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Brand loyalty among Norwegian car owners

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ABSTRACT

Obtaining brand-loyal customers has been demonstrated to be vital for profitability and survival of firms. Loyal customers generally have a higher willingness-to-pay and lower price sensitivity compared to other customers. In this article, we study brand loyalty among car owners using empirical data on 35,000 car changes in Norway from 1985 to 2013. In contrast to earlier studies on loyalty within this industry that aimed at revealing the attitudes of customers, our data discuss the actual behaviour. As a supplement to our behaviour data set, we use satisfaction measures produced by Autoindex. Average loyalty, as measured by the consecutive purchase of the same brand, amounts to 26.4%. By including returning customers and measuring the repurchase of the same brand as one of the customer's three previous cars, the average loyalty increases to 36.7%. In general, the most prevalent brands attract the most loyal customers. A logit model is applied to describe the factors that have the strongest influence on brand loyalty. The information obtained by this study is of interest to several parts of the automotive industry value chain. Moreover, the analysis is relevant for researchers conducting attitudinal studies on loyalty and satisfaction by comparing this information to the actual behaviour of customers.

1. Introduction

In the competitive world of consumer durables, brand-loyal customers are vital for the profitability and survival of firms. Branding products and attracting loyal customers are important components of many businesses competitive strategies.

The marketing cost to attract a new customer has been found to be about six times higher than retaining an existing one (Mellens et al., 1996). Loyal customers are also more willing to pay higher prices and are less price-sensitive compared to other customers (Krishnamurthi and Raj, 1991). Moreover, loyal customers can increase the quality as well as productivity of retailer service departments as they offer information about customers' needs and preferences. The automotive retail market is one of the most mature and developed markets that exist. There are a number of different car makes and models that are growing increasingly similar, which boosts competition between automobile manufacturers and makes brand loyalty an important competitive factor (see e.g., Söderlund, 2004).

By the end of 2014, there was a rolling stock of approximately 2.5 million cars owned by 1.9 million private households in Norway (Statistics Norway, 2015). A total of 430,000 second-hand cars are sold annually in the Norwegian market. Approximately 81% of the consumers who bought a car between 1985 and 2013 had already owned a car according to our data set. The experience that car owners have with the different brands is vital for the future sale of these makes (Devaraj et al., 2001). Our data thus indicates that brand loyalty is important in the Norwegian market for both new and used cars.

Auto retailers often sell auto repair services, and the income from these services constitutes a significant part of their total income. According to an interest organisation for road traffic (OFV), the average maintenance and service costs in 2014 for a mid-range car in Norway was approximately 12% of total annual auto expenses (OFV, 2014a). This implies that the quality and productivity of the retailer's auto repair departments have a profound influence on the consumers' brand loyalty (Bloemer and Pauwels, 1998; Verhoef et al., 2007).

The way in which changes in loyalty among car owners influence the market for cars depends on how dominant these brands are when consumer loyalty changes. The more prevalent the make is, the more significant the changes are when loyalty affects the market. We can illustrate this effect with Norwegian data. In 2013, 348,232 Volkswagen passenger cars and 80,868 Mitsubishi passenger cars (OFV, 2014b) were registered. The stock of Volkswagen cars was approximately four times greater than that of Mitsubishi cars. This means, broadly speaking, that a similar change in loyalty for those two brands among their owners is four times more significant for the sale of all other brands if the change in loyalty occurs with Volkswagen rather than Mitsubishi. Therefore, car dealers should be alert to changes in brand loyalty for the most prevalent brands.

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The aim of this article is twofold. First, we present car owners' brand loyalty for the 20 most prevalent makes in Norway. We then analyse how brand loyalty is influenced by characteristics of car owners and satisfaction with the dealers and the car. The analysis applies an extensive empirical data set containing repurchasing information for cars in Norway for the period 1985–2013. Because the market for cars is mature in all industrialized countries, information about both exogenous and controllable factors for auto retailers that influence car owners' loyalty to different brands is of interest for actors at many stages of the value chain in this industry.

In Section 2, we discuss the concept and measurement methods of brand loyalty. In Section 3, we will describe the data with an emphasis on loyalty and market shares for different brands. Section 4 presents the model, followed by the empirical results and a discussion in Section 5. Finally, in Section 6, we present the conclusions and highlight the possible implications and limits of this study.

2. Brand loyalty measures

2.1. Consumer repurchasing behaviour and brand loyalty

In the marketing literature, researchers attempt to distinguish between repeat purchasing behaviour and brand loyalty behaviour (Mellens et al., 1996). Odin et al. (2001, p. 76) states that '*Repurchasing the same brand could be a result of a reflective loyalty, as a result of brand commitment or a favourable attitude against the brand, or an inertia of purchase, that is to say, a repeat purchasing of the same brand without a real motive for the choice made*'. Hence, if inertia makes an individual repurchase the same brand, then the behaviour is not brand loyalty but rather a repeat purchase.

Despite this observation, we have chosen to measure brand loyalty in the auto market as repurchasing a car of the same brand one earlier has owned. Most consumers do not buy cars regularly (e.g., on a monthly or yearly basis). In our data set, the average time period between which a consumer purchases a car is four and a half years (see Section 3). Therefore, buying a car is, for most people, a decision with considerable economic consequences and is subject to careful consideration. Thus, purchasing a car will be mostly a reflective decision based on information gathering and is not governed by inertia.

2.2. Our loyalty measures

In a considerable part of the literature, a difference is noted between behavioural and attitudinal measures of brand loyalty. Behavioural measures address actual observed behaviour or self-reported actual past behaviour. Attitudinal measures, on the other hand, rely on preference statements or statements of likely behaviour. For a thorough discussion, see e.g., Jacoby and Chestnut (1978), Mellens et al. (1996) and Söderlund (2004).

Our unique data from the Norwegian Public Road Administration (NPRA) are behavioural. Here, we can follow an individual consumer's car-purchasing history from 1985 to 2013. Whereas self-reports of actual past behaviour can be biased by lack of memory and strategic answering, our data contains evidence of actual behaviour. To our knowledge, no study has been published on car owners' brand loyalty based on their actual evidenced behaviour. In addition, we will use material from Autoindex,[1] which we will characterize as attitudinal. The Autoindex material is a survey measuring consumer confidence regarding dealers and cars in the automotive market.

When potential customers choose between different makes (brands) of cars, the purchase pattern that should be observed as evidence of brand loyalty can be discussed. Consecutive purchasing of the same brand is denoted as transaction loyalty by Mannering et al. (1991) or consistent loyalty by Mellens et al. (1996). A car owner could also have a split loyalty – always buying one of two makes – or an unstable loyalty – repeating but not consecutively purchasing the same brand, as noted by Jacoby and Chestnut (1978).

Based on the definitions in the literature, we have operationalised two different measures of brand loyalty, which are denoted P and Q. See Appendix A for a formal definition of the two loyalty measures.

- The probability (P) that the car owner buys the same brand in two consecutive car purchases ($0 \leq P \leq 1$).
- The probability (Q) that the car owner buys the same brand as in at least one of last three previous car purchases ($0 \leq Q \leq 1$).

The first measure (P) is an example of transaction loyalty or consistent loyalty, while the second measure (Q) could be characterized as unstable loyalty. The higher the values of P and Q are, the more loyal the car owners are towards their preferred brand. Because Q is a broader measure of brand loyalty[2] compared to P, $Q \geq P$. While (P) is a common measure of loyalty for consumer durables, our second measure (Q) is, of course, debatable. We could, for example, have defined loyalty (Q^*) as the probability that a car owner buys the same brand as at least one of the two previous car purchases. Q^* would thus be a more narrow definition of loyalty than Q but is still a wider definition than P. This implies that $P<Q^*<Q$. Choosing P and Q instead of P and Q^* provides us with loyalty measures that are more different, and this increases the reliability and generalizability of our results.

The reasons for the high values for loyalty measures, such as P and Q, are satisfaction with the car, satisfaction with the sales service of the dealer and satisfaction with the dealers' after-sales service (Bloemer and Pauwels, 1998; Mittal and Kamakura, 2001). In the Norwegian automobile industry, it is a normal practice for dealers to represent one brand only. Dealers also have their own workshops that perform maintenance and repairs on their designated car brand. Therefore, satisfaction with the dealer's sale and after-sales service is likely to enhance brand loyalty to the car make.

These findings are consistent with Autoindex's survey, which attempts to measure car owners' satisfaction and loyalty.[3] The survey focuses on satisfaction with the car, the dealer and the after-sales service regarding maintenance and auto repair. For a thorough discussion of variables that influence brand loyalty, see, for instance Söderlund (2004), Selnes (2002) and Johnson et al. (2001).

Finally, we find it worth noting that our measures of brand loyalty may also be high if some brands are relatively cheap and other brands are not available. Therefore, high values for P and Q do not necessarily mean that car owners are very satisfied and loyal to the brand but that financial and other circumstances force them to choose a specific brand (see Mellens et al. (1996) and Söderlund (2004)).[4] This possibility is a weakness with regard to

[1] Autoindex is a national customer satisfaction barometer or index that measures customer satisfaction in the automotive market. The consulting firm Loyalty Group AS compiles Autoindex. More information about the index can be found at Loyaltygroup.no.

[2] Let (A, A, B, A) represent the purchasing sequence of brands A and B for person 1, whilst (A, B, A, B) gives the similar behaviour for person 2. According to the first measure (P), only person 1 is loyal to product A, whilst both persons are loyal according to the second measure (Q).

[3] Surveys like Autoindex are also prepared in other countries. For example, in the US, similar surveys, such as Consumer Reports and the J.D. Power Report, exist.

[4] Söderlund (2004) discusses barriers that can enhance loyalty even if the customers are dissatisfied – for instance, barriers of information, social barriers, economic barriers and barriers caused by market structure.

our measures. Earlier data from East Germany would probably have shown very loyal car owners buying East German-produced cars, such as Trabant, even if their satisfaction with the car were at a very low level. In Norway, this is a considerable smaller problem because the population in our period of research have had relatively strong purchasing power and a plentiful supply of both inexpensive and expensive models and makes.

3. Empirical data

3.1. The data set

NPRA prepared most of the empirical material applied in this study. The nature of the data allows us to follow each car owner's 'car history' over the period in question; that is, we can observe when the owner changes cars, the car's age and brand. Autoindex provides information on the car owners' satisfaction with the cars and dealers.

Because we are interested in explaining brand loyalty, we only study car purchases among private consumers who already own a car. Consequently, first-time buyers and purchases made by firms (company cars) are not part of this empirical material. We have limited our study on repurchasing cars to the years 1985 to 2013. We have also delineated our material about changing cars to persons in Norway whose family names are Hansen, Karlsen and Olsen. Because these names are the equivalent of Smith and Browns in Norway, with a nationwide prevalence, there is no reason to believe that this selection imposes any selection biases in the sample. Further, we have limited the analysis of cars to the 20 most prevalent brands in 2013 (OFV, 2014b). We have also information about the age, gender and residence of the buyers when the purchase took place. After these limitations and a purge of obviously incorrect data, we have information on 35,068 purchases of cars made by 9 120 different individuals, which is an average of 3.8 purchases per person in this period.

Table 1 gives an overview of the variables. Approximately 26.4% of car owners in Norway repurchased the same make as the previous car in the period studied, whereas 36.7% repurchased the same brand as one of the previous three cars owned. The average age of the people repurchasing cars was approximately 42 years; almost 80% of the purchases were made by men, and 16.1% were conducted in the Norwegian capital of Oslo. Differences in brand loyalty between the capital and the rest of the country are included because both the number of car dealers and the number of potential customers are significantly larger in Oslo compared to the rest of the country.

Autoindex provides national car satisfaction indices for each of the Scandinavian countries on a scale ranging from 1 (lowest) to 1000 (highest). The indices measure car owners' satisfaction with dealers and cars for each brand. We have access to the Autoindex statistics released from 2006 to 2014, of which each of these annual scores builds on car purchases for the previous seven years. Consequently, our data set produces an average score for each brand based on purchasing perceptions from 1999 to 2013. Although the satisfaction data from Autoindex does not cover the entire time span of the behaviour data set, we believe it to be a good approximation as approximately 82% of the observed car changes have taken place in this period.

A more detailed analysis of the data shows that Volkswagen, Toyota and Ford were the brands that most car owners purchased when they acquired a new or used car. These cars' shares were 12% for Volkswagen and 10% for Toyota and Ford. Just over 1% of the registered repurchases were Renault, SAAB, Skoda, Subaru and Suzuki.

Table 1
Descriptive statistics (N = 35068).

Variables	Mean	St. dev.	Min.	Max.
Loyalty P[a]	0.264	0.440	0	1
Loyalty Q[a]	0.367	0.482	0	1
Age (years)	42.13	13.81	18	85
Residence (1 if Oslo)	0.161	0.368	0	1
Gender (1 if male)	0.793	0.405	0	1
Vehicle age (years)	6.73	7.760	0	96
Owner time (years)	4.52	4.293	0	40
Dealer satisfaction[b]	831	16.26	801	860
Car satisfaction[b]	806	35.25	751	872

[a] Value varies from 0 to 1, with 1 representing perfect loyalty.
[b] Satisfaction is measured on a scale ranging from 1 (lowest) to 1000 (highest).

3.2. Different brands, loyalty and market shares

Fig. 1 shows Norwegian car owners' brand loyalty, measured by our two measures, Q and P, for the 20 most prevalent car brands in Norway. The brands are ranked descending according to average loyalty with regard to the repurchase of the previously owned car, P. According to Fig. 1, Toyota ranks highest followed by Opel, Vauxhall and Ford. The probability that a representative car owner buys the same brand for two consecutive car purchases for these makes are 34.2%, 33.6% and 32.4%, respectively. Renault has the lowest brand loyalty among the 20 specific makes – only 8% of the Renault buyers had previously owned one. Seven car makes have loyalty rates that are higher than average ($\bar{P}$), which is 26.4%, and the most prevalent car brands raise the average.

Our second definition of brand loyalty (Q) results in a slightly different ranking compared to our first definition. According to Fig. 1, Opel has the highest brand loyalty rate, followed by Ford and Toyota. However, with this definition of brand loyalty, Renault and Hyundai have the lowest score among Norwegian car owners. A total of seven brands have loyalty rates above the 37% average. With this new loyalty measurement, the most prevalent car makes are positioned above the average.

A closer study of the empirical material shows that the difference in brand loyalty between Oslo and the rest of the country is small for most car makes, but it is slightly more significant when measured by Q rather than P. Citroen, BMW, Audi and Skoda stand out with slightly higher brand loyalty in Oslo, while the opposite is true for Honda, SAAB and Renault.

Summing up, both our measures of brand loyalty show, first, that the three most prevalent brands in Norway (Volkswagen, Toyota and Volvo) have relatively high but not the highest national brand loyalty levels. Volkswagen – the most popular make sold in Norway – ranks fourth and fifth in our two loyalty measurements, signalling that the dealers of Volkswagen have not produced the most loyal customers. Secondly, small differences in loyalty for these three brands are observed for customer in Oslo and the rest of the country, which indicates that these 'big' brands have a dealer-net offering more similar service across the country as opposed to brands with lower market shares.

4. The model

In this section, we will specify and discuss the properties of our chosen model and address the characteristics of loyal car owners. A mixture of characteristics, including those of the car owners, the cars, and the car owners' satisfaction with the vehicles and dealers, are introduced. Some of these issues are discussed in, for example, Mannering et al., (1991) and Bloemer and Pauwels (1998).

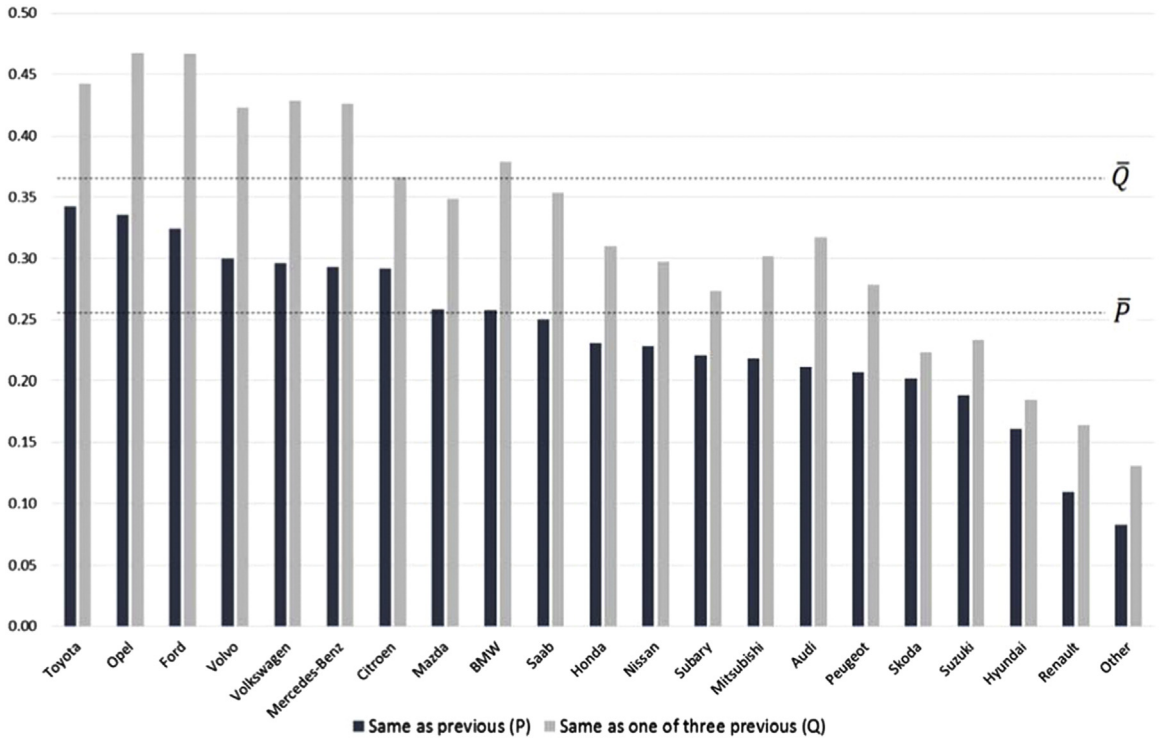

Fig. 1. Brand loyalty for the 20 most prevalent car makes in Norway during the 1985–2013 period.

4.1. Model specification

Because the dependent variable addresses whether the individual is loyal (taking a value of 1) or not (taking a value of 0), the variable is classified as categorical and binary and is therefore suitable for logistic regression (see e.g. discussion in Maddala (1983) or Long and Freese (2014)). The average probability of a car owner being loyal with the next car purchase, as measured by our loyalty measures P and Q, can be expressed in the logistic form as

$$P=\frac{1}{1+\exp\left[-(\alpha_0+\alpha_1X_1+\alpha_2X_2+\alpha_3X_3+\alpha_4X_4+\alpha_5X_5+\alpha_6X_6+\alpha_7X_7+\alpha_8X_8)\right]} \quad (1)$$

$$Q=\frac{1}{1+\exp\left[-(\beta_0+\beta_1X_1+\beta_2X_2+\beta_3X_3+\beta_4X_4+\beta_5X_5+\beta_6X_6+\beta_7X_7+\beta_8X_8)\right]} \quad (2)$$

In (1) and (2), X_1 is the buyer's age in the year the repurchase takes place, X_2 is the buyer's gender (X_2=1 if man) and X_3 is the buyer's domicile (X_3=1 if Oslo, the capital of Norway). These are all characteristics of the individual. X_4 is the age of the car involved in the transaction and X_5 is the number of years since the previous car purchase. For persons with only one car, X_5 expresses the length of time they owned their previous car. X_6 represents the year in which the purchase took place. The two last variables are an average of the Autoindex's indices for the car owner's satisfaction with their dealer (X_7) and their car (X_8).

From (1) and (2), it follows that the marginal effects on the brand loyalty of changes in one of the independent variables are as follows:

$$\frac{\partial P}{\partial X_k}=\left[\frac{\exp\left[-(\alpha_0+\alpha_1X_1+\alpha_2X_2+\alpha_3X_3+\alpha_4X_4+\alpha_5X_5+\alpha_6X_6+\alpha_7X_7+\alpha_8X_8)\right]}{\left\{1+\exp\left[-(\alpha_0+\alpha_1X_1+\alpha_2X_2+\alpha_3X_3+\alpha_4X_4+\alpha_5X_5+\alpha_6X_6+\alpha_7X_7+\alpha_8X_8)\right]\right\}^2}\right]\alpha_k=P(1-P)\alpha_k \quad (3)$$

$$\frac{\partial Q}{\partial X_k}=\left[\frac{\exp\left[-(\beta_0+\beta_1X_1+\beta_2X_2+\beta_3X_3+\beta_4X_4+\beta_5X_5+\beta_6X_6+\beta_7X_7+\beta_8X_8)\right]}{\left\{1+\exp\left[-(\beta_0+\beta_1X_1+\beta_2X_2+\beta_3X_3+\beta_4X_4+\beta_5X_5+\beta_6X_6+\beta_7X_7+\beta_8X_8)\right]\right\}^2}\right]\beta_k=Q(1-Q)\beta_k \quad (4)$$

where k=1, …, 8.

Because $0<P, Q<1$, the expressions in (3) and (4) imply that $\frac{\partial P}{\partial X_k}, \frac{\partial Q}{\partial X_k}\geq(<)0$ when $\alpha_k, \beta_k\geq(<)0$. The signs of the partial derivatives thus follow the corresponding coefficients. It also follows from (3) and (4) that $\frac{\partial P}{\partial X_k}$ and $\frac{\partial Q}{\partial X_k}$ are at their maximum values when $P=\frac{1}{2}$ and $Q=\frac{1}{2}$, respectively. Using Eqs. (1) and (2) leads to X_k having the strongest influence on P and Q when the brackets in their denominators are zero.[5] This leads to

$$X_k^P=-\frac{1}{\alpha_k}\left(\alpha_0+\sum_{j=1}^{8}\alpha_jX_j\right)\text{where } j\neq k \text{ and} j,k=1,\ldots,8 \quad (5)$$

[5] Because $\frac{1}{1+exp[0]}=\frac{1}{2}$.

$$X_k^Q = -\frac{1}{\beta_k}\left(\beta_0 + \sum_{j=1}^{8}\beta_j X_j\right) \text{where } j \neq k \text{ and} j,k=1, \ldots, 8 \quad (6)$$

The variables X_k^P in (5) and X_k^Q in (6) denote that the X_k values have the greatest effect on P and Q, respectively. Contrary to a linear model, the marginal effect of each variable is not constant but varies with the values of all independent variables. The marginal effect on P from increasing X_k will be higher (lower) when $X_k < (>) X_k^P$, whereas the marginal effect on Q will be higher (lower) when $X_k < (>) X_k^Q$.

4.2. A-priori assumptions about the signs of the parameters

Generally, older consumers may be more loyal to a brand because of their accumulated investment in brand-specific knowledge. Younger consumers, in contrast, are at a stage in life that requires investment in consumer knowledge, which makes them more likely to search for information and switch brands (Mittal and Kamakura, 2001). This behaviour is supported by Mannering et al. (1991), who argue that car buyers' loyalty increases with age. A similar result is proposed by Power and Associates' (2012) customer retention study of the American market for vehicles. This finding suggests that $\alpha_1, \beta_1 > 0$.

There is evidence from earlier studies that men and women differ in loyalty to firms and individual service providers (Melnyk et al., 2009). While female consumers tend to be more loyal than males to individuals, such as individual service providers, this difference reverses when the object of loyalty is a group of people, or a company (Melnyk and van Osselaer, 2012). This finding suggests that males are more loyal to car makes than females when purchasing a car. Other empirical studies focusing on the car market in particular, however, have mixed results. Mittal and Kamakura (2001) found women to be more loyal than men in the American automotive market, while Powers and Associates (2012) concluded the opposite. Consequently, we cannot establish a clear presumption regarding the signs of α_2 and β_2; that is, $\alpha_2, \beta_2 \geq (<) 0$.

The supply of different brands has been and remains better in Oslo than the rest of the country. The fact that there are fewer makes from which to choose outside the capital implies, in our opinion, that car owners outside the capital are more loyal; they have fewer brands from which to choose and therefore fewer opportunities to demonstrate disloyalty. The above argument is supported by Mittal and Kamakura (2001), who found suburban residents are more loyal than urban residents in the automotive market. Consequently, we assume that $\alpha_3, \beta_3 < 0$.

The cost of repurchasing a car reduces with the car's age. This fact indicates that most people are probably more willing to change brands if they are buying an older car because this is a smaller investment that lasts for a shorter period of time. The perceived risk for the buyers attempting to buy a new brand is, therefore, lower for older vehicles. This finding suggests that $\alpha_4, \beta_4 < 0$.

It is reasonable to believe that the longer a person has owned a car, the more satisfied he/she has been with the vehicle and the more loyal he/she is; that is, $\alpha_5, \beta_5 > 0$. On the other hand, it is possible that consumers who rarely change cars could be less brand conscious and, to a lesser extent, committed to cars. This suggests that $\alpha_5, \beta_5 < 0$. Consequently, clear signs for α_5 and β_5 are difficult to establish by a-priori reasoning alone; i.e., $\alpha_5, \beta_5 \geq (<) 0$.

Our impression is that the focus and use of resources on branding and other activities has been significant and was increasing during the period studied, which entails increasing brand loyalty. Conversely, different brands in the car market have become more similar and different car manufacturers have increased the number of models in different price segments. This trend reduces the consequences for buyers who change brands and thus leads to lower brand loyalty. We argue that the last effects of similarity and availability outweigh the initial effects, leading to the assumption that $\alpha_6, \beta_6 < 0$.

Customer satisfaction is a primary driver of customer loyalty (Johnson and Auh, 1998). Increased satisfaction strengthens loyalty and increases the repurchase probability, although not linearly. Friedman (2000) found evidence of a significant negative cubic relationship between consumer loyalty and customer satisfaction, and Auh and Johnson (1997) found evidence for this type of relationship using data from the American automotive industry. Because it is a normal practice in Norway that each dealer represents only one brand, increased satisfaction with both dealers and cars should increase brand loyalty. Therefore, we assume that $\alpha_7, \beta_7 > 0$ and $\alpha_8, \beta_8 > 0$.

5. Empirical results and discussion

The model results presented below reveal the extent to which the different explanatory variables influence brand loyalty in the automobile industry. This information is relevant for all parts of the value chain when the aim is to increase the repurchase rate. Additionally, we would like to comment specifically on two applications of our analysis, both of which relate to the inclusion of attitudinal variables (customer satisfaction) whose values are, to some extent, controllable for the car industry itself.

5.1. Parameter values and marginal probabilities

Table 2 shows that the likelihood ratio test is significant at a one percent level, which indicates that the model is well adapted to the data. Moreover, all regression coefficients except β_6 (purchase year) have signs in accordance with our a priori assumptions. Only the coefficients for gender (α_2) and the dummy for capital (α_3) are not significant at a 3% level or lower.

The regression coefficients reported in the first and fourth numeric columns in Table 2 indicate the effect of the independent variable on the log odds of the outcome. Logged odds are difficult to interpret. Therefore, we also report the marginal probabilities ($\frac{\partial P}{\partial X_k}$, $\frac{\partial Q}{\partial X_k}$, $k = 1, \ldots, 8$). They show the absolute changes in P and Q when an independent variable changes marginally. As we emphasized in Section 4, calculating marginal probabilities requires us to set values for the independent variables. We compute the marginal effect for each observation i, where $i = 1, \ldots, N$, using the observed values of the independent variables, and then compute the average of these effects; see Maddala (1983) and Long and Freese (2014) for a discussion. This is often referred to as the average partial effect (APE). For a continuous explanatory variable X_k, the average partial effect for continuous variables, $APEC_k$, is given in Eq. (7). In (7) we introduce $\hat{\gamma} = \hat{\alpha}, \hat{\beta}$, which represents the estimated coefficients for both P (i.e., $\hat{\alpha}$) and Q (i.e., $\hat{\beta}$).

$$APEC_k = \frac{1}{N}\sum_{i=1}^{N}\left[\frac{\exp\left[-\left(\hat{\gamma}_0 + \hat{\gamma}_1 X_1 + \hat{\gamma}_2 X_2 + \hat{\gamma}_3 X_3 + \hat{\gamma}_4 X_4 + \hat{\gamma}_5 X_5 + \hat{\gamma}_6 X_6 + \hat{\gamma}_7 X_7 + \hat{\gamma}_8 X_8\right)\right]}{\left\{1+\exp\left[-\left(\hat{\gamma}_0 + \hat{\gamma}_1 X_1 + \hat{\gamma}_2 X_2 + \hat{\gamma}_3 X_3 + \hat{\gamma}_4 X_4 + \hat{\gamma}_5 X_5 + \hat{\gamma}_6 X_6 + \hat{\gamma}_7 X_7 + \hat{\gamma}_8 X_8\right)\right]\right\}^2}\right]\hat{\gamma}_k, \quad k=1, 4, 5, 6, 7, 8 \quad (7)$$

For the dichotomous independent variables, we follow the same procedure, but the study changes the value from 0 to 1 rather than looking at the marginal change (see e.g., Pampel (2000) and Maddala (1983)). In our model, gender (X_2) and a dummy for Oslo (X_3) are binary independent variables. Let us look specifically at the dummy variable X_2, where the average predicted difference in probability of a

Table 2
Regression results and summary statistics.

Independent variables	Same brand as the previous car purchased (P)			Same brand as at least one of three previous cars purchased (Q)		
	α-coeff.	Sign. (p-value)	Marginal probability	β-coeff.	Sign. (p-value)	Marginal probability
Age (X_1)	0.0263	001	0.005	0.0231	<0.001	0.005
Gender (X_2)	0.0562	0.073	0.010	0.1508	<0.001	0.033
Capital dummy (X_3)	−0.0320	0.348	−0.060	−0.0943	0.003	−0.021
Vehicle age (X_4)	−0.0434	<0.001	−0.008	−0.0276	<0.001	−0.006
Owner time (X_5)	−0.0302	<0.001	−0.006	−0.0625	<0.001	−0.014
Purchase year (X_6)	−0.0064	<0.001	−0.001	0.0088	<0.001	0.002
Satisfaction dealer (X_7)	0.0066	<0.001	0.00125	0.0041	<0.001	0.00078
Satisfaction car (X_8)	0.0046	<0.001	0.00087	0.0039	<0.001	0.00077
Constant term	−3.179	0.627	0.005	−25.43	<0.001	0.005
Summary statistics:						
Number of observations	35,068			35,068		
Likelihood ratio (26 degrees of freedom)	2030.90	<0.001		1825.99	<0.001	

man (X_2=1) compared to a woman (X_2=0) exhibiting brand loyalty is given by $APED_2$ in Eq. (8). The average partial effects for the dummy variable X_3, $APED_3$, in Table 2 are produced similarly.

$$APED_2=\frac{1}{N}\sum_{i=1}^{N}\left\{\frac{1}{1+\exp\left[-\left(\hat{\gamma}_0+\hat{\gamma}_2+\hat{\gamma}_1X_1+\hat{\gamma}_3X_3+\hat{\gamma}_4X_4+\hat{\gamma}_5X_5+\hat{\gamma}_6X_6+\hat{\gamma}_7X_7+\hat{\gamma}_8X_8\right)\right]}-\frac{1}{1+\exp\left[-\left(\hat{\gamma}_0+\hat{\gamma}_1X_1+\hat{\gamma}_3X_3+\hat{\gamma}_4X_4+\hat{\gamma}_5X_5+\hat{\gamma}_6X_6+\hat{\gamma}_7X_7+\hat{\gamma}_8X_8\right)\right]}\right\} \quad (8)$$

In Table 2, we have calculated these marginal probabilities (changes) for both the continuous and the discrete variables. If, for example, the age of the owner increases by one year, the probability of loyal behaviour increases by 0.5% points (100×0.005) for both loyalty measures.

A closer inspection of the results in Table 2 shows that car owners' brand loyalty increases with age. The probability of consecutive purchases of the same brand (P) and purchase of the same brand as that of one of the three previous cars (Q) both increase by 0.5% points when their ages increase by one year.[6] The relationships are illustrated in Fig. 2.

The estimates indicate that men are slightly more brand-loyal than women. The probability of men buying the same brand of car that they had already owned (P) (the significance level is 7.3%) and the same brand as one of the last three cars they had owned (Q) are 1% point and 3.3% points higher than for women, respectively. As far as brand loyalty between car owners in Oslo and the rest of the country is concerned, our two loyalty measures provide different results. Our first measure (P) does not indicate any significant differences, whilst Q shows 2.1% points lower brand loyalty in Oslo than the rest of the country.

Consumers buying older cars are less loyal than those buying newer cars. The probability of buying the same brand of car as one they already owned (P) and the same brand as one of the last three cars they have owned (Q) decrease by 0.8% points and 0.6% points when the age of the purchased car increases by one year. The probabilities of the relevant intervals of car age are illustrated in Fig. 3.

Car owners who rarely change vehicles (low-frequency changers) are the most disloyal. The probability of buying the same brand as one they already own (P) and the same brand as one of the last three cars they have owned (Q) decreases by 0.6% points and 1.4% points when the time they had owned their last car increases by one year. The probabilities of the relevant intervals of owner time are illustrated in Fig. 4.

Our two measures of brand loyalty show opposite conclusions

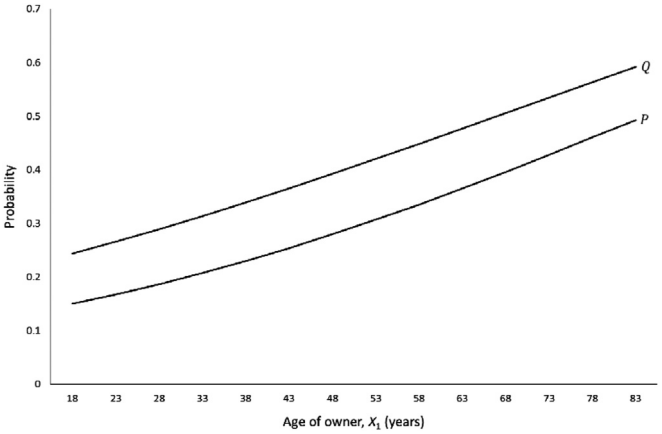

Fig. 2. The relationship between the age of the owner and probability of brand-loyal behaviour when fixing all other independent variables at average values.

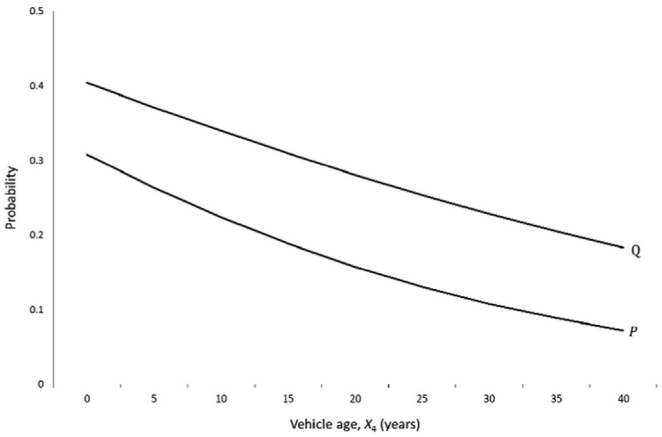

Fig. 3. Relationship between vehicle age and the probability of brand-loyal behaviour when fixing all other independent variables at average values.

regarding the development of Norwegian car owners' brand loyalty in the past 30 years. This development over time is illustrated in Fig. 5. Both measures indicate, however, that brand loyalty has been fairly stable. The value of P has annually decreased by 0.1% points whereas Q has annually increased by 0.2% points.

An increase in the car owners' average satisfaction rate with both the car and the dealer strengthen their brand loyalty. The

[6] For the continuous independent variables, a marginal change and a one-unit change gave the same results.

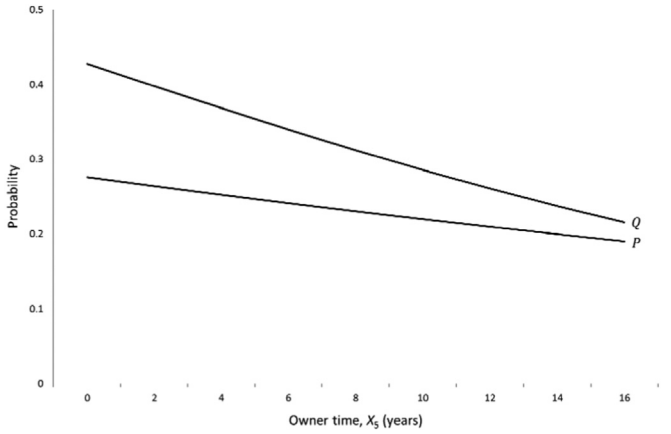

Fig. 4. The relationship between owner time and the probability of brand-loyal behaviour when fixing all other independent variables at average values.

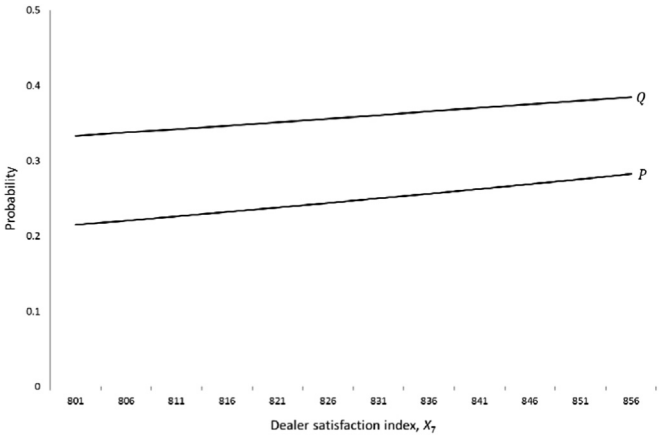

Fig. 6. The relationship between customer satisfaction with the dealer and the probability of brand-loyal behaviour when fixing all other independent variables at average values.

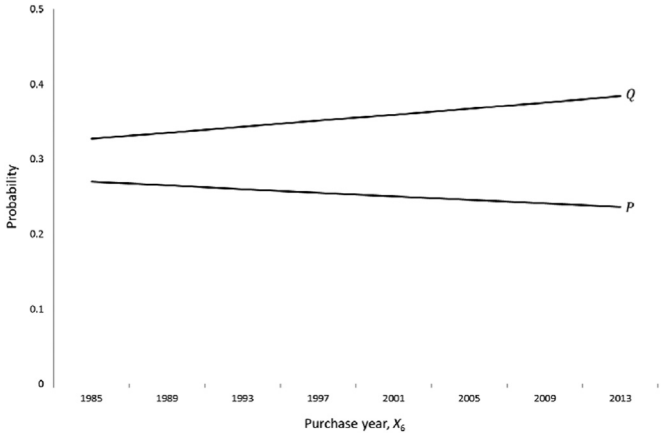

Fig. 5. The relationship between purchase year (time) and the probability of brand-loyal behaviour when fixing all other independent variables at average values.

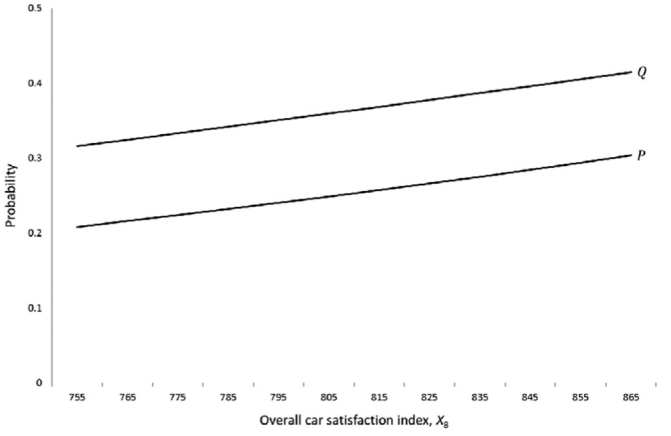

Fig. 7. The relationship between customer satisfaction with the car and the probability of brand-loyal behaviour when fixing all other independent variables at average values.

results in Table 2 indicate that satisfaction with the dealer (X_7) means more for loyalty than satisfaction with vehicle (X_8). Every ten point increase in X_7 or X_8, for example, increases P by 1.3% points and 0.9% points, respectively. Additionally, note that both satisfaction parameters have greater influence on loyalty when studying consecutive purchases (P) than when focusing on the unstable loyalty measure (Q). The impacts of the satisfaction with the dealer and the car on brand loyalty are visualized over their actual spans in Figs. 6 and 7, respectively.

5.2. Substitution between quality of dealer and quality of car

The two variables obtained from the attitudinal study by Autoindex address customer satisfaction with the dealer (X_7) and the car itself (X_8). These variables can be influenced by the automotive industry to some extent. Therefore, we will elaborate the degree of substitution between X_7 and X_8 in greater detail – that is, the extent to which better dealer service can compensate for poorer quality of the vehicle holding buyers' loyalty constant.

It is clear from Table 2 that actual loyalty behaviour relates positively to X_7 and X_8 at a significant level. Furthermore, we can infer from the parameter values in Table 2 that satisfaction with the dealer has a higher impact on loyalty than satisfaction with the car. Because both factors pull in the same direction, there is a trade-off in which a decrease in one factor can compensate for an increase in the other, maintaining the same level of brand loyalty. This substitution effect is found by studying the relative relationship between marginal changes in X_8 (satisfaction with car) and X_7 (satisfaction with dealer). The substitution effect is derived in Eq. (9) using the method of implicit differentiation (see e.g., Sydsæter and Hammond, 2006) in combination with Eqs. (1)–(4) and Table 2.

$$\frac{\partial X_8}{\partial X_7} = -\frac{\frac{\partial P}{\partial X_7}}{\frac{\partial P}{\partial X_8}} = -\frac{\alpha_7}{\alpha_8} = \frac{0.0066}{0.0046} \quad \text{and} \quad \frac{\partial X_8}{\partial X_7} = -\frac{\frac{\partial Q}{\partial X_7}}{\frac{\partial Q}{\partial X_8}} = -\frac{\beta_7}{\beta_8} = \frac{0.0041}{0.0039} \tag{9}$$

The marginal rate of substitution (MRS) between X_8 and X_7 is −1.43 for P and −1.05 for Q. Hence, when a brand experiences a one-unit decrease in satisfaction with the dealer, it can maintain the same level of brand loyalty by improving satisfaction with the car by 1.43 units and 1.05 units for P and Q, respectively. The difference in MRS between P and Q indicates that the satisfaction with the dealer is, relatively speaking, more important for consecutive purchases than for customers returning from other brands. It is worth noting that our model specification tacitly implies a constant MRS, meaning that X_8 and X_7 are perfect substitutes. This is reasonable for moderate changes in perceived satisfaction with the dealers and cars.

In our data set, attitudinal data form the basis for the satisfaction variables X_7 and X_8. The fact that both these variables significantly influence car owners' loyalty indicates that the actual

behaviour is related to such attitudinal data. This conclusion supports the use of resources on attitudinal studies, such as Autoindex, and suggests that the information they produce is useful when explaining actual loyalty behaviour.

6. Conclusions and implications

Because loyal customers are less sensitive to price, brand-loyal car owners are desirable for firms in most industries. In the automotive industry, the level of brand loyalty has mostly been revealed by attitudinal studies; that is, statements from customers on intended repurchase behaviour. Such information is related to uncertainty that is often found in stated preference studies due to customers having an agenda (tactical answering) or in which they do not have complete information on future behaviour (e.g., Sheeran, 2005; Solvoll, 1994). In this article, we study brand loyalty among Norwegian car owners using empirical data on approximately 35,000 car changes in Norway from 1985 to 2013. In contrast to earlier studies on loyalty within this industry that aimed to reveal customer attitudes, our data examine the actual behaviour.

This article addresses two types of brand loyalty: first, a strict version that includes only repurchases of the same brand (consecutive purchases) (P); second, a wider definition includes customers purchasing a brand they have owned at least once in the previous three car ownerships (returning customers) (Q). The last measure is often denoted as an unstable loyalty measure. In the Norwegian data set, the average brand loyalty is 26.4% for the first strict definition and 36.7% for the second wider definition. The prevalent brands seem to have higher loyalty among customers, with the best scores for Toyota, Opel (Vauxhall) and Ford.

The characteristics of brand loyalty in the Norwegian automobile industry are studied in more detail using a logit model. It is clear that older customers and males are more loyal than their counterparts. In contrast, the age of vehicle and low frequency of car changes is related to lower loyalty. The model gives some mixed results regarding the influence of location on loyalty (living in Oslo) and its development over time. The first indicator (P) shows no significant influence of location, whereas loyalty decreased over time. The other loyalty indicator (Q), by contrast, shows significantly the lowest loyalty in Oslo and increasing loyalty over time. Both loyalty measures show, however, moderate annual changes during the period in question.

With respect to the satisfaction measures with the dealer and the vehicle, we can further study the substitution rate between the two variables while keeping car owners' loyalty constant. It is evident that the quality of the dealer is more influential on brand loyalty than the quality of the car. This is valid for both loyalty measures, but the effect is most prominent for repurchase behaviour. Being concerned with the quality of the dealers is, thus, vital for the car industry, particularly at the national level because the dealers' quality is more controllable than vehicles' quality.

The fact that the satisfaction measures significantly influence loyalty indicates that the attitudinal studies using data on customers' purchase intentions does indeed give an indication of actual behaviour. Hence, using resources to obtain and analyse attitudinal data has some merit for explaining actual purchasing behaviour.

Similar to all empirical studies, this analysis has several limitations. We do not have information on the properties of the cars, such as model specifications or price, or the customers, such as income. Future studies on brand loyalty should include discussions of these variables. Quantitative measures of loyalty other than those we have employed are also relevant. Moreover, customer satisfaction variables can be further decomposed to reveal more aspects regarding the relationship between brand loyalty and purchasing behaviour. Despite these limitations, we have nevertheless used an extensive data set over actual behaviour to estimate the relevant loyalty measures for car ownership and studied how these measures relate to important characteristics of the owners, the vehicles and the owners' satisfaction with the cars.

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Appendix

A. Defining the loyalty measures

Let us assume that the car brands are given by parameter z. We can arrange the car changes along a time dimension as indicated by subscript t. Consequently, the registration of a car change is given by z_t.

The first, strict definition of brand loyalty, P, includes the repurchase of the same brand as the previous car owned by the customer. Thus, $P = 1$ if $z_t{=}z_{t-1}$, else 0.

The second and wider definition of brand loyalty, Q, includes the purchase of the same brand that the customer has owned at least once out of the three previous cars. Thus, $Q = 1$ if $z_t{=}z_{t-1} \bigvee z_t{=}z_{t-2} \bigvee z_t{=}z_{t-3}$.

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