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The differential effects of time and usage on the brand premiums of automobiles

Eyal Biyalogorsky [a], Amir Heiman [b], Eitan Muller [c]

[a] The Interdisciplinary Center (IDC), Israel
[b] Hebrew University of Jerusalem, Israel
[c] New York University, USA and The Interdisciplinary Center (IDC), Israel

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ABSTRACT

We investigate how the status and functional benefits of cars' brands lose value over time. Theoretically, we show that brands with a higher status, or that appeal to status-conscious consumers, exhibit steeper price decline over time. Empirically, we take advantage of the phenomenon of twin cars – pairs of car models that are nearly identical from a structural and mechanical standpoint, but that are sold under differing brand names – to disentangle the effects of physical wear and tear, which should impact both the premium brand and the corresponding standard brand similarly; and time-related price decline, which should affect each brand differently. The main result is that a premium car's price declines much faster than that of the corresponding standard car (controlling for physical condition, mileage, and initial price). This result suggests that status declines faster than do functional attributes, and status seekers tend to replace their cars earlier.

1. Introduction

The Porsche Cayenne and the iPhone are examples of high-end brands that yield psychological and social status benefits for some consumers. Expensive houses, luxury products, and designer items have always been symbols of wealth and success. Owners of luxury goods enjoy functional benefits from the quality of these products, as well as psychological and social benefits from the ownership of high-status brands. Many durable goods lose value over time, as their performance deteriorates, technology changes or the hedonic benefit declines. Cars, for example, incur more wear and tear the older they are, and the more they are driven. What is not clear is whether this decline in value is correlated with the quality of the car or the status of the brand.

Some evidence suggests a positive correlation between the temporal decline in the price of a brand and its quality and status. Thus, for example, the five-year average price decline for the most expensive BMW 7 Series is steeper than that of the 6 Series, the latter being steeper than the 5 Series, and similarly, for the Mercedes S Class versus the less expensive E Class (Blackley 2018). The more luxurious and expensive version of the same brand might be excepted to have better performance and durability, and therefore the positive relationship between stronger status and stronger decay in price may suggest that the psychological and social benefits of owning higher status car decline in a steeper manner relative to owning a regular car with similar functional performances.

E-mail addresses: ebialogorsky@idc.ac.il (E. Biyalogorsky), amir.heiman@mail.huji.ac.il (A. Heiman), emuller@stern.nyu.edu (E. Muller)

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In this paper, we investigate how cars' status-related benefits hold up over time in the used car market. We take advantage of the phenomenon of twin cars – car models that are virtually the same from a structural standpoint but are sold under differing brand names – to disentangle the effects of physical wear and tear from the effect of the decline in value due to time. Physical wear and tear refer to the deterioration in performance (compared to the initial level of performance) related to the level of use of the car that causes continual stress on the various car components. The decline in value due to age refers to the decline due strictly to the passage of time since it started operating, controlling for the level of physical wear and tear. It should capture effects such as loss of status and newness over time. Physical wear and tear should affect both the premium brand and its standard twin similarly (as they are physically indistinguishable). Time since launch, however, should affect each brand differently, as it mostly captures the effect of status decline (after controlling for the car's physical condition).[1]

We begin by presenting an analytical dynamic model of consumer valuation in the durable goods market of new and used cars that includes the possibility of status consciousness on the part of some consumers. We show that as the importance of status increases, the price of the used car decreases compared to the price of the new car.

We then use data on the prices of new and used cars to estimate the decline in car values depending upon their conditions and ages. For 21 twin car pairs, for an average observation period of nine years, we have data (for each year and mileage) on the car's age; its usage in terms of distance driven; its external condition and status (higher vs. lower). Essentially, we break the price decline, either the absolute price decrease (e.g., $2,000 per year) or the percentage decrease (e.g., 10% per year), into two components: The decrease due to age, i.e. the passage of time assuming no usage of the car, and the decrease due to the usage of the car, i.e. the amount of miles driven. We then take the ratio of the price decrease due to age and due to usage for the premium brand and for the standard brand. If the ratio of these two ratios is larger than 1, we conclude that the relative price decrease of the premium brand due to age is stronger for the premium brand than the standard brand. For example, if the estimated absolute decrease of price due to age is $2000 per year for a premium brand, and $15000 per year for a standard brand, and the estimated price decrease due to usage is $1000 per 10,000 miles for a premium, and $900 for a standard, then the ratio for the premium brand is 2 ($2000/$1000), and for the standard brand$1.66 = 1,500/900$. The relative ratio is 1.2, indicating that the premium brand losses more value due to age relative to the standard brand.

We run pooled regression as well as individual regressions on absolute and percent decline in price to come up with our main result that the age-based decline of premium brands, which captures the decay in their status related benefits, occurs considerably faster than that of their standard brand twins, controlling for mileage driven, condition of the car, and initial price. Importantly, this result is true in terms of the absolute decline in prices, as well as the percentage decline in prices. This result demonstrates that the correct cost of owning a premium-brand car is not just its high initial price, but also the faster decline of its status benefit, as compared to the standard brand version of that same car.

2. Literature review

It is well accepted that products have two broad types of attributes: functional and hedonic /self-expressive. For example, the 2018 Toyota Camry's 2.5-liter, inline 4-cylinder engine, and 8-speed sequential-shift automatic transmission are all functional attributes. In contrast, the semi-military appearance of the Jeep Patriot, coupled with the corresponding copy on the website: "trail-conquering hero" are self-expressive (Sajeesh, Hada & Raju 2020; Belk 2013; Han, Nunes, & Drèze 2010). Aaker and Joachimsthaler, 2000 wrote, "... [brands] have personalities that provide emotional and self-expressive benefits and that differentiate themselves on hedonic attributes." To differentiate otherwise similar products, firms frequently try to differentiate along the hedonic attributes (Chan, Berger, & Boven 2012).

The value of hedonic benefits changes over time (Richins & Bloch 1991). Dinnin (2009) demonstrated that the benefit of newness declines over time because as owners become accustomed to their possessions, their level of involvement with the product declines (Richins and Bloch 1991). Moreover, as the excitement of the purchase declines, so does the appeal of the new product (Higgins 2006).

While this phenomenon is hypothesized to operate for all brands (Strahilevitz & Loewenstein 1998), and although the underlying psychological mechanism operates the same way across brands, it may entail a greater decline in value for higher-status brands, as such brands have a larger component of status value that might lead to higher excitement at the time of purchase, which accordingly will decrease faster. Wang and Wallendorf (2006) show that the relationship between status and the duration of ownership is negatively correlated, and the effect is stronger for products that signal higher social status. In a survey of consumers, Dhar and Wertenbroch (2000) found that signaling status by owning a car decays as the product ages and as more consumers own it. Also, the rate of the decay effect is stronger in luxury categories than it is in utilitarian products.

For some consumers, some of the benefits of owning a product are related to purchasing the product rather than keeping it, which can also be a factor that leads to a loss in value over time. For example, Okulicz-Kozaryn et al. (2015) found that owning a premium brand contributed to wellbeing only in the first year after the purchase. This phenomenon is explained by adjustment to elevated status, which then becomes the reference (Kahneman Diener & Schwarz, 1999).

[1] Products sitting on a shelf without use might also experience physical deterioration. Thus, decline in value because of age might also capture some aspects of physical wear and tear. However, to the extent that this occurs, it works against our hypotheses.

In many product categories, such as electronics and cars (but not collectors' cars), the perceived status of the brand is related to newness and purchase excitement. For example, the most current top-end model of the iPhone confers more status on its owner than do older models. In other product categories, such as houses, this relationship does not hold. Our interest is in the former product category. Based on the argument above, we hypothesize that in such categories, the value of the status benefits conferred by owning the brand deteriorates quickly over time. In practice, many other factors influence the decline in a brand's price besides its status (Jayarajan, Siddarth, & Silva-Risso 2018). To control for these factors, we turn to an investigation of the specific case of twin cars to test standard versus premium brands' effects on prices and demand. The idea is that status is attached to the brand name, while the other factors that might affect a decline in value are attached to the physical car. As physical aspects are very similar for twin cars, differences in decline in value can be attributed mainly to the differences in status between them.

The automobile industry adopted platform sharing, that is, pooling components across different products, as one of the means to reduce production costs (Moreno & Terwiesch 2017). For example, VW also owns Skoda, Seat, and Audi. Having four brands allows it to produce large quantities of each platform, yet have sufficient differentiation. VW's Golf platform is used by 20 other models, including Audi Q3, Audi TT, and Skoda Octavia (Pries, 2003). The ultimate manifestation of this strategy of platform sharing is twin cars that are mechanically virtually the same car sold under differing brands (Sullivan, 1998). As the quality of twin cars' functional attributes is expected to be similar, the difference in consumers' evaluations between them can be attributed to a higher status image of the more premium brand. For twin cars, the deterioration in functional attributes is similar for both versions of the car (Gavazza, Lizzeri, & Roketskiy, 2014). Therefore, a change in the price gap between the two twin car brands can be attributed to the differential decline in the two brands' respective images.

Previous studies presented mixed evidence regarding the decline in prices of higher-quality versus lower-quality brands. Sullivan (1998) found that stronger car brands retain higher value in the second-hand market. However, Sullivan's measure of brand strength is based solely on functional benefits. Stahl et al. (2012) found a positive correlation between the hedonic (status) component of a car's brand equity and customers' retention of the brand. In contrast, Kurz and Li (2015), and Pleshcheva, Klapper, and Dannewald (2018) found that the length of ownership of luxury cars is shorter than that of non-luxury cars, implying a lower retention. Thus, it remains unclear what the effects of status benefits are on the retention of value.

Sullivan (1998) and Esteban-Bravo and Lado (2011) empirically tested the hypothesis that the price differences between twin cars are related to the benefits of possessing the brand itself. Their work showed that consumers are willing to pay more for new cars of the higher-status brand than for its lower-status twin. While these papers show that the differences in prices can be attributed to differences in status, they did not analyze how the price differences change over time and how they are related to changes in the values of cars' functional and status attributes over time. Our findings show that while status has an effect of pushing a car's price up, it also has a negative (second-order) effect on price: Status declines quickly, causing faster and more substantial declines in the used-car price of high-status brands. As rational consumers take into account the price at which they will be able to sell their cars, status decay causes a decrease in their willingness to pay. Therefore, the price of a new car does not fully reflect its status value in consumers' eyes.

3. An analytical model

In the previous section, we laid the theoretical foundation for expecting that the value that consumers place on the status-related benefits of a brand to decrease at a fast rate (at least for some product categories, e.g., cars). The decrease in value would, in turn, be expected to reduce consumers' willingness-to-pay (WTP) for the brand. Intuitively, this should lead to lower brand prices, and we claim that this should cause the prices of brands that have a larger relative component of status benefits to decrease faster than the prices of brands with lower relative status benefits.

However, the market price of a brand does not correspond directly to the willingness to pay for it. Rather, the market price is an outcome of the interplay between consumers' willingness-to-pay and the supply or quantity available of the brand. While it seems intuitive that a decrease in willingness to pay should lead to a price reduction, it can also lead to an adjustment in terms of quantity supplied, thus leading to a smaller reduction in price.

Besides, a forward-looking consumer would take the future reduction in value into account when purchasing the brand and will only be willing to pay a lower price to begin with. Thus, although the value of the high-status brand decreases, it is not clear whether its price decreases likewise. As we are interested in the relative price declines of high-status vs. low-status brands and quantity adjustments may not be the same for both, it is important to show that indeed one would expect that in equilibrium, the price of the high-status brand indeed declines faster.

To see whether the decrease in valuation of the status benefits leads to a faster decline in the equilibrium prices of used products that have a larger initial share of status benefits, we construct a simple model of the equilibrium price in a market of a durable good (specifically cars) that considers the effect of forward-looking consumers and the supply of products in a dynamic framework. This model demonstrates that, indeed, if status benefits decline faster, then products that offer a more substantial component of these will exhibit a larger decline in equilibrium price over time (both in terms of nominal prices and percentage-wise).

We extend the standard durable goods models (see, e.g., Desai & Purohit 1999; Purohit 1997) to include both functional and status benefits. Some consumers care only about the functional benefits provided, while others are status-conscious, i.e., they care both about the functional and the status benefits of owning the product. We assume that status concerns are unrelated to the tangible benefits that a consumer derives from a car. A consumer can be status-conscious even if s/he does not derive much tangible benefit from the car (s/he keeps it in the garage and rarely uses it); or conversely, a consumer may have no status concerns and still derive tangible benefits from driving the car. A used car delivers fewer benefits than a new car. Importantly, we assume that while tangible benefits may decline relatively slowly, status benefits deteriorate rapidly. Without loss of generality, we assume that a used car provides no status benefits.

In the model, a monopolist manufacturer markets a car that lasts for two periods. The manufacturer sets the price of a new car in each period (prices can differ across the periods). The marginal cost of production is c. In the first period, only new cars are available in the market, while in the second period, new cars, as well as used ones from the first period, are available in the market. A car provides functional benefits such as reliable transportation and a comfortable ride, as well as psychological and social benefits that are related to owning a vehicle that provides status. Used and new cars are differentiated in both dimensions, functionality and status. The decline in the benefits provided by used cars is nonsymmetric: While used cars provide fewer functional benefits, these used cars confer no status on their owners at all. We use δ to denote the residual functional value of a used car, and thus $1-\delta$ denotes the amount of decline in value. We use s to denote the amount of status conferred by a new car (used cars provide no status benefits). The s term can be thought of as capturing the decline in status of the premium brand over and above the decline of the standard brand. While the $1-\delta$ term can be though of as capturing the decline in value to usage.

There are two types of heterogeneity in the model: First, all consumers care about the functional use of the car, yet are heterogeneous in their valuation of the functional benefits. Second, only a portion of consumers, r, cares about status. We denote the per-period valuations of the functional benefit by φ and assume that φ is distributed uniformly between 0 and $\bar{\varphi}$. We use s to denote the value that the consumers who care about the status derive from the car (s is the same for all consumers who care about status). In any period, each consumer uses at most one car. All consumers are potentially active in the market in both periods, and there is no new entry of consumers in the second period. Table 1 presents the utility that is derived from new vs used car and whether or not the consumers care about status.

Each consumer decides whether and what type of car to buy in each period. As consumers only need one car, we assume that if a consumer already owns a car from Period 1 decides to buy another in the second period, that consumer sells her old car in the used market. Consumers' gross utilities of the per-period value are:

$$utility = \begin{cases} \varphi + s & \text{if the car is new and consumer is status}-\text{conscious} \\ \varphi & \text{if the car is new and consumer is not status}-\text{conscious} \\ \delta\varphi & \text{if the car is a used car} \end{cases} \quad (1)$$

Fig. 1 shows how consumers behave under this set of valuations:

The top line depicts the behavior of the status-conscious consumers, -and the bottom one the behavior of the non-status-conscious consumers. The consumers with the highest valuations elect to buy a new car in each period. At lower valuations, consumers buy a new car and hold it for two periods, and even lower-valuation consumers wait and then buy a used car. As can be seen in Fig. 1, status-conscious consumers buy more new cars owing to the value that they place on the status of owning a new car. Note that Fig. 1 includes all of the behaviors that are possible in equilibrium in the model. For example, not buying a car in Period 1 and then buying a new one in Period 2 is not possible in equilibrium.

Let Q_{1n}, $Q_{2n,}$ and $Q_u$be the number of new cars sold in Period 1, Period 2, and the number of used cars sold in Period 2, respectively. Note that $Q_u = Q_{2n}$, as only consumers who buy new cars in the second period offer their used cars for sale, thus capping the number of used cars available. And, all of the used cars are sold, because the market clears.

In the model, as there is full information for all players, there is an interior solution, and the market clears, i.e., the number of cars offered for sale in each period is equal to the number of cars sold in each period. Consider, for example, the number of new cars offered in Period 1, Q_{1n}: This is equal to the number of consumers who buy a new car in Period 1, which in Fig. 1 is equal to $r\left(\bar{\varphi}-\varphi_{2s}\right)$ status conscious plus $(1-r)\left(\bar{\varphi}-\varphi_2\right)$ non-status-conscious consumers. We obtain the following market-clearing condition: $Q_{1n} = r\left(\bar{\varphi}-\varphi_{2s}\right) + (1-r)\left(\bar{\varphi}-\varphi_2\right) = \bar{\varphi} - r\varphi_{2s} - (1-r)\varphi_2$. Similar considerations of market clearance in Period 2 lead to the complete set of market clearance conditions in the model:

$$Q_{1n} = r\left(\bar{\varphi}-\varphi_{2s}\right) + (1-r)\left(\bar{\varphi}-\varphi_2\right) = \bar{\varphi} - r\varphi_{2s} - (1-r)\varphi_2 \quad (2)$$

$$Q_{2n} = r\left(\bar{\varphi}-\varphi_{1s}\right) + (1-r)\left(\bar{\varphi}-\varphi_1\right) = \bar{\varphi} - r\varphi_{1s} - (1-r)\varphi_1 \quad (3)$$

$$Q_u = r(\varphi_{2s} - \varphi_{3s}) + (1-r)(\varphi_2 - \varphi_3) \quad (4)$$

If we denote the price of a used car by P_u, then the participation constraint of the marginal consumers who buy used cars in both segments implies that $P_u = \delta\varphi_3$. Noting that it must be the case that $\varphi_{3s} = \varphi_3$, and substituting for Q_{1n} and Q_{2n} from Equations (2) and (3), we find that:

$$P_u = \delta(\bar{\varphi} - Q_{2n} - Q_{1n}) \quad (5)$$

Table 1
The utility from new or used car across consumers' types.*

Consumer type/car type	New	Used
Consumers who are status conscious	$\varphi + s$	$\delta\varphi$
Consumers who are not status conscious	φ	$\delta\varphi$

* φ and s are is per-period valuations of the functional and status benefits, respectively, while δ denotes the residual functional value of a used car.

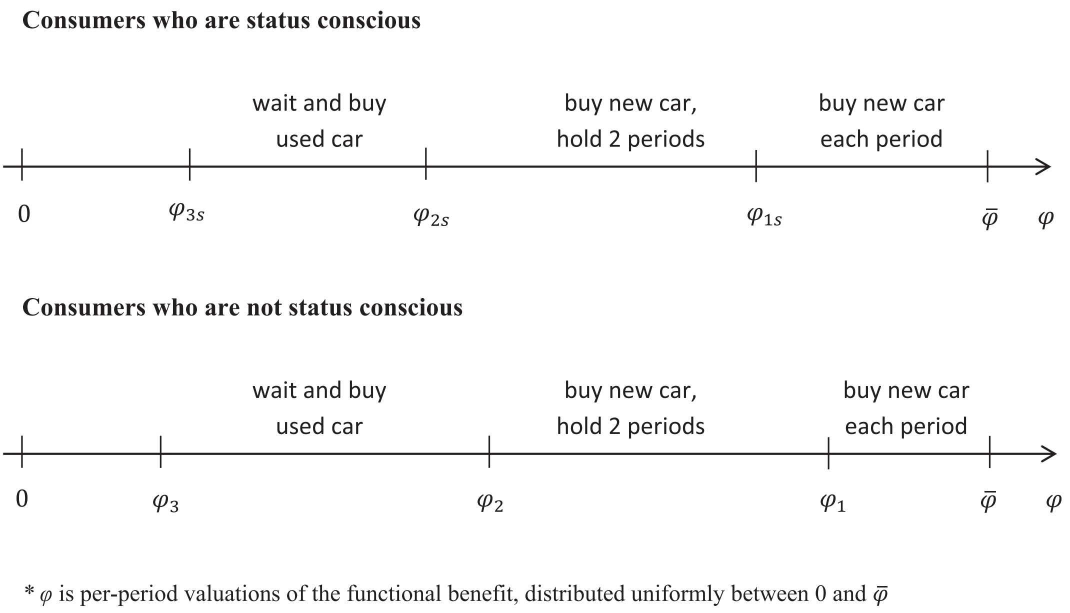

Fig. 1. Consumer segments and behavior*.

From the incentive constraints of the consumers who are indifferent between buying a new car in the second period and keeping their old cars, we find that:

$$P_{2n} = (1-\delta)\varphi_{1s} + s = (1-\delta)\varphi_1 \tag{6}$$

Using Equations (3) and (6), we can express φ_{1s} as:

$$\varphi_{1s} = \bar{\varphi} - Q_{2n} - \frac{1-r}{1-\delta}s \tag{7}$$

$$P_{2n} = (1-\delta)\left(\bar{\varphi} - Q_{2n}\right) + rs \tag{8}$$

Similarly, from the incentive constraints of the consumers who are indifferent between buying a new car in the first period and waiting to buy a used car in the second one, we find that:

$$P_{1n} = \varphi_{2s} + s + P_u = \varphi_2 + P_u \tag{9}$$

Using Equations (2) and (9), we can express φ_{2s} as:

$$\varphi_{2s} = \bar{\varphi} - Q_{1n} - (1-r)s \tag{10}$$

$$P_{1n} = \bar{\varphi} - Q_{1n} + rs + P_u \tag{11}$$

Putting it all together, we get the following demand system:

$$P_u = \delta\left(\bar{\varphi} - Q_{2n} - Q_{1n}\right) \tag{12}$$

$$P_{2n} = (1-\delta)\left(\bar{\varphi} - Q_{2n}\right) + rs + P_u \tag{13}$$

$$P_{1n} = \bar{\varphi} - Q_{1n} + rs + P_u \tag{14}$$

The seller maximizes profit over the two periods. Solving for the subgame perfect decisions by the seller, we get the following results for the prices of interest:

$$P_u = \frac{\delta[3\bar{\varphi}\delta + (c - rs)(4 + \delta)]}{4 + 6\delta} \tag{15}$$

$$P_{2n} = \frac{4\left(c + rs + \bar{\varphi}\right) + 2\left(3c + rs + \bar{\varphi}\right)\delta - \left(5c + rs + 3\bar{\varphi}\right)\delta^2}{2(2 - \delta)(2 + 3\delta)} \tag{16}$$

$$P_{1n} = \frac{\left(4 + \delta(\delta - 2)^2\right)rs + c\left(4 + \delta\left(4 - \delta^2 - 2\delta\right) - 4\right) + \bar{\varphi}\left(4 + 8\delta - 3\delta^2\right)}{2(2 - \delta)(2 + 3\delta)} \tag{17}$$

Our main interest is in how status (s) affects the relative prices of used cars versus new cars. Looking at the ratio of the used car price in Period 2 (P_u) to the new car price in Period 2 (P_{2n}) we find that:[2]

Result 1: As the importance of status increases, the price of the used car decreases more as compared to the price of the new car, that is: $\frac{\partial(P_u/P_{2n})}{\partial s} < 0$.

As the effect or importance of status increases, the equilibrium price of the used car decreases compared to the price of the new car. This decrease has two sources:

First, there is a direct effect of status on valuations of cars, and as status decreases more rapidly than does wear, the prices of cars with more status or more status-conscious consumers decline more. Second, the greater the role status plays in the valuation of a new car, the more those cars are offered for sale as used cars in Period 2 (consistent with Kurz & Li 2015), thus depressing the prices of used cars. Thus, there is an indirect effect of status decrease over time on used car prices through its effect on the supply of used cars: The greater the supply of used cars, the lower their prices, and the number of cars offered for sale on the used car market increases with status.

4. Empirical analysis

The previous section presented a two-period model where we showed that a brand's price decline correlates with its status, i.e., the price of cars associated with a higher status value or that attract more status-conscious consumers, should decrease over time faster. Premium cars have a larger portion of status value than do standard cars and more status-conscious consumers. Therefore, premium cars' prices are predicted to decline faster than those of standard cars (both in absolute terms and percentage-wise).

In practice, many other factors, besides its status, influence a car's rate of decline in value. To test if price declines are larger for premium brands while controlling for these factors, we focus on the prices of twin cars, utilizing a method that can be construed as a natural experiment to investigate the effects of standard versus premium brands on prices. The idea is that status is attached to the brand name, while the other factors that might affect price decline are attached to the physical condition of the car. As physical aspects are very similar between twin cars, we can attribute differences in price decline to the differences in status between them. Specifically, three indicators mark a car's deterioration: a) the car's age; b) its usage in terms of distance driven, and c) its appearance, the last two being related to the car's physical condition. Thus, we would expect to see little difference in decline in these dimensions between the twin car brands. On the other hand, the car's age also captures decline in value that is not merely physical and thus can capture differences in the decline in status between the twin car brands.

4.1. Data

To create a list of twin cars, we began with a 2009 article from Edmunds, a leading online resource for automotive information (Edmunds.com 2009). The article defines twinned vehicles and contains a list of them that includes cars, SUVs, minivans, and trucks. Its definition is as follows:

Twin Cars: "Twinned vehicles are basically the same under the skin but are sold under different brand names and marketed as unique vehicles. Manufacturers see this as a way of killing two birds with one stone: expanding their reach in various market segments while avoiding the higher costs of engineering a new vehicle. This practice is also referred to as 'badge engineering,' since an automaker can create the illusion of an 'all-new' model simply by changing the badges, the grille, and other superficial styling details. Twinned vehicles are built on the same chassis and share most of their under-hood and

[2] Results are the same if we use the difference in prices as the measure instead of the ratio.

interior components, but often have different sheet metal, amenities and interior design. This idea extends as well to 'triplet' and 'quadruplet' vehicles, as in the case of the Buick Enclave / GMC Acadia / Saturn Outlook / Chevrolet Traverse quads."

For each pair of twins, we determined the period in which both specific twin vehicles were available for sale. For example, while the GMC Acadia was available from 2007, its twin, the Buick Enclave, was available from 2008; and their twin, the Chevrolet Traverse, only from 2009. Thus, the final period that appears in our dataset for this pair is 2009–2013 (see row 6, Table 2).

We dropped all discontinued vehicle brands, mostly General Motors', as a discontinued brand might have significant effects on its price without a corresponding effect on the twin. We eliminated the following GM brands that were all discontinued in 2010: Pontiac, Hummer, Saturn, and Saab (the latter was sold in 2010 and declared bankruptcy in 2011). We also eliminated Mercury, a Ford division that was discontinued in 2011, as well as other discontinued models such as the Cadillac XLR, which was last manufactured in 2009. We also eliminated the two twins: Chevrolet Impala/Buick Lacrosse and Dodge Avenger/Chrysler Sebring, as they shared a platform for only three and four years, respectively. Lastly, in the data for Mazda Tribute, one year (2007) is missing. In total, we have 14,120 observations. The final list appears in Table 2 and contains 36 cars and 21 pairs of twin vehicles (note that the two "triplets" contain three cars each).

For all of the cars included in the final list, we used the Kelley Blue Book to determine the new and used car prices of each model. KBB collects its data from auctions, private party transactions, and lessors; and then classifies the cars according to their condition, ranging from "excellent" to "fair," and mileage. Sullivan (1998) used NADA (National Automobile Dealer Association) data to extract the prices of twins. Both KBB and NADA base their price estimates on surveys, data from auctions, lessor, and end-user (private sector) transactions. The differences between the two sources – KBB and NADA – is in the weight they give to each source in estimating the market price: KBB places more emphasis on mileage, condition, features, and popularity; while NADA focuses on vehicles' wholesale prices. KBB and NADA are examples of so-called blue book estimates that are used extensively in the car industry to set prices of used cars. Empirically, all of the various price estimate sources appear to provide similar estimates (e.g., https://www.autoblog.com/article/best-blue-book).

We chose to use KBB, as it allows us to control for the car's usage and condition, and so avoid issues that may arise from the stock of used cars in the market differing in terms of average usage and condition across the twin car brands at any point in time. We use the data on the prices for a private party seller (rather than a dealer). The data includes price estimates for a private party for each year, for ten mileage groups (10,000 to 100,000 distance), standard equipment, and the four conditions of the vehicle (see www.kbb.com for a used car guide description of the four conditions).

Table 3 depicts a sample of the data that includes just two years of data for the Lincoln MKX SUV for only one condition of the vehicle ("very good"). Eyeballing Table 3, one can observe that the Lincoln MKX loses about $2000 value a year (keeping mileage constant) and about $1000 every 10,000 miles driven (keeping age constant). Indeed, in the regression to be reported momentarily, performed on the entire seven-year dataset for this SUV, we find that the MKX loses $1754 a year, and $1060 for every 10,000 miles driven.

4.2. An illustrative example

We use the data on the prices of the Lincoln MKX and its twin the Ford Edge to illustrate our point regarding the larger decline in prices of the premium car as it ages. In Fig. 2, we plot the 2013 prices of the Lincoln MKX and the Ford Edge for model years from 2007 to 2013 for a car in excellent condition that was driven 10,000 miles per year (i.e., the prices for the 2012 model are for cars that were driven 10,000 miles, for the 2011 model 20,000 miles, and so forth).

Table 2
List of twin vehicles (premium brand in **bold**).*

	Vehicle Type	Brand and Model	Observation Period
1	Cars	**Chrysler 300**/Dodge Charger	2006–2013
2		**Hyundai Accent**/Kia Rio	2005–2013
3		**Lexus ES350**/Toyota Camry	1993–2013
4		**Lincoln MKS**/Ford Taurus	2009–2013
5		**Lincoln MKZ**/Ford Fusion	2007–2012
6	SUVs	**Buick Enclave/GMC Acadia**/Chevrolet Traverse	2009–2013
7		**Cadillac Escalade/GMC Yukon**/Chevrolet Tahoe	2002–2012
8		**Ford Escape**/Mazda Tribute	2001–2011
9		**Hyundai Tucson**/Kia Sportage	2005–2013
10		**Infiniti QX56**/Nissan Armada	2005–2010
11		**Jeep Compass**/Jeep Patriot	2007–2013
12		**Lexus LX570**/Toyota Land Cruiser	2008–2011
13		**Lincoln Navigator**/Ford Expedition	1998–2013
14		**Lincoln MKX**/Ford Edge	2007–2013
15	Minivans	**Chrysler Town & Country**/Dodge Grand Caravan	1993–2013
16	Trucks	**GMC Canyon**/Chevrolet Colorado	2004–2012
17		**GMC Sierra**/Chevrolet Silverado	1999–2012

* Source: Edmunds.com; Rows 6 and 7 include three vehicles each, and thus the number of paired twins is 21, while the number of vehicles is 36. See our note on GMC and other brands designated as premium or standard in the robustness section.

Table 3
Data sample for Lincoln MKX Sport Utility.*

Year	Price ($)	Age (years)	Mileage (10,000)	Condition Excellent	Very Good	Good	Fair
2013	32,302	1	1	0	1	0	0
2013	31,184	1	2	0	1	0	0
2013	29,987	1	3	0	1	0	0
2013	28,841	1	4	0	1	0	0
2013	27,704	1	5	0	1	0	0
2013	26,387	1	6	0	1	0	0
2013	24,874	1	7	0	1	0	0
2013	23,261	1	8	0	1	0	0
2013	21,672	1	9	0	1	0	0
2013	20,236	1	10	0	1	0	0
2012	30,564	2	1	0	1	0	0
2012	29,525	2	2	0	1	0	0
2012	28,415	2	3	0	1	0	0
2012	27,351	2	4	0	1	0	0
2012	26,295	2	5	0	1	0	0
2012	25,072	2	6	0	1	0	0
2012	23,667	2	7	0	1	0	0
2012	22,170	2	8	0	1	0	0
2012	20,693	2	9	0	1	0	0
2012	19,361	2	10	0	1	0	0

* Sample of two years out of seven, for "Very Good" condition.

The plots clearly show that for each model year, the decline is larger for the premium car (the Lincoln MKX) than for its standard twin (the Ford Edge), both in absolute terms (Panel a) and percentage terms compared to the price of the new 2013 model (Panel b).

These data are consistent with the theoretical and economic rationale presented in sections 2 and 3 and is typical of other car pairs in the data. In the following section, we present an econometric analysis of the dataset that provides more formal evidence of the effects seen in this illustrative example.

4.3. Pooled regressions

To understand the effect of status on the price of a car over time, we ran the following regression that explains the price of the car based on its condition, status, and the relative initial price (where j is the car model and t the year)[3]:

$$\begin{aligned} price_{jt} &= \alpha_0 + \alpha_1 RelativeInitialPrice_j + \alpha_2 Age_{jt} + \alpha_3 Mileage_{jt} + \alpha_4 Condition_{jt} + \alpha_5 Status_j \\ &\quad + \alpha_6 Status_j \cdot Condition_{jt} + \alpha_7 Status_j \cdot Age_{jt} + \alpha_8 Status_j \cdot Mileage_{jt} + \alpha_9 Condition_{jt} \cdot Age_{jt} + \varepsilon_{jt} \end{aligned} \tag{18}$$

The "Status" variable is assigned the value of 1 for the premium vehicle and zero otherwise.[4,5] In addition, the model includes interactions of the status variable with the car's condition, age and mileage. The *RelativeInitialPrice* variable (calculated as $P_{j0} - \sum_{i=1}^{n} P_{i0}/n$) represents the deviation of the car initial purchase price from the mean of the prices of the relevant status category, i.e., premium and standard brands. The initial purchase price of a car might capture other factors or information that are related to the quality of the car beyond the observables (brand name, etc.). To try and control for this, we include the *RelativeInitialPrice* variable that indicates if a car has a relatively higher initial price compared to its status group. Lastly, as the error terms might be correlated in twin cars, for example, because of a common supply glitch that affects both standard and premium models, we ran a cluster-robust variance estimation, where the clustering is over the twin cars (Wooldridge 2003).

Table 4 presents the results. The full model (Model 3), which includes the interactions of mileage and age with status and the interactions between mileage and car's condition, is compared to two partial models. Model 1 estimates the effect of mean-centered prices, mileages, age, and condition of the vehicle on the price. Model 2 adds to Model (1) the status variable, as well as the interactions of status with the condition of the vehicle. The results all seem reasonable and show that car prices decrease with cars' ages, usage (distance driven), and conditions, with the largest value loss occurring when a car shifts from good to fair condition.

[3] Note that there is a distinct price for each brand, time, mileage, condition, and status. For visual simplicity, we dropped the mileage, condition, and status subscripts from the equation.

[4] Note that we assign status designations at the level of the model name. Thus, the umbrella brand name can appear as a premium brand as well as a standard one (for example Jeep Compass is premium in the analysis, while Jeep Patriot is standard). Implicitly this assumes that all brand value resides at the model level. To test whether this assumption matters, we conducted a robustness test by removing these instances. This did not affect the results. For details, see section 5.

[5] GMC brands are categorized as status brands. See section 5 (Robustness checks) for alternatives.

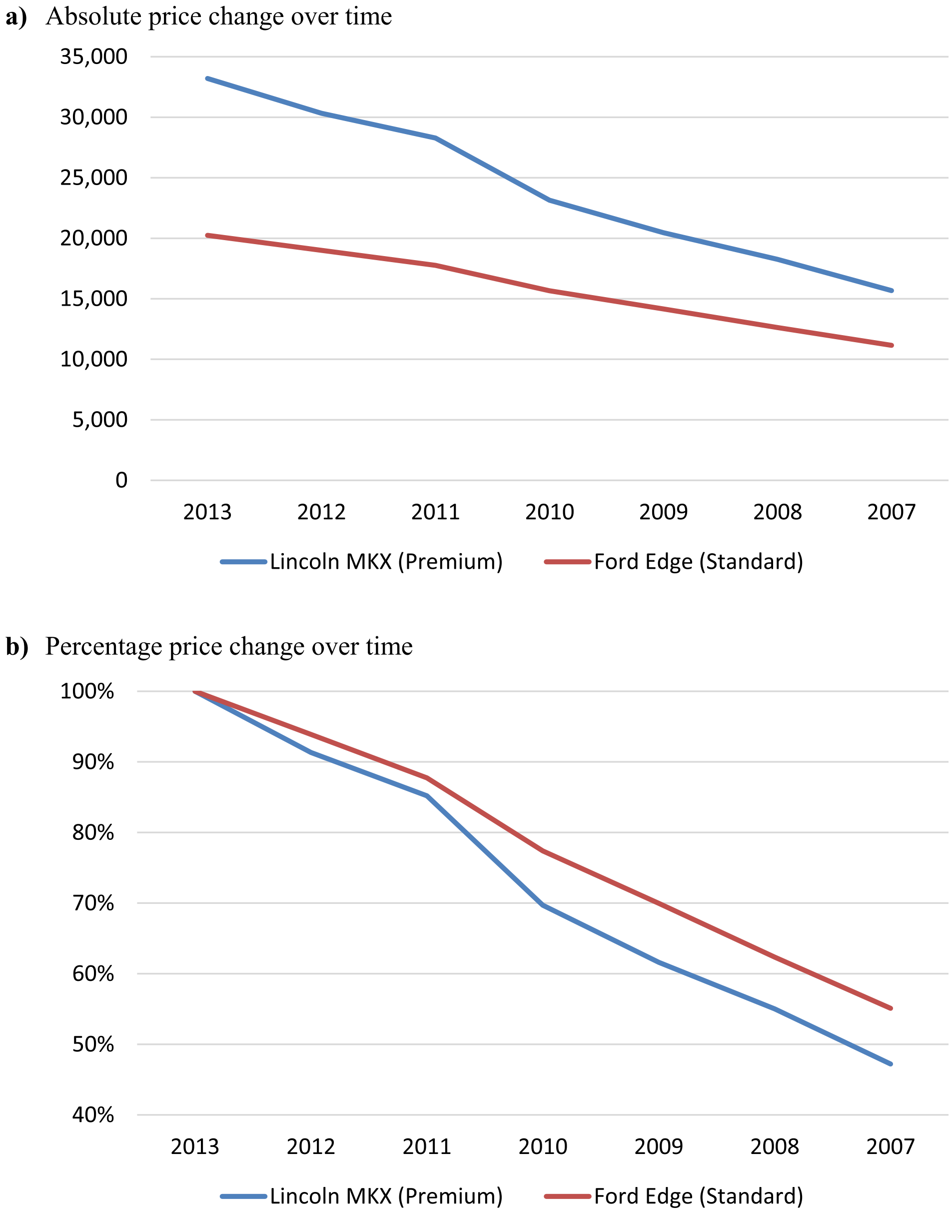

Fig. 2. Change in price as a function of age: Lincoln MKX (premium car) and Ford Edge (standard car): Data is for a car in excellent condition that is driven 10,000 miles each year.

Comparing the main effect of status between Models 3 and 2 shows the importance of accounting for the differential impact that status has on the price decline of cars. Model 3 estimates an effect of about $8900 of status on the initial price of a car, which more than doubles the estimate of Model 2 (about $3770). Model 3 estimate is much closer to the average difference in initial price between premium and standard car prices in our dataset ($9054) than is the Model 2 estimate.

Looking at how status impacts the price decline of cars, we see that higher-status cars have a steeper price decline for every year of age (by about $600 per year), and miles driven (by about $200 per 10,000 miles). As the average mileage driven per year in the US is about 13,500 miles (in 2018[6]), we see that the effect of status on the price decline due to age is stronger on average than its effect on price decline due to mileage. This finding is consistent with the notion that status perceptions are mostly affected by the newness of the car[7].

[6] Reported by the US Department of Transportation: https://www.fhwa.dot.gov/ohim/onh00/bar8.htm

[7] The sign of the term *RelativeInitialPrice* is positive indicating that the higher the initial price relative to the average of its status group their higher its price in the consecutive years. The inclusion of this variable does not affect our substantive results, as a regression without this variable, yields parameters that are, of course, somewhat different, yet the main results hold.

Table 4
Age / Mileage multipliers of twin vehicles: Pooled regressions.*

	Model 1	Model 2	Model 3
Intercept	26,429	24,459	22,308
	(1,651)	(1,523)	(1,376)
Relative Initial Price	0.50	0.52	0.53
	(0.078)	(0.087)	0.087)
Age (years)	−1,147	−1,148	−916
	(196)	(197)	(180)
Mileage (10,000 miles)	−689	−689	−583
	(87)	(87)	(71)
Very Good Condition	−472	−424	-$665
	(39)	(34)	(50)
Good Condition	−903	−798	-$1,352
	(95)	(83)	(129)
Fair Condition	−2,129	−1859	−3,121
	(218)	(182)	(298)
Status (1 = premium)		3,771	8,902
		(615)	(829)
Status*Very Good Condition		−92[NS]	−87
		(22)	(21)
Status*Good Condition		−201[NS]	−188
		(64)	(60)
Status*Fair Condition		−515	−486
		(114)	(105)
Status*Age			−601
			(104)
Status*Mileage			−203
			(54)
Age*Very Good			36
			(5)
Age*Good			82
			(13)
Age*Fair			186
			(30)
Adjusted R-Square	79.5%	79.9%	82.3%
The ratio of Age/Mileage Multipliers (Premium/Standard)		**1.27**	**1.23**

* Number of observations in all models = 14,120; Robust standard error in parenthesis; All coefficients are significant at 95% level, exceptions denoted by NS; In Model 1, the mean around which the relative initial price is centered is a single price of the average initial prices ($28,023), while in Models 2 and 3, it is $32,441 for premium brands and $23,086 for standard brands; "Excellent Condition" is the benchmark category.

More importantly, comparing the ratio of the effects of age to mileage on the price declines between standard and premium cars, we see that the ratio is higher for premium cars, as predicted by the model. The way to compute this ratio is as follows: Consider a car that travels 10,000 miles[8] and divide the price decline resulting from age by the price decline that results from mileage driven in each of the two groups – premium and standard. This ratio represents the ratio of elasticities of age (a) relative to elasticity of mileage (m), that is if $\mu_a = \frac{dp}{da}\frac{a}{p}$ is the elasticity of age and $\mu_m = \frac{dp}{dm}\frac{m}{p}$ is the elasticity of mileage, then the ratio of the effects of age to mileage on the price decline is the ratio of the elasticities μ_a/μ_m. A ratio that is higher than unity suggests that the price is more sensitive to age than it is to mileage and vice versa. The results indicate that a standard car price would decline on average by $916 and $583 due to age and mileage, respectively. The age/mileage ratio, μ_a/μ_m is thus 1. 53. A premium brand's price declines by $1517 (=916 + 601) due to age, and by $786 (=583 + 203) due to mileage, resulting in an age/mileage ratio of 1.93. To find out how much larger is the age-to-mileage price decline of a premium car over and above a standard one, we divide both ratios to obtain the 1.23 figure. We can thus summarize these findings as follows:

Result 2: On average, when taking into account a car's premium status, as well as its initial price, a premium car's price decline due to age is considerably larger than that of a standard car (controlling for their respective mileages).

We focus on the age/mileage ratio result as the main claim that we make is that the value of status declines more quickly. Thus, cars with a higher status component should exhibit a proportionately higher price decline due to status than to other factors. Empirically, we posit that price declines due to age capture status effects more than do declines due to mileage. A higher age/mileage ratio for premium cars than for standard cars is consistent with the notion of a faster decline of the status value.

8 While the intermediate calculations depend upon the miles travelled, the ratio does not.

Table 5
Individual regressions results (premium brand in **bold**).*

Vehicle	Intercept (base price)	Age (year)	Mileage (10,000)	V. Good	Condition Good	Fair	N	Adj. R-Squared
Chrysler 300	30,977	−2,056	−810	−574	−1,067	−2,698	320	87.9%
Dodge Charger	21,223	−778	−686	−488	−904	−2,191	320	95.2%
Hyundai Accent	12,493	−593	−353	−354	−586	−1,478	360	94.5%
Kia Rio	11,945	−837	−295	−331[x]	−534	−1,300	360	86.3%
Lexus ES350	29,637	−1,191	−627	−418	−772	−1,990	840	93.3%
Toyota Camry	17,106	−643	−378	−293[x]	−528	−1,380	840	91.7%
Lincoln MKS	31,635	−1,569	−1,015	−670	−1,310	−3,360	200	94.6%
Ford Taurus	20,779	−1,068	−699	−510	−970	−2,445	200	93.1%
Lincoln MKZ	23,532	−1,289	−725	−529	−962	−2,454	240	97.9%
Ford Fusion	15,261	−708	−498	−404	−729	−1,825	240	96.3%
Buick Enclave	36,074	−2,537	−1,149	−720	−1,640	−3,680	200	90.4%
GMC Acadia	30,867	−1,601	−1,006	−621	−1,287	−3,311	200	94.1%
Chevrolet Traverse	26,096	−1,516	−837	−590	−1,140	−2,880	200	93.2%
Cadillac Escalade	56,248	−3,520	−1,301	−723	−1,506	−3,484	440	93.9%
GMC Yukon	54,287	−3,300	−1,291	−703	−1,508	−3,363	440	94.9%
Chevrolet Tahoe	33,529	−1,771	−850	−535	−1,027	−2,543	440	94.6%
Ford Escape	19,161	−1,175	−459	−364	−613	−1,402	440	96.7%
Mazda Tribute	13,307	−768	−327	−297[x]	−488	−1,110	400	91.4%
Hyundai Tucson	22,447	−1,469	−570	−458	−803	−1,842	360	96.6%
Kia Sportage	19,968	−983	−566	−436	−778	−1,789	360	94.0%
Infiniti QX56	42,894	−2,634	−1,197	−658	−1,383	−3,208	240	96.7%
Nissan Armada	29,125	−1,544	−867	−550	−1,052	−2,404	240	96.8%
Jeep Compass	20,272	−997	−633	−464	−861	−2,007	280	96.1%
Jeep Patriot	16,391	−423	−592	−468	−832	−1,904	280	93.0%
Lexus LX570	72,513	−2,007	−2,624	−1,250	−2,800	−6,700	160	99.2%
Toyota Land Cruiser	63,827	−1,033	−2,388	−1,175	−2,675	−6,225	160	97.8%
Lincoln Navigator	45,140	−2,667	−806	−526[NS]	−1,034	−2,434	640	94.8%
Ford Expedition	31,579	−1,806	−585	−428[NS]	−786	−1,867	640	94.8%
Lincoln MKX	35,040	−1,754	−1,060	−663	−1,376	−3,221	280	96.6%
Ford Edge	21,517	−756	−726	−492	−952	−2,210	280	97.9%
Chrysler T&C	18,967	−836	−368	−303[NS]	−532[NS]	−1,256	840	74.1%
Dodge Grand Caravan	14,671	−524	−318	−299[NS]	−493	−1,135	840	78.0%
GMC Canyon	22,826	−619	−731	−511	−950	−2,177	360	96.5%
Chevrolet Colorado	22,561	−609	−729	−483	−1,275	−2,139	360	85.4%
GMC Sierra	18,068	−586	−499	−404	−659	−1,516	560	88.1%
Chevrolet Silverado	17,475	−560	−490	−375	−634	−1,447	560	87.7%
Average	**$28,318**	**-$1,354**	**-$807**	**-$572**	**-$1,055**	**-$2,455**	**392**	**92.9%**

* All coefficients are significant at the 99% level, except 95% (marked with x) and non-significant (NS).

4.4. Individual regressions

The advantage of the pooled regression is that the effect of status could be directly measured while controlling for mileage driven and condition of the car. The obvious limitation is that we pool all observations, thus it is not clear whether the main result holds for all or most of the individual vehicles or is driven by a small subset of the cars in the dataset. We thus ran individual regressions, that is, for each used car model *j*, the price at time *t* is a function of age, mileage, and condition, as follows:

$$price_{jt} = \alpha_{0j} + \alpha_{1j}Age_{jt} + \alpha_{2j}Mileage_{jt} + \alpha_{3j}Condition_{jt} + \varepsilon_{jt} \tag{19}$$

Table 5 shows the results of the individual regressions. In general, the model fits the data well with R-Squares well over 90% for most of the cars in the dataset. In addition, for most of the cars in our dataset (over 85% to be exact), price decline due to age is greater than the price decline due to driving 10,000 miles. This result means that an added year to the age of the car subtracts more value from the car's resale price than does 10,000 additional miles (about $1350 a year vs. $810 per 10k miles in our dataset). As the age coefficient captures, among other things, technological change that renders older cars less valuable, it is not surprising that it tends to have a stronger effect on a car price. Even cars that have not been driven at all lose value over time.[9]

In Table 6, we use the regression results to show how the rate of price decline due to age and mileage differ systematically between premium and standard cars. The second and third columns of Table 6 depict the standardized age and mileage coefficients of each car, that is, α_1 and α_2 of Equation (19). The fourth column presents the ratio of the age coefficient divided by

[9] Note that another explanation for this – that age and miles driven are correlated – largely does not hold in the case of the Kelley Blue Book data, where these factors are orthogonal by design (though the expert opinions may still be unconsciously biased to some degree by this empirical regularity in the marketplace).

Table 6
Age/Mileage (standardized) multipliers of twin vehicles: Individual regressions.*

Vehicle Model	Age coefficient	Mileage coefficient	Age/Mileage multiplier	Ratio of Age/Mileage Multipliers*
Chrysler 300	−0.83	−0.41	2.03	
Dodge Charger	−0.63	−0.69	0.90	2.24
Hyundai Accent	−0.78	−0.52	1.51	
Kia Rio	−0.85	−0.33	2.56	0.59
Lexus ES350	−0.93	−0.23	4.00	
Toyota Camry	−0.92	−0.26	3.59	1.12
Lincoln MKS	−0.56	−0.73	0.76	
Ford Taurus	−0.55	−0.73	0.75	1.01
Lincoln MKZ	−0.69	−0.65	1.06	
Ford Fusion	−0.60	−0.71	0.84	1.25
Buick Enclave	−0.67	−0.62	1.09	
GMC Acadia	−0.57	−0.72	0.78	1.39
Buick Enclave	−0.67	−0.62	1.09	
Chevrolet Traverse	−0.61	−0.68	0.89	1.22
GMC Acadia	−0.57	−0.72	0.78	
Chevrolet Traverse	−0.61	−0.68	0.89	0.88
Cadillac Escalade	−0.91	−0.31	2.98	
GMC Yukon	−0.91	−0.32	2.81	1.06
Cadillac Escalade	−0.91	−0.31	2.98	
Chevrolet Tahoe	−0.88	−0.38	2.29	1.30
GMC Yukon	−0.91	−0.32	2.81	
Chevrolet Tahoe	−0.88	−0.38	2.29	1.23
Ford Escape	−0.92	−0.33	2.82	
Mazda Tribute	−0.89	−0.33	2.67	1.06
Hyundai Tucson	−0.89	−0.38	2.32	
Kia Sportage	−0.80	−0.51	1.56	1.49
Infiniti QX56	−0.76	−0.58	1.31	
Nissan Armada	−0.69	−0.66	1.06	1.23
Jeep Compass	−0.70	−0.64	1.10	
Jeep Patriot	−0.40	−0.81	0.50	2.20
Lexus LX570	−0.27	−0.91	0.30	
Toyota Land Cruiser	−0.16	−0.93	0.17	1.77
Lincoln Navigator	−0.96	−0.18	5.31	
Ford Expedition	−0.95	−0.19	4.96	1.07
Lincoln MKX	−0.72	−0.62	1.15	
Ford Edge	−0.54	−0.76	0.71	1.59
Chrysler Town & Country	−0.84	−0.18	4.79	
Dodge Grand Caravan	−0.84	−0.24	3.48	1.38
GMC Canyon	−0.57	−0.75	0.76	
Chevrolet Colorado	−0.53	−0.71	0.75	1.02
GMC Sierra	−0.79	−0.48	1.65	
Chevrolet Silverado	−0.78	−0.49	1.60	1.03
Average	**−0.72**	**−0.53**	**1.89**	**1.29**

* Ratio larger than 1 implies that price decline due to age relative to the price decline due to mileage is greater for premium.

the mileage coefficient, i.e., α_1/α_2. We claim that the ratio of the price decline due to age to the price decline due to miles driven should be larger in premium vehicles than in their standard twins. Indeed, the last column of the table depicts the ratio of age/mileage coefficient for the premium car divided by the same coefficient for the standard car. If our hypothesis is correct, this ratio should be greater than one: Indeed, for 19 out of the 21 pairs, the ratio of age/mileage coefficients is greater for the premium vehicles than for their standard twins. The individual regression results are consistent with the findings of the pooled regression: They indicate that by and large, the results are in the same direction for almost all car pairs, and thus are not driven by some small influential subset of cars.

5. Robustness checks

i. Price percentage decline: We ran the regressions with the percentage decline in price as the dependent variable instead of the absolute decline in price. Thus, we modified Equations (18) and (19) so that the left-hand-side of both equations were replaced with $price_{jt}/price_{j0}$, and also the variable $RelativeInitialPrice_j$ was dropped from Equation (18)[10]. The resultant model is represented in Equation (20), and the results of the percent pooled regression are presented in Table 7.

[10] Note that the DV is Equation (20), i.e., $\frac{price_{jt}}{price_{j0}}$, which represents the relative price of a car at the age t relative to the price of the same car when it was purchase, is a linear transformation of the percent price depreciation $\frac{price_{jt}-price_{j0}}{price_{j0}}$.

Table 7
Pooled percentage regression.*

Intercept	0.973
	(0.028)
Age (years)	−0.040
	(0.035)
Mileage (10,000 miles)	−0.026
	(0.002)
Very Good Condition	−0.029
	(0.001)
Good Condition	−0.057
	(0.002)
Fair Condition	−0.132
	(0.004)
Status (1 = premium)	−0.007
	(0.192)
Status*Very Good Condition	0.003
	(0.001)
Status*Good Condition	0.048
	(0.001)
Status*Fair Condition	0.010
	(0.003)
Status*Age	−0.005
	(0.003)
Status*Mileage	0.001
	(0.051)
Age*Very Good	0.001
	(0.000)
Age*Good	0.003
	(0.000)
Age*Fair	0.007
	(0.001)
Adjusted R-Square	82.1%
Ratio of Age/Mileage Multipliers (Premium/Standard)	**1.19**

* Number of observations = 14,120; Robust standard error in parenthesis; All coefficients are significant at 95% level, except for Status and Status*mileage that are not significant; Status parameter should not be significant in a percent regression as both premium and standard cars intercept is the same (100%).

$$\frac{price_{jt}}{price_{j0}} = \alpha_0 + \alpha_1 Age_{jt} + \alpha_2 Mileage_{jt} + \alpha_3 Condition_{jt} + \alpha_4 Status_j + \alpha_5 Status_j \cdot Condition_{jt} + \alpha_6 Status_j \cdot Age_{jt} + \alpha_7 Status_j \cdot Mileage_{jt} + \alpha_8 Condition_{jt} \cdot Age_{jt} + \varepsilon_{jt} \tag{20}$$

Though the parameters certainly changed and the Status parameter is non-significant, our main results still hold: Comparing the ratio of age to mileage price declines between standard and premium cars, we see that the ratio is higher for premium cars (1.19). Note that while the Status parameter in our main regression (Equation (18)) is significant as it represents the additional initial price of the premium car over and above the standard car, in the percent regression the Status parameter should not be significant, as both premium and standard cars intercept is the same (100%).

The results of the percent decline individual regressions (19) are precisely the same as those reported for the absolute decline in price in Tables 5 and 6. This shows that the results are not merely an artifact of higher-priced cars exhibiting larger absolute declines in prices, but that also in relative terms, premium cars lose more value over the same period.

ii. Premium and standard categorization: We tested all of the cases where the categorization into a premium or standard car was not entirely self-evident. Our model assumes that brand value resides with the model name, and not the umbrella brand name. This is an approximation, as the umbrella brands do have value.

To test this, we ran the pooled regression without the pairs where the umbrella brands had multiple instances and could potentially be a premium brand or a standard brand (Hyundai / Kia, Jeep Compass / Patriot, and Ford / Mazda). The resulting ratio (of age to mileage price declines between standard and premium cars) is 1.19.

We also tested what happens if we change the classification of the GMC brands (Acadia and Yukon) from premium to standard. We ran a pooled regression while categorizing these GMC brands as standard instead of premium, and the resulting ratio is 1.27.

iii. Cars vs SUVs vehicle types: We tested the robustness of our findings when analyzing data at the vehicle type level: cars vs. SUVs (minivans and trucks contain only one and two pairs, respectively). The resulting ratio is 1.43 and 1.10, where the effect is larger for cars. The difference in ratios might be because the price premium that a consumer pays for a premium new car versus a standard new car is higher than that for an SUV (52% vs. 38%), which may indicate that the perceived heterogeneity in cars' status is higher than for SUVs' status.

iv. Twin regressions. To take advantage of the twin cars configurations to remove potential effects of some unobservable factors that influence both models, for each twin pair of car models, we ran a joint regression as follows (*i* and *j* being twin pairs such as *i* = Cadillac Escalade, and *j* = Chevy Tahoe):

$$price_{ijt} = \alpha_{0ij} + \alpha_{1ij}Age_{ijt} + \alpha_{2ij}Mileage_{ijt} + \alpha_{3ij}Condition_{ijt} + \alpha_{4ij}Status_{ij} + \alpha_{5ij}Status_{ij} * Age_{ijt} + \alpha_{6ij}Status_{ij} * Mileage_{ijt} + \varepsilon_{ijt} \tag{21}$$

The results replicate the results of the individual regressions, in that the last column of Table 6 is an exact replication of the corresponding table of the twin regressions, except for the pair Ford Escape and Mazda Tribute in which, as we reported, one year of data is missing (where the ratio of age/mileage multipliers is 1.09 instead of 1.06).

We thus conclude that our main result is robust to the specific dataset used, as well as to model specifications.

6. Conclusions and implications

As the status benefits of durable goods become more important, understanding how these benefits decline over time is crucial for firms to develop successful marketplace strategies. In this research, we study the decline of a durable good's status benefits versus the decline in its functional benefits in the context of cars. We present an analytical dynamic model of consumer valuation in the durable goods market of new and used cars, which includes the possibility of status consciousness on the part of some consumers. We show that as the importance of status increases, the decline in the price of the used car is greater (relative to its initial price) both in absolute terms and percentage-wise. In the empirical analysis, we use data on prices of new and used cars (for each year and mileage) that include the age of the car; its usage in term of distance driven; its external condition, and its status (premium vs. standard) for 21 twin car pairs for an average observation period of nine years. We find that a premium car's price decline due to age is much greater than that of the standard car (controlling for the price decline due to mileage, car's condition and the car's initial price). This result, which confirms our analytical model, demonstrates that the true cost of owning a premium car is not just its initial high price, but rather the much faster fall in the car's value over its lifetime, as compared to the standard version of that same premium brand.

Our finding that stronger brands lose value faster than the weaker brands, and this difference cannot be attributed to a given car's variation of functional attributes. Instead, we show that this phenomenon occurs due to the decline in the status benefits that older units of premium brands provide to consumers (compared to the value of a new unit). The fast decline in the benefit of status results in a faster decline in price of high-status brands. This, in turn, causes status seekers to replace their cars earlier and deflate their value faster.

Theoretically, the price of a new car is equal to the net present value of its stream of functional and status benefits at each year plus the salvage value, i.e., price of used car at the second-hand market (SHM). The lower the price of a car at the SHM the lower the price of a new car. Thus, hypothetically, the steeper decline of the used car's price relative to its purchasing price of high-status cars class, relative to the rate of decline in the price over time of regular models, should be reflected in lowering the difference between the initial prices of high-status and regular status cars. As building and maintaining status is costly, and there are positive relationships between status and price difference, it should lead manufacturers of the stronger brands to try to control the steep decline in the price of luxurious and status used cars. Promoting leasing is an efficient way to increase the retention of customers (Dasgupta, Siddarth, & Silva-Risso, 2007), reduce replacement transaction cost (Johnson, Schneider, & Waldman, 2014), and allow status-seeking consumers to drive only new luxury brands. Therefore, the higher percentage of leased luxury cars can be explained, at least partially, by their rapid loss of status benefits and their lower wear and tear decline. Similarly, other strategies of supporting second-hand markets or prices, such as proactively buying cars on the second-hand market or providing guarantees of price floors in second-hand markets, might help in mitigating the effect of the steep drop in price. Given sufficient time lag, some older models become attractive and actually increase in price because they become known as 'vintage.' Firms may also consider ways in which they can promote and expand the market for 'vintage' models, thereby again helping to mitigate the drop in price.

Our model suggests that status seekers are replacing their high-status car because the benefit of the status is declining faster than the functional benefit. Status seekers might be signaling to others that they can afford losing money, and they do not care about it. This implied behavior, that lead to a choice of a brand that is more expensive and in addition losses price faster, helps the owner to differentiate themselves from people who assign high importance to the price they would get at the SHM when they would sell the car. This suggests that instead of trying to control the price decline of the high-status brands, firms might try to embrace it by promoting strategies that support shorter duration of ownership in the high-status cars. For example, by offering incentives to replace it in shorter time than the three-year time frame of the common leasing contracts. Having a car that is likely to be functionally perfect, and knowing that there is a strong market for such cars and that the segment of buyers of the used ex-status cars do not overlap with status seekers allow to discriminate prices without fearing from having strategic behavior of new car buyers.

More generally, our results indicate that status benefits are not a fixed constant effect, but rather a dynamic construct that needs to be carefully managed. While this seems self-evident for services, the fact that the status benefits of durable goods decline quickly over time poses serious challenges to managers on how to respond: How should this impact the rate of new model introductions? What strategies are available to firms to prop up the status of older units (for example, by supporting and creating vintage markets and demand), and when should those strategies be used? These are important managerial issues for durables that need to be further explored in future research.

Our study analyzed a single industry, the car's market and used data on twin cars to isolate the difference in functional quality from status. This limits the ability to generalize our findings. Future studies on other product categories such as collectible watches and jewelry, designers' luxurious bags, shoes and apparel can shed further light on this topic.

References

Aaker, D. A., & Joachimsthaler, E. (2000). *Brand Leadership*. New York: Free Press.
Belk, R. W. (2013). Extended self in a digital world. *Journal of Consumer Research, 40*(3), 477–500.
Blackley, J., 2018. Cars With the Lowest and Highest Depreciation. iSeeCars.com, retrieved from https://www.iseecars.com/cars-low-high-depreciation-2018-study.
Chan, C., Berger, J., & Van Boven, L. (2012). Identifiable but not identical: Combining social identity and uniqueness motives in choice. *Journal of Consumer Research, 39*(3), 561–573.
Dasgupta, S., Siddarth, S., & Silva-Risso, J. (2007). To lease or to buy? A structural model of a consumer's vehicle and contract choice decisions. *Journal of Marketing Research, 44*(3), 490–502.
Desai, P. S., & Purohit, D. (1999). Competition in durable goods markets: The strategic consequences of leasing and selling. *Marketing Science, 18*(1), 42–58.
Desai, P., & Purohit, D. (1999). Leasing and selling: Optimal marketing strategies for a durable goods firm. *Management Science, 44*(11), S19–S34.
Dhar, R., & Wertenbroch, K. (2000). Consumer choice between hedonic and utilitarian goods. *Journal of Marketing Research, 37*(1), 60–71.
Dinnin, A. (2009). The appeal of our new stuff: How newness creates value. *Advances in Consumer Research, 36*, 261–265.
Edmunds.com. 2009. Twinned vehicles: Same cars, different brands: Knowing which cars are twins gives consumers more choice. Retrieved from www.edmunds.com/car-buying/twinned-vehicles-same-cars-different-brands.html.
Esteban-Bravo, M., & Lado, N. (2011). Brand value in horizontal alliances: The case of twin-cars. *Journal of the Operational Research Society, 62*(8), 1533–1542.
Gavazza, A., Lizzeri, A., & Roketskiy, N. (2014). A quantitative analysis of the used-car market. *American Economic Review, 104*(11), 3668–3700.
Han, Y. J., Nunes, J., & Drèze, X. (2010). Signaling status with luxury goods: The role of brand prominence. *Journal of Marketing, 74*(4), 15–30.
Higgins, E. T. (2006). Value from hedonic experience and engagement. *Psychological Review, 113*(3), 439–460.
Jayarajan, D., Siddarth, S., & Silva-Risso, J. (2018). Cannibalization vs. competition: An empirical study of the impact of product durability on automobile demand. *International Journal of Research in Marketing, 35*(4), 641–660.
Johnson, J. P., Schneider, H. S., & Waldman, M. (2014). The role and growth of new-car leasing: Theory and evidence. *Journal of Law and Economics, 57*(3), 665–698.
Kahneman, D., Diener, E., & Schwarz, N. (1999). *Well-being: Foundations of hedonic psychology*. Russell Sage Foundation.
Kurz, C. and G. Li. 2015. Who drives luxury cars (only for a while)? Board of Governors of the Federal Reserve System, FEDS notes, June 21. Retrieved from www.federalreserve.gov/econresdata/notes/feds-notes/2015/who-drives-luxury-cars-20150601.html.
Moreno, A., & Terwiesch, C. (2017). The effects of product line breadth: Evidence from the automotive industry. *Marketing Science, 36*(2), 254–271.
Okulicz-Kozaryn, A., Nash, T., & Tursi, N. O. (2015). Luxury car owners are not happier than frugal car owners. *International Review of Economics, 62*(2), 121–141.
Pries, L. 2003. Accelerating from a multinational to a transnational carmaker: The Volkswagen consortium in the 1990s" in Globalization or Regionalization of the European Car Industry, Michel Freyssenet, Koichi Shimizu, Giuseppe Volpato (eds.), pp. 51-72 Palgrave MacMillan.
Purohit, D. (1997). Dual distribution channels: The competition between rental agencies and dealers. *Marketing Science, 16*(3), 228–245.
Richins, M. L., & Bloch, P. H. (1991). Post-purchase product satisfaction: Incorporating the effects of involvement and time. *Journal of Business Research, 23*(2), 145–158.
Sajeesh, S., Hada, M., & Raju, J. S. (2020). The effect of consumer heterogeneity on firm profits in conspicuous goods markets. *International Journal of Research in Marketing, 37*(2), 258–280.
Stahl, F., Heitmann, M., Lehmann, D. R., & Neslin, S. A. (2012). The impact of brand equity on customer acquisition, retention, and profit margin. *Journal of Marketing, 76*(4), 44–63.
Strahilevitz, M. A., & Loewenstein, G. (1998). The effect of ownership history on the valuation of objects. *Journal of Consumer Research, 25*(3), 276–289.
Sullivan, M. W. (1998). How brand names affect the demand for twin automobiles. *Journal of Marketing Research, 35*(2), 154–165.
Wang, J., & Wallendorf, M. (2006). Materialism, status signaling, and product satisfaction. *Journal of the Academy of Marketing Science, 34*(4), 494–505.
Wooldridge, J. M. (2003). Cluster-sample methods in applied econometrics. *American Economic Review, 93*(2), 133–138.