Assessing Customer Evaluation and Revenue Consequences of Component

Sharing Across Brands in the Vertical Product Line

Peter C. Verhoef and Koen H. Pauwels

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Assessing Customer Evaluation and Revenue Consequences of Component Sharing Across Brands in the Vertical Product Line

Peter C. Verhoef[1]

School of Economics

Erasmus University Rotterdam

Koen H. Pauwels[2] [3]

Tuck School of Business at Dartmouth

[1] Peter C. Verhoef, Erasmus University Rotterdam, School of Economics, Department of Marketing and Organization, Office H15-17, Burg. Oudlaan 50, 3067 PA Rotterdam, The Netherlands, Phone: +31 10 408 2809, Fax: +31 10 408 9169, e-mail: Verhoef@few.eur.nl

[2] Assistant Professor, Tuck School of Business at Dartmouth, 100 Tuck Drive, Hanover, NH 03755, Phone: (603) 646 1097, Fax: (603) 646 5295, koen.h.pauwels@dartmouth.edu.

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Abstract

Component sharing may look great in the boardroom, but not in the showroom. Indeed, savings on R&D and production costs could be offset by a plunge in customer brand attractiveness and willingness to pay. This paper investigates the impact of component sharing on customer evaluation of luxury, volume and economy brands offered in a car manufacturer's vertical product line and its subsequent revenue consequences. The authors consider both the harm to the higher-end brand and the benefits for the lower-end brand, and analyze with a random effects model how the size of these effects depends on the brand combination, the type of component, the source of the components sharing, and customer characteristics. An experimental study shows that the harm for the higher-end brand is largest, when (1) a luxury brand shares components with a volume brand, (2) the source of the components is the higher-end brand, and when (3) the customer has a high initial evaluation of the higher-end brand. For the lower-end brand, the positive effect is largest, when (1) a volume brand shares with an economy brand, (2) the lower-end brand is the source of the components, and (3) customers have a high initial evaluation of the higher-end brand. Components that have a strong impact on evaluation are interior, wheels, chassis and the engine. Simulations show that sharing components typically translates in negative revenue consequences for both analyzed manufacturers. An interesting exception emerges for the Japanese manufacturer, which obtains a boost in total revenue when its small luxury brand shares components with its large volume brand.

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1. Introduction

Firms in different industries have adopted product-based strategies seeking product designs that allow high variety in the market place while simplifying the production and distribution system with a relatively low level of component variety and assembly complexity (Fisher, Ramdas and Ulrich 1999). Component sharing is an example of such product-based strategy. In component sharing, families of products have similar components. Examples of component sharing can be found in many industries, including automobiles, computer hardware and consumer electronics (Desai, Kekre, Radhakrishnan and Srinivasan 2001, Moore, Louviere and Verma 1999). The automotive industry is particularly known for its use of component sharing, as new products drive firm profitability and stock market value (Pauwels, Silva-Risso, Srinivasan and Hanssens 2004), but are very costly to develop: from up to $100 million in the late 1950s to up to $4 billion in recent years (Sherman and Hoffer 1971, White 2001). The advantages of component sharing are twofold: leveraging high R&D costs over multiple products and achieving production efficiencies. Recently however, car reviewers have criticized several manufacturers, including General Motors, for the use of component sharing (Desai et al. 2001, White 2004). Likewise, Volkswagens' strategy of component sharing between brands in different price segments is believed to cannibalize sales of its higher priced brands (Edmonson 2003). Moreover, Ramdas and Randall (2004) recently showed that component sharing is not always an effective strategy for maximizing product quality. In today's business press, the potential drawbacks of component sharing are a hotly debated issue (Business Week 2004)

Two research streams have shed light on parts of the component sharing picture. First, the management science literature demonstrated the cost efficiency of component sharing practices in the automotive industry (Fisher et al. 1999). Using analytical models, Desai et al. (2001) and Krishnan and Gupta (2001) discuss the appropriateness of component sharing. Ramdas and Sawhney (2001) propose a methodology that can be used to determine the optimal number of line extensions sharing components by taking cost- and revenue implications into account. Recently, Ramdas and Randall (2004) investigate the impact of component sharing on product reliability. While these studies point to potential disadvantages

of component sharing, such as cannibalization and decreased product differentiation, they do not directly examine consumer perceptions and evaluation of component sharing.

Second, the branding literature has investigated how brand- and line extensions and ingredient branding impact consumer brand evaluations (e.g. Desai and Keller 2002, Loken and John 1993, Park, Jun and Shocker 1996, Simonin and Ruth 1998). In general, these studies show that such branding practices can have both positive and negative effects on brand evaluations depending on the execution of the branding strategy. However, the practice of component sharing has yet to receive scientific analysis from a branding perspective.

From a managerial point of view, the impact of component sharing on brand evaluation is becoming an important question. Usually, firms are reluctant to share information on component sharing practices with the market, as they fear consumer backslash. However, as component sharing has become common practice in many industries, consumers have start noticing. Even general newspapers nowadays publish articles on component sharing, both in the US (e.g. Financial Times 2004) as in Europe (e.g. De Tijd 2004). Finally, over 60% of new vehicle buyers researched their purchase on the Internet, where they can easily compare product specifications and consumer comments (Jupiter Research 2003). For all these reasons, manufacturers cannot simply trust that their component sharing practices will remain a secret for all but the savviest consumers. Business Week (2004) recently made this point clear: "While sharing the basic structure of a car or truck can generate huge savings for most models, Ford discovered that it just won't wash in the luxury market. Most car buyers have no idea what a platform even is. But word quickly gets around when a new model shares its undercarriage with more plebeian cars. And it turns out that someone paying $40.000 for the luxury cachet of his first Jaguar cares a great deal that car's guts are being shared with something that may cost only $20.000 or so" (p. 72-73). However, the popular press lacks a systematic investigation of both negative and the positive evaluation effects of component sharing for a manufacturer's brand portfolio. Indeed, sharing the "car's guts" with Jaguar may increase evaluation of the Ford car priced at "only $20,000 or so". In this context, the high-end component may function as an ingredient that improves the reputation of the brand at the low end of the market (Park, Jun and Shocker

1996). Indeed, component sharing "sometimes means mass-market consumers get engineering that was originally intended for the luxury crowd" (White 2004).

As a result, we postulate that component-sharing practices impact customer evaluations for both sharing brands, which impact subsequent purchase behavior and prices paid for the car. However, this impact might be different for different customer sharing strategies and brand combinations. In this paper, we develop a conceptual model that assesses the impact of different component sharing strategies on customers' brand evaluations and their subsequent impact on purchase behavior and prices. Based on this model, firms can assess the revenue consequences of component between brands in the vertical product line. Firms should subsequently decide whether the cost reductions achieved with component sharing outweigh possible negative revenue consequences.

The outline of this paper is as follows. First, we elaborate on how component sharing differs from other branding strategies such as brand extensions and ingredient branding. Next, we discuss relevant theory and formulate our hypotheses. Section 4 details our methodology, while section 5 reports the findings. We conclude with managerial implications, study limitations and avenues for further research.

2. Component sharing and branding strategies

A firm's product line or portfolio can be characterized by its horizontal and vertical structure. The horizontal structure refers to the firms' activities in different product categories. For instance, the rich research stream on brand extensions has focused on this horizontal structure by studying spillover- and feedback effects of brand extensions (e.g. Keller and Aaker 1992). Researchers have also considered the vertical nature of product lines (Randall, Ulrich and Reibstein 1998); the focus of our study.

In today's markets, firms offer different brands along the vertical product line with three general positioning strategies: 1) luxury (prestige, premium) brands, 2) volume (mass-market) brands, and 3) economy (price) brands. For instance, Volkswagen AG offers Audi (luxury), Volkswagen (volume) and Skoda (economy) in the car market. Originally, brands were designed and manufactured in isolation. To achieve manufacturing economies of scale, firms started to share components among the offered brands

(Fisher, Ramdas and Ulrich 1999). Nowadays, luxury brands may share components with volume brands, and volume brands may share components with economy brands. As a result, brands along the vertical product line may have similar product attributes.

To some extent, the component sharing issue seems to be closely related to ingredient branding (Park et al. 1996, Simonin and Ruth 1998, Venkatesh and Mahajan 1997). In ingredient branding, a brand (e.g. Compaq or Godiva) explicitly communicates that one single attribute from the product is from a specific manufacturer (e.g. Intel or Slim Fast). Component sharing differs from ingredient branding in three important ways. First, ingredient branding concerns two different brands operating in different product categories (i.e. computers and chips or washing powder and soap). Usually, the host branded product consists of many ingredients or components of which one ingredient is branded by a supplier from outside the product category. In the case of component sharing, one or more attributes are shared with a brand in the same product category. Second, brands sharing components usually do not actively communicate this in the market. In contrast, ingredient branding is a very explicit strategy in which brands actively communicate the inclusion of the branded ingredient in the product. For instance, Chrysler advertises the 'Hemi' engine in its top-line Dodge models (Wall Street Journal 2004). Third, the motives underlying ingredient branding and component sharing are different. Firms apply ingredient branding to enhance brand value while component sharing is applied to gain economies of scale. Still, explicit measurement of the effects of component sharing on brand pricing power is crucial, as customer revenue implications may far outweigh any cost efficiency gains (Goshn 2004).

3. A revenue model framework for component sharing

Figure 1 displays our framework to assess the revenue consequences of component sharing. Its main research contribution is that we allow changes to customer evaluation for both involved brands. Its key managerial message is that component sharing may impact market revenues through its trade-off effects on purchase intentions and willingness-to-pay for both the higher-end and the lower-end brands.

These revenue consequences may however differ between customer sharing strategies, depending on 1) the positioning of the component sharing brands (luxury-volume versus volume-economy combination), 2) the identified source of the component, and 3) the component type being shared. We discuss these factors below.

-- Insert Figure 1 about here --

3.1 Effect of Component Sharing on Brand Evaluations

The general expectation underlying our model is that component sharing across brands in the vertical product line will negatively affect brand evaluations of the higher-end brand and will have positive consequences for evaluations of the lower-end brand. Several behavioral theories support this assumption. The branding literature suggests that brands can be understood in terms of a set of attributes, each at particular performance levels (Keller 1998). As components are shared, some attributes of the sharing brands become more alike. Hence, the differentiation between sharing brands decreases (Desai et al. 2001), especially if this differentiation is based on attributes that can be traced back to the shared components. Likewise, the economic value of a product to the customer consists of the reference value and the differentiation value (Nagle and Holden 1995). Lower brand differentiation decreases the brands' uniqueness, which subsequently may decrease customer value of higher-end brands. Moreover, consumer research suggests that price differences across brands are frequently interpreted in terms of quality differences (Bolton, Warlop and Alba 2003). When components are shared, the perceived quality differences between brands shrink. Consequently, consumers may question the fairness of the price difference between a higher-end and a lower-end brand, resulting in lower brand evaluations for the higher-end brand. As for the lower-end brands, the above arguments imply that component sharing may increase their evaluation. Indeed, these lower-end brands may also start sharing higher-end brand associations (Janiszewski and Van Osselaer 2000, Keller 1998). Specifically, the use of a higher-end brand component in a lower priced brand may signal a higher quality for that brand. As a consequence, its customer evaluation will increase (Desai and Keller 2002, Rao, Lu and Ruekert 1999).

3.2 Impact of Brand Combination

First, we expect that the effect of component sharing on changes in brand evaluation depends on the positioning of the higher-end and lower-end brands. Luxury brands or prestige brands are positioned in the premium high end of the market. Economic theory suggests that consumers buy such brands in order to advertise their wealth, thereby achieving greater social status, which is known as the Veblen effect (Bagwell and Bernheim 1996, Braun and Wicklund 1989). Likewise, the branding literature suggests that these brands are purchased for exclusivity and communication of status (Kirmani, Sood and Bridges 1999, Park, Milberg and Lawson 1991). The brands status is, amongst others, based on the customers' assumption that these brands are unique; i.e. have their own distinctive unique characteristics. If such brands now share components with lower-positioned brands, their uniqueness would become tainted and the social status of owning them would severely diminish. The negative effect of component sharing with a lower-end brand might be less strong for volume brands, as brand uniqueness is not such an important issue for a volume brand, sharing components with a lower-end brand might therefore not severely impact its attractiveness.

From the perspective of the lower-end brand, the customer evaluation benefits from component sharing may also depend on the positioning of the higher-end brand. Indeed, components shared with a luxury brand may transfer quality and prestige to the lower-end brand (Simonin and Ruth 1998). The effect should also depend on the positioning of the lower-end brand. Brands that are already associated with having good quality components will benefit less from sharing components with higher-end brands.

To control for the effect of the consumers' perceived brand evaluation of both the high-end, and lower-end brand, we also include the initial evaluation of these brands as determinants of changes in brand evaluation. Thereby, we expect that the initial evaluation of the high-end brand will positively impact the positive change in evaluation of the low-end brand, while it will negatively impact the change in evaluation of the high-end brand. For the initial evaluation of the low-end brand, we expect that the positive change of the low-end brand will be smaller if consumers already have a high initial evaluation

of the low-end brand. The negative change in evaluation of the high-end brand will be smaller if consumers already have a high initial evaluation of the low-end brand.

3.3 Source of Component sharing

In our study, we consider three sourcing formats: (1) the higher-end brand shares (sends) a component brand with (to) the lower-end brand, (2) the higher-end brand and lower-end brand share the same component, and (3) the lower-end brand shares (sends) a component with (to) the higher-end brand. Note, that the 'objective' end result is identical across the sourcing strategies: two brands have the same component. Why then would the source of component sharing impact customer evaluation? Research on judgment and decision-making has shown that framing messages differently affects the evaluation of these messages (Levin and Geath 1987, Shiv, Edell and Payne 1997, Thaler 1985, Tversky and Kahneman 1981). In our context, sourcing format 1 communicates that the higher-end brand sends its component to a lower positioned brand. Such message should mainly transfer consumer associations from the more prestigious higher-end brand to the lower-end brand, but limit the (negative) transfer from the lower-end to the higher-end brand. Sourcing format 2 is more neutral and only communicates that the two brands have the same component without mentioning its original source. Sourcing format 3 is most negatively framed for the higher-end brand, as consumers may believe that lower-end brand components are inferior. As a result, format 3 should create severe negative effects on the higher-end brand's evaluation. Anecdotic evidence for this is provided by practices of Ford, where the prestige brand Jaguar is referred to as an upgraded Ford Mondeo, because it receives components from this Ford sub-brand.

Interestingly, it is unclear which sourcing format is better or worse for the lower-end brand. On the one hand, ingredient-branding literature would suggest that imputing a component from a higher-end brand with a higher quality reputation should have the most positive consequences for the lower-end brand (e.g. Park et al. 1996). On the other hand, identifying the lower-end brand as the source may communicate to consumers that the component quality of this brand is apparently so good, that a higher-end brand is using the same component.

3.4 Impact of Component Type

Both theory and anecdotal evidence suggest that the impact of component sharing on brand evaluations depends on the component type being shared. Importantly, components differ on at least two dimensions: importance and visibility. As for the former, Fisher et al. (1999) distinguish between components with a strong influence on product quality, such as the car engine, versus components with a weak influence on product quality, such as car brakes. Researchers and car manufacturers typically assume that components with a weak influence can easily be shared without having any negative repercussions (Yasukawa 1992). In the same vein, Desai et al. (2001) report that the importance of the component determines whether component sharing is appropriate. Finally, research on product categorization and product attributes suggests that essential attributes are highly influential for an understanding of the concept of the car (Eysenck and Keane 1990).

As to the latter, manufacturers have learnt the hard way that visible differences are key to maintaining a brand image (Financial Times 2004). For example, Bentley was embarrassed to hand over its first $ 200K Continental GTs with the same cheap black plastic key used for the $ 22K Volkswagen Golf. In general, while many components related to the intrinsic quality of a car are not directly visible to consumers (e.g. car platform and brakes), others (e.g. the interior) make up the visual elements contributing to the 'extrinsic quality'. This extrinsic quality of a product is crucial to its market success (Bloch 1995, Cooper and Kleinschmidt 1987). As visible components are shared, the similarity of brands becomes more salient to consumers. Hence, we expect that the perceived differentiation between car brands will decrease more strongly when visible components are shared.

4. Research Design and Analysis

We empirically test our model in an experiment. Using this experiment we vary brand combinations, sourcing strategies, and the shared components. Appendix 1 details the pretest results, and the experimental procedures and measures, which we summarize below.

4.1. Choice of brands and components

Based on pre-tests (see Appendix 1), we choose two sets of real brands: (1) Audi, Volkswagen and Skoda (A/V/S), and (2) Lexus, Toyota and Suzuki (L/T/S) as respectively the luxury, volume and economy brands. Our motivation for selecting these brand sets is threefold: (1) they are widely known in the respondent population, (2) they differ in terms of top-line contribution by luxury versus economy brands[4], and (3) they cover Western brands, which are often criticized for an over-reliance on component sharing, and Japanese brands, which are reluctant to compromise 'product uniqueness' (Ykusawa 1992, Fisher, Ramdas and Ulrich 1999). Moreover, we select components that vary in terms of importance and visibility. The eight selected components, shown in table 1, substantially differ on these dimensions.

-- Insert Table 1 about here --

4.2 Data collection

We collect our data by means of an Internet questionnaire to the panel of a Dutch market research agency. The selected respondents are 20-65 years old, and usually purchase new cars (not second-hand cars) in the full-size car market. This selection yields 179 respondents, of which 34 did not fully complete the questionnaire. The resulting sample size of 145 respondents includes 67 respondents for A/V/S, and 78 respondents for L/T/S. The average age is 43 years, approximately 75% is male, 88% earned an education of high school or higher, and 63% of respondents have an above average income. The relative high education and high income of our respondents is probably due to our focus on new large car buyers.

4.3 Design and measures

First, respondents are assigned to one of the two brand sets. For each brand set, the study design is a 2 (Brand Combination) x 3 (Source Format) between-subjects factorial design, combined with a within-subjects design for the 8 shared component types. Each respondent is randomly assigned to one of the six conditions.

[4] In 2004 sales, Dutch sales for Audi, VW and Skoda reached respectively 11,313; 42,480 and 6,286. The numbers for Lexus, Toyota and Suzuki are respectively 569; 29,286 and 11,619.

We started the questionnaire with some questions on car, and brand ownership. Next, we presented the respondents with pictures of the brands in the brand set (see Appendix A.2). Subsequently, each respondent was asked to evaluate the brand attractiveness on a 1-100 (1=absolutely unattractive, 100 =absolutely very attractive) scale, the maximum price in Euros they are willing to pay for that brand and their purchase intentions for the brand on a 0-10 scale (0=absolutely not planning to buy, 10=absolutely planning to buy). The average score on the initial brand questions are provided in Table 2. In line with our brand classification, pairwise t-tests show significant differences in the brand evaluations and average willingness to pay between all considered brands in the brand set ($p<0.01$).

Next, we described to the respondent, that the manufacturer is planning to share components between two brands. The description differed for the three source component conditions (see Table 3). One by one, we confronted the respondents with 8 components being shared. These components were randomly presented to the respondents to overcome any order effects. For each component, the respondent was asked to evaluate the attractiveness of the higher-end brand and the lower-end brand on a 1-100 scale. We ended the questionnaire with straightforward questions on income, education, age, and gender.

-- Insert Tables 2 and 3 about here --

4.4 Analysis

The analysis of our model framework (Figure 1) involves two stages. In the first stage, we estimate the effect of sharing strategies on change in customer evaluation. In the second stage, we estimate the effect of evaluations on both purchase intentions and willingness to pay.

The dependent variable in the first stage is the change in customer evaluation of customer i of the higher-end (he) and the lower-end brand (le) due to component sharing strategies (s), given by:

$$\Delta EVA_{i,he,s} = EVA_{i,he} - EVA_{i,he,s} \quad (1)$$

$$\Delta EVA_{i,le,s} = EVA_{i,le} - EVA_{i,le,s} \quad (2)$$

As each respondent is confronted with 8 component types being shared, we have 8 observations per respondent. Hence, our data can be considered as panel data. To account for the interdependency between these 8 observations, we estimate a random effects model (Greene 2002, Train 2003), assuming the

random effect (u_i) for respondent i is the same for each shared component. We include dummies for the experimentally manipulated conditions. For the brand combination, we include the dummy LUXVOL (Luxury-Volume), leaving the Volume –Economy combination as the base case. For the component source, we include HILOW (Higher End to Lower End) and LOWHI (Lower End to Higher End), leaving HI&LOW (no identified source) as the base scenario. A dummy BS is included to control for the brand set (0=L/T/S,1=A/V/S). We include a vector of 7 dummies COMP for 7 of the shared components, using wipers as the benchmark (this component was considered least important in our pre-tests). Initial evaluations of the higher end and lower end brands are included as $EVA_{i,he}$ and $EVA_{i,le}$. Finally, we aim to control for observed consumer heterogeneity by a set of variables (denoted as X), including dummies for the ownership of the three considered brands in our brand sets, age, income, education and car expertise (how long the respondent has owned a car). The resulting random effects regression models are given by:

$$\Delta EVA_{i,he} = \beta_0+\beta_{1,he}LUXVOL_i+\beta_{2,he}\ HILOW_i+\beta_{3he}\ LOWHI_i+\ \beta_{4,he}BS_i + \gamma_{,he}\ COMP_{ik}+\ \delta_{1,he}\ EVA_{i,he}+\ \delta_{2,he}\ EVA_{i,le}+\ \lambda_{he}\ X_i+\ \varepsilon_{ik,he}+u_{i,he} \quad (3)$$

$$\Delta EVA_{i,le} = \beta_0+\beta_{1,le}LUXVOL_i+\beta_{2,le}\ HILOW_i+\beta_{3,le}\ LOWHI_i+\ \beta_{4,le}BS_i + \gamma_{,le}\ COMP_{ik}+\ \delta_{1,le}\ EVA_{i,le}+\ \delta_{2,le}\ EVA_{i,le}+\lambda_{le}\ X_i+\ \varepsilon_{ik,le}+u_{i,he} \quad (4)$$

with ε_{ik} the unique random term for respondent i, and component k, and u_i is the respondent-specific term. Both ε_{ik} and u_i are bivariate normal distributed with means (0,0), variances σ^2 and ϖ^2 , correlation 0, and also assumed uncorrelated across individuals. The models are estimated in LIMDEP 8.0 (Greene 2002).

In the second stage of the analysis, we use seemingly unrelated regression (SUR) to estimate the effect of the evaluations on purchase intentions (PI) and willingness to pay (WTP) per brand (b). SUR accounts for the fact that the errors of the equations for PI and WTP might be correlated. In our model, we account for customer-specific effects (Z): ownership of brand, age, income, education, and car expertise (how long the respondent has owned a car). The model specification is:

$$PI_{i,b} = \alpha_{0,p} + \alpha_{1,p}*EVA_{i,b,} + \theta_p*Z_i + \varepsilon_{i,b,p} \quad (5)$$

$$WTP_{i,b} = \alpha_{0,w} + \alpha_{1,w}*EVA_{i,b,} + \theta_w*Z_i + \varepsilon_{i,b,w}$$

We estimate these models per brand, because the effect of EVA on PI, and WTP might differ between brands. For instance, while consumers might highly value Audi, its high price may limit purchase intent.

5. Findings

5.1 Descriptive Results

Before presenting our estimation results, we briefly discuss the descriptive findings in Table 4. For the total sample, we find that component sharing on average decreases the evaluation for the high-end brand by 6.23 (standard deviation = 15.26), while it increases evaluation for the low-end brand by 2.61 (s.d. =14.87). Both values significantly differ from 0 ($p<0.01$), and are in line with our expectations for both sets of brands. Interestingly, the absolute change for the high-end brand is significantly larger than the absolute change for the low-end brand ($p<0.01$). We find significant differences between the two brand-sets. The average deviation is significantly larger for L/T/S, than for A/V/S. This difference is consistent with the alleged lower component sharing by Japanese brands (Fisher et al. 1999), and reflected in the larger price differences between them.

Our results show significant differences in changes in evaluations between the brand combinations ($p<0.01$) and the source of the components ($p<0.01$) for both the high-end and the low-end brand. We particularly find that the luxury-volume combination yields the highest change in evaluation. Interestingly, we also find that the lower-end brand's evaluation gets a higher boost when it is identified as the source of component sharing.

-- Insert Tables 4 and 5 about here --

5.2 Model Results Evaluation

Change in Evaluation for the High End brand

Estimation results of equations (4) with random effects are displayed in the first two columns of Table 5. For interpretation of the coefficients, it is important to note that a negative coefficient implies a larger negative change in evaluation of the high-end brand.

First, we find that the change in evaluation depends on the type of brand combination, as we find a negative significant effect of LUXVOL ($p<0.01$). Thus, if a luxury brand shares components with a volume brand, the negative change in evaluation is larger than when the volume brand shares components with an economy brand. This supports the notion that the luxury brand has a special status/prestige, which is more affected by sharing than the evaluation of brands in the lower ends of the spectrum. Note also, that we find a significant negative effect of the initial evaluation of the high-end brand (EVA_{he}) ($p<0.01$). High-end brands with strong initial evaluation suffer a larger decrease in customer evaluation when sharing components. The opposite occurs for the initial evaluation of the low-end brand (EVA_{le}): component sharing with a better-evaluated low-end brand is less harmful for the high-end brand ($p<0.01$).

Second, the identified source of component sharing does significantly affect the evaluation changes. In line with expectations, we find that the largest negative change occurs when the lower-end brand is named as the component source (LOWHI) ($p<0.01$). The smallest change occurs when naming the high-end brand as the source (HILOW) ($p<0.01$). Our results also show that the negative change in evaluation is significantly larger for L/T/S than for A/V/S ($p<0.01$).

With respect to the components, we find that sharing the interior ($p<0.01$), wheels ($p<0.05$) and the chassis ($p<0.05$) have a significant larger negative impact than sharing the wiper component. The effects of sharing the other components do not significantly differ from sharing the wiper component.

Finally, we find significant effects of our included consumer characteristics. We particularly highlight the effect of owning one of the shared brands. We find that owners of the luxury and volume brands have larger negative change in evaluation than non-owners ($p<0.01$), while the opposite occurs for economy brand owners. This finding is consistent with the notion that owners of luxury and volume brands care more about maintaining their brand status and uniqueness (Kirmani, Sood and Bridges 1999).

Change in Evaluation for the Low End Brand

For interpretation of the coefficients in the last column of Table , note that a positive coefficient implies a larger positive change in evaluation of the lower-end brand.

First, our findings for brand combination mirror those for the evaluation change in the high-end brand. The change in evaluation of the volume brand when sharing components with the luxury brand is smaller than the change in evaluation of the volume brand sharing with the economy brand ($p < 0.01$). Managerially, the negative consequences for the luxury brand are relatively large, while the benefits for the volume brands are relatively small. For the volume-economy combination, the opposite holds: the economy brand evaluation benefits are higher than the evaluation harm for the volume brand.

Second, the initial evaluation of the two brands also affects the change in evaluation of the low-end brand. Particularly, we find that the change is larger when the high-end brand has a high initial evaluation ($EVAL_{he}$) ($p < 0.01$), while it is lower when the low-end brand has a high initial evaluation ($EVAL_{le}$) ($p < 0.01$). Thus, low-end brands that are already evaluated favorably by consumers do not benefit much from sharing components with high-end brands.

Our results also show that the change in evaluation depends on the source of the component. We find that the largest change occurs when the low-end brand functions as a source (LOWHI) of the shared components ($p < 0.01$). In other words, consumers apparently conclude that the lower-end brand must have really good quality components, for them to be used in a higher-end brand. Interestingly, the smallest evaluation increase occurs when the high-end brand is named as a source (HILOW) ($p < 0.01$). This finding is surprising, as the ingredient branding literature would suggest that specifying the higher-end brand as the source should yield the largest evaluation increase for the lower-end brand. Together with our finding for the higher-end brand evaluation, this result suggest that no framing format is dominated by others from the manager's perspective: the sourcing formats that yield higher benefits to the lower-end brand, cause more harm to the evaluation of the higher-end brand.

With respects to the components, the car engine is the sole component that has significantly larger positive effect on the receiving brand ($p < 0.05$). We also find significant effects of our included consumer characteristics. The evaluation change is larger when the consumer owns the volume brand ($p < 0.01$) or the economy brand ($p < 0.01$). It is smaller when the consumer owns a luxury brand ($p < 0.01$).

5.3 Purchase Intent and Willingness To Pay Models

In table 6, we report the estimation results of equation (5) using Seemingly Unrelated Regression. As many variables failed to reach effects with p-values below 0.20, we deleted these variables to achieve a more parsimonious model. The R^2 varies between 0.19 and 0.420 for the intention models, and between 0.14 and 0.39 for the price (WTP) models. As expected, we find a significant positive effect of brand evaluations on purchase intentions and willingness to pay in all cases. The size of these effects varies between brand types. We also find some significant effects of the included consumer characteristics.

- Insert Table 6 about here –

6. Assessing Revenue Effects

To assess the revenue consequences of the component sharing strategies, we have to make some assumptions by: (1) setting the expected base quantity to the 2004 sales of the cars on the Dutch market, and (2) using the average measure of consumer characteristics across all respondents, as a proxy for actual potential buyers. Most importantly, we acknowledge that our self-report results may overestimate actual consumer decisions, as marketing literature has established that intentions are powerful, but imperfect predictors of future purchase behavior (Morwitz and Schmittlein 1992). For automobile purchases, the authors found that only about 30% of the respondents who intended to buy a car in the next 0-6 months actually did so (ibid). While this finding does not necessarily translate into intention *changes* due to component sharing, we believe it serves as a useful benchmark for our revenue impact simulation. Therefore, we perform our calculation assuming that market actions by (potential) customers will only partially translate into actions, by weighting intention and willingness-to-pay changes by a factor of 0.3. Evidently, the latter calculation can also be used by managers to incorporate the phenomenon that only a subsection of potential customers learn about component sharing before making their purchase decision.

For illustration purposes, we perform our revenue impact calculation for four components, one from each cell of table 1: interior, wipers, engine and platform/chassis. Following our model in Figure 1, we first calculate the impact of component sharing on the customer evaluation of each brand, using the estimates of table 5. Next, we translate this evaluation change to percentage effects on purchase intention

and willingness to pay, using the estimates in table 6. In absolute values, changes to purchase intention are in the [.17%, 16.31%] range, while changes to willingness to pay are in the [.03%, 4.44%] range. As none of these values appeared unreasonable to car industry analysts, we proceed with computing the revenue consequences by multiplying the actual 2004 market sales and prices with our % changes, weighting the intention and willingness to pay findings by 0.3. Tables 7-9 summarize the results for each of the three sourcing formats.

- Insert Tables 7, 8 and 9 about here -

Overall, component sharing has the expected *negative* impact on revenues, which should then be compared to anticipated cost savings to guide decision making. For the German manufacturer, the revenue decline ranges from 0.53% to 4.25% of the total revenue of the involved brands. For the Japanese manufacturer, we in general find revenue drops in a lower range: from .01% to 2.98%. In other words, brands matter: Toyota Motor Corporation appears to suffer less than Volkswagen AG in terms of revenue consequences from component sharing. Interestingly, we even find a *positive* revenue impact for Lexus sharing with Toyota, especially for important components (engine and platform/chassis) and when Toyota is identified as the source. A priori, two reasons may explain this result. First, Lexus' brand status may not decrease much (perhaps even increase) as a result of sharing components with Toyota, as Toyota cars have a strong reputation for quality and reliability. Our findings do not support this explanation, as purchase intentions for Lexus do drop by 7%-15%, and willingness to pay by 1%-5% as a result of component sharing. Instead, our calculations support a second explanation: Toyota sales dwarf Lexus sales in the Netherlands, so that any benefit to Toyota is weighted much more than any harm to Lexus. In this case, company revenues may actually benefit from spreading the word on component sharing between the major volume brand and a very small luxury brand. Evidently, such behavior may conflict with long-term objectives, such as building the luxury brand.

As expected, the type of shared component matters: sharing an important *and* visible component such as the car's interior typically generates the strongest revenue loss. However, revenue consequences are not that much lower for components that rate low on importance and/or visibility. To the extent that these

findings are reflected in the market place (see acknowledged limitations below), our results suggest that manufacturers should carefully consider customer evaluation for any type of component sharing.

Finally, the component source matters, which is good news to manufacturers that can exercise some control over this issue. For luxury brands sharing with volume brands, it appears best to identify the lower-end brand as the source. For volume brands sharing with economy brands, it again pays to identify the volume brand as the source. In other words, a general guideline emerges: *identify the volume brand as the component source*. The generalizability of this guideline is strongly tied to the large relative contribution of the volume brand to the manufacturer's top line. Indeed, the volume brand represents 77% of revenues for both analyzed brand combinations.

7. Conclusions and Avenues for Future Research

This paper analyzed the revenue consequences of component sharing by considering customer evaluation changes for both the higher-end brand and the lower-end brand. First, consistent with anecdotal evidence (Business Week 2004), we find that component sharing harms customer evaluation of the higher-end brand. The size of this negative effect, however, depends on the component source and on the type of component shared. It is largest for the car's interior, which is both important and visible to consumers. It also becomes larger when the lower-end brand is the source of the component. In this case, negative associations of the lower-end brand may be transferred to the higher-end brand.

For the lower-end brand, the positive impact of component sharing also depends on the analyzed conditions. First, the economy brand seems to benefit most from component sharing. This brand has the lowest perceived quality and status, and it does not take much to improve its evaluation. In contrast, the volume brand already has a sound reputation with respect to most of the components. Second, identifying the lower-end brand as the source of the shared component helps. This appears *counterintuitive*, as one would expect that a component from the higher-end brand might function as a kind of ingredient for the lower-end brand. One explanation for this finding is that consumers will perceive that components of the

lower-end brand are apparently so good, that they are shared with the higher-end brand, which boosts the evaluation of the lower-end brand. Further research is needed to validate this explanation.

We also assessed the revenue impact of component sharing strategies. In general, component sharing will have negative revenue effects, because the negative change in evaluation of the higher-end brand is much larger than the positive evaluation change for the lower-end brand. Therefore, manufacturers should be very careful when implementing component sharing. However, our simulations imply positive revenue effects when small (niche) luxury brands share components with very large volume brands. In the short run, component sharing may thus improve both revenues and costs. In the long-run though, these positive changes might be offset by large negative effects on the perceived prestige of luxury brands.

The current study has several limitations, including the choice of country and respondent sample, the focus on only six brands, and the use of stated (self-reported) impact instead of actual sales data. Moreover, we focused on the customer side of component sharing; which received little previous study. Other parts of the profitability equation are needed to balance the revenue and cost drivers. For instance, we could not obtain precise information on the component cost-coefficient (Desai et al 2001) for a representative group of manufacturers (such information is highly confidential and likely differs per firm). Future research can also use a between-subjects design to assess the differences between components, and study boundary conditions, such as timing of sharing (i.e., immediately or after 1 year). One particular interesting avenue for further research is to directly analyze the sales impact of component sharing announcements and articles.

Despite these limitations, the current study provides several key insights which are relevant to the decision on and the execution of component sharing. As consumers are becoming more knowledgeable about component sharing practices, managers should aim for solutions that look good in the boardroom and in the showroom.

Appendix: Pretest, and experimental procedures and measures

A1. Pretests

We selected a European brand combination Audi, Volkswagen and Skoda, and a Japanese brand combination Lexus, Toyota and Suzuki. Within these brands, we choose cars of the same size: Audi A4 Sedan, Volkswagen Passat Sedan and the Skoda SuperB Sedan; and Lexus IS 2000, Toyota Corolla Verso, and Suzuki Lilian. The dealer prices of the considered brands for Audi, VW and Skoda are respectively 33.000 Euro, 29.500 Euro, and 26.000 Euro. For Lexus, Toyota and Suzuki these prices are respectively 34.000 Euro, 26.000 Euro, and 17.000 Euro. In order to enhance external validity, we also provided typical information (identical across cars) on motor, gear and steering specifications. Some validity for our classification is provided in a separate pre-study, where we asked 50 consumers to evaluate the brands in terms of perceived price level, perceived prestige level and perceived quality on a 10-point scale. The average scores for Audi are 7.48, 8.01 and 7.92. For Volkswagen, these average scores are 7.01, 7.77 and 7.48. The average scores for Skoda are 5.28, 4.77 and 6.05. Pair wise t-tests reveal significant differences ($p < 0.05$) between Audi and Volkswagen, Audi and Skoda, and Volkswagen and Skoda on all these variables. We also asked these respondents to classify the brands in the luxury segment, the volume segment and the economy segment. In line with our classification 84% considered Audi as a luxury brand, 60% considered Volkswagen as a volume brand and 74% considered Skoda as an economy brand. Thus, these brands can indeed be considered as luxury, volume and economy brands. These 50 consumers also evaluated Toyota and Suzuki. The average scores on perceived price level, perceived prestige level and perceived quality on a 10-point scale for Lexus are 7.35, 7.48, and 7.40, for Toyota are 6.91, 7.14 and 7.78 and for Suzuki are 5.46, 5.67, and 6.36. These results show that based on price, and prestige level Lexus can be considered as prestige brand, Toyota as volume brand, while Suzuki can be considered as an economy brand. Note the very high quality score for Toyota, which reflects its reputation as the most reliable brand in the Dutch market. 76.9% of respondents classified Lexus as a prestige brand, 72% classified Toyota as volume brand, while 75% classified Suzuki as economy brand. Overall, these results support our classification of the considered brands.

We also aim to select components that vary in terms of importance and visibility, drawing upon various sources: statements in prior literature on component sharing practices in this industry (Fisher et al. 1999) and desk research by a research assistant. The selected 8 components are engine, brakes, wipers, platform/chassis, design, interior, shock absorbers, and wheels, as shown in table 1. 114 Dutch consumers master students evaluated the importance (1= not important, 7 = very important) and the visibility of the components (1=not visible, 7=very visible). Table A.1 shows substantial variation in the importance and visibility of these components, in line with our framework in table 1.

Table A.1:
Average importance and visibility of selected components

Component	Average Importance	Average Visibility
Design	5.87	6.41
Engine	5.89	4.57
Brakes	5.64	3.71
Interior	5.56	6.19
Shock Absorber	4.97	3.30
Platform/Chassis	4.50	3.48
Wheels	4.33	5.10
Wipers	3.66	4.31

Appendix A.2
Experiment material: picture and information on the three brands
A: Audi/Volkswagen/Skoda

Audi A4: Important characteristics of this car are:
2.0 l motor, 100 KW
5 gears
Power steering
Air conditioning
Price: 33.000 Euro

Volkswagen Passat: Important characteristics of this car are:
2.0 l motor, 100 KW
5 gears
Power steering
Air conditioning
Price: 29.500 Euro

Skoda SuperB: Important characteristics of this car are:
2.0 l motor, 100 KW
5 gears
Power steering
Air conditioning
Price: 26.000 Euro

B: Lexus/Toyota/Suzuki

Lexus IS 2000 Sport Business: Important characteristics of this car are:
2.0 l motor, 100 KW
5 gears
Power steering
Air conditioning
Price: 34.000 Euro

Toyota Corolla Verso: Important characteristics of this car are:
1.6 l. Motor, 75 KW
5 gears
Power steering
Air conditioning
Pice: 26.000 Euro

Suzuki Lilian: Important characteristics of this car are:
1.6 l. Motor, 75 KW
5 gears
Power steering
Air conditioning
Priice: 17.000 Euro

Table 1:

Component Importance and Visibility

	More Important	**Less Important**
More Visible	**Interior** **Design**	**Wheels** **Wipers**
Less Visible	**Engine** **Brakes**[5]	**Platform/Chassis** **Shock Absorbers**

[5] While Fisher et al. (1999) note industry belief that brakes are less important, our respondents in a pre-test (n=118) indicated brakes are important, consistent with Business Week (2004).

Table 2:

Initial Average Evaluations (standard deviations) for Brands

	Evaluation	Price (in Euros)	Intentions
Audi	73.3 (13.1)	26,776 (9,353)	4.42 (2.6)
VW	68.4 (13.4)	24,356 (6,718)	4.35 (2.5)
Skoda	61.6 (16.7)	19,582 (7,953)	4.0 (2.2)
Lexus	66.1 (20.1)	25,609 (7,975)	3.6 (2.4)
Toyota	59.74 (18.0)	20,343 (4,392)	3.8 (2.5)
Suzuki	54.9 (17.3)	15,186 (6,230)	2.8 (2.1)

Table 3:

Source Component Scenarios

General Introduction	In the car-industry it may occur, that car manufacturers use the same components in different brands. This occurs mainly when manufacturers offer multiple brands. For instance, Brand A may have the same brakes as Brand B.
High-end to low-end	The manufacturer has decided to use component (name) in the low-end (name) brand that is also used in the high-end (name) brand
High-end & Low-end	The manufacturer has decided that the component (name) in both the high-end (name) and low-end brand is equal.
Low-end to High-end	The manufacturer has decided to use component (name) in the high-end (name) brand that is also used in the low-end (name) brand.

Table 4:

Descriptive Statistics on Experimental Conditions (N=1160)

Brand Positioning Combination	**Higher-End Brand**	**Lower End-Brand**	**Source Format (Framing) of Component Sharing**	**Higher-End Brand**	**Lower End-Brand**
Luxury – Volume	-4.93	0.18	Higher-End to Lower-End	-4.55	0.07
(standard deviation)	(13.63)	(11.45)		(12.67)	(12.12)
Volume– Economy	-7.28	4.66	Higher-End & Lower-End	-6.78	2.91
	(16.38)	(16.99)		(19.75)	(16.74)
			Lower-End to Higher-End	-7.39	4.94
				(13.03)	(15.44)
p-value	0.01	0.00		0.02	0.00
Shared Component	**Higher-End Brand**	**Lower End-Brand**	**Shared Component**	**Higher-End Brand**	**Lower End-Brand**
Engine	-6.17	3.17	Design	-4.91	2.44
	(14.70)	(14.81)		(13.91)	(14.82)
Wiper	-5.40	2.33	Wheels	-7.11	2.36
	(15.21)	(14.80)		(16.42)	(15.11)
Interior	-7.45	2.63	Chassis/platform	-6.69	2.52
	(16.36)	(15.02)		(15.24)	(14.76)
Brakes	-5.99	2.64	Shock Absorbers	-5.82	2.96
	(14.87)	(15.02)		(15.01)	(14.51)
p-value	0.86	1.00			
Brand Set					
Audi-Volkswagen-Skoda	-4.82	1.97			
	(13.04)	(13.76)			
Lexus-Toyota-Suzuki	-7.37	3.16			
	(16.77)	(15.76)			
p-value	0.01	0.18			

Table 5:
Estimation Results for First-Stage: Equations (3) and (4) (N=1160)

Variables	ΔEVA HE	ΔEVA LE
LUXVOL	-0.76**	-1.39**
(standard deviation)	(0.31)	(0.23)
HILOW	1.25**	-3.39**
	(0.38)	(0.29)
LOWHI	-2.10**	1.63**
	(0.38)	(0.29)
BS	2.95**	-1.33**
	(0.32)	(0.23)
ENGINE	-0.77	0.84*
	(0.55)	(0.43)
INTERIOR	-2.06**	0.07
	(0.61)	(0.41)
BRAKES	-0.59	0.31
	(0.61)	(0.44)
DESIGN	0.49	0.11
	(0.57)	(0.39)
WHEELS	-1.72*	0.03
	(0.63)	(0.44)
SHOCK ABSORBERS	-0.42	0.19
	(0.61)	(0.46)
CHASSIS	-1.28*	0.19
	(0.59)	(0.44)
EVA_{he}	- 0.51**	0.46**
	(0.01)	(0.01)
EVA_{le}	0.44**	-0.47**
	(0.01)	(0.01)
AGE	-0.11**	-0.17**
	(0.02)	(0.02)
SEX	0.97**	0.45
	(0.37)	(0.26)
EDUC	1.89**	1.00**
	(0.24)	(0.29)
INCOME	-2.97**	1.03**
	(0.42)	(0.29)
EXPERIENCE	0.02	0.15**
	(0.02)	(0.01)
OWNLUX	-7.56**	-8.07**
	(0.85)	(0.60)
OWNVOL	-8.56**	3.24**
	(0.46)	(0.33)
OWNECON	8.74**	2.68**
	(0.98)	(0.74)
CONSTANT	8.65**	-0.83
	(1.80)	(1.16)
S.D. CONSTANT	9.34**	10.33**
	(0.14)	(0.10)
Loglikelihood RE	-4098.61	-4542.76
Loglikelihood OLS	-4469.68	-3786.33
p-value Likelihood-ratio (RE-OLS) test	0.00	0.00

Table 6:

Effects of Evaluation on Purchase Intent and Willingness-to-Pay (equation 5)

AUDI		**VOLKSWAGEN**		**SKODA**	
INTENTIONS	*Coefficient*	*INTENTIONS*	*Coefficient*	*INTENTIONS*	*Coefficient*
CONSTANT	-0.54	CONSTANT	-0.66	CONSTANT	-3.55
EVAL	0.07**	EVA	0.10**	EVA	0.09**
EXPER	-0.06*	AGE	-0.04*	INCOME	0.76
		OWNVOL	1.42*		
R^2	0.22	R^2	0.34	R^2	0.42
PRICE	*Coefficient*	*PRICE*	*Coefficient*	*PRICE*	*Coefficient*
CONSTANT	15205	CONSTANT	1526.35	CONSTANT	3573.41
EVAL	137.00	EVA	214.26**	EVA	254.24**
EDUC	2668.40	INCOME	2963.90*	INCOME	11411.62*
AGE	-167.68				
ONWLUX	-10771				
OWNECON	7397.58				
R^2	0.17	R^2	0.21	R^2	0.39
LEXUS		**TOYOTA**		**SUZUKI**	
INTENTIONS	*Coefficient*	*INTENTIONS*	*Coefficient*	*INTENTIONS*	*Coefficient*
CONSTANT	-1.23	CONSTANT	0.00	CONSTANT	-1.48
EVAL	0.05**	EVA	0.06**	EVA	0.05**
EDUC	0.52			EDUC	0.43
R^2	0.19	R^2	0.30	R^2	0.21
PRICE	*Coefficient*	*PRICE*	*Coefficient*	*PRICE*	*Coefficient*
CONSTANT	8016.23	CONSTANT	12412.08**	CONSTANT	166623.23
EVAL	108.51**	EVA	50.98*	EVA	50.71
EXPER	-192.22**	AGE	119.53**	INCOME	-227.31**
INCOME	5184.07*	OWNVOL	-2164.85**	EXPER	3648.98*
R^2	0.24	R^2	0.14	R^2	0.21

Notes:
* $p<0.05$; **$p<0.01$

Table 7:

Revenue impact (in Euros) of component sharing strategies without specifying component source

	Audi-VW	VW-Skoda	Lexus-Toyota	Toyota-Suzuki
Interior	- 29, 506 K	- 42, 873 K	- 111 K	- 22, 203 K
Engine	- 19, 500 K	- 29, 945 K	*3, 243 K*	- 15, 960 K
Platform	- 26, 700 K	- 35, 498 K	*468 K*	- 18, 875 K
Wipers	- 25, 698 K	- 23, 831 K	- 198 K	- 13, 886 K
Average	-29, 351 K	-33,037 K	*851 K*	-17,731 K

Table 8:

Revenue impact (in Euros) of component sharing strategies from higher-end to lower-end brand

	Audi-VW	VW-Skoda	Lexus-Toyota	Toyota-Suzuki
Interior	- 58, 328 K	- 35, 480 K	- 14, 061 K	- 21, 413 K
Engine	- 48, 394 K	- 22, 513 K	- 10, 753 K	- 15, 159 K
Platform	- 55, 523 K	- 28, 072 K	- 13, 488 K	- 18, 071 K
Wipers	- 54, 474 K	- 16, 343 K	- 14,142 K	- 13, 048 K
Average	-54,180 K	-25,602 K	-10,490 K	- 16,923 K

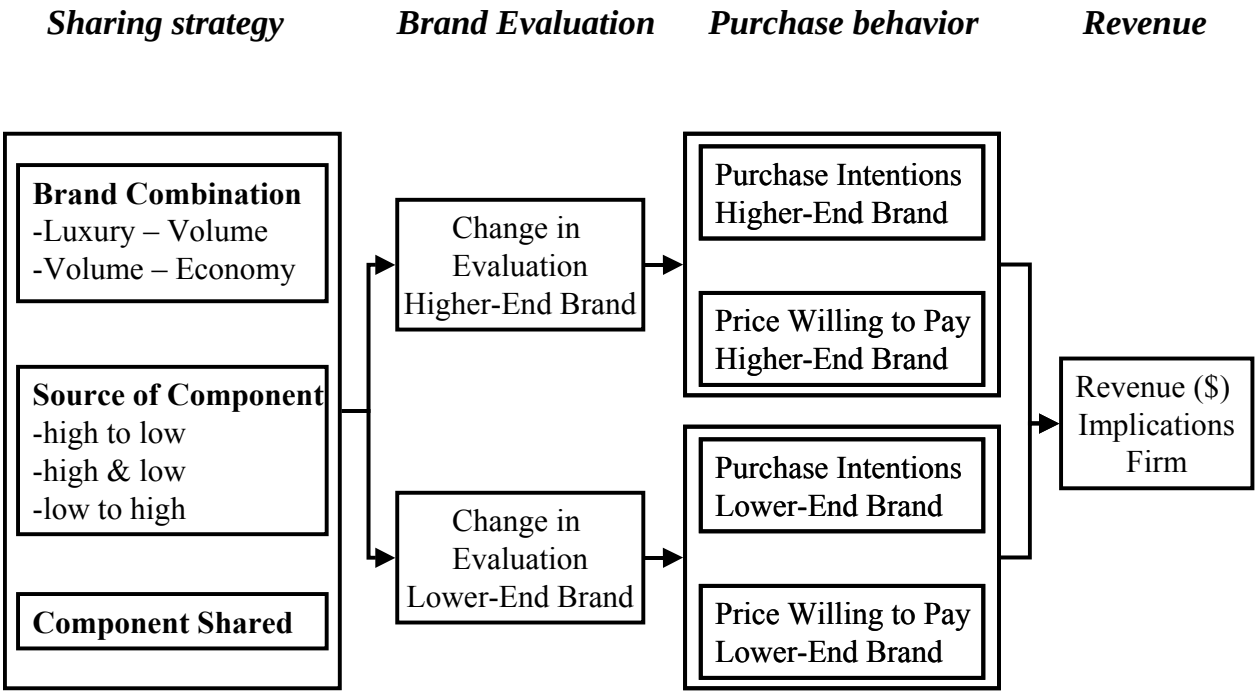
Table 9:

Revenue impact (in Euros) of component sharing strategies from lower-end to higher-end brand

	Audi-VW	VW-Skoda	Lexus-Toyota	Toyota-Suzuki
Interior	- 18, 687 K	- 60, 174 K	*6, 523 K*	- 28, 597 K
Engine	- 8, 675 K	- 46, 111 K	*9, 898 K*	- 22, 393 K
Platform	- 15, 898 K	- 52, 858 K	- 506 K	- 18, 777 K
Wipers	- 14, 946 K	- 41, 290 K	*6, 431 K*	- 20, 359 K
Average	11,641 K	-50,108 K	*5,587 K*	-22,532 K

Figure 1:

Model Framework for Assessing Revenues Impact of Component Sharing Strategies



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