p_{1D}))]^{-1}[(a - (p_{2A} - p_{2D}))]^{-1}} ]</td>
</tr>
<tr>
<td>DD/DD border: ( x_2 = (a - (p_{2A} - p_{2D})) / 2a )</td>
<td>[ q_{DD} = \frac{a^2(4 + \delta + \lambda(p_{1A} - p_{1D}))}{16a^4[(a + (p_{1A} - p_{1D}))]^{-1}[(a + (p_{2A} - p_{2D}))]^{-1}} ]</td>
<td>[ q_{DD} = \frac{a^2(4 + \delta + \lambda(p_{1A} - p_{1D}))}{16a^4[(a + (p_{1A} - p_{1D}))]^{-1}[(a + (p_{2A} - p_{2D}))]^{-1}} ]</td>
</tr>
</tbody>
</table>

**At high values of \( \delta \) when AD & DA regions are non-empty:**

- AA/AD border: \( x_3 = (a + \delta - (p_{2A} - p_{2D})) / 2a \)
- AA/DD border: \( x_2 = (a + \delta - (p_{1A} - p_{1D})) / 2a \)
- DD/AD border: \( x_3 = (a - (p_{1A} - p_{1D})) / 2a \)
- DD/DD border: \( x_2 = (a - (p_{2A} - p_{2D})) / 2a \)

**At low values of \( \delta \) when AD & DA regions are empty:**

- AA/AD border: \( x_3 = (a + \delta - (p_{2A} - p_{2D})) / 2a \)
- AA/DD border: \( x_2 = (a + \delta - (p_{1A} - p_{1D})) / 2a \)
- DD/AD border: \( x_3 = (a - (p_{1A} - p_{1D})) / 2a \)
- DD/DD border: \( x_2 = (a - (p_{2A} - p_{2D})) / 2a \)

**No other borders:**

- AA/AD border: \( x_3 = (a - (p_{2A} - p_{2D})) / 2a \)
- AA/DD border: \( x_2 = (a - (p_{1A} - p_{1D})) / 2a \)
- DD/AD border: \( x_3 = (a - (p_{1A} - p_{1D})) / 2a \)
- DD/DD border: \( x_2 = (a - (p_{2A} - p_{2D})) / 2a \)
Table 4. First-Order Necessary Conditions for Price Equilibrium

<table>
<thead>
<tr>
<th>Cost advantage</th>
<th>Shared-resource advantage</th>
<th>Shared-customer advantage</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\frac{\partial \pi_A}{\partial p_{IA}}$</td>
<td>$4\alpha - \delta + 4(\gamma - 2p_{IA} + p_{ID})$</td>
<td>$8^{-1}\alpha^{-4}[4\alpha^4 - 2\alpha^3(\delta - 2(\gamma - 2p_{IA} + p_{ID}) + 4\alpha^2\delta (2(p_{JA} - p_{JD}) - \lambda(p_{IA} - p_{ID}))$</td>
</tr>
<tr>
<td>$\frac{\partial \pi_D}{\partial p_{ID}}$</td>
<td>$\alpha + \gamma + p_{IA} - 2p_{ID}$</td>
<td>$\alpha + \gamma + p_{IA} - 2p_{ID}$</td>
</tr>
<tr>
<td>Price equilibrium exact solution:</td>
<td>$p_{IA}^* = \alpha + \gamma - (\delta / 6)$</td>
<td>$p_{ID}^* = \alpha + \gamma - (\delta / 12)$</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Differentiation (WTP) advantage</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>$\frac{\partial \pi_A}{\partial p_{IA}}$</td>
<td>$\frac{4\alpha + \delta + 4(\gamma - 2p_{IA} + p_{ID})}{8\alpha}$</td>
</tr>
<tr>
<td>$\frac{\partial \pi_D}{\partial p_{ID}}$</td>
<td>$\frac{4\alpha - \delta + 4(\gamma + p_{IA} - 2p_{ID})}{8\alpha}$</td>
</tr>
<tr>
<td>Price equilibrium exact solution:</td>
<td>$p_{IA}^* = \alpha + \gamma - (\delta / 12)$</td>
</tr>
</tbody>
</table>

At low values of $\delta$ (when AD & DA are non-empty)...:

$\frac{\partial \pi_A}{\partial p_{IA}} = 96^{-1}\alpha^{-4}[4\alpha^4 + 24\alpha^3(\delta - 2(\gamma - 2p_{IA} + p_{ID})) - 6\alpha^2\delta (2\lambda(\gamma - 2p_{IA} + p_{ID}) - 4(\gamma - 2p_{IA} + p_{ID})$ |

At high values of $\delta$ (when AD & DA are empty)...:

$\frac{\partial \pi_A}{\partial p_{IA}} = 96^{-1}\alpha^{-4}[4\alpha^4 + 16\alpha^3(3 - \lambda) (\delta - 2\gamma - 2(p_{IA} + p_{JA}) + (p_{ID} + p_{JD})$ |

where the product numbers are indexed by $i, j \in \{1, 2\}$ for $i \neq j$. 
Figure 1. Hotelling square under baseline symmetric case (no advantage)

Figure 2. Varying the cross-market preference correlation

Possible interpretations of the cross-market preference correlation...

More negative cross-market correlation can mean:
- Customers more averse to one-stop shopping.
- Customers more disloyal (e.g., faddish)
- Customers know more about combining products
- Easier to combine products from different firms (e.g., standardized interfaces)
- More threat of "hold up" from single sourcing

More positive cross-market correlation can mean:
- Customers more strongly prefer one-stop shopping.
- Customers more loyal
- Customers know less about combining products
- Harder to combine products from different firms (e.g., proprietary interfaces)
- Less threat of "hold up" from single sourcing

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Figure 3. Borders shift differently under shared-customer differentiation (WTP) advantage

Figure 4. Output, margin, and profit effects of shared-resource scope advantages

Figure 3a. Shared-customer differentiation (WTP) advantage

Figure 3b. All other scope advantages

Figure 4a. Outputs of firms A & D (for 1 product)

Figure 4b. Margins of firms A & D, scaled by transport-cost parameter $\alpha$

Figure 4c. Profits of firms A & D, scaled by transport-cost parameter $\alpha$
Figure 5a-A: Equilibrium output. Firm A’s output (for 1 product only)

Figure 5a-D: Equilibrium output. Firm D’s output (for 1 product only)

Figure 5b-A: Equilibrium margin. Firm A’s margin, scaled by α

Figure 5b-D: Equilibrium margin. Firm D’s margin, scaled by α

Figure 5c-A: Equilibrium profit. Firm A’s profit, scaled by α

Figure 5c-D: Equilibrium profit. Firm D’s profit, scaled by α

Figure 5. Output, margin, and performance effects of shared-customer cost advantage
Figure 6. Output, margin, and performance effects of shared-customer differentiation advantage
Figure 7a-i: Profit backfiring region. Derivative of firm A’s approximate equilibrium profit with respect to $\delta$, with blue ‘flooded’ area where increasing $\delta$ reduces firm A’s profit.

Figure 7a-ii: Profit backfiring region. Region of parameter space shown in blue where increasing $\delta$ reduces firm A’s profit.

Figure 7b-i: Aggressiveness of D’s response. Derivative of firm D’s approximate equilibrium margin with respect to $\delta$, ‘flooded’ blue where D responds most aggressively to higher $\delta$ ($<-0.4$).

Figure 7b-ii: Aggressiveness of D’s response. Region of parameter space shown in blue where firm D’s response to increased $\delta$ is most aggressive (margin derivative $<-0.4$).

Figure 7c-i: Change in density on region border. Rate at which equilibrium density of customers along AA/DA (or AA/AD) border decreases as $\delta$ increases, ‘flooded’ blue where rate of decrease is lowest (i.e., rate of increase $>0.2$).

Figure 7c-ii: Change in density on region border. Region of parameter space shown in blue where the equilibrium density of customers along AA/DA (or AA/AD) border increases most rapidly as $\delta$ increases (derivative $>0.2$).

Figure 7. Backfiring of marginally increasing shared-customer cost advantage
Figure 8a-i: Profit backfiring region. Derivative of firm A’s approximate equilibrium profit with respect to $\delta$, with orange ‘flooded’ area where increasing $\delta$ reduces firm A’s profit.

Figure 8a-ii: Profit backfiring region. Region of parameter space shown in orange where increasing $\delta$ reduces firm A’s profit.

Figure 8b-i: Aggressiveness of D’s response. Derivative of firm D’s approximate equilibrium margin with respect to $\delta$, ‘flooded’ orange where D responds most aggressively to higher $\delta$ ($< -0.5$).

Figure 8b-ii: Aggressiveness of D’s response. Region of parameter space shown in orange where firm D’s response to increased $\delta$ is most aggressive (margin derivative $< -0.5$).

Figure 8c-i: One-stop vs. split-purchase buyers. Proportion of total demand outside of AD and DA regions, ‘flooded’ orange where AD and DA regions constitute at least 40% of total demand.

Figure 8c-ii: One-stop vs. split-purchase buyers. Region of parameter space shown in orange where equilibrium demand in AD and DA regions is at least 40% of total demand.

Figure 8. Backfiring of marginally increasing shared-customer differentiation advantage
Figure 9a-i: Shared-customer cost advantage. Firm A’s equilibrium profit, scaled by $\alpha$, with blue ‘flooded’ area where profit dips below the no-advantage profit level.

Figure 9a-ii: Shared-customer cost advantage. Region of parameter space shown in blue where firm A’s equilibrium profit dips below the no-advantage level.

Figure 9b-i: Shared-customer WTP advantage. Firm A’s equilibrium profit, scaled by $\alpha$, with orange ‘flooded’ area where profit dips below the no-advantage profit level.

Figure 9b-ii: Shared-customer WTP advantage. Region of parameter space shown in orange where firm A’s equilibrium profit dips below the no-advantage level.

Figure 9. Regions with negative total profitability of deploying shared-customer scope advantages.

Figure 10. Comparing profit of cost-based versus WTP-based shared-customer advantages.

Firm A’s equilibrium profit, scaled by $\alpha$, is shown in orange for shared-customer cost-based scope advantage, and shown in blue for shared-customer differentiation-based scope advantage.
REFERENCES


