MSc. Thesis

Classic Cars: A New Alternative Investment Vehicle?

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Abstract

This thesis investigates the price determinants and investment performance of classic cars. We investigate a sample of over 29,000 classic car auction sales conducted between January 1998 and July 2017. A hedonic regression methodology is used in order to construct several constant-quality classic car price indices. Based on these indices, we estimate that classic cars appreciated in value by around 3.37 % and 5.63 % annually, respectively in real and in nominal terms. Compared to other asset classes, return performance has been strong. Over the period covered, only gold outperformed classic cars. When we incorporate dividend yields into equity returns, we find that equities as an asset class slightly outperform classic cars. On a risk-adjusted basis, the performance is similar, with both asset classes showing Sharpe ratios of around 0.30. Comparing the risk-adjusted performance of classic cars to other asset classes, we find that gold and government bonds outperformed classic cars, as measured by their larger Sharpe ratios.

We find that classic car investments partially hedge against inflation. Accounting for non-synchroneity in the returns between classic cars and equity markets, we find a much stronger relationship between the two than initially expected. This shows that wealth effects are important drivers of classic car returns. While this limits the diversification potential of classic cars, the systematic risk of classic car investments remains low.

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1. Introduction

The relatively low-yield environment that has characterized financial markets in the past years has left investors seeking for greater returns. In this search for yield, investors' focus has shifted away from traditional asset classes such as stocks, bonds, and cash. Instead, capital invested in alternative investments has been increasing steadily. In recent years, one alternative asset class that has been gaining in popularity among investors is that of 'collectibles', also referred to as 'emotional assets'.

Emotional assets could potentially provide greater returns than traditional asset classes. But there are other benefits that 'investments of passion' (Dimson and Spaenjers, 2014a) might offer. First, it is often argued that these type of investments are relatively uncorrelated to more traditional financial investments. From a diversification perspective, this makes them attractive candidates to add to a portfolio. Next, holding these assets could also provide hedging benefits against market downturn or inflation. Additionally, it is in the nature of emotional assets that part of their return is enjoyed not in the form of financial reward, but in the form of an 'emotional dividend', for example in aesthetic value or because they can act as a signal of wealth (Campbell, Koedijk & De Roon, 2009).

Within the field of collectibles, a vast range of different emotional assets have been recognized and investigated by academics. These include, but are not limited to, investments in wine (Burton & Jacobsen, 2001; Sanning, Shaffer & Sharratt, 2006; Dimson, Rousseau & Spaenjers, 2015), collectible stamps (Dimson & Spaenjers, 2011), fine violins (Ross & Zondervan, 1989; Graddy & Margolis, 2011), rare gemstones and diamonds (Renneboog & Spaenjers, 2012), and fine art (Baumol, 1986; Goetzmann, 1993; Mei & Moses, 2002; Renneboog & Spaenjers, 2013). To this date however, no substantial research has been conducted into the risk and return characteristics of classic car investments[1]. Given the increased popularity of this alternative investment and the large size of the classic car market, this lack is striking.

Stories of classic Ferraris and other high-end vintage cars auctioned off for astronomical prices regularly reach the news. In 2016 for example, a 1957 Ferrari 335S Spider Scaglietti was sold at an auction in Paris for a record-setting €32 million (Sharman, 2016). While academic research in this field is lacking, media articles discussing the supposed benefits or dangers of investing in collectible automobiles

[1] The Classic Car Club of America (CCCA) defines a classic car as *"a fine or distinctive automobile, either American or foreign built, produced between 1915 and 1948"* (CCCA, 2016). In this thesis, the term 'classic car' refers to the much less restricting definition of any car that is older than 25 years. In addition, terms such as 'vintage car', 'classic car', and 'collectible car' are used interchangeably.

frequently emerge[2, 3, 4]. The analysis in this thesis will focus on one main question: "To what extent can classic cars be regarded as a viable alternative investment class?" In order to answer this question, we will apply hedonic regression methodologies on an extensive data set of car auction records. Through this analysis, we will gain an understanding of the factors driving classic car values. Most important, this methodology enables us to compute indices that control for differences in the quality of classic cars traded, so that we can construct an objective measure of the risk and return characteristics of this asset class. Furthermore, we will compare the returns on our indices to those on other financial and real assets. This way, we can evaluate whether classic car investments can add value to a portfolio through diversification benefits. Lastly, we will analyse whether classic car investments can serve a hedging function against inflation and stock market downturns.

The outline of this thesis is as follows. *Section 2* will provide an overview of the literature on collectible investments. Current literature on classic cars as an alternative asset class will also be discussed. *Section 3* will outline the sources of data and introduce the hedonic regression model used. Our results will be presented in *Section 4*. We test the robustness of one of our main assumptions in *Section 5*. Finally, a conclusion and discussion will be provided in *Section 6*.

[2] "Best of Money: the classic car is the investment star". Financial Times. April 8, 2016. Retrieved from: https://www.ft.com/content/fc2a08b8-f824-11e5-96db-fc683b5e52db

[3] "Passion investing in classic cars is gaining speed". CNBC. January 4, 2016. Retrieved from: http://www.cnbc.com/2016/01/04/passion-investing-in-classic-cars-is-gaining-speed.html

[4] "Stop kidding yourself. A classic car is (almost) never a good investment". Bloomberg News. August 14, 2015. Retrieved from: https://www.bloomberg.com/news/articles/2015-08-14/stop-kidding-yourself-a-classic-car-is-almost-never-a-good-investment

2. Literature background

2.1. Alternative investments

2.1.1. Background on 'alternatives'

In recent years, alternatives investments have become increasingly more popular, both amongst practitioners and academics. Generally, 'alternative investments' refer to asset classes that fall outside the scope of many traditional investments such as stocks, bonds and cash (Baker & Fillbeck, 2013). According to this definition, alternative investments encompass a broad range of different offerings. Even within the field of alternative investments, a distinction can be made between somewhat traditional alternatives and more or less 'alternative alternatives' (Blessing, 2011). The former group contains asset classes such as real estate, private equity, foreign exchange, hedge funds, and commodities. In the latter group, a wide range of exotic investments can be found. Examples include investments in timberland, carbon emissions, collectible assets, and catastrophe-linked bonds (Blessing, 2011).

Capital allocated to alternative investments has increased dramatically in the past few decades (World Economic Forum, 2015). University endowment funds have played a leading role in this trend. Historically, they have been allocating a large portion of their capital to alternative asset classes such as hedge funds, commodities and private equity (Lerner, Schoar & Wang, 2008). An often-cited example is Yale's widely successful endowment model. In 2015, the endowment's capital was for over 70% invested in alternatives (Yale Investment Office, 2015). Pension funds are also increasing their investments in alternative asset classes. According to a report by Blackstone (2016), pension funds now allocate 27% of their capital to alternatives, on average. While these developments mainly refer to 'traditional' alternative asset classes such as private equity and real estate, in recent years more niche alternative asset classes have also gained in popularity. This phenomenon is mainly caused by an expansion of information being available through specialised data provides and price indices, better accessibility of alternative assets through investment funds and ETFs, and the increased perception of 'truly' alternatives as a viable asset class (Coslor and Spaenjers, 2016).

2.1.2. Collectibles and the market for classic cars

'Collectibles', sometimes referred to as 'emotional assets' or 'investments of passion' (Dimson & Spaenjers, 2014a), are one specific subclass of the alternative investments universe. What generally defines collectibles is that they intrinsically are of limited value. That is, unlike financial assets, merely holding emotional assets will not generate cash flows. And unlike commodities, they cannot be used as part of an industrial process. But collectibles do provide consumption value in the sense that one can derive pleasure from their usage or aesthetic appearance. They can also be valuable for an owner in other ways, as they can act as a signal of wealth and social status (Campbell, Koedijk & De Roon, 2009). Besides classic cars, many other collectible assets exist; amongst which paintings and other art works, antiques, sports and celebrity memorabilia, stamps, wine and whiskey, collectible books, diamonds and other gemstones, and rare coins.

Of all collectibles markets, the market for classic cars is one of the largest. AXA Art Insurance (2016) estimates that global classic car transactions in 2015, including private sales, exceeded €15 billion. Mische and Spizzirri (2014) estimate the global value of classic cars to be around $120 billion in 2012. For the United States alone, total auction sales of classic cars amounted to $1.2 billion in 2016. The market is also growing quickly, as this number increased more than sevenfold since the year 2000 (Historica Selecta, 2016). According to research by Knight Frank (2016), classic cars in the top segment have seen price increases of 467% over the last ten years.

Several factors characterize the market for collectibles, and thus also the classic car market. First of all, the main participants are 'collectors': *"people who, actively, selectively and passionately, acquire and possess things removed from ordinary use and perceived as part of a set of non-identical objects or experiences"* (p. 479: Belk, 1995). Especially in the high-end collectibles market, the behaviour of 'high-net-worth individuals' is important in driving prices, as they spend significant amounts of wealth to investments of passion (Capgemini & RBC, 2013). While motivations for collecting are often emotional and social, Burton and Jacobsen (1999) state that *"a substantial proportion of collectors also hope for financial gains"* (p. 195).

Second, transactions in collectibles markets occur through either of three channels: auctions, specialised dealerships and private sales. Auctions are mostly organised in the form of an English auction, meaning that the auctioneer accepts increasingly higher bids until the item is sold. It is common to place a 'reserve price' on an item for sale, so that when the bidding does not reach a certain level, the lot will go unsold. This practice guarantees sellers of a certain price and causes manipulation in which illegal 'rings' collude in the betting process to be less effective (Ashenfelter, 1989).

Third, there is a great deal of inefficiency in the price-setting process of collectible markets. Illiquidity and opacity contribute to this. Geographic segmentation also plays a role. Renneboog and Spaenjers (2014) argue that the art market is segmented in two ways: because of practical and legal barriers, and through international variation in the demand for different types of art. This effect likely also plays a role in the classic car market as trade barriers are even higher: a car's size and weight make transportation impractical, and legislation, registration and import tariffs make it costly. Especially in the past, car manufacturers were symbols of nationalistic pride. In that sense, it might seem reasonable that the 'home country bias' existing in art markets (Renneboog and Spaenjers, 2014) is also prevalent in the market for classic cars.

2.1.4. Recent developments in the collectibles market

A series of developments have made investing in collectibles more popular and more accessible to the investor public. Coslor and Spaenjers (2016) describe these developments for the art market, but they can be generalized to the collectibles market as a whole.

First, the market for collectibles has become vastly more transparent in recent years. For many different types of collectibles, specialised data providers who publish information on prices and market developments have emerged. These companies oftentimes aggregate pricing information into collectibles indices that are similar in use and methodology as financial indices. Ginsburgh et al. (2006) identify many uses for such a collectibles price index. An important one is that it can provide an overview of the market as a whole. As a consequence, an index can serve as a benchmark against which the performance of an investment in collectibles can be evaluated (Coslor and Spaenjers, 2016). Second, price indices enable comparisons with other asset classes, as volatilities and correlations can be measured. This makes it possible to assess whether collectibles can add diversification value to a portfolio. These days, indices are available for fine wine[5], art[6], collectible stamps[7], diamonds[8], and rare coins[9]. The classic car market has also seen an emergence of data and index providers. Classic car insurance company Hagerty, for example, publishes collector car price indices for Blue Chip cars, Affordable Classics, 1950's Americans and a few other categories. They also create sentiment and market strength indicators. Furthermore, a company known as HAGI publishes similar indices. In Germany, a well-known collectible car index is called the Deutscher Oldtimer Index, or DOX. More information on these indices is provided in Section 2.6.1.

[5] Liv-Ex, or London International Vintners Exchange, is an exchange for investment-grade wine. Information about the Liv-Ex 100 Fine Wine Index is available here: https://www.liv-ex.com/

[6] E.g. Artprice.com publishes several such indices: https://www.artprice.com/

[7] E.g. The Great Britain 30 by Stanley Gibbons: http://www.stanleygibbons.com/investment/gb30-rarities-index/

[8] E.g. http://www.idexonline.com/diamond_prices_index

[9] E.g. http://www.stanleygibbons.com/investment/gb200-rare-coin-index/

A second development in the market for art and other collectibles is the increased perception of collectibles as an investment class. Coslor and Spaenjers (2016) state that more and more investment managers accept the concept of art as an investment. The great amounts of academic research and the availability of more information in general have opened up the collectibles market to a world of global finance (Coslor and Spaenjers, 2016; Horowitz; 2011). According to a report by Deloitte and ArtTactic (2016), 78% of wealth managers feel that art and collectibles should be part of wealth management offerings.

Third, the market for collectibles has become a lot more professional. Coslor and Spaenjers (2016) call this development the 'financialization' of collectibles classes. These days, specialized investment funds operate in every large market for collectibles. Similar to private equity funds, they gather investments and use the proceeds to invest in collectible items. Such funds also operate in the classic car market. The WMG Collectible Car fund, for example, is currently in capital-raising phase and seeking £50 million of equity (WMG Advisors, 2017). The fund is targeting annual returns of 20%, according to one of the fund's managers, Pieter van Leuven (Personal communication, 2017). The car fund is set up as a closed-end fund, meaning that investors can only liquidate their shares if they find a buyer privately. The WMG Collectible Car fund does not aim to invest solely in classic cars. Modern classic cars of investment grade will also be considered for purchase. Van Leuven expects a first close in early 2018, after which the fund will invest in 10 to 15 collectible cars that are to be held for about 3 years (Personal communication, 2017). A few other investment funds are also known to operate in the classic car market. Examples are The Classic Car Fund and The Rolling Art Fund.

2.2. Reasons for investing in collectibles

Academics researching emotional assets have brought up several arguments in favour of investing in collectible assets. These reasons can be roughly grouped into four categories: investment outperformance, diversification benefits, hedging benefits and nonpecuniary rewards. It must be noted, however, that there is a wide variety in the extent to which the following arguments are backed by empirical research.

2.2.1. Return outperformance

Several researchers have made an effort to investigate the return performance of investments in collectibles. Overall, their results have been mixed. The majority of researchers conclude that, on average, investments in art and other collectibles show lesser returns than equity investments. Some studies do find that collectibles investments outperform government bonds, and sometimes even corporate bonds. Mei and Moses (2002), for example, find that art investments showed strong returns of 8.2% annually (in real terms) over the period 1950-1999. Yet Renneboog and Spaenjers (2013) find much lower real returns on these investments of only 3.97% annually, over an almost similar period spanning 50 years, starting from 1957. The reason for this difference is that Renneboog and Spaenjers focused on a much broader sample that does not only include top works. They conclude that corporate bonds and equities outperform art investments. For other collectibles classes, results are also widely dispersed. A detailed summary of the literature on the returns of collectibles investments will be presented in *Section 2.4*. For an overview of investments returns on various collectible asset classes, please refer to Table 1 and Table 2 in *Section 2.4*.

2.2.2. Diversification

In 1952, Harry M. Markowitz laid the groundworks for modern portfolio theory. In his paper "Portfolio Selection", he argued that not only the risk and return characteristics of securities within a portfolio are relevant, but also the covariance relationships that they share. By taking these diversification benefits into consideration, an investor can construct an 'efficient portfolio' for which it would be impossible to increase returns without also incurring greater risks (Markowitz, 1959). Stated differently; by diversifying a portfolio, an investor can achieve a better return-to-risk ratio. These findings imply that even when an asset does not provide an exceptional return, the inclusion of that asset can still improve the performance of a portfolio by reducing its riskiness, provided that the asset shows a negative or low correlation to the assets already in the portfolio.

Multiple researchers have looked into the correlational characteristics of collectibles investments. Many of them find low correlations of collectibles with other financial assets, and even within the collectibles markets cross-wise correlations are low. Sanning et al. (2007) investigate the performance of wine investments. They apply the Fama-French three-factor model to wine prices and find that the returns of wine covary minimally with stock market returns. While the three-factor model is able to explain 90% of the variation in stock returns, it can only explain 9% of the variation in wine returns. This indicates that wine investments have low exposures to equity risk factors, suggesting that in theory they could serve as diversifying investments.

Similar results are found by Renneboog and Spaenjers (2012), Dimson and Spaenjers (2011) and Dimson et al. (2015), who find relatively low beta's for investments in respectively white and coloured diamonds, collectible stamps, and wine. Investments in these collectibles are thus only modestly exposed to systemic risk factors. Again, these findings suggest that collectible investments can add value to a portfolio by providing diversification benefits.

2.2.3. Hedging benefits

As most collectibles are real, tangible assets, some are regarded as 'stores of value'. In theory, these assets should provide security against inflation and market downturns. This hedging property varies wildly over the type of collectible asset. Diamonds, stamps and rare coins are traditionally viewed as such safety assets. In order for an asset to be considered as a hedge, its returns must be, in theory, positively correlated to inflation and negatively correlated to the returns on other financial assets.

Renneboog and Spaenjers (2012) examine the investment performance of rare diamonds and other gems. Much like gold, it is often believed that diamonds can act as hedging assets. During the period between 2003 and 2010, investment returns did indeed beat inflation by a wide margin. While prices decreased less than the stock market during the financial crisis and were quick to recover after, diamond investments still performed poorly during the crisis. Additionally, for the whole sample period, Renneboog and Spaenjers find strong positive covariances in the returns between diamonds and stock markets. This suggests that diamonds' propensity to protect against market declines is less strong than oftentimes believed. Other researchers draw similar conclusions regarding the hedging abilities of other collectible classes. Sometimes called 'paper gold' (Wagenheim, 1976), collectible stamps are traditionally also regarded as a hedging asset. Collectible stamp investments do indeed hedge against expected inflation (Dimson and Spaenjers, 2011). Moreover, evidence for stamps' partial hedging property against unexpected inflation has been found. While Dimson and Spaenjers' evidence remains inconclusive to the claim that stamp investments provide security against market downturns, they do indicate that during the last financial crisis in 2008, stamp prices increased by, on average, 35%.

After researching the prices of rare coins, Kane (1984) reaches the conclusion that they serve as a "*potent inflation hedge*" (p. 51). Unfortunately, he does not investigate the correlation between rare coin returns and stock price movements. Graddy and Margolis (2011) research the investment performance of fine violins. According to their study, movements in the price of violins – and especially the finest ones – are negatively correlated with S&P 500 and FTSE returns.

Empirical results in this regard remain mixed, however. Some studies suggest that there is in fact a positive correlation between equity returns and the returns on investments in collectibles. Goetzmann, Renneboog, and Spaenjers (2011), Chanel (1995), and Goetzmann (1993) report that returns on art and collectibles are related to stock market valuations, through the mechanism that wealth levels of investors are significantly tied to equity prices. This issue is further discussed in *Section 2.5.3*.

2.2.4. Nonpecuniary rewards

It is in the nature of emotional assets that part of their return is enjoyed in an emotional sense. Campbell et al. (2014) write that emotional assets have consumption value and that they *"provide the owner with greater utility in the form of aesthetic value and can act as a signal of the owner's wealth"* (p. 2). The consumption value from owning collectibles can be regarded as an income stream sometimes described as an 'emotional dividend' (Spaenjers et al., 2015) or an 'aesthetic return' (Campbell, Koedijk and De Roon, 2014). To cite an example, the *"viewing pleasure and admiration of artistic skill or genius"* (p. 10) is such an emotional dividend relating to paintings. An investor can decide freely when to collect emotional dividends, for example by admiring a painting, or by consuming a bottle of fine wine. Thus, adding collectibles to a portfolio adds a unique dimension to investing, as it opens the possibility of transferring consumption value over time, which results in greater utility than traditional investments (Campbell, Koedijk and De Roon, 2014).

Nonpecuniary rewards can also be attributed to the activity of collecting in general. Belk (1995) and Burton and Jacobsen (1999) describe the psychological and social benefits of collecting. The practice of collecting provides many collectors with a sense of purpose and meaning in life. For some, it can yield a sense of expertise that is lacking in other situations (Belk, 1995). The search for new items and the anticipation when a much-envied item is obtained can also add excitements to one's life. Moreover, collecting provides entry into a social group of persons with similar interests (Burton and Jacobson, 1999). The success in competing with other collectibles might help to obtain or maintain status in the collecting community (Storr, 1983). The same general motivations apply to collectible car enthusiasts. They feel a strong connection with classic cars for a multiple of reasons, often emotional and not always completely rational. These reasons include the emotional and experiential aspects of cars, the social aspects of the classic car community, and the cars' implications regarding racing culture and automobile history (Tam-Scott, 2009).

2.3. Costs of investing in collectibles

In relation to traditional financial investments, the costs of investing in collectibles are substantial. An overview of the most substantial costs is provided in this section, drawing heavily from observations by Dimson and Spaenjers (2014a), and Campbell (2008).

2.3.1. Transaction costs

A large share of transactions within the market for collectibles takes place trough auction houses or dealerships. The fees that are charged by these parties can be substantial. In the case of auctions, buyers are oftentimes charged a 'premium' and sellers a 'commission'. These commissions together can easily compromise a quarter of the transaction value. Campbell (2008) reports transaction costs for art auctions that can sometimes be as much as 30% of the sale price. Furthermore, it is common practice at dealerships to buy back collectible items only at a steep discount (Dimson & Spaenjers, 2014a). Because of their large magnitude, these transaction costs will significantly impact the returns on collectibles investments.

Despite high transaction costs, average holding periods for collectibles investments are much longer than for many other asset classes. As this lowers the frequency of trading, it will offset the strong negative impact of transaction costs, at least partially. Dimson and Spaenjers (2011) find that for a sufficiently long holding period for stamp investors, the investment returns after transaction costs are largely similar for stamp and equity investments.

2.3.2. Illiquidity

The costs associated with illiquidity are implicit transaction costs (Dimson & Spaenjers, 2014a). Compared to most financial asset classes, the collectibles market is extremely illiquid. Unlike to financial exchanges, auctions are not held continuously. Transactions through dealerships and private sales take place only sporadically. Burton and Jacobsen (2001) report that it can take up to five months to liquidate a portfolio of wine. As a consequence, in the unwelcome event that an investor is forced to liquidate a portfolio, he or she will only be able to realize this at 'fire sale prices'. Campbell's (2008) notion that liquidity is likely to decrease during market downturns further increases these costs, since the periods of market downturn will also be the periods when an investor is most likely to be forced into liquidation.

2.3.3. Opacity and asymmetric information

While most collectibles markets have seen great improvements in this regard (see section *2.1.4. Recent developments in the collectibles market*), the level of transparency in the market for collectibles is nowhere near that of most financial markets. High-quality data is oftentimes not available, or exclusively at high costs, and even then the information is not comparable to financial data. For most collectible asset classes, expertise in the corresponding market is required. This results in high barriers of entry for new market participants, as it is often costly and time-intensive to obtain the information necessary for participating in the market for collectibles.

2.3.4. Other costs

There are several other costs that, depending on the specific type of collectible, will have an impact on investment returns. For classic car investments, holding costs are numerous. First, since cars are tangible assets, a storage facility is needed. In order for the cars to preserve well, factors such as temperature and humidity must be regulated strictly. As most investment-grade classic cars are highly valuable, storage costs are further impacted by the need for security. Regular maintenance is essential for the cars to appreciate in value. Insurance and taxes can also add up significantly.

Next to holding costs, there are several other costs. In some cases, it might be necessary to restore the car completely. In these events, restoration costs can easily surpass the acquisition value. Transportation must take place in a safe and delicate way, which makes it costly. When classic cars are shipped in from abroad, import taxes might be involved. Collectible cars that are bought with the idea to be enjoyed, for example by participating in historical events, will be even more costly in terms of maintenance and insurance.

2.4. The returns on collectibles investments

2.4.1. Methodologies for measuring returns on collectibles investments

Several different methods to measure the returns of collectibles investments are frequently used. They can be grouped into the following four broad categories.

The most straightforward methodology is by computing returns based on the *yearly average transaction price* (Renneboog & Spaenjers, 2011). This method implicitly assumes that the items sold in any given year are a random selection of the total universe of collectibles items. The assumption is problematic however, since it does not adjust for differences in quality of the items sold. It could very well be, for example, that higher-quality items are more likely to be sold in times when collectibles prices are high, that is, in times following high collectibles returns.

A second approach utilizes the *geometric mean estimator* (Renneboog & Spaenjers, 2011). This method adjusts for differences in quality by only considering the items that were sold at least twice during the sample period. The geometric mean estimator might induce a selection bias however, since potentially relevant information from the remainder of the data set is disregarded. Another drawback stems from the data being aggregated over the whole sample period. Because of this, it is not possible to calculate within-period returns, which thus prevents the construction of an index (Renneboog & Spaenjers, 2011).

A third and widely used methodology is that of *repeat-sales regressions* (RSR). According to Goetzmann (1993), *"[it] uses the purchase and sale price of individual properties to estimate the fluctuations in value of an average or representative asset over a particular time period"* (p. 1371). Unlike the first methodology, repeat-sale regression do control for differences in quality by computing returns based on the prices of the same object trading at two or more different points in time. An important drawback is that the method only looks at repeat sales. As noted earlier, repeat sales are not necessarily representative for the whole sample of transactions. Goetzmann (1993) illustrates this by stating that *"the decision by an owner to sell a work of art (and consequently the occurrence of a repeat sale in the sample) may be conditional upon whether or not the value increased"* (p. 1373). Furthermore, many private collectors and museums do not re-sell their items (Anderson, 1974). Besides causing this selection bias, considering only repeat sales also greatly reduces the sample size. This can be especially problematic for collectibles, where transaction data is already scarce in the first place given the infrequent trading of most collectible items (Renneboog & Spaenjers, 2011).

The fourth method is frequently used in the calculation of collectibles returns and will serve as the main methodology employed in this thesis. The main assumption of this *hedonic regression* (HR) approach is *"that goods are valued for their utility bearing attributes or characteristics"* (p. 34: Rosen, 1974). These utility-bearing characteristics, also called hedonic characteristics, are used as independent variables in a regression model with the price of the object as the dependent variable. The hedonic regression controls for heterogeneity in the sample by attributing shadow prices to hedonic characteristics (Renneboog and Spaenjers, 2011; Ginsburgh, Mei and Moses, 2006). Including time-specific dummies to the model will make it possible to capture price changes over time. A benefit of this methodology, in contrast to the repeat-sales regression, is that all transactions in the sample space can be considered. Furthermore, the hedonic regression methodology eliminates the possible selection bias introduced when only studying repeat sales. A severe drawback of the hedonic regression methodology is that it imposes the strong assumption that *"the set of included attributes captures almost all of the uniqueness of the work of art [or, for that matter, any other item under investigation]"* (Renneboog and Spaenjers, 2009; p. 6). In order to mitigate the negative implications caused by this assumption, we employ a hedonic regression model with a large selection of hedonic attributes that in turn must be able to explain a large portion of the variance in collectible car transaction prices. Further, the hedonic regression methodology employed in this thesis also restricts coefficient to be constant over the time sample covered. In our case, this implies that classic car investors' preferences do not change over the course of 19 years. We will analyse this issue further in *Section 3.2.1.*, and investigate the consequences of relaxing this assumption in *Section 5*.

2.4.2. Returns on art investments

Of all collectibles investments, the subset formed by art investments has been researched most in academic literature. A wide range of papers has been written on the subject over the last few decades. This section will be devoted exclusively to the financial return performance of art investments.

One of the first to study the investment performance of paintings over a long time period from 1780 to 1960 was Anderson (1974). He combines transactions on paintings from two sources, namely from Reitlinger (1961) and Mayer (1972). By employing both the hedonic regressions and the repeat-sales regressions methodologies, Anderson finds average annual returns (in nominal terms) of respectively 3.3% and 4.9%. Anderson concludes that, when ignoring the consumption value of paintings, the risk-adjusted returns on art investments are not high enough to make them attractive compared to other investments. Baumol (1986) also investigates Reitlinger's data set and shares a similar conclusion. Over the period spanning from 1652 until 1961, he finds annual returns of 0.55% and 1.25% in respectively real and nominal terms. These returns are extremely low, especially in comparison to government bonds whose yields over the same period have been slightly higher. Baumol's returns are substantially lower than those of Anderson, which is mainly caused by different methodologies being employed and the expanded timeframe being covered by Baumol. Goetzmann (1993), in a highly influential study, finds more results. To evaluate the risk and return characteristics of art investments, he constructs an index based on a repeat-sales regression. The index spans the period 1715-1986. Following Anderson (1974) and Baumol (1986), he makes use of data provided by Reitlinger. For the full period, Goetzmann finds nominal returns of 3.2% per year. In the period 1850-1986, art investments perform better with an annual return of 6.2%. For that same timespan, art investment also outperform the capital appreciation of stocks and the returns on bonds. Goetzmann concludes that when taking in account the dividend yield, art investments and stock investments produced similar returns. Art investments did this, however, at a significantly higher level of volatility. Mei and Moses (2002) report even higher returns. Between 1950 and 1999, investments in art showed a real annual compounded return of 8.2%. Over this period, art outperformed bonds, while art's return performance is almost similar to the S&P 500 and the Dow Jones. Looking at a wider time period spanning from 1875 to 1999, Mei and Moses find that art investments show greater returns than bonds but do not generate the returns that stocks offer. Renneboog and Spaenjers (2013) are the first to investigate a comprehensive data set that does not only include the works of top artists. They investigate the main determinants of art prices and compare the returns of art investments to those of other investments. Conducting a hedonic regression with a large amount of hedonic characteristics on over a million art transactions, Renneboog and Spaenjers find real returns on art investments of 3.97% per year. Over the same period, the S&P 500 generated a real annual return of 6.63%, and on a risk-adjusted basis, corporate bonds also outperformed art investments. However, compared to Treasury Bills, gold, real estate and commodities, investments in art offered a slightly favourable risk-to-reward ratio.

The findings in the literature mentioned above and in other studies are presented in Table 1 on page 16.

2.4.3. Returns on investments in other collectibles

A sizable literature also exists for other collectible investments. Several studies have investigated the investment performance of fine wine. Krasker (1979) was one of the first to research this subject, albeit over a rather limited period from 1973 to 1977. Krasker does not report any absolute returns, but his main finding is that wine investments generated a rather low outperformance of on average 64 basis points over the yield on Treasury bills. Burton and Jacobsen (2001) researched these same investments in a more extensive manner. They employ a repeat-regression on wine auction sales over a ten-year period starting in 1986 and find that average nominal returns were equal to 7.9% annually. Comparing these returns to the returns on the Dow Jones Industrial Average or the one-year Treasury bill rate does not look favourable. With nominal returns of respectively 13.5%, exclusive of dividends, and 5.8%, investments in wine would have dramatically underperformed other financial investments. Dimson et al. (2015) reach a similar conclusion. Over the complete sample period from 1900 to 2012, they find an average annual real return of 5.3%. While these returns do not beat equity returns, wine investments do outperform corporate bonds and other collectibles classes such as stamps and art over the period researched.

Renneboog and Spaenjers (2012) estimate that investments in white and coloured diamonds generated an annual real return of respectively 6.4% and 2.9% over the period from 1999 to 2010. Dimson and Spaenjers (2011) find real annual returns on collectible stamps equal to 2.9% over a hundred-year period. An often-cited paper on the subject of investments in violins is that of Graddy and Margolis (2011). They study returns over the periods 1850-2006 and 1980-2006. For these periods, they find annual returns equal to respectively 3.3% and 4.0% (in real terms). Employing a hedonic regression over the latter period, the real returns change to a slightly higher 5.4% annually. Both Kane (1984) and Dickie et al. (1994) have conducted studies into the investment performance of rare coins, albeit both investigated a small sample. It must also be noted that in particular Kane's study spans a time period of high inflation. Their results differ significantly, with Kane finding annual inflation-adjusted returns of 13.7%, while Dickie et al. find a real annual return of -3.7%.

An overview of the return performance of various collectibles investments is presented in Table 2 on page 17.

Table 1. Annual return performance of art investments

All returns are presented as annual average percentage returns. Return numbers are rounded to tenths. The sample studied refers to paintings, unless stated otherwise under 'Notes'.

Author(s)	Period	Methodology	Real return	Nominal return	Notes
Anderson (1974)	1780-1960	*Hedonic regression*	2.6%	3.3%	-
	1653-1970	*Repeat-sales regression*	3.8%	4.9%	Based on 1,730 repeat sales
Stein (1977)	1946-1968	*Yearly avg. transaction price*	-	10.5%	Assumes random sampling
Baumol (1986)	1715-1986	*Geometric mean estimator*	0.6%	-	-
Frey and Pommerehne (1989)	1635-1949	*Geometric mean estimator*	1.4%	1.8%*	Assumes random sampling
	1950-1987	*Geometric mean estimator*	1.6%	6.7%*	Assumes random sampling
Goetzmann (1993)	1715-1986	*Repeat-sales regression*	2.0%	3.2%	Annualised decade returns
	1850-1986	*Repeat-sales regression*	3.8%	6.2%	Annualised decade returns
	1900-1986	*Repeat-sales regression*	13.3%	17.5%	-
Pesando (1993)	1977-1992	*Repeat-sales regression*	1.5%	7.3%*	Modern prints
Chanel et al. (1996)	1855-1969	*Geometric mean estimator*	5.5%	-	-
	1855-1969	*Hedonic regression*	4.9%	-	-
Goetzmann (1996)	1907-1977	*Repeat-sales regression*	5.0%	-	-
Czujack (1997)	1963-1997	*Hedonic regression*	8.3%	-	Picasso paintings
Mei and Moses (2002)	1875-1999	*Repeat-sales regression*	4.9%	-	-
	1950-1999	*Repeat-sales regression*	8.2%	-	-
Goetzmann et al. (2011)	1830-2007	*Repeat-sales regression*[10]	3.0%	-	-
Renneboog and Spaenjers (2013)	1957-2007	*Hedonic regression*	4.0%	8.2%	-
Dimson and Spaenjers (2014a)	1900-2012	*Repeat-sales regression*[11]	2.4%	6.4%	-

* Return number obtained from Burton and Jacobsen (1999).

[10] Goetzmann et al. (2011) follow the Bayesian formulation of a repeat-sales regression. This method avoids spurious negative autocorrelation and is useful when the sample size is small (Goetzmann et al. 2011).

[11] Returns for the period 1900-2007 were obtained by taking the repeat sales regression estimates of Goetzmann et al. (2011). Returns over the five years from 2007 to 2012 were obtained by chain-linking the returns on the UK Art Market Index of Artprice.com.

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Table 2. Annual return performance of collectible investments (other than art investments)

All returns are presented as annual average percentage returns. Returns are rounded to tenths.

Author(s)	Period	Methodology	Real return	Nominal return	Note
Wine					
Krasker (1979)	1973-1979	*Repeat-sales regression*	-7.7%	0.4%	Net of transaction costs
Burton and Jacobsen (2001)	1987-1996	*Repeat-sales regression*	3.1%	7.9%	-
Dimson et al. (2015)	1900-2012	*Repeat-sales regression*	5.3%	9.4%	-
Coins					
Kane (1984)	1970-1979	*Yearly avg. transaction price*	13.4%*	20.6%	Assumes random sampling
Dickie et al. (1994)	1984-1999	*Hedonic regression*	-3.7%	0.2%	Refers to cents only[12]
Stamps					
Dimson and Spaenjers (2011)	1900-2008	*Repeat-sales regression*	2.9%	7.0%	-
Diamonds					
Renneboog and Spaenjers (2012)	1999-2010	*Hedonic regression*	6.4%	-	White diamonds
	1999-2010	*Hedonic regression*	2.9%	-	Coloured diamonds
Violins					
Ross and Zondervan (1989)	1803-1987	*Repeat-sales regression*	2.2%	-	Stradivarius violins
Graddy and Margolis (2011)	1850-2006	*Repeat-sales regression*	3.3%	5.5%	Based on 75 repeat sales
	1980-2006	*Repeat-sales regression*	4.0%	6.1%	Based on 75 repeat sales
	1980-2006	*Hedonic regression*	5.4%	7.5%	-
Dimson and Spaenjers (2014a)	1900-2012	*Repeat-sales regression*[13]	2.5%	6.5%	-

* Return number obtained from Burton and Jacobsen (1999).

[12] Dickie et al. (1994) also report nominal annual returns for nickels, dimes, quarters, and halves, respectively: 0.4%, 0.17%, -0.9%, and -1.0%.

[13] Dimson and Spaenjers (2014) follow the Bayesian formulation of a repeat-sales regression. This method avoids spurious negative autocorrelation and is useful when the sample size is small (Goetzmann et al. 2011).

2.5. The risks of investing in collectibles

Investing in the market for collectibles assumes risks that are not – or to a lesser extent – assumed when investing in traditional asset classes. The majority of academic literature concludes that collectibles are high-risk investments. Goetzmann (1993) states that returns on art investments are *"no higher than would be justified by the extraordinary risks they represent"* (p. 1370). Researchers have found high return volatilities for other collectibles asset classes as well. In the case of diamonds for example, Renneboog and Spaenjers (2012) find substantial volatility comparable to the volatility of equity returns. Dimson and Spaenjers (2011) find a similar result for stamps, concluding that "*the volatility of these returns is much higher than that of bonds and closer to equities*" (p. 444).

2.5.1. Stylistic risk

Art and collectibles prices depend heavily on expectations about future demand. According to Dimson and Spaenjers (2014a), this might be hard to predict since tastes are subject to change over time. This 'stylistic risk' might be underestimated when looking at past investment performance, because these returns suffer from survivorship bias. It is especially problematic in the case of auction records. Goetzmann (1993) argues that the future sale price of a collectible depends on the amount of people who are willing to buy the object when it is available for sale. As a result, pieces that 'fall from fashion' are underrepresented in auction sales. Auction records will therefore fail to capture the returns of collectible objects that are not in demand anymore. Investors might assume that past returns are in some way indicative of future returns, while in fact they have been generated on a subsample of collectibles that became or remained fashionable. It seems plausible to assume that this issue is also present in the case of classic cars. In the past, car design has changed continuously, partly because of shifting stylistic preferences but also because of changing safety regulations. As a result, it might be hard to predict how enthusiasts' appreciation of beauty will change in the future.

2.5.2. Changes in income

An argument often proposed to dispute the diversification potential of art and other collectibles investments is that the wealth of the agents willing to invest in the collectibles market is highly correlated with equity valuations. Since the behaviour of these agents in turn influence art and collectibles prices, an indirect relationship exists between (lagged) equity returns and collectibles returns. Goetzmann, Renneboog and Spaenjers (2011) examine this relationship for art prices. Their findings support the view that the income of wealthy market participants is a key factor in influencing art investment returns. These findings also hold for other collectibles classes, and for luxury consumption in general (Dimson and Spaenjers, 2014). As a result, an investment in collectibles is considerably exposed to changes in income levels. Because of this relationship, the diversification potential of many asset classes is reduced.

2.5.3. Price risk

According to Fama's (1970) definition; *"A market in which prices always fully reflect available information is called efficient"* (p. 383). David et al. (2013) researched the efficiency of the art market, and find that it cannot even be considered as weak form efficient. Moreover, Baumol (1986) presents five arguments to argue that the art market is not competitive. First, he states that pieces of art are heterogeneous in nature. Even two pieces by the same artist having a common theme can be sold for vastly different prices. Second, by the rarity and desirability of some items, merely owning an item could make one a monopolist. Third, transactions take place so infrequently that some lots will not be sold even once in a century. Fourth, information is not publicly available and mostly concentrated amongst a few informed players. Fifth, in contrast with financial assets, there is no clear methodology to value a work of art. Baumol concludes that the occurrence of these five factors make it unlikely that forces in the art market will move prices towards equilibrium. As a result, "*prices can float more or less aimlessly and their unpredictable oscillations are apt to be exacerbated by the activities of those who treat such art objects as 'investments'*" (p. 10). Since of all collectibles markets, the art market is by far the largest and the most-developed one, and since a large share of transactions take place through auctions in all collectibles markets, the results for the art market presented above likely also hold for collectibles markets in general.

The inefficiency in the formation of art and collectible prices induces several risk factors. Goetzmann (1995) points out an important one, namely 'price risk'; uncertainty about the immediate resale value of a collectible. Thanks to the efficiency and liquidity of most stock exchanges, the price risk for equities is relatively small. Only when new information is released or when the market as a whole moves strongly might an investor suffer from a decrease in resale value. For the US housing market, price risk is already more prevalent. Case and Shiller (1987) estimate that price risk amounts to between 5% and 10% of housing values. Yet for art investment, Goetzmann finds this price risk to be extraordinary high, indicating that for an art investor, an immediate resale could have disastrous financial consequences.

2.5.4. Speculative bubbles

Extensive academic research has been conducted in order to identify sufficient conditions for the existence and non-existence of price bubbles in financial markets. These bubbles can arise in markets where investors behave myopically (Tirole, 1982) or irrationally (De Long, Schleifer, Summers & Waldmann, 1990). Furthermore, bubbles can form in markets that impose short sale and borrowing constraints on participants (Scheinkmann and Xiong, 2003). These conditions are likely met in the collectibles markets. It is therefore not surprising that in the past, investment bubbles have occurred in several collectibles markets.

Indices on art prices show 'bubble-like behaviour' such as short-term persistence and long-term reversion (Spaenjers, Goetzmann & Mamanova, 2015). Pénasse et al. (2014) investigate 'remarkable' boom-bust patterns in the art market. They look at the relationship between sentiment and art prices, by introducing a 'fads' term in the pricing of artworks. In this process, they use Camerer's (1989) definition of fads being "*mean-reverting deviations from intrinsic value caused by social or psychological forces*" (p. 3). Pénasse et al. (2014) find strong evidence that 'faddish beliefs' indeed play a role in influencing art prices. Renneboog and Spaenjers (2012) report boom-bust sequences in the prices of diamonds during the late 1970's and early 1980's. Moreover, many other researchers find evidence for boom-bust cycles in the markets for fine art, rare coins, and stamps (Renneboog and Spaenjers, 2013; Kane, 1984; Dimson and Spaenjers, 2011).

The classic car market has not been immune to pricing bubbles either. In the late 1980's, many speculators acquired classic cars, hoping to resell them quickly. This development was partially fuelled by the strong Japanese yen, which enabled wealthy Japanese buyers to purchase classic cars cheaply in the US. Around 1990, the market crashed, and especially high-end Ferraris and Porsches saw their values decrease severely. In 1989, a Japanese investor bought an extremely rare Ferrari 250 GTO for a little under $14 million. A few years later, in 1994, a US-based Ferrari dealer acquired that same car for only $2.7 million[14]. In the past two years, concerns about a pricing bubble in the classic car market increased. While collectible car prices decreased significantly in both 2015 and 2016, it seems that classic car prices have recovered again.

2.5.5. Forgeries, frauds and theft

Scams and other forms of fraudulent behaviour exist in almost any kind of market. In the market for collectibles, they are more prevalent. Dimson and Spaenjers (2014b)

[14] "The Ups and Downs of the 250 GTO". M. Sheehan. September 2002. Retrieved from: https://web.archive.org/web/20100922134001/http://ferraris-online.com/Articles/SCM_0209.html

report a stamp fraud that caused the Stanley Gibbons catalogue to remove one specific stamp type in 1960 because all copies were believed to be forgeries. Dimson and Spaenjers further mention several other occasions of forgeries in the market for violins and wine. Forgeries occur frequently in the art market. There are not many reliable statistics available. According to Thomas Hovey, former director of the Museum of Modern Art, around 40% of the artworks considered for purchase by the museum where either fake or over-restored (Landesman, 1999).

While in theory a classic car could be counterfeited, in practice this risk is not severe. Next to forgeries, another risk that collectibles investors need to be wary of is the acquisition of previously stolen goods (Dimson and Spaenjers, 2014). Other forms of fraudulent behaviour are however more common. A seller could, for instance, manipulate the odometer, maintenance history or the engine, registration or chassis numbers. Misrepresentations of the car's provenance occur rather frequently. For this reason, classic car owners go to great length to research the history of their cars, oftentimes consulting the help of specialised firms[15]. Just as with any other valuable item, the risk of theft is severe for classic cars. While this risk is insurable, highly professional robberies occasionally occur which can have disastrous financial consequences for a classic car investor's portfolio.

2.6. Collectible cars as an investments class

2.6.1. Classic car price indices

As mentioned earlier, various independent research firms are operating within the industry, and some publish classic car price indices. Several different indices are available. Historic Automobile Group International[16] (HAGI) is one of the industry leaders. Its indices include the HAGI Top Index – which tracks the price changes of 50 rare models – and separate indices based on the marques Ferrari, Porsche and Mercedes-Benz. The indices are calculated using a proprietary methodology, and are based on a database of auction transactions and private sales. Only cars in the best condition are taken into account. Furthermore, the index is capitalization-weighted and updated monthly. HAGI's indices saw their inception on December 31, 2008.

Hagerty also publishes several indices, specifically for Blue Chip, 1950's Americans, Affordable Classics, British Cars, German Collectibles, Ferrari and Muscle Cars. Blue Chip includes 25 famous classic car icons, while Affordable Classics denote cars

[15] For example, Ferrari has an in-house department that provides such services, known as Ferrari Classiche.
[16] http://www.historicautogroup.com/

priced under $40,000 that were built between the 1950's and 1970's. Hagerty's classic car insurance division supplies this data. The indices are adjusted for inflation. Hagerty's indices are being published since January 2007.

Further well-known classic car indices are the Kidston 500 and the DOX. The Kidston 500, or K500, is published by a classic car dealer and consultant. It tracks the value of 500 classic car models. The German car manufacturer's association VDA also publishes an index. This one is called DOX, which stands for Deutscher Oldtimer Index. A total of 88 different models from 35 marques compose this index. All these models are produced in large quantities and generally considered affordable. The main drawback of this index is its pricing methodology, which is not based on actual sales but on expert opinion. The DOX has been available since 1999.

While far from scientifically robust, the returns on classic car indices can offer an indication of the returns that a collectible car investor could have generated in the past. The DOX increased from a level of 1,000 in 1999 to a level of 2,516 in 2016 (VDA, 2017), a compounded return of 5.6% annually. HAGI's Top Index has shown an increase of 344% since its inception at the end of 2008 (HAGI, 2017). Hagerty's Blue Chip index has increased by more than 400% since January 2007 (Hagerty, 2017).

2.6.2. Value drivers of a classic car

Inherent to all emotional assets, and thus also to collectible cars, is the absence of a clear valuation methodology. At auctions, price estimates are based on historical sales and taxations by experts. Nonetheless, the actual hammer price can deviate significantly from these estimates. In the end, a complex interplay of various factors plays a role in determining the value of a classic car. The fact that cars are initially produced in limited quantity, coupled with the natural decay of the available stock through wear, damage and loss has a price-increasing effect on classic car values (Daxhammer & Klein, 2015). In Historica Selecta (2016), several – relatively straightforward and often related – determinants of classic car prices are mentioned, amongst which are rarity, condition, authenticity, design, and racing history (including provenance).

Rarity. In general, cars produced in only a small quantity are more valuable. Indirectly, this also goes for cars that are unique because of their individual history. This happens for cars that were previously owned by a notable person, or that appeared in well-known movies. Classic car enthusiasts refer to the documentation of ownership and special events pertaining to the car as 'provenance'. In many cases, the association with celebrities and glamour also plays a role, as exemplified by the "Steve McQueen" effect, where any car previously owned by the actor commands significant premia[17]. Similarly, a 1964 Aston Martin DB5 that was driven by Sean Connery in the James Bond movie 'Goldfinger', sold for £2.9 million in 2010 ($4.6 million), while similar DB5's sold for amounts between $200,000 and $300,000 [18]. Next to rarity, age is a related factor, as there are simply not many of the earliest automobiles left. Thus, cars from the earlier eras are in general more expensive than younger automobiles.

Condition. The finest (and most valuable) examples of classic cars are those that participate in events known as Concours d'Elégance. In these events, focus is mainly on two characteristics, namely condition and authenticity. Cars must be presented in flawless condition, and are often in a better state than new. This criterion goes not only for concours-level cars, but also holds in general. A car that remains in better condition is, all other things constant, more valuable. For this reason, concours-level classic are usually not driven, and instead brought to events by trailer.

Authenticity. Besides condition, emphasis in Concours is also very strongly on authenticity. Original cars, which never received any restorative work, are valued at a premium. It is very important for a car's configuration to match the original factory configuration. Car enthusiasts denote this as 'correctness'. This can go very far. For example; *"hose clamps, ordinarily parts that cost a few cents, must be of the correct type and produced by the same manufacturer as originally supplied to the car"*(p. 116; Tam-Scott, 2009). A car that has all major parts authentic, including the engine, transmission, chassis and sometimes even more, is said to have 'matching numbers'. The presence of this denotation adds considerable value.

Design. The appearance of a classic car obviously matters in determining value. Of all value drivers, a car's aesthetic appeal is perhaps the most emotional one, and the hardest to quantify. In general, enthusiasts value proportion and functional form, such as an aerodynamical shape (Tam-Scott, 2009). Certain cars are also deemed attractive because their appearance exemplifies a certain time period. The design of a car does, however, not only refer to aesthetic appearance. The technical design also plays a role. Cars that are equipped with desirable or expensive options are generally worth more. The same goes for certain technical features. For example, cars equipped with automatic transmission are considered less desirable then their manually-shifted counterparts.

Racing history. Racing cars are amongst the highest valued of all classics. Especially the machines that participated successfully in prestigious racing events, such as the Formula One, the 24-hour race of Le Mans or the Mille Miglia, dominate auction sale

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[17] See, for example: http://www.latimes.com/business/autos/la-fi-hy-mcqueen-effect-20140816-story.html.

[18] http://www.rmsothebys.com/lots/lot.cfm?lot_id=568242

records[19]. These cars are extremely desirable, as they are rare and perceived as beautiful, engineering masterpieces that shaped racing history.

Besides the aforementioned points, there are several more value drivers. An obvious one is a car's marque, or make. Certain car brands have a reputation for luxury, quality or outstanding performance. This reputation is strongly associated with racing pedigree. Marques such as Ferrari, Porsche and Mercedes-Benz with a rich and successful history produced some of the finest classic cars. Next to this, documentation is important. Maintenance records, registration forms, ownership documentation, and records of special events must be meticulously kept. Lastly, the lower the reported mileage of a car, the more valuable it is. Unfortunately, we are not able to include reported mileage for three reasons. First, the variable is in many cases missing from our data set. Second, Sports Car Market reports odometer readings in some cases in miles, and in other cases in kilometres. It is not always indicated which unit applies. Third, oftentimes the mileage is reset after the car is renovated completely, or when the engine is replaced. For these reasons, we ignore odometer levels in our analysis.

2.6.3. Investment performance of classic cars

While the investment performance of most other collectible asset classes has been researched, not much academic research has been conducted into the risk and return characteristics of classic car investments. To date, only two academic studies have been conducted in this regard, and both are of limited value.

Martin (2016) analyses a sample of 96 collectible automobile types provided by Hagerty Insurance Group, spanning the time period from 2007 to 2016. This analysis is entirely based on the HAGI indices that were previously introduced. Martin finds annual returns (in nominal terms) ranging from 3.23% for American Muscle Cars to 18.22% for German Collectibles. Looking at risk-adjusted returns, investments in collectible cars compare favourably to equity investments. The former shows a Sharpe ratio of 0.58 over the 2007-2016 period, while the best performing equity index (NASDAQ Composite) produced a Sharpe ratio of 0.23. Besides these attractive returns, collectible car investments also correlated weakly with other asset classes. The returns on the investments in the collectible car group as a whole showed a correlation of 0.33, 0.31 and 0.19 with respectively the returns on the Dow Jones, the S&P 500 and the NASDAQ Composite indices. Investment returns on collectible classics and bond returns move almost independently, according to the correlation

[19] To illustrate this: out of the top 10 most expensive auction sales of classic vehicles, 9 were former racing cars. See: https://en.wikipedia.org/wiki/List_of_most_expensive_cars_sold_at_auction.

coefficient of 0.01. At -0.18, there is a negative correlation between returns on gold and those on classic car investments.

Daxhammer and Klein (2015) conduct an almost similar study. They use return figures obtained from three sources, namely the German DOX and OTX indices, as well as indices by HAGI. As a result, the time span investigate is limited by the tracking period of these indices. For the DOX, it ranges from 1999 to 2017, but for the others it is shorter. Unfortunately, Daxhammer and Klein do not calculate any return figures and instead only report returns of the indices. With regards to correlations, they find the following. First, the three car indices are highly correlated, with correlation coefficients of more than 0.90. Moreover, the HAGI and DOX indices are also highly correlated to gold prices and the returns on the AGI art index. Stock returns, as measured by the S&P500 and DAX30, are not significantly correlated to collectible car prices, yet it would have been interesting if lagged stock returns were also included in these calculations. Finally, there is a moderate correlation between bond returns and classic car index returns.

Both Martin's (2016) and Daxhammer and Klein's (2016) research lack scientific robustness. They solely make use of readily published classic car indices. There are several issues with this methodology. First of all, it is not exactly clear how these indices are constructed, and whether adjustments for infrequent trading and heterogeneity have been applied. Second, the cars that are included in these indices are generally the most popular and widely known classics. Besides, the number of different car models included is often limited. As a result, the indices in no way represent the complete classic car investment universe. Furthermore, the inclusion of only well-known automobile models induces a strong survivorship bias into the construction of the index. Our research is different in that it focusses on an extensive transaction-based sample ranging over a wider time span, while employing a hedonic regression methodology which corrects for heterogeneity and infrequent trading in a transparent and robust manner.

3. Data and Methodology

3.1 Data

3.1.1. Auction records of classic car transactions

We obtain data on classic car transactions through Sports Car Market's Platinum auction database. This online database contains over 200,000 records. Every auction record is separated into four parts. The first one contains basic information, including the make, model, production year, auction date and the name of the auction house. The second part is a piece of text written by a reporter of Sports Car Market magazine. It consists of a description of the car's condition, the car's features and other useful information. The third section is called 'market opinion'. It provides an expert's advice on whether the car is a good buy. Even though this information is useful, in many cases it is missing or not quantifiable enough to be included into our analysis. The fourth part is named 'vehicle information'. It provides an extensive overview of the car's technical features such as the engine type and displacement, and the type of engine induction. The car's condition and mileage are also reported in this section, as well as exterior features such as paint color and body style. Unfortunately, the information provided in the 'vehicle information' section is not consistently available amongst all records. Some records, for example, might only show the engine type and displacement of a car, while other records provide information on exterior color, body type, engine type and mileage. To mitigate this problem, we only obtain auction records that include an image of the vehicle, as these entries are almost exclusively the most complete. Of this subset, we only obtain the 37,000 or so records that are actual sales, as unsold lots are also report in the database. We select cars produced before the year 1990, and later delete all records of cars that were younger than 25 years of age at the time of auction. Furthermore, all lots that were sold for an amount lower than $1000 (in 2017 dollars) are removed. Subsequently, we hand-check the data to clear all transactions that do not involve cars. The deleted entries include motorcycles, automobile memorabilia, individual parts (such as engine blocks and rolling chassis), horse carriages, tractors and many other non-automobile objects. Cars that are not in running condition are also removed. Subsequently, we check the data set for missing values, which were mostly about car specifications, e.g. missing displacement, engine type or body type figures. A handful of online sources were used to retrieve this information[20]. We further delete observations that have missing information that we cannot retrieve (such as exterior color or condition). Since the year 1997 contains only 39 transactions, we

[20] We make use of www.carfolio.com, www.conceptcarz.com, www.automobil-catalog.com and www.wikipedia.org to retrieve information on car specifications.

chose to ignore all sales from this year. In the end, we are left with a total sample of 29,002 auction transactions.

3.1.2. Other data

In order to construct adjusted auction prices, we obtain US CPI numbers from Thomson Reuters DataStream. Even though in our analysis monthly CPI numbers are used, we present the CPI series below in annual terms, for sake of brevity.

Table 3. Annual US CPI Series from 1998 to 2017

Consumer Price Index for all Urban Consumers: All items, seasonally adjusted. As constructed by the US Bureau of Labor Statistics. Obtained through DataStream. The CPI levels below are reported on July 15 of every year. Annual inflation rates are calculated from July to July.

Year	CPI Level	Inflation	Year	CPI Level	Inflation
1998	163,2	1.87%	2008	219,0	5.50%
1999	166.7	2.14%	2009	214.7	-1.96%
2000	172.7	3.60%	2010	217.6	1.34%
2001	177.4	2.72%	2011	225.4	3.58%
2002	180.0	1.47%	2012	228.6	1.42%
2003	183.7	2.06%	2013	232.9	1.88%
2004	189.1	2.94%	2014	237.4	1.95%
2005	194.9	3.07%	2015	237.9	0.19%
2006	202.9	4.10%	2016	239.9	0.85%
2007	207.6	2.32%	2017	244.0	1.73%
				Average:	2.14%

Next, we obtain return numbers on various financial and real assets that will be used for the calculation of correlations. We download the yields on one-year US treasury notes and 3-month Treasury Bills from Federal Reserve Economic Data (FRED). Data on equity returns, bond returns and gold returns is downloaded through Thomson Reuters DataStream. We further download index levels of the Artprice Global Index (in USD) through Artprice.com[21].

3.1.3. Descriptive statistics

The average auction price in our sample amounts to $218,182, while the median is equal to $55,902 (both in 2017 dollars). A total of 1,182 transactions with an auction price of more than one million inflation-adjusted dollars occur. The top 15 most

[21] Retrieved from: http://imgpublic.artprice.com/pdf/agi.xls

expensive auction sales in our sample are presented in Appendix 3. Table 4 presents the yearly average transaction price and number of auction sales per year in our sample.

Table 4. Yearly average transaction prices.

All auction prices are deflated using the US CPI series and reflect dollar values as of Jul 15, 2017. *The year 2017 includes auction sales up to July 2017.

Year	# Obs.	Average price (2017$)	Year	# Obs.	Average price (2017$)
1998	548	$ 99,345	2008	1,948	$ 211,748
1999	392	$ 164,450	2009	1,230	$ 182,698
2000	681	$ 175,601	2010	1,576	$ 178,844
2001	599	$ 121,584	2011	1,653	$ 202,874
2002	952	$ 115,808	2012	2,475	$ 215,559
2003	1,107	$ 102,067	2013	2,498	$ 277,722
2004	1,380	$ 122,636	2014	2,365	$ 342,327
2005	1,601	$ 140,330	2015	1,544	$ 412,269
2006	1,831	$ 183,381	2016	1,525	$ 313,239
2007	1,945	$ 209,203	2017*	1,152	$ 218,561

Roughly 52% of the cars sold are of American make. The rest are mainly of British, German and Italian descent (17%, 12% and 11%, respectively)[22]. The most frequent marque in the sample is Chevrolet, followed by Ford, Ferrari, Mercedes-Benz and Jaguar. Statistics on the frequency of car marques in our sample are reported in Appendices 1 and 2. Almost a third of the classic cars have coupé body styles, but there is also an almost similar amount of convertibles, as well as many roadsters (see Appendix 4 for an overview).

We provide an overview of average real auction prices for a select number of categories in Table 5 on the next page. These include the marques Chevrolet, Duesenberg, Ferrari, Jaguar, Mercedes-Benz and Porsche. We further group the cars by the built period. Moreover, average auction values per condition rating are included, where a reporter of Sports Car Market evaluates the condition. Lastly, we also group the observations by a few common body types. Please refer to Appendix 4 for a description of these body types.

[22] This analysis is based on a subsample that entails 27,830 of the 29,002 observations in the total sample, since manually searching for all originating countries proved too cumbersome a process for the many unknown and infrequent car marques in the sample.

Table 5. Average auction prices for a select number of classic car categories

Auction prices have been converted to real dollars using the US CPI series. The values below *Condition* refer to Sports Car Market's condition rating scheme.

Category	Observations	Percentage	Average price (2017$)	Median Price (2017$)
Make				
Alfa Romeo	80	0.28%	$638,084	$83,518
Aston Martin	115	0.40%	$534,287	$266,160
Bugatti	183	0.63%	$1,038,764	$590,405
Cadillac	841	2.90%	$116,743	$69,337
Chevrolet	4,439	15.65%	$77,615	$49,033
Delahaye	85	0.29%	$581,862	$243,214
Duesenberg	145	0.51%	$1,343,430	$1,057,972
Ferrari	1,517	5.35%	$1,224,458	$309,050
Ford	2,833	9.77%	$77,597	$34,215
Lamborghini	186	0.64%	$412,356	$236,896
Jaguar	1,431	5.04%	$176,877	$75,640
Maserati	350	1.21%	$401,652	$122,214
Mercedes-Benz	1,439	5.07%	$393,443	$86,712
Porsche	992	3.50%	$244,579	$78,485
Talbot-Lago	70	0.24%	$1,043,540	$343,121
Era				
Veteran	323	1.14%	$223,216	$97,133
Brass	492	1.73%	$281,565	$90,064
Vintage	1,207	4.25%	$268,916	$78,783
Pre-war	3,600	12.69%	$342,227	$100,502
Post-war	21,896	77.19%	$199,989	$50,633
Modern classic	849	2.99%	$128,124	$31,583
Condition				
1	4,665	16.45%	$499,314	$137,195
3	9,138	32.21%	$128,659	$35,027
5	412	1.45%	$96,514	$14,776
Auctioneer				
Bonhams	4,726	16.29%	$254,692	$81,318
RM Sotheby's	414	1.43%	$1,034,965	$274,803
Christie's	899	3.10%	$220,639	$87,868
Type				
Coupe	8,484	29.91%	$234,748	$50,224
Racer	969	3.42%	$936,663	$204,251
Roadster	3,176	11.20%	$383,531	$83,873
Sedan	2,816	9.93%	$80,269	$26,494
Concept car	35	0.12%	$862,838	$474,205
Total sample	**29,002**		**$218,182**	**$55,902**

3.2 Methodology

3.2.1. Hedonic regression model

In this thesis, a hedonic regression model similar to that in Renneboog and Spaenjers (2013) will be employed. The main assumption of this regression is *"that goods are valued for their utility bearing attributes or characteristics"* (Rosen, 1974). The hedonic regression will make it possible to attach implicit prices to attributes of objects in the sample. There are two main approaches to the construction of hedonic indices. The first is the hedonic imputation (HI) index, and the second is the dummy time hedonic (DTH) index. Both these methods rely on a hedonic regression to remove the effect of quality changes on prices. The difference is that the DTH index method constrains regression parameters to be constant across periods, while the HI index method allows for changing parameters (Diewert et al., 2008). When constructing HI indices, the interest is more on the change of parameters (Silver and Heravi, 2007). In this thesis, we want estimated coefficients to reflect the price changes that are not due to changes in characteristics. Therefore, we will employ the DTH regression methodology. We will construct a dummy variable for each auction year. These dummies will then capture time effects on a quality adjusted price index. Issues regarding parameter instability will be addressed later, in Section 5.

Our dummy time hedonic regression model can be represented as follows (Renneboog & Spaenjers, 2009):

$$\ln P_{it} = \sum_{m=1}^{M} \alpha_m X_{mit} + \sum_{t=1}^{T} \beta_t \delta_{it} + \varepsilon_{it} \qquad (1)$$

where $\ln P_{it}$ represents the natural log of the inflation-adjusted price of car i at time t, X_{mit} is the m-th characteristic X of car i at time t, and δ_{it} is a dummy equal to 1 if car i has been auctioned in year t (and equal to 0 otherwise). The implicit (shadow) price of the m-th characteristic X is denoted by α_m.

We calculate DTH index levels using the following formula:

$$I_t = \exp(\beta_t) * 100 \qquad (2)$$

where I_t is the collectible car price DTH index at time t, and β_t is the time dummy of equation (1), corresponding to year t. By construction, the price index evaluates to 100 for the year 2007 since β_{2007} has a value of zero.

Since our procedure involves logarithmic and anti-logarithmic transformations, this index will tend to follow the geometric mean of prices, rather than the arithmetic mean (Renneboog and Spaenjers, 2013). This issue is caused by the logarithmic transformation of our dependent variable. It is a well-established fact that leastsquares estimation of log-linear models leads to unbiased estimates of the parameters (Teekens and Koerts, 1972). Following earlier literature, we correct for this "logarithmic transformation bias" using the formula (Triplett 2004):

$$I_t^* = I_t * \exp({SE_{\beta_t}}^2/2) \qquad (3)$$

where I_t^* and I_t are respectively the corrected and uncorrected index levels at time t, and ${SE_{\beta_t}}^2$ is the squared standard error of the dummy coefficient corresponding to year t. The resulting corrections are in all cases very small. We will obtain real return numbers by first-differencing the yearly corrected index levels. Next, we will compute nominal returns using the same procedure, however the coefficients will be based on a regression with the natural logarithm of unadjusted auction prices as the dependent variable.

A drawback of the aforementioned hedonic regression methodology in the computation of price indices is that it oftentimes underestimates the volatility of returns. There are two related reasons for this phenomenon. The first, common amongst emotional assets, is denoted as 'appraisal smoothing': assessments of an infrequently traded item's value often "*depend on previous price observations and are only partially adjusted in any period*" (p. 452; Dimson and Spaenjers, 2011). Second, since our index levels denote averages of time-ordered variables, it is likely that returns suffer from serial autocorrelation. This is known as the 'Working' effect (Working, 1960). The consequence is strong (positive) serial autocorrelation in the index returns. We test for this occurrence, yet find that these issues do not play a role in our index series. The returns on our index are actually negatively autocorrelated, albeit not statistically significant. The application of Dimson and Spaenjers' (2011) correction methodology would in that case have a smoothing effect on returns, rather than the intended desmoothing one[23]. By definition, this would artificially lower the volatility of returns. We therefore do not apply this correction.

3.2.2. Hedonic characteristics

A strong assumption underlying any hedonic regression methodology is that a large proportion of the variance in the dependent variable must be attributable to variance in hedonic characteristics. In our case, this implies that the value of a classic car must

[23] Dimson and Spaenjers (2011) correct for volatility underestimation with the following formula:

$$R_t^u = (R_t - \alpha R_{t-1})/(1-\alpha)$$

where R_t^u denotes the 'unsmoothed', adjusted return for period t, R_t and R_{t-1} denote the observed returns for respectively period t and the previous period t-1, and α corresponds to the autocorrelation coefficient of the observed returns at lag 1.

be largely explained by the different attributes that we include in our model. These choices are therefore important. We outline our decisions below.

Production year. The year in which a car is built is an important value driver. We classify every car in our sample into a time period based on the year of production. This categorical variable will then be converted into multiple dummies. We classify time periods according to conventions by several classic car associations[24]. While the naming is widely used, there are slight variations in the exact specification of these time periods. We choose to employ the classification shown in Table 6.

Table 6. Car period classifications

The dummy variable *dEra6*, corresponding to the 'modern classic', serves as the base level (indicated with an asterisk).

Time period	Car naming	Dummy	Observations
1888 - 1907	Veteran	*dEra1*	326
1908 - 1916	Brass	*dEra2*	493
1917 - 1929	Vintage	*dEra3*	1,212
1930 - 1946	Pre-war	*dEra4*	3,650
1947 - 1975	Post-war	*dEra5*	21,281
1975 - 1990	Modern classic	*dEra6**	2,040
Total			**29,002**

Displacement. Displacement is the total volume of air that is displaced by a full stroke of all the engine's pistons. It is an important factor in the pricing of a car as it directly correlates with an engine's power: ceteris paribus, and engine with larger displacement is more powerful. Since our sample also contains car that are steam- or electrically powered and the notion of displacement makes no sense in that regard, we cannot include displacement as a continuous variable. Instead, we separate the displacements of gasoline-powered cars into intervals, and base our dummies on this classification. Sports Car Market uses several different units in the reporting of displacement, including liters (L), cubic inches (cid) and cubic centimeters (cc). We convert all displacement numbers into cubic centimeters, and then classify them according to Table 7 on the following page.

Authenticity. Classic car enthusiasts greatly value the extent to which a car is in its original state. Unfortunately, there is no obvious variable available to capture this so-called 'correctness'. The only crude measure is a dummy construct that indicates the presence of the words 'matching numbers' (*dMatchingNumbers*) in the description of

[24] I.e. the Veteran Car Club of Great Britain, the Vintage Motor Car Club of America and the Classic Car Club of America.

the auction lot. This means that all the major parts, such as engine, transmission and chassis, are the components as present on the car when it came out of production. We also include a dummy to capture the observations that are the opposite of original, namely 'replicas': cars that are made to resemble a unique, oftentimes expensive and well-known car. Replicas are indicated by the dummy variable *dReplica*. The dummies *dMatchingNumbers* and *dReplica* occur a total of respectively 312 and 491 times, and concern respectively 1.07% and 1.69% of the total sample.

Table 7. Displacement interval classification

Displacement reported in cubic centimeters (cc). The dummy variable *dDisplacement3* serves as the base level (indicated with an asterisk).

Displacement (cc)	**Dummy**	**Observations**
(40; 1,150]	*dDisplacement1*	1,262
(1,150; 2,050]	*dDisplacement2*	3,611
(2,050; 3,050]	*dDisplacement3**	3,705
(3,050; 4,050]	*dDisplacement4*	4,029
(4,050; 5,550]	*dDisplacement5*	7,407
(5,550; 7,050]	*dDisplacement6*	7,158
(7,050; 27,000]	*dDisplacement7*	1,830
Total		**29,002**

Condition. Sports Car Market uses an indicator between 1 and 6 to evaluate the general condition of a car. The rating is based on the personal opinion of the magazine's reporters. In this regard, the rating 1 indicates a car that is in perfect (Concours d'Elégance-level) condition, while 5 indicates a car that is *"a nasty beast that runs but has many problems"*. We removed all cars that were rated with a '6' as these are not in running condition and only good for parts. The complete rating scheme is presented in the Table 8 on the next page.

Rarity. The rarity of a car is best proxied for by taking the total amount of cars produced of a certain make and model. There are however a number of problems with this approach. First of all, production figures are only rarely mentioned in the SCM's Platinum database. Manually searching for these numbers would not only be an enormous amount of work, it is also not possible since production numbers (oftentimes of older automobiles) are not always documented or publicly available. We introduce several indicator variables designed to proxy rarity. The first is a dummy that indicates whether the car's marque occurs only once in the complete data set. We denote this variable *dUnique*. We further mark cars of the body type 'concept car' with the dummy variable *dConceptCar*. These cars are made to showcase new styling and technology, and are often displayed at motor shows to gauge the customer's reaction. Since they are often extreme in design, we chose to include them as a category under the body type variables. A related indicator variable corresponds to prototypes. We denote these cars with the indicator variable *dPrototype*. Prototypes are slightly different from concept cars as they are made for testing rather than showcasing purposes. Therefore, they are closer to the phase of actual production. Both concept cars and prototypes are rare and oftentimes desired by classic car enthusiasts. We classify the indicators *dUnique*, *dConceptCar* and *dPrototype* to respectively 275, 35, and 114 observations, or 0.95%, 0.12%, and 0.40% of the total sample.

Table 8. Sports Car Market condition rating

Condition as reported by a reporter of Sports Car Market magazine. The dummy assigned to condition rating 4 has been used as the base level (indicated with an asterisk).

Rating	Description	Dummy	Observations
1	National concours standard/perfect	*dCond1*	4,755
2	Very good, club concours, some small flaws	*dCond2*	11,464
3	Average daily driver in decent condition	*dCond3*	9,692
4	Still a driver but with some apparent flaws	*dCond4**	2,130
5	A nasty beast that runs but has many problems	*dCond5*	961
Total			**29,002**

Racing history. We first define a dummy variable that identifies racing cars. Sports Car Market classifies all cars sold into different body types. Of these, the category named 'Racer' automatically corresponds to racing vehicles. A total of 706 observations, or 2.43% of the total sample, denote such racing cars. To indicate whether a car has participated in prestigious racing events, we construct several indicator variables. These are *dFormulaOne*, *dIndy500*, *dMilleMiglia* and *dLeMans*, which correspond respectively with participation in the Formula 1, the Indianapolis 500, the now defunct Mille Miglia and the 24 Hours of Le Mans.

Table 9. Racing event dummy variables

Indicates whether an automobile has participated in any of the following racing events.

Dummy	Vehicle participated in	Sum	Mean
dFormulaOne	Formula 1 (1950-now)	33	0.0011
dIndy500	Indianapolis 500 (1911-now)	29	0.0010
dMilleMiglia	Mille Miglia (1927-1957)	69	0.0024
dLeMans	24 Hours of Le Mans (1923-now)	24	0.0008

Make. Dummies are generated to capture the most frequent marque's reputation and quality. We generate these dummies in the following manner. All marques that have more than or equal to 20 observations in the data set are assigned their own indicator variable. These 95 different marques are thus assigned the dummies *dMake1* to *dMake95*, encompassing a total of 27,310 observations. The 548 marques with fewer than 20 sales (for a total of 1,692 observations) are all grouped into the 96th indicator variable. The dummy corresponding to the marque Chevrolet serves as the base level. Appendix 1 and Appendix 2 list all marques that occur in our sample.

Design. We introduce a dummy variable that indicates whether the car sold is regarded as part of Total Car Score's "Top 10 Best Looking Cars of All Time". This dummy variable is equal to one when the corresponding car sold belongs to the vehicles in this ranking. It equals zero otherwise. A total of 920 observations from our data set occur in Total Car Score's Top 10 ranking. The list of the most beautiful classic car designs is presented in appendix 9.

Body type. We classify the data into 22 different body types, which are then used to generate indicator variables from. The body types range from pickup truck to convertible, and from horseless carriage to station wagon. Please refer to Appendix 4 for a complete overview. The body types 'concept car' and 'racer' are also included in this variable. These have been used in capturing rarity and racing pedigree. The dummy variable corresponding to the body type 'sedan' serves as the base level.

Exterior color. Similar as to other categorical variables, we generate dummy variables based on the 24 different exterior colors that exist throughout our data set. It must be noted that these do not always reflect the car's exterior color. Some of these cars are not painted, and their exterior is brushed metal, copper or wood. In other cases, the paint layer is not existent (anymore). These instances are denoted by the categories rust and primer (an initial layer of coating material applied so that paint better bonds). We declare the exterior color 'black' as base level. A detailed overview of all exterior color dummies can be found in Appendix 5.

Technical features. We define several different variables that reflect technical specifications of the car. These include 21 different engine types, ranging from 1 to 16 cylinders in three different configurations (e.g. V8 for the widely popular 8 cylinder engine placed in a V-configuration). Other engine categories include steam, electric and rotary engines. For a detailed overview of these engine indicator variables, please refer to appendix 7. We use the common and inexpensive 'I4' engine as the base category. The dummy *dRHD* marks whether an observation is a right-hand drive vehicle. Furthermore, *dThreeWheeler* indicates a car that has only three wheels. The variable *dForcedInduction* is equal to 1 in case the car's engine contains a fuel injection system, a turbocharger or a supercharger. Engines with forced induction are generally more powerful than their naturally aspirated counterparts. Lastly, we include the dummy *dAutomatic* to indicate the presence of an automatic gearbox.

Table 10. Technical feature dummies.

Indicates whether a car is right-hand driven, three-wheeled, equipped with forced induction or with an automatic transmission.

Dummy	Indicates	Sum	Mean
dRHD	Right-hand drive vehicle	353	0.0121
dThreeWheeler	Three-wheeled vehicle	100	0.0034
dForcedInduction	Fuel injection or turbo/supercharger	2,715	0.0935
dAutomatic	Automatic transmission	8,072	0.2780

Auction house. We declare auction house dummies in a similar way as the car marque dummies. The 25 auctioneers that have more than 200 sales in the data set are assigned the dummies ranging from *dAuctionHouse1* to *dAuctionHouse25*. We make an exception for 'Rick Cole Auctions'; while it only has 20 sales, its average sale price is considerably higher than the average sale price in the group of other auction houses ($2,827,000 against $53,344). Thus, we assign it the indicator variable *dAuctionHouse26*. The 49 other auctioneers with less than 200 sales (for a total of 2,322 transactions) are assigned to the *dAuctionHouse27* dummy. The auction house 'Mecum Auctions' serves as the reference category. An overview is presented in Appendix 6. Furthermore, we include dummy variables for automobiles sold at the prestigious Pebble Beach Concours d'Elégance and the Goodwood Festival of Speed (*dPebbleBeach* and *dGoodwood*).

Table 11. Auction event dummies.

Indicates whether an automobile was sold during one of following events.

Dummy	Indicates	Sum	Mean
dGoodwood	Sold at Goodwood Festival of Speed	395	0.0136
dPebbleBeach	Sold at Pebble Beach Concours d'Elégance	428	0.0147

Time dummies. In order to generate index returns, we construct year dummies based on the year of the auction date. The year 1998 serves as the base year. We control for seasonality effects by adding month dummies to our model. These dummies indicate the month of sale. January serves as our reference month.

Table 12. Year dummies.

Indicates whether a car was sold in one of the following years. The year 2017 includes sales up to July 15, 2017.

Dummy	Sold in	Sum	Dummy	Sold in	Sum
dYear1998	1998	548	*dYear2008*	2008	1,948
dYear1999	1999	392	*dYear2009*	2009	1,230
dYear2000	2000	681	*dYear2010*	2010	1,576
dYear2001	2001	599	*dYear2011*	2011	1,653
dYear2002	2002	952	*dYear2012*	2012	2,475
dYear2003	2003	1,107	*dYear2013*	2013	2,498
dYear2004	2004	1,380	*dYear2014*	2014	2,365
dYear2005	2005	1,601	*dYear2015*	2015	1,544
dYear2006	2006	1,831	*dYear2016*	2016	1,525
dYear2007	2007	1,945	*dYear2017*	2017	1,152

4. Empirical results

4.1.1. Hedonic regression results

This section will present the result of our hedonic regressions. In all cases, we run the regression for two different models. In the first model, the dependent variable is the natural logarithm of the unadjusted, nominal auction price. This model will eventually yield the nominal returns for our collectible car index. The second model will serve as the basis for the calculation of real returns; the natural logarithm of the inflation-adjusted (deflated) auction price acts as the dependent variable. The explanatory variables are the same in both models.

Our complete model contains dummies for the production period, condition, marque, exterior color, body type, auction house, uniqueness, engine displacement, engine type, racing history, technical features, and auction year dummies. From now on, the complete model that makes use of nominal auction prices will be referred to as the nominal model, while the model with inflation-adjusted prices will be referred to as the real (i.e. deflated) model. For our complete hedonic regression, we find an R^2 equal to 0.697 for the real model, and an R^2 of 0.702 for the nominal model.

Several characteristics have a strong economic impact on classic car values. We convert characteristic's shadow prices to marginal price impacts (in percentages) to get an indication of their relative importance[25]. We find the largest price impact for concept cars. Cars that are built during the veteran era also command significant premia: relative to our base category of modern classics, they are ceteris paribus 624% higher valued. Cars that are of the marques Duesenberg, Bugatti, Talbot-Lago, Aston Martin and Ferrari are significantly higher priced (with relative price impacts of respectively 486%, 365%, 362%, 344%, and 325%). We find that racing history is indeed very important, with the dummy corresponding to racing cars having a strong price impact, as well as dummies indicating Le Mans and Mille Miglia provenance. Furthermore, we find strong premia for several other marques, for veteran and brass automobiles, and for cars in the best condition. An overview of the strongest economic significance is provided below in Table 13.

[25] The formula is as follows: $\frac{\delta P_i}{P_i} * 100\% = (\exp(\alpha_m) - 1) * 100\%$, where $\frac{\delta P_i}{P_i}$ denotes the marginal price impact and α_m denotes the coefficient of characteristic m.

Table 13. The 20 hedonic characteristics with the strongest economic significance

All coefficients are estimated using OLS regression. Significance at the 10%, 5% and 1% level corresponds with respectively one, two and three asterisks. The nominal model uses the unadjusted auction price as the dependent variable, while the real model uses the deflated auction price.

Variable	**Characteristic**	**Price Impact (%)**	
		Nominal	*Real*
dType2	Body type = Concept car	924.06%***	924.09%***
dEra1	Built during veteran era	601.53%***	601.36%***
dMake33	Make = Duesenberg	486.41%***	486.60%***
dLeMans	Participated in Le Mans	371.86%***	371.99%***
dMake28	Make = Bugatti	365.52%***	365.52%***
dMake54	Make = Talbot-Lago	362.05%***	361.70%***
dMake36	Make = Aston Martin	344.06%***	344.35%***
dType13	Type = Racer	331.83%***	332.05%***
dMake3	Make = Ferrari	325.28%***	325.47%***
dMilleMiglia	Participated in Mille Miglia	310.16%***	311.03%***
dEra2	Built during brass era	283.57%***	283.55%***
dMake46	Make = Delahaye	270.36%***	270.41%***
dCond1	Condition = 1	249.81%***	249.83%***
dMake80	Make = Hispano-Suiza	229.63%***	229.43%***
dEngineType7	Equipped with H8-Engine	196.91%***	198.00%***
dMake82	Make = Dual-Ghia	196.54%***	196.86%***
dMake24	Make = Lancia	187.64%***	187.62%***
dMake6	Make = Porsche	187.52%***	187.73%***
dMake85	Make = Fiat-Abarth	185.02%***	185.02%***
dEra4	Built during pre-war era	176.27%***	176.28%***

Regarding statistical significance, we find that cars in the best conditions, roadsters, racers, and Ferraris command the most significant premia. All other era classifications, except for modern classics, are highly significant. We find strong statistical significance for the coefficients on the variables corresponding to Ferrari, Shelby, Bentley, Duesenberg, and Bugatti. Vehicles equipped with an automatic transmission trade for a significant discount (26.75%), as well as cars sold by Silver Auctions, which are in general 48.05% less valuable. Convertibles and cars within the top 10 beautiful designs are significantly more valuable. All era denominations except for 'modern classics' are highly significant. Table 14 provides an overview. The full regression results are provided in Appendix 8.

Table 14. The 20 hedonic characteristics with the strongest statistical significance

In decreasing order (based on absolute *t*-statistics of the real model). All coefficients are estimated using OLS regression and are significant at the 1% level. The nominal model uses the unadjusted auction price as the dependent variable, while the real model uses the deflated auction price.

Variable	Characteristic	Price impact (%)	*t*-statistic	
			Nominal	*Real*
dCond1	Condition = 1	249.83%	60.22	60.22
dCond2	Condition = 2	126.49%	43.97	43.98
dType14	Body type = Roadster	154.71%	42.31	42.31
dType13	Body type = Racer	332.05%	40.87	40.88
dMake3	Make = Ferrari	325.47%	38.90	38.90
dEra4	Built during pre-war era	176.28%	36.63	36.63
dEra5	Built during post-war era	109.42%	35.92	35.91
dType3	Body type = Convertible	88.99%	35.32	35.33
dBeautifulDesign	In 10 best-looking cars	126.92%	28.13	28.13
dEra2	Built during brass era	283.45%	27.38	27.37
dEra1	Built during veteran era	601.36%	27.26	27.25
dMake15	Make = Shelby	168.59%	27.22	27.22
dMake14	Make = Bentley	172.83%	25.41	25.41
dMake33	Make = Duesenberg	486.60%	24.30	24.30
dAuctionhouse5	Silver Auctions	-48.05%	-24.05	-24.03
dAutomatic	Automatic transmission	-26.75%	-24.00	-24.00
dMake28	Make = Bugatti	365.47%	23.47	23.47
dEra3	Built during vintage era	123.82%	22.84	22.83
dType20	Body type = Tourer	117.94%	22.75	22.75
dType4	Type = Coupe	49.50%	21.92	21.93

4.1.2. General classic car price index

Table 15 reports the results of our hedonic index regression. The index starts in the year 1998 and continues until July 2017. The index level in the year 1998 is set equal to 100. Both nominal and real returns are presented. Over the whole period, the nominal index appreciates 159%, with an appreciation of 73% for the index in real terms.

Between 1998 and 2017, we find an estimated arithmetic mean return of 3.37%, in real terms. The geometric mean return is lower, at 2.91% yearly[26]. Figure 1 presents these results in graphical form. Over the last few years, the index has appreciated

[26] The nominal equivalents of these average returns are 5.63% (arithmetic) and 5.15% (geometric).

considerably. There is, however, a substantial amount of volatility in these returns. For our nominal index, the standard deviation of annual returns amounts to 10.03%.

Table 15. Time dummy hedonic regression results for the time dummies 1998 - 2017. The year 1998 serves as the reference year, at which the index is set to a value of 100. Coefficients are estimated using OLS regression. Significance at the 10%, 5% and 1% level corresponds with respectively one, two and three asterisks. The nominal model uses the unadjusted auction price as the dependent variable, while the real model uses the deflated auction price. We apply the correction of equation (3) to the calculation of index levels. †The year 1998 serves as the base year and its corresponding dummy has not been included in the model.

Year	Coefficient	Index	Return	Coefficient	Index	Return
	Nominal model			*Real model*		
1998†	n/a	100.00		n/a	100.00	
1999	0.025	102.57	2.57%	0.004	100.56	0.56%
2000	0.017	101.73	-0.83%	-0.036	96.54	-4.00%
2001	-0.100**	90.49	-11.05%	-0.181***	83.54	-13.46%
2002	0.059*	106.11	17.27%	-0.038	96.35	15.33%
2003	0.059*	106.08	-0.03%	-0.062*	94.12	-2.32%
2004	0.196***	121.59	14.62%	0.0501	105.20	11.77%
2005	0.412***	150.96	24.16%	0.233***	126.39	20.15%
2006	0.567***	176.35	16.82%	0.355***	142.76	12.95%
2007	0.609***	183.88	4.27%	0.370***	144.94	1.53%
2008	0.720***	205.43	11.72%	0.442***	155.73	7.45%
2009	0.689***	199.12	-3.07%	0.416***	151.70	-2.59%
2010	0.630***	187.77	-5.70%	0.341***	140.72	-7.24%
2011	0.699***	201.11	7.10%	0.377***	145.97	3.73%
2012	0.688***	198.98	-1.06%	0.346***	141.49	-3.07%
2013	0.893***	244.32	22.79%	0.537***	171.24	21.03%
2014	0.954***	259.56	6.24%	0.581***	178.91	4.48%
2015	1.065***	290.21	11.81%	0.691***	199.70	11.62%
2016	0.954***	259.59	-10.55%	0.568***	176.68	-11.53%
2017	0.953***	259.31	-0.11%	0.545***	172.59	-2.31%
Arithmetic mean return:			5.63%			3.37%
Geometric mean return:			5.15%			2.91%

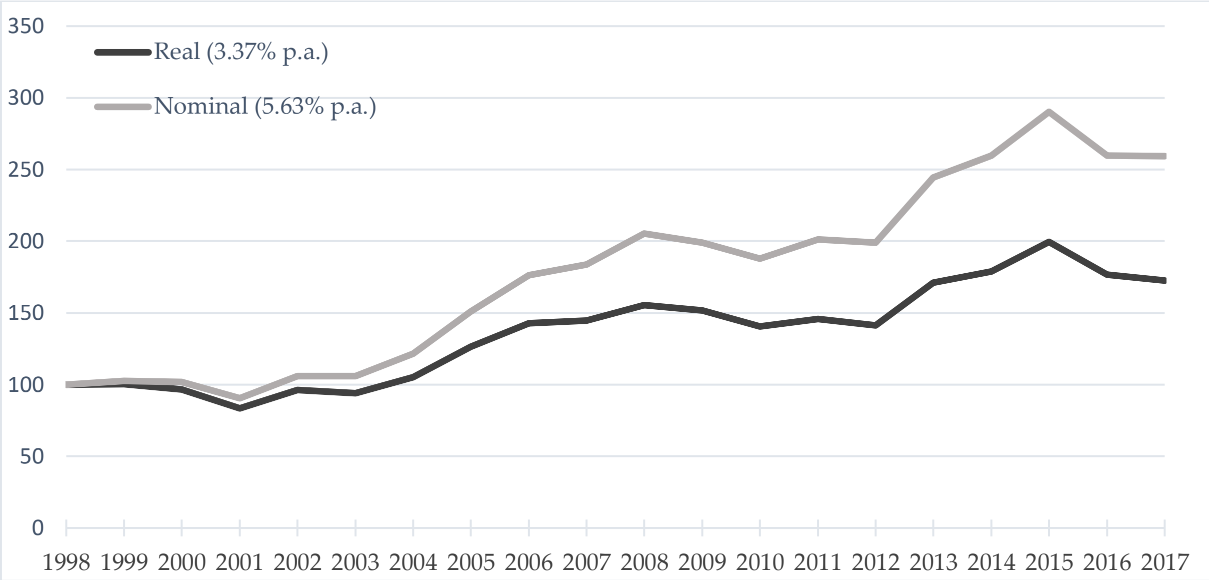

Figure 1. This figure shows the development of our constant-quality classic car index over the time period from 1998 to 2017, in real and in nominal terms. Real returns have been deflated using the US CPI index. Arithmetic mean annual returns are presented in parenthesis. The index is set equal to 100 at the beginning of 1998.

4.1.3. Sub-indices

In this section, we will construct several indices based on subsamples of our data set. We will consider sub-indices for cars approved by the Classic Car Club of America, for affordable classics, and for "Blue Chip" classic cars. Next, we will construct indices based on production eras, where we look at veteran and brass cars, vintage cars, pre-war classics, post-war classics and modern classics. We will also consider indices based on nationality; specifically automobiles of German, Italian, British and American makes. Finally, we will construct indices for Ferraris, Porsches, and Mercedes-Benz's. The general methodology will be similar to that of our earlier classic car index, but our hedonic regression models will in some cases be slightly adjusted. Our results are presented in Table 16 and Figures 2, 3, 4 and 5.

CCCA approved classics. The Classic Car Club of America (CCCA) defines a classic car as *"a fine or distinctive automobile, either American or foreign built, produced between 1915 and 1948"* (CCCA, 2016). We use the list of 'approved classics' as published on the CCCA's website (see Appendix 10) to match our sample with these models. This yields a data set of 2,488 auction sales. We adjust our hedonic regression model by changing the amount of marque dummies. We also exclude all dummies relating to the built period except for the 'vintage' and 'pre-war' periods, since roughly all observations in our subsample are produced during these two periods. After running our hedonic regression, we find average annual real returns equal to 3.24%. The development of this index is graphically represented in Figure 2.

Affordable classics. We make use of Hagerty's Affordable Classics constituent list as published on Hagerty's website (see Appendix 12). After matching this list with our data set, we end up with a sub-sample of 911 auction records. Regarding index returns, we find that that affordable classics generated average real returns of 4.09% annually, against a volatility of 15.23%. The development of this index is graphically represented in Figure 2.

'Blue Chip' classics. Hagerty also constructs an index of the most highly valued classic cars, named the 'Blue Chip' index. The makes and models included in this index are presented in Appendix 11. We construct a data set of 833 Blue Chip automobile auction sales. We use this sample to construct a quality-adjusted index that tracks the value of Blue Chip classic cars. We do indeed find high index returns, with an average annual price appreciation of 10.04%, in real terms. The development of this index is graphically represented in Figure 2.

Nationalities. We further construct induces based on the nationalities of the constituent car marques. We produce such indices for *German*, *Italian*, *British* and *American* automobiles. Our hedonic regression models remain identical. For our index of German cars, we find real annual returns of 4.72%, on average. The Italian index performed very strong, with an average annual appreciation of 8.87%. Returns on our British and American indices were lower. We find that British classics appreciate with 4.03% per annum on average, while American cars appreciate 2.28% per year, both in real terms. See Figure 3 for a graphical representation.

Marques. We extend our analysis to indices composed exclusively by cars of certain marques. We do this for the makes Ferrari, Mercedes-Benz and Porsche. For our Ferrari index, we estimate an average annual real return of 11.29%. The average price appreciation on Porsches and Mercedes-Benz's was lower, at respectively 7.04% and 4.71% (in real and annual terms). See figure 4.

Period denominations. Lastly, we will construct several indices for cars stemming from certain time periods. Because of data scarcity, we will group the veteran (1888-1907) and brass (1908-1916) cars into one index. We further construct indices composed of vintage (1917-1929), pre-war (1930-1946), post-war (1947-1975), and modern classics (1976-1990). We find the strongest returns for the indices of older denominations. Our Veteran & Brass index generated returns of 5.96% on average, while the Vintage index appreciated on average by 6.74%. Pre-war cars performed the worst, with an average annual real return of 1.23%. Figures on other period denomination indices are presented in the table below. A graphical overview is presented in Figure 5.

Table 16. Returns of classic car sub-indices

Average returns for several sub-indices. All indices have been calculated over the period 1998-2017, except for those based on CCCA approved classics which were computed over the period 2000-2017.

Sub-index	Obs.	Nominal return	Real return	Volatility
CCCA approved	2,488	5.28%	3.24%	15.89%
Affordable classics	911	6.34%	4.09%	15.23%
Blue Chip classics	833	12.50%	10.04%	21.95%
German classics	3,398	7.01%	4.72%	12.03%
Italian classics	3,164	11.28%	8.87%	18.43%
British classics	5,132	6.29%	4.03%	11.73%
American classics	15,025	4.53%	2.28%	10.72%
Ferrari	1,538	13.76%	11.29%	25.82%
Porsche	1,022	9.44%	7.04%	19.88%
Mercedes-Benz	1,495	6.95%	4.71%	17.15%
Veteran & Brass	819	8.23%	5.96%	21.71%
Vintage	1,212	8.98%	6.74%	25.45%
Pre-war	3,650	3.43%	1.23%	15.94%
Post-war	21,281	5.88%	3.62%	10.53%
Modern classic	2,040	7.16%	5.05%	14.30%
Total sample	**29,002**	**5.63%**	**3.37%**	**10.03%**

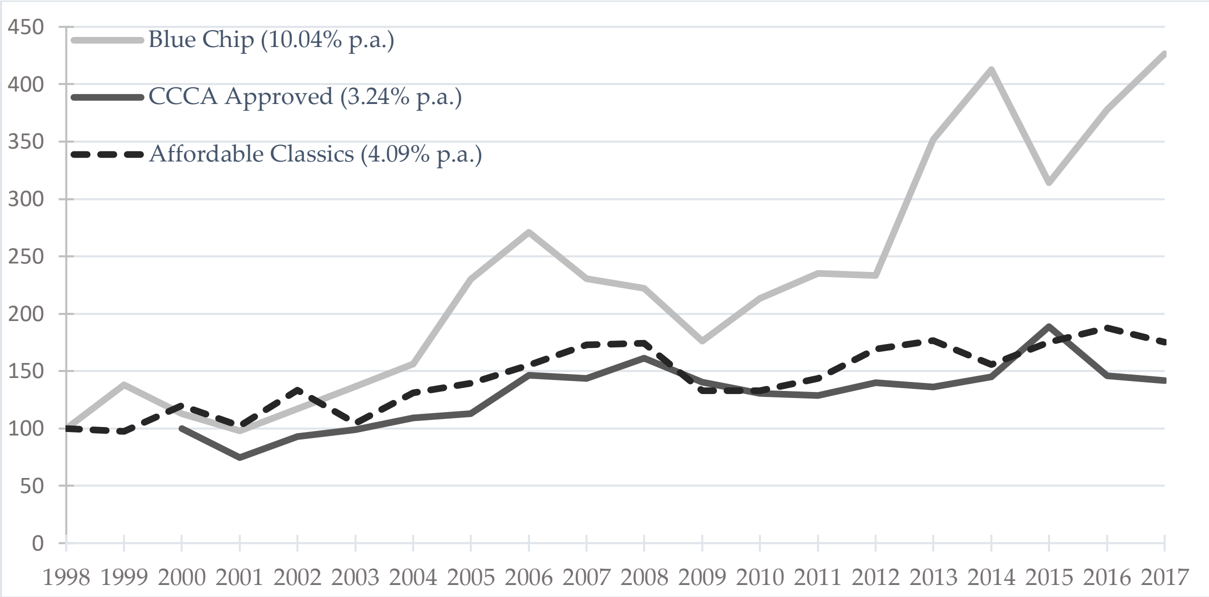

Figure 2. This figure shows the development of our constant-quality price indices for Blue Chip classics, CCCA approved classics, and Affordable Classics. Index levels are presented over the period 1998-2017, with the exception of the Blue Chip index which has been calculated over the period 2000-2017. Index levels are calculated in real terms. The indices are set equal to 100 at the beginning of 1998 (2000=100 for the Blue Chip index). Average annual real arithmetic returns are presented in parenthesis.

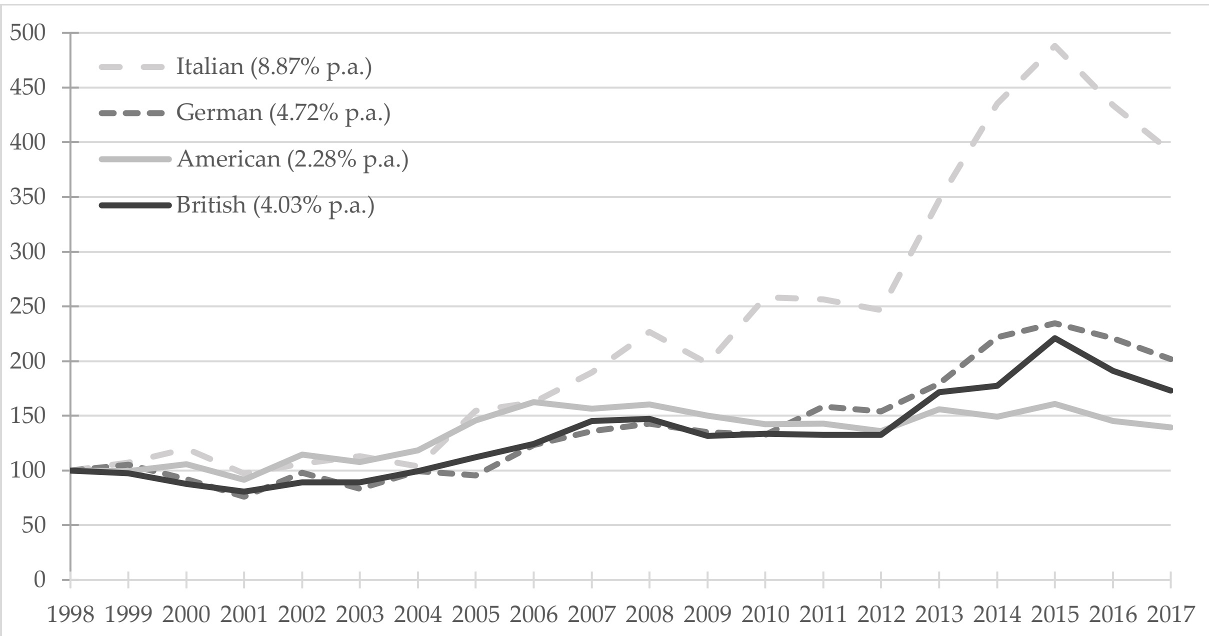

Figure 3. This figure shows the development of our constant-quality price indices for Italian, German, American and British classic cars. Index levels are presented over the period 1998-2017, in real terms. The indices are set equal to 100 at the beginning of 1998. Average annual real arithmetic returns are presented in parenthesis.

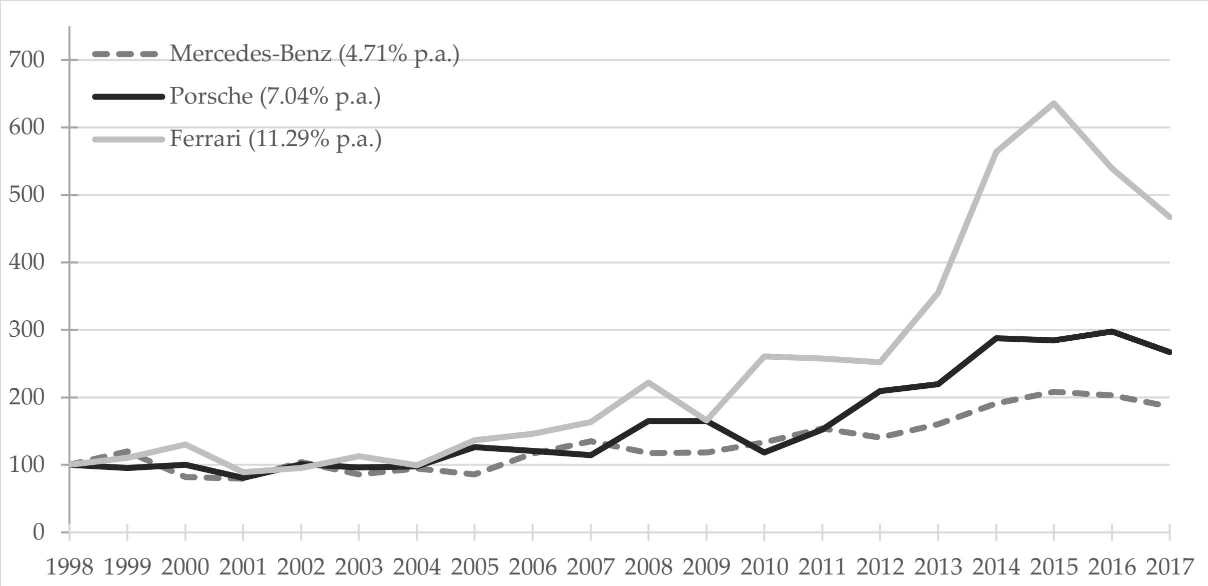

Figure 4. This figure shows the development of our constant-quality price indices for the marques Ferrari, Porsche and Mercedes-Benz. Index levels are presented over the period 1998-2017, in real terms. Average annual real arithmetic returns are presented in parenthesis. The indices are set equal to 100 at the beginning of 1998.

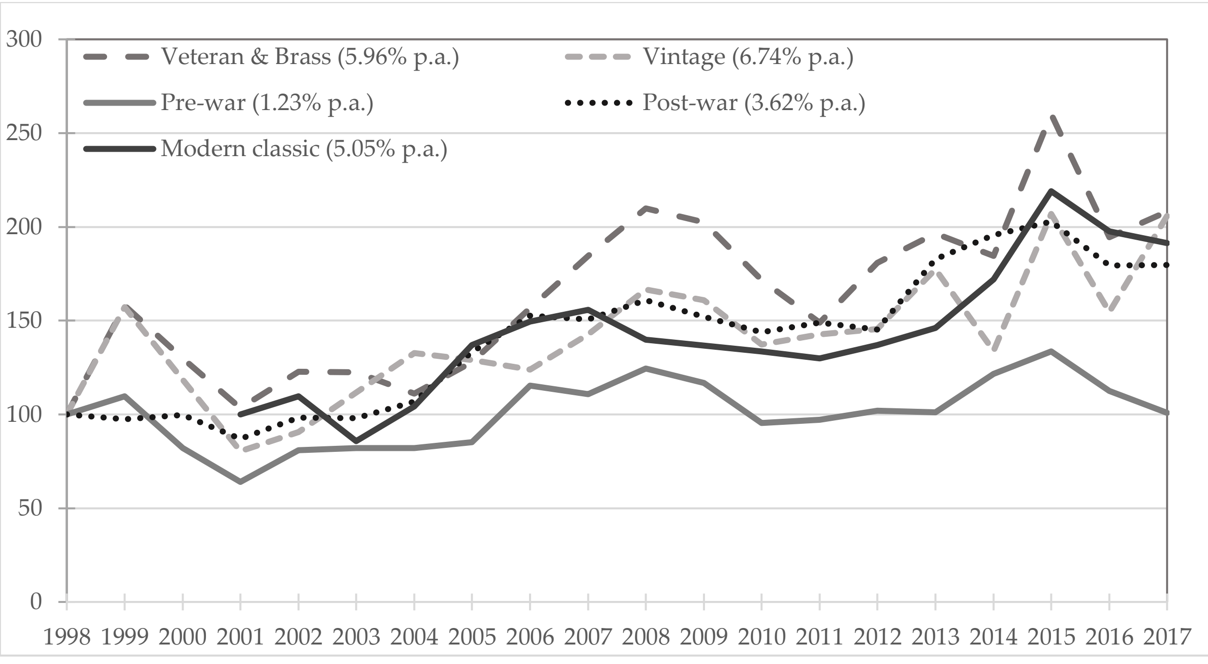

Figure 5. This figure shows the development of our constant-quality price indices for several built period denomination indices. We construct indices for Veteran & Brass cars (1888-1916), Vintage cars (1917-1929), Pre-war cars (1930-1946), Post-war cars (1947-1975) and Modern classics (1976-1990). Index levels are presented over the period 1998-2017, in real terms. Average annual real arithmetic returns are presented in parenthesis. The indices are set equal to 100 at the beginning of 1998.

4.1.4. Classic cars and other assets

In this section, we will compare the returns on our collectible car index to those on equities, bonds, bills, art and gold. Regarding equities, we include the US-based S&P 500 and the global MSCI World index. We include bond returns as determined by total returns on the Bank of America Merrill Lynch Global Government Bond index. This index invests in investment grade government bonds of all maturities issued by developed countries. Data on equities, bills and bonds are downloaded though Thomson Reuters DataStream. We further include yield on 3-month Treasury Bills obtained through FRED Economic Data. Data on gold prices per Troy ounce as traded on the London Bullion Market is downloaded through DataStream. Lastly, we include the Art Price Global Index, obtained through Artprice.com.

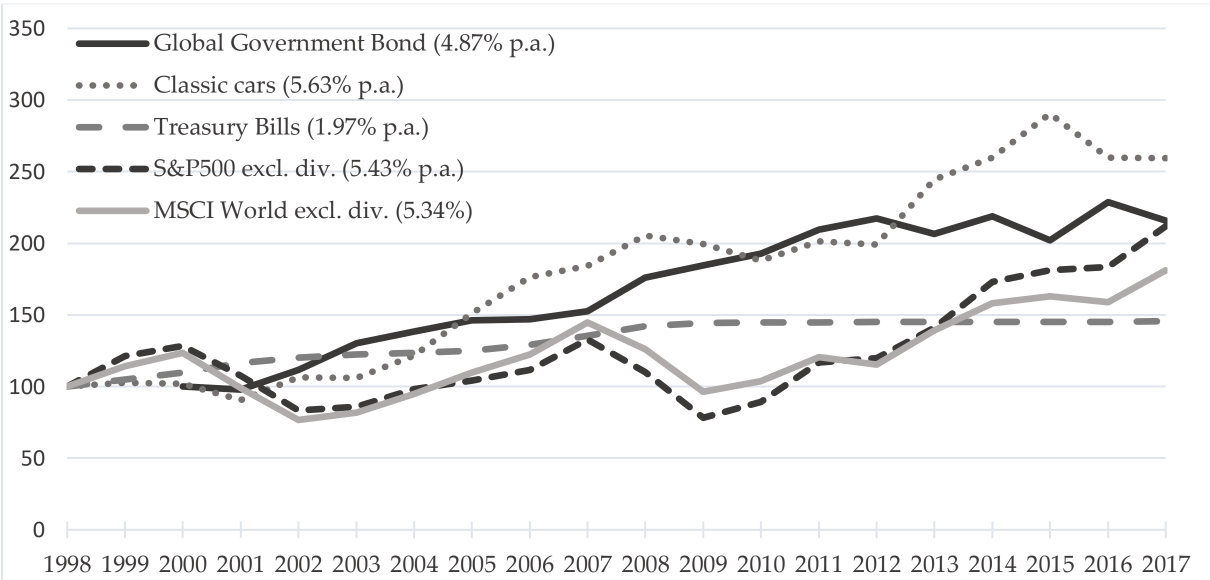

Figure 6. The figure compares the nominal classic car index to indices for various financial assets. We present nominal index values for equities, bills, and bonds, over the time frame 1998-2017. Arithmetic mean annual returns (in nominal terms) are presented in parenthesis. The indices are set equal to 100 at the beginning of 1998, with the exception of the Bond index which is set equal to 100 at the beginning of 2000. Average annual nominal arithmetic returns are presented in parenthesis. All data comes from Thomson Reuters DataStream, except for the yields on 3M Treasury Bills which were obtained from FRED Economic Data.

Comparing the nominal returns on our classic car index to those on financial assets, we find that our classic car index performs relatively strong. Over our rather limited time frame, we find that the classic car index outperforms bonds, bills, and equities. However, it must be noted that the equity indices covered to not include dividend yields. Assuming a dividend yield of about 2% annually, equities as an asset class outperform classic cars. On a risk-adjusted basis, government bonds outperform our classic car index, as exemplified by the larger Sharpe ratio for government bonds.

Equities including dividends yield a Sharpe ratio that is very much similar to that of classic cars.

We further compare the returns on our classic car index to those on real assets. In this regard, classic cars outperform art but are not able to keep up with the appreciation on gold prices. Over the time period covered, gold's return performance has been outstanding. Looking at a broader timeframe, gold appreciated on average by 6.1% annually (Dimson and Spaenjers, 2011). From this perspective, the return performance of classic cars seems closer to that of gold, yet still slightly worse.

Looking at Sharpe ratios in real terms, we find that classic cars underperform bonds and gold, but outperform equity markets, bills and art. Assuming a dividend yield of 2%, the Sharpe ratio of equities amounts to around 0.30. This risk-adjusted performance is comparable to that of classic car returns. Table 17 on the following page provides an overview of our results.

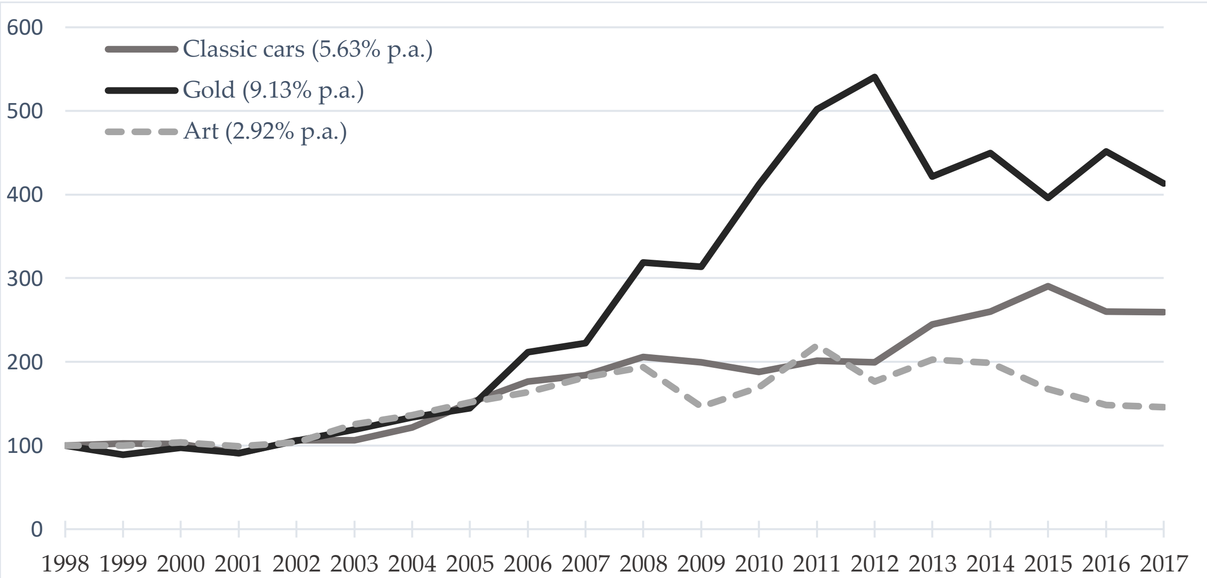

Figure 7. The figure compares the classic car index to indices for various real assets. We present nominal index values for gold and art, over the time frame 1998-2017. Arithmetic mean annual returns (in nominal terms) are presented in parenthesis. The indices are set equal to 100 at the beginning of 1998. Average annual nominal arithmetic returns are presented in parenthesis. Data on gold prices is downloaded through Thomson Reuters DataStream, and data on art prices through Artprice.com.

We now turn to pairwise correlation coefficients between classic car returns and the returns on the asset classes outlined earlier. Table 18 reports our results. Our classic car index shows moderate correlations with inflation, the MSCI World index and with art returns. These amount to around between 0.33 and 0.36. Due to the relatively small return sample size, however, these coefficients are not statistically significant at the 10%-level. But with t-stats all above 1.44, there seems to be some amount of reliability in these correlations.

Based on our real returns, correlations between classic cars on the one hand and Treasure Bills and the MSCI World index on the other amount to -0.27 and 0.29. With absolute t-stats of 1.16 and 1.27, these are however not yet significant at the 10%-level. Other asset classes show relatively small and insignificant pairwise correlations with our classic car index.

Table 17. Distribution of classic cars and other assets.

Average returns on various financial and real assets over the period 1998-2017. Sharpe ratios have been computed using the return on 3M Treasury Bills as the risk-free rate. Data on gold prices (US$/Troy ounce), equity indices (S&P 500 and MSCI World, both excluding dividends), bonds (according to the Bank of America Merrill Lynch Global Government Bond Index), and inflation (US CPI Series, Seasonally Adjusted) has been downloaded through Thomson Reuters DataStream. Art index returns stem from Artprice.com. We obtain yields on 3M Treasury Bills though FRED Economic Data.

	Mean annual return			
	Geometric	**Arithmetic**	**S.D.**	**Sharpe**
Nominal returns				
Classic cars	5.15%	5.63%	10.44%	0.35
S&P 500	4.03%	5.34%	16.30%	0.21
MSCI World	3.18%	4.20%	14.35%	0.16
Gov. Bonds	4.63%	4.87%	7.32%	0.40
Bills	1.80%	1.97%	2.09%	-
Gold	7.76%	9.13%	17.97%	0.40
Inflation	2.13%	2.14%	1.55%	-
Art	2.00%	2.92%	13.84%	0.07
Real returns				
Classic cars	2.91%	3.37%	10.03%	0.33
S&P 500	1.85%	3.08%	15.69%	0.19
MSCI World	1,01%	1.97%	13.68%	0.14
Gov. Bonds	2.52%	2.75%	6.99%	0.38
Bills	-0.34%	0.10%	1.93%	-
Gold	5.50%	6.72%	16.65%	0.40
Art	-0.13%	0.65%	12.76%	0.04

Various costs involved with classic car investments were not taken into account in our comparison analysis. Storage, transaction, transportation, insurance, maintenance and restoration costs are substantial for classic cars, and more so than for other asset classes. Taking these costs into account would severely reduce returns.

The financial returns we presented above must thus be regarded as a theoretical upper limit: a classic car investor would in real-life generate average returns that are far below the averages we presented here. To mitigate this point, it is likely that average holding periods for classic car investments are longer than for other asset classes. Furthermore, benefits in the form of emotional dividends and exclusion of capital-gain taxes (in some countries) are also enjoyed. The net result would probably still be that classic car investments are more costly.

Table 18. Correlation matrix of returns on classic cars and other asset classes.

The table reports the pairwise correlation coefficients between our classic car index ('classic cars') and other asset classes computed over the period 1998-2017. Correlation coefficients in italics are calculated based on nominal return data, while the others are based on real returns. Significance at the 10%, 5% and 1% level corresponds with respectively one, two and three asterisks. Data on gold prices (US$/Troy ounce), equity indices (S&P 500 and MSCI World, both excluding dividends), government bonds (according to the Bank of America Merrill Lynch Global Government Bond Index), and inflation (US CPI Series, Seasonally Adjusted, US Bureau of Labor Statistics) has been downloaded through Thomson Reuters DataStream. Art index returns stem from Artprice.com. We obtain yields on 3M Treasury Bills though FRED Economic Data.

	Classics cars	**Inflation**	**S&P500**	**MSCI World**	**Gov. Bonds**	**Gold**	**Art**	**Bills**
Classics cars	-	*0.329*	*0.141*	*0.338*	*-0.080*	*0.071*	*0.363*	*-0.093*
Inflation	0.227	-	*0.245*	*0.305*	*0.234*	*0.530***	*0.611****	*0.420**
S&P500	0.099	0.164	-	*0.931****	*-0.255*	*-0.121*	*0.491***	*-0.350*
MSCI World	0.294	0.212	0.929***	-	*-0.269*	*-0.108*	*0.539***	*-0.304*
Gov. Bonds	-0.186	0.245	-0.332	-0.360	-	*0.586****	*0.284*	*-0.771****
Gold	-0.017	0.453*	-0.191	-0.194	0.497**	-	*0.346*	*0.123*
Art	-0.162	0.537**	0.457**	-0.373*	0.149	0.270	-	*0.059*
Bills	-0.271	0.519**	-0.045	-0.072	0.128	0.222	0.343*	-

4.1.5. Collectible car investments and inflation

We will now investigate whether classic car investments hedge against inflation. In the next section, we will dig deeper into the relationship between the classic car market and the equity markets.

We first look at the correlation between classic cars investment returns and inflation (Table 18). Looking at real and nominal pairwise correlations, we do find positive relationships, albeit not statistically significant. For other asset classes, namely art, gold and Treasury Bills, we do find a significantly positive relationship. At first sight, these asset classes do seem to hedge against inflation. We further investigate this matter by comparing returns on classic cars to measures of anticipated and unanticipated inflation. We follow the procedure outlined by Dimson and Spaenjers (2011). Following Fama and Schwert (1977), we take the yields on 3-month Treasury Bills as a proxy for anticipated inflation. We repeat this analysis with lagged inflation as our indicator of expected inflation. Both these proxies provide us with an expectation of inflation in year *t+1*, at the end of year t. Dimson and Spaenjers (2011) test the effectiveness in predicting inflation of both these proxies and come to the conclusion that both of them are reasonable predictors of anticipated inflation. We run the following regression model for several asset classes:

$$R_t = \alpha + \beta \cdot E(\Delta_t) + \gamma \cdot [\Delta_t - E(\Delta_t)] + \eta \qquad (4)$$

where R_t is the nominal return on the asset class in year t, $E(\Delta_t)$ is the expected inflation rate in year t according to our proxy, Δ_t is the actual inflation rate in year t, and $[\Delta_t - E(\Delta_t)]$ is the unanticipated inflation rate in year t. An asset class hedges against expected inflation if β is equal to one, while it hedges against unexpected inflation of γ is equal to one. The estimation results of equation (4) can be found in Table 19.

Due to the limited years of return data available on our classic car index, t-tests against our null hypothesis yield in most cases small test statistics. As a result, we often fail to reject the null hypothesis that assumes the asset class to be an effective inflation hedge. When using treasury yields as the proxy for expected inflation, we find that classic car investments do seem to hedge against expected inflation, as exemplified by the beta coefficient that is not significantly different from unity. Equities and government bonds also seem to possess this ability. Turning to our lagged inflation proxy measure, we do not seem to find this result for classic cars, even though we fail to reject the null hypothesis. Again, art, T-Bills and government bonds do seem to hedge against unexpected inflation.

Taking lagged inflation as the proxy measure of expected inflation, we seem to find mild evidence for classic car's hedging property against unanticipated inflation. However, equities and government bonds seem to provide better protection. Equities also possess this ability. Especially government bonds seem to perform well as inflation hedges. Independent of our proxy measure, government bonds seem to provide a hedge against both anticipated and unanticipated inflation.

Concluding, we find evidence that classic car investments do indeed provide at least a partial hedge against inflation. This evidence does depend however on the proxy for expected inflation. Furthermore, we find that this hedge works mainly against expected inflation. To a lesser extent, classic car investments hedge against unanticipated inflation to a lesser extent. Focusing on anticipated as well as unanticipated inflation, we find that asset classes such as government bonds and equities provide better protection.

Table 19. Inflation hedging abilities of classic cars and other asset classes.
We test whether assets hedge against expected and unexpected inflation, using lagged inflation and 3-month T-Bill yields as proxies for expected inflation. We perform a t-test on whether coefficients are statistically significant from 1. Data on gold prices (US$/Troy ounce), equity indices (S&P 500 and MSCI World, both excluding dividends), government bonds (according to the Bank of America Merrill Lynch Global Government Bond Index), and inflation (US CPI Series, Seasonally Adjusted, US Bureau of Labor Statistics) has been downloaded through Thomson Reuters DataStream. Art index returns stem from Artprice.com. We obtain yields on 3M Treasury Bills though FRED Economic Data.

	β	t-stat H_o: $\beta = 1$	γ	t-stat H_o: $\gamma = 1$	R^2
Proxy: Lagged inflation					
Classic cars	3.471	1.079	2.297	0.845	0.140
S&P500	-2.631	-1.096	2.001	0.451	0.261
MSCI World	-0.844	-0.615	2.393	0.694	0.219
Gov. Bonds	0.822	-0.104	1.018	0.016	0.057
Gold	4.655	1.022	5.860	2.028	0.292
Art	2.023	0.437	4.992	2.541	0.487
Bills	1.288	0.743	0.637	-1.394	0.408
Proxy: 3-Month Treasury yield					
Classic cars	1.567	0.357	2.944	1.180	0.174
S&P500	0.686	-0.139	4.896	1.657	0.310
MSCI World	1.218	0.110	4.749	1.825	0.320
Gov. Bonds	1.204	0.161	0.879	-0.096	0.061
Gold	5.549	1.800	6.572	2.125	0.293
Art	4.645	2.068	6.203	2.845	0.420

4.1.6. Collectible car investments and equity markets

To gain more insight into the relationship between equity markets and the market for classic cars, we make use of Dimson's (1979) aggregated coefficients methodology. We found moderate correlation coefficients between classic car returns and returns on the MSCI World index (see the correlation matrix in Section 4.1.4.). However, the correlation between the S&P 500 and classic car market is quite low. Yet these results do not recognize the non-synchroneity in the returns of these assets. This problem has several causes. First, prices of classic car automobiles are slow to adjust, part because of infrequent trading, and part because of the 'appraisal smoothing' discussed earlier. But our method of constructing indices also matters. Implicitly, all transactions in a given year are assigned to the year's midpoint, which then governs the return for that given year. This can cause small discrepancies between reported and actual price trends. By running a regression on lagged, matching and leading equity returns, we can correct for this non-synchronicity in asset returns. The formula looks as follows (Dimson & Spaenjers, 2011):

$$R_t = \sum_{i=-a}^{b} \beta_i \cdot R_{t+i}^{m} + \varepsilon_t \qquad (5)$$

where, R_t denotes the return on our classic car index at time *t*, *a* the number of lagged equity returns, *b* the number of leading equity returns, and R_t^m refers to the equity return at time *t*. We can construct the aggregate beta as follows (Dimson, 1979):

$$\beta = \sum_{i=-a}^{b} \beta_i \qquad (6)$$

Following this procedure for our return data, we find that traditional betas are relatively low. Expanding the model to a lead and lag return, we find that there is considerable non-synchroneity between returns on classic car investments and equity returns. Especially when using the MSCI World index as our equity reference return, the relationship is striking. In that case, the first model produces an aggregated coefficient that is statistically significant at the 10% level. The other two models generate aggregated coefficient that are substantial but insignificant, even though they are not far from significant. The aggregated beta increases to 0.741 when taking into account a leading and two lagging terms. This finding indicates that there are significant wealth effects driving the returns on classic car investments.

Table 20. Dimson (1979) aggregated beta coefficients.

This table Reports the result of the OLS regression of equation (5). This regression uses the real returns on our classic car index as the dependent variable. The model includes a lagged equity returns and b leading equity returns as independent variables. We perform the analysis with S&P 500 and MSCI World index as equity benchmarks. Equity return data is downloaded through Thomson Reuters DataStream. Significance at the 10%, 5% and 1% level corresponds with respectively one, two and three asterisks

	β_{-2}	β_{-1}	β_0	β_1	β	R^2
S&P 500						
Model 1 (a=0 and b=0)	-	-	0.103	-	0.103	0.024
Model 2 (a=1 and b=1)	-	0.186	0.018	0.177	0.381	0.100
Model 3 (a=2 and b=1)	0.003	0.199	0.159	0.022	0.383	0.104
MSCI World						
Model 1 (a=0 and b=0)	-	-	0.247*	-	0.247*	0.104
Model 2 (a=1 and b=1)	-	0.157	0.189	0.189	0.534	0.175
Model 3 (a=2 and b=1)	0.209	0.067	0.291	0.173	0.741	0.227

5. Robustness test

5.1.1. The issue of parameter instability

A severe drawback of the dummy time hedonic regression methodology is that coefficients are held constant over the time period covered. Especially over large timeframes this might be a rather strong assumption, since it implies that investor preferences do not change. According to Triplett (2004), the 'adjacent regression methodology' provides an alternative method. In the adjacent year regression, only the data of two adjacent periods is pooled. Coefficients are still held constant, but only for a relatively short time period. In our case, this time period spans two years. Since tastes change far less over these two years, this imposes a far lesser constraint on the coefficients.

The method works as follows. We run separate regression for every two-year period starting from 1998 to 2017. We run these regressions with all previous hedonic variables, except for the time-period dummies. Instead, we add a dummy variable that indicates whether a car was sold in the second year of the two-year window. Suppose that we run the first adjacent period regression. In that case, we only include auction records of the years 1998 and 1999. Our indicator dummy is then equal to one for all automobiles sold in 1999. The coefficient on this dummy enables us to calculate the price change in our index going from 1998 to 1999. Effectively, we are repeating our dummy time hedonic regression methodology, but only with a sample of two years. Eventually, we can use the coefficients on the indicator dummies to construct year-to-year price changes, and thus also index values.

In general, the returns implied by our adjacent year regressions closely follow the returns from earlier calculations. Only in the first three years, where our sample is thinner, the adjacent year regressions produces higher returns. During several periods, the adjacent year index provides slightly lower return numbers. However, the mean returns are very similar. Comovement is also strong, as exemplified by the correlation coefficient of 0.90 between the real returns implied by our adjacent period regressions and the returns estimated from earlier hedonic regressions. While the assumption of constant preferences over time may be strong, our adjacent period regression results lend support to the finding that this assumption does not lead to significantly different return estimates.

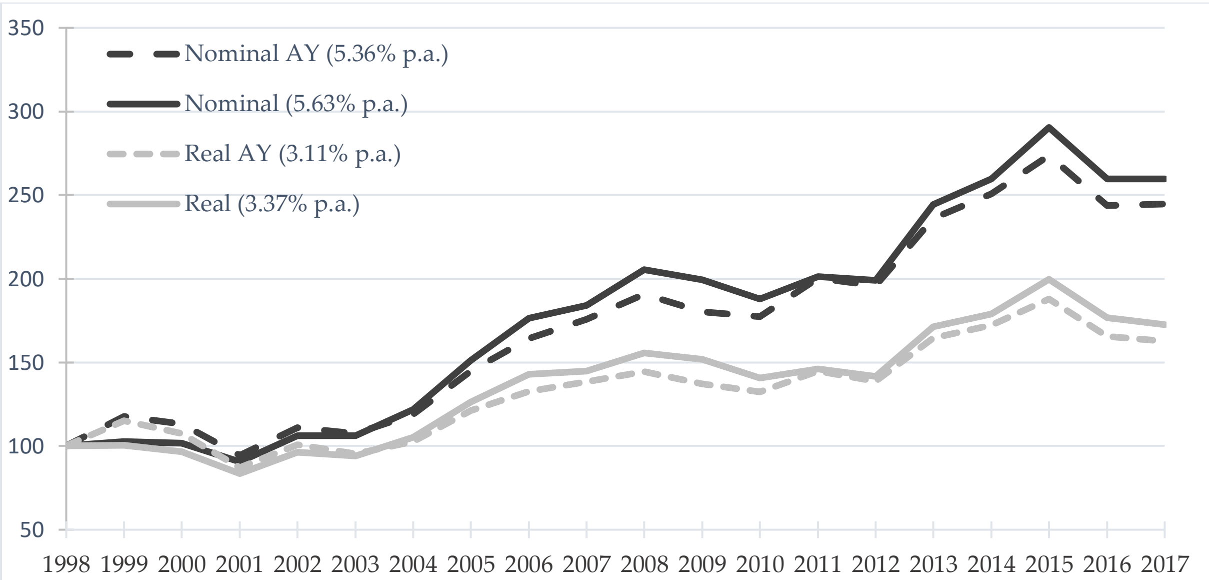

Figure 8. Comparison between index levels obtained by the time-dummy hedonic regression and adjacent year (AY) regression methodologies.

6. Conclusion and discussion

Investments of passion have become increasingly more popular in recent years. In comovement with this trend, classic car investments gained in publicity and popularity. Research into this topic has been lacking, and the few studies conducted to date suffer from severe limitations. In this thesis, we tried to address some of these limitations by employing a hedonic regression index methodology in order to adjust for infrequent trading and quality differences of classic cars auctioned. We further make use of an extensive data set of auction records conducted between January 1998 and July 2017. Since 1998, our classic car index has appreciated at a yearly average rate of 5.63%, in nominal terms. Over this time frame, such a return performance compares favorably to other asset classes, both on an absolute return basis as on a risk-adjusted basis. Looking at absolute returns, only gold performed better over the time frame covered. In risk-adjusted terms, both gold and government bonds showed larger Sharpe ratios. However, the returns on equities do not include dividend yields. Taking dividend yields of an assumed 2% annually into account, we must conclude that equity markets slightly outperformed classic car investments in absolute return terms, and that risk-adjusted performance is similar. Moreover, we find return volatilities of classic car returns that are lower than those on equities, but larger than the volatility of government bond returns.

We further evaluate various sub-indices of classic cars. We find that within the classis car market, returns between subsectors can be widely dispersed. In particular for Blue Chip classics, Italian classic, and Ferraris we find very strong returns. These returns, however, come at substantial volatilities. We further find that over our time period, pre-war era classics and American classics produced rather low annual returns.

Our results do not incorporate the numerous costs involved in classic car investments. Returns on classic car investments will be substantially lower after correcting for transaction, storage, maintenance, insurance, restoration, and other holding costs. The returns we presented here should therefore be regarded as an upper limit. It might be interesting for future research to focus on these after-cost returns. This could be done similarly as in Dimson and Spaenjers (2011), who investigate post-costs returns of collectible stamps.

As a byproduct of using a hedonic regression methodology, our understanding of the various factors that drive classic car values has increased. We found that older cars, racing cars (in particular those that participated in prestigious racing events), and cars in the best conditions command the strongest premia. Several marques, including Ferrari, Duesenberg, Bugatti, Talbot-Lago, Aston Martin and Delahaye are valued strongly. It would however also be interesting to investigate which factors drive the returns of classic car investments. Previous research has suggested that the limited quantity in which classic cars exist, coupled with the continuous decrease in this quantity trough loss, damage and wear, might have a price-increasing effect on classic car values. Emotional and social reasons are important determinants in shaping demand for classic cars. Our research has suggested that wealth effects might play a role, since after accounting for non-synchronicity in equity and classic car returns, we find a substantial positive correlation between the two. Further research in this area would be beneficial. Modelling classic car prices in a framework comparable to that of Dimson et al. (2015), in which the value of wine consumption is evaluated against the value of infinite storage, might also be interesting.

After researching the hedging properties of classic car investments, we find evidence that classic cars at least partially hedge against expected inflation. In contrast to other asset classes such as government bonds and equities however, in the case of unanticipated inflation this evidence seems less compelling. We further research the relationship between classic car investments and equity markets and find that after accounting for non-synchroneity in returns, comovement between the two is substantial. Even though on first sight correlation coefficients between classic cars and equity markets seem small, this finding suggests that there are significant wealth effects driving the returns on classic cars. All in all, classic cars seem a viable alternative investment. Classic car investments are unique in that they combine a great source of enjoyment with the potential of investment gains and a partial inflation hedging ability.

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Appendix 1. Marque dummy classifications

The following car manufacturers have been assigned to manufacturer dummy variables. In total, 648 different manufacturers occur in the sample, of which the 95 manufacturers with more than or equal to 20 observations in the data set are assigned to a unique indicator variable (for a total of **27,310** observations). The 548 marques with less than 20 observations (for a total of 1,692 observations) are all assigned the same indicator variable named *dMake96* (see Appendix 2).

Marque	# Obs.	Dummy	Marque	# Obs.	Dummy	Marque	# Obs.	Dummy
Chevrolet	4522	*dMake1*	Duesenberg	145	*dMake33*	Volvo	43	*dMake65*
Ford	2831	*dMake2*	Cord	125	*dMake34*	Stutz	43	*dMake66*
Ferrari	1538	*dMake3*	Sunbeam	124	*dMake35*	Jeep	41	*dMake67*
Jaguar	1461	*dMake4*	Aston Martin	115	*dMake36*	Crosley	40	*dMake68*
Mercedes-Benz	1461	*dMake5*	Austin-Healey	114	*dMake37*	Nash-Healey	37	*dMake69*
Porsche	1022	*dMake6*	Isetta	101	*dMake38*	Vauxhall	35	*dMake70*
Rolls-Royce	891	*dMake7*	Morris	100	*dMake39*	LaSalle	33	*dMake71*
Cadillac	841	*dMake8*	Nash	94	*dMake40*	DeLorean	33	*dMake72*
Pontiac	743	*dMake9*	DeSoto	94	*dMake41*	Kaiser-Darrin	33	*dMake73*
MG	675	*dMake10*	Daimler	92	*dMake42*	Imperial	32	*dMake74*
Buick	599	*dMake11*	Hudson	91	*dMake43*	Panhard*	31	*dMake75*
Packard	586	*dMake12*	Pierce-Arrow	88	*dMake44*	Abarth	31	*dMake76*
Plymouth	541	*dMake13*	Toyota	87	*dMake45*	Bristol	31	*dMake77*
Bentley	531	*dMake14*	Delahaye	85	*dMake46*	Iso	31	*dMake78*
Shelby	520	*dMake15*	Morgan	83	*dMake47*	Locomobile	30	*dMake79*
Lincoln	488	*dMake16*	Renault	82	*dMake48*	Hisp.-Suiza*	30	*dMake80*
Volkswagen	481	*dMake17*	Datsun	82	*dMake49*	De Dion*	30	*dMake81*
Dodge	471	*dMake18*	Alfa Romeo	80	*dMake50*	Dual-Ghia	30	*dMake82*
Oldsmobile	429	*dMake19*	Willys	78	*dMake51*	Autobianchi	29	*dMake83*
Chrysler	425	*dMake20*	Land Rover	73	*dMake52*	Marmon	28	*dMake84*
Maserati	348	*dMake21*	Riley	71	*dMake53*	Fiat-Abarth	27	*dMake85*
Fiat	335	*dMake22*	Talbot-Lago	70	*dMake54*	Rover	26	*dMake86*
Mercury	290	*dMake23*	DeTomaso	68	*dMake55*	Stanley	26	*dMake87*
Lancia	255	*dMake24*	Edsel	61	*dMake56*	Wolseley	25	*dMake88*
Triumph	244	*dMake25*	AC	56	*dMake57*	Honda	24	*dMake89*
BMW	206	*dMake26*	Peugeot	52	*dMake58*	Mini Cooper	24	*dMake90*
Lamborghini	186	*dMake27*	Jensen	52	*dMake59*	Talbot	23	*dMake91*
Bugatti	183	*dMake28*	GMC	50	*dMake60*	Isotta Frasch.*	23	*dMake92*
Studebaker	177	*dMake29*	Facel Vega	48	*dMake61*	Siata	21	*dMake93*
Lotus	159	*dMake30*	Delage	47	*dMake62*	Hupmobile	21	*dMake94*
Citroën	156	*dMake31*	Messerschmitt	46	*dMake63*	Rambler	20	*dMake95*
Lagonda	148	*dMake32*	International	45	*dMake64*	-	-	-

*These marques are named full-out: Panhard et Levassor, Hispano-Suiza, De Dion-Bouton, and Isotta Fraschini.

Appendix 2. Marques included under the 'other'-category

The following 548 marques with less than 20 observations in our sample are all assigned to the 96th indicator variable named *dMake96*. A total of **1,692** auction sales are indicated by this dummy.

Marque	# Obs.	Marque	# Obs.	Marque	# Obs.	Marque	# Obs.
Frazer Nash	19	Diamond	10	Detroit Electric	6	Audi	4
Kaiser	19	Kissel	10	Oakland	6	Tojeiro	4
Mercedes	18	Holden	10	Matra	6	Suzuki	4
Cisitalia	18	White	9	Heinkel	6	Maybach	4
Bizzarrini	17	Chalmers	9	Special	6	Pegaso	4
Voisin	17	Berkeley	9	McLaughlin-Buick	5	Premier	3
Maxwell	16	Kurtis	9	Jensen-Healey	5	DuPont	3
Singer	16	Miller	9	Race	5	Columbia	3
Benz	16	Lanchester	9	McLaren	5	Chandler	3
Model	15	Darracq	9	Willys-Knight	5	British Leyland	3
Tucker	15	Moretti	9	Lotus-Climax	5	Durant	3
Invicta	15	Lea-Francis	9	Lorraine-Dietrich	5	National	3
Mazda	15	Essex	9	Stanguellini	5	Alpine	3
Franklin	14	DKW	9	Mors	5	Marcos	3
OSCA	14	Muntz	9	Stevens-Duryea	5	Bitter	3
Humber	14	Peerless	9	Napier	5	Chaparral	3
Austin	14	AMC	9	Holsman	5	Amphicar	3
REO	13	Innocenti	8	Knox	5	OM	3
Ghia	13	Standard	8	Ruxton	5	Swallow	3
Bricklin	13	Victoria	8	Borgward	5	Gordon-Keeble	3
Blackhawk	13	Lola-Chevrolet	8	Overland	5	Swift	3
Graham	13	Metropolitan	8	Rochet-Schneider	5	Terraplane	3
Batmobile	13	Vespa	8	DB	5	GAZ	3
Healey	12	Jowett	7	Clément	5	Monarch	3
Hillman	12	Pope-Hartford	7	Stoddard-Dayton	5	Chevron	3
Cooper	12	Thomas	7	Schacht	5	Belsize	3
Intermeccanica	12	Elva	7	Clément-Panhard	4	Fitch	3
TVR	12	Cunningham	7	Hillegass	4	Woodill	3
Lola	12	Autocar	7	Connaught	4	Clenet	3
Tatra	12	Winton	7	Monteverdi	4	Steyr	3
Saab	12	Simplex	7	Edwards	4	Metz	3
Mercer	11	Devin	7	Lozier	4	Salmson	3
Cooper-Climax	11	Wolseley-Siddeley	7	Crossley	4	Milburn	3
Auburn	11	Panther	7	Willys-Overland	4	Railton	3
Opel	11	Nissan	7	Kellison	4	G.N.	3
Mini	11	NSU	7	Trojan	4	Delaugère	3
Checker	11	Lister-Jaguar	6	Puma	4	Sears	3
Goggomobil	11	Frazer Nash-BMW	6	Rauch & Lang	4	G.N.U.	3
Panhard	11	Excalibur	6	Brabham-Repco	4	Dinalpin	3
Horch	10	Delaunay-Belleville	6	Simca	4	Decauville	3
Minerva	10	Alvis	6	Avanti	4	Kleinschnittger	3
HRG	10	March	6	BMC	4	F.M.R.	3
Subaru	10	Reliant	6	Trabant	4	American	3

Appendix 2. Marques included under the 'other'-category (Continued)

Marque	# Obs.	Marque	# Obs.	Marque	# Obs.	Marque	# Obs.
Bond Bug	3	Rosengart	2	American Bantam	2	Watson-Offenh.*	1
Hotchkiss	3	Crane-Simplex	2	Lister-Chevrolet	2	Griffin	1
Barré	2	Beck	2	Aster	2	Case	1
Skoda	2	Derby	2	Pierre Faure	2	Lombard	1
Haynes-Apperson	2	Meyers	2	Abarth-Simca	2	Rally	1
Fisson	2	Bayliss	2	Hustler	2	Otto	1
Waverley	2	Tojeiro-Butterworth	2	Clément-Bayard	1	Scarab	1
Talbot-Darracq	2	Gurney	2	Liver	1	Farman	1
Auto Union	2	Armstrong-Sidd.*	2	Fletcher	1	Goddeu	1
Kurtis-Offenhauser	2	Cleveland	2	Emeryson	1	Maudslay	1
Brewster	2	Vanden	2	Trumbull	1	SAVA	1
Cooper-Maserati	2	Haynes	2	Wills-Sainte	1	Krieger-Braiser	1
Nardi-Danese	2	Glasspar	2	Michelotti	1	Pratt-Elkhart	1
OTAS	2	Rockne	2	Lotus-BRM	1	Sterling	1
Brough	2	Rochdale	2	Thames	1	Victress	1
McLaren-Elva	2	Watson	2	Elva-Porsche	1	Dax	1
Chrysler-Ghia	2	Baja	2	ERA	1	Locust	1
Squire	2	Sharp	2	Lynx	1	Brabham	1
Mallock	2	Northern	2	Surtees	1	Rene	1
Merlyn	2	Le Bestoni	2	Lenawee	1	Matra-Simca	1
Calcott	2	Fournier-Marcadier	2	Bosley	1	Steyr-Puch	1
Richard Brasier	2	EMW	2	VOP	1	Midget	1
Georges Richard	2	Graham-Paige	2	Pkora	1	British Duryea	1
Paige	2	Gardner-Serpollet	2	Cole	1	KVA/Hi-Tec	1
Sabra	2	Flajole	2	Barris	1	Foose	1
Lotus-MG	2	Offenhauser	2	Nagant	1	Ballot	1
Meteor	2	Berliet	2	Turner-miesse	1	Rolland-Pilain	1
CGV	2	Brasier	2	Costin-Nathan	1	Economy	1
Martini	2	Hurtu	2	BRM	1	Francesco	1
Foyt	2	Brewster-Ford	2	Mercedes-Simplex	1	Atalanta	1
Humberette	2	Henry J.	2	McLaren-Cosworth	1	Safir	1
Star	2	Ed Roth	2	Santler	1	Pierce-MG	1
Theophile	2	Kaiser-Jeep	2	Pick	1	Cooper-Bristol	1
Miller-Ford	2	Mitchell	2	Siddeley	1	Galloway	1
Little	2	Proteus	2	Caterham	1	Riley-Ford	1
Austro-Daimler	2	Zundapp	2	Davis	1	Huff-Ford	1
Pope-Waverley	2	Am General	2	Cosworth	1	Westfield	1
Bertone	2	Sunbeam-Talbot	2	Elva-Ford	1	Sizaire-Naudin	1
MMC	2	Mathis	2	Cartercar	1	Kieft	1
Erskine	2	Stearns-Knight	2	Wisconsin	1	Lucenti	1
Darmont	2	Moon	2	Royale	1	March-Ford	1
Rexette	2	SS	2	E.J.S.	1	McLaren-Chevrolet	1
Dreyer	2	American Austin	2	Roesch-Talbot	1	Lotus-Bristol	1
Deep	2	Continental	2	MRE	1	Gulf	1
Henney	2	King	2	Brush	1	Gregoire	1
Itala	2	Peel	2	H.A.R.	1	Manta	1
Alpine-Renault	2	Mochet	2	McQuay-Norris	1	Tecno	1
Chevron-Ford	2	Velorex	2	Washington	1	Wombat Car Co.	1

Appendix 2. Marques included under the 'other'-category (Continued)

Marque	# Obs.	Marque	# Obs.	Marque	# Obs.	Marque	# Obs.
Bulant	1	Excelsior	1	Ogle	1	DRA	1
Kelmark	1	Lyncar	1	Gladiator	1	De Dietrich	1
BSH	1	B & Z	1	Wilson-Pilcher	1	Davies	1
Germain	1	Zagato	1	Buffum	1	Felday	1
Silver Stream	1	Dellow	1	Flexible	1	Rickenbacker	1
Chitty	1	Worth	1	Kougar-Jaguar	1	Interstyl	1
Marble	1	EMPI	1	Jurisch	1	Djinn	1
Krit	1	Bantam	1	Reyonnah	1	Diva	1
U.S.	1	Dutton	1	Avolette	1	Ladawri	1
Buckler	1	Longhorn	1	Maico	1	Auto-Carrier	1
Empire	1	Cheetah	1	Lightburn	1	Unic	1
Sparks	1	Lomax	1	Scootacar	1	Zebra	1
Stearns	1	Ferves	1	Eshelman	1	Crouch	1
Brisko-Dryer	1	Jackson	1	Benjamin	1	Zoe	1
Tom Beaty	1	Inter-State	1	Charron	1	Marlboro	1
Lola-Climax	1	McFarlan	1	Turner	1	Malicet	1
Kanzler	1	Thomas-Flyer	1	Glassic	1	Pininfarina	1
Veritas-BMW	1	Bergholt	1	Broc	1	Matra-Bonnet	1
Selden	1	Jewel	1	Le Zebre	1	Abarth-Osella	1
Orient	1	Neustadt-Perry	1	Modena	1	Gerin	1
Success	1	Frontenac	1	Holman-Moody	1	EMF	1
Duryea	1	Tourist	1	Epperly	1	Penske-march	1
Velie	1	Lazzarino	1	Gardner	1	Vinot	1
Mini	1	Argo	1	Cottin & Desg.*	1	Meskowski	1
Sbarro	1	Henny	1	Cyklon	1	Elgin	1
Glockler-Porsche	1	Gobron-Brillié	1	Lacoste	1	Citröen	1
Marlin	1	Hertz	1	IKA	1	Costin	1
Brouhot	1	Monica	1	Commer	1	Lion-Peugeot	1
Raymond	1	Phillips	1	Smith	1	Brawner	1
SMA	1	Cramer	1	Falcon	1	Raynaud	1
Van Blerck	1	Rounds	1	Vulcan	1	Georges Irat	1
Bromme	1	Lesovsky	1	McKee	1	Amilcar	1
Chrisman	1	Snowberger-Off.*	1	Ginetta	1	DFP	1
John Fray	1	Alco	1	B.N.C.	1	HAZ	1
Beardmore	1	Kapi	1	Philos	1	Car Nation	1
Eldredge	1	David	1	Roamer	1	K.R.I.T.	1
Karns	1	PTV	1	Pegasus	1	Crofton	1
Kollins	1	Trident	1	Rapier	1	H.E.	1
Marion	1	Kougar	1	Osi	1	Apollo	1
Sebring	1	Fleur	1	Winfield	1	Bocar	1
Logan	1	Baker	1	Waltham	1	AAR	1
Chandler-Curtiss	1	Léon Bollée	1	Hesketh	1	De Sanctis	1
Giannini	1	Foers	1	Beaumont	1	Pullman	1
Alta	1	Buckmobile	1	Bean	1	Tempo	1
Pinzgauer	1	McIntyre	1	FMR	1	Tracta	1
Steyr-Allard	1	Woods	1	Diatto	1	Breguet	1

*These marques are named full-out: Armstrong-Siddeley, Watson-Offenhauser, Snowberger-Offenhauser, and Cottin & Desgouttes.

Appendix 3. Top 15 most expensive auction sales

All auction prices are in million US dollars. Real prices are deflated using the US CPI series and reflect dollar values as of July 15, 2017.

Year	Make and model	Price	Real Price	Auction Date	Auction house
1962	Ferrari 250 GTO Berlinetta	$38.1	$39.2	August 15, 2014	Bonhams
1957	Ferrari 335S racer	$35.9	$36.9	February 5, 2016	Artcurial
1954	Mercedes-Benz W196 racer	$29.5	$30.9	July 12, 2013	Bonhams
1956	Ferrari 290 MM racer	$28.1	$28.8	December 10, 2015	RM Sotheby's
1967	Ferrari 275 GTB/4S NART Spyder	$27.5	$28.8	August 17, 2013	RM Auctions
1964	Ferrari 275 GTB/C Speciale coupe	$26.4	$27.2	August 16, 2014	RM Auctions
1955	Ferrari 410 Sport roadster	$23.0	$23.7	August 17, 2014	Rick Cole Auct.
1955	Jaguar D-Type	$21.8	$22.1	August 19, 2016	RM Sotheby's
1939	Alfa Romeo 8C 2900B Lungo Spider	$19.8	$20.1	August 20, 2016	RM Sotheby's
1961	Ferrari 250 GT SWB California Spyder	$18.6	$19.3	February 2, 2015	Artcurial
1954	Ferrari 375 MM+ Sports Racer	$18.3	$18.9	June 17, 2014	Bonhams
1959	Ferrari 250 GT LWB California Spyder	$18.2	$18.4	August 20, 2016	Gooding & Co.
1964	Ferrari 250 LM coupe	$17.6	$18.1	August 15, 2015	RM Sotheby's
1961	Ferrari 250 GT SWB California Spyder	$17.2	$17.6	March 11, 2016	Gooding & Co.
1961	Ferrari 250 GT SWB California Spyder	$16.8	$17.3	August 16, 2015	Gooding & Co.

Appendix 4. Body Type classifications

We classify these body types into the following dummy variables. The body type 'sedan' serves as the reference category.

Body Type	Dummy	# Obs.	Feature(s)
Buggy	*dType1*	79	Lightweight automobile with off-road capability and sparse bodywork
Concept car	*dType2*	35	Made to showcase new styling and/or new technology
Convertible	*dType3*	8,278	Ability to convert from open-roof to closed-roof.
Coupe	*dType4*	9,434	Fixed roof, gradually sloping down on the back-side. Most often a car with two doors.
Cyclecar	*dType5*	37	Small, lightweight and inexpensive car popular in the 1910's and 1920's. Sometimes equipped with a motorcycle engine.
Hatchback	*dType6*	83	Same as station wagon, but shorter
Horseless carriage	*dType7*	151	The oldest of automobile types, essentially horse carriages equipped with a mechanical engine.
Hot rod	*dType8*	75	American car with large (often visible) engine modified for linear speed.
Off-road	*dType9*	57	Light-weight truck mostly used for its off-road capabilities.
Limousine	*dType10*	695	Luxurious car generally driven by a chauffeur with a partition between the driver and passengers compartment.
Microcar	*dType11*	184	Very small cars, with light engines. Replaced cyclecars in the 1940's.
Pick-up	*dType12*	749	Light duty truck with enclosed cab and open cargo area.
Racer	*dType13*	698	Car that was built specifically built for the participation in racing events.
Roadster	*dType14*	3,249	Light, sporty, and open two-seat car.
Runabout	*dType15*	88	Light, basic automobile popular until around 1915.
SUV	*dType16*	150	Car with off-road features (e.g. 4-wheel drive, high ground-clearance) but that is generally meant for road use.
Sedan	*dType17**	2,890	Passenger car in three-box configuration, with a closed cargo compartment.
Station wagon	*dType18*	651	Sedan car with the roof extended rearward over a shared cargo compartment.
Targa	*dType19*	158	Semi-convertible car with a removable roof section and a roll bar behind the seats.
Tourer	*dType20*	947	Open car seating four or more people, meant for travelling.
Utility	*dType21*	126	Car used with a commercial purpose, or for carrying out a specific task.
Van	*dType22*	188	Minibus. Includes camper vans.
Total		**29,002**	

Appendix 5. Exterior color classifications

We classify these exterior colors into the following dummy variables. The exterior color 'black' serves as the reference category.

Exterior Color	**Dummy**	**# Obs.**
Beige	*dExteriorColor1*	731
Black	*dExteriorColor2**	4,497
Blue	*dExteriorColor3*	3,803
Bronze	*dExteriorColor4*	235
Brown	*dExteriorColor5*	323
Charcoal	*dExteriorColor6*	37
Copper	*dExteriorColor7*	79
Gold	*dExteriorColor8*	370
Gray	*dExteriorColor9*	690
Green	*dExteriorColor10*	2,732
Ivory	*dExteriorColor11*	623
Maroon	*dExteriorColor12*	1,467
Metal	*dExteriorColor13*	143
Orange	*dExteriorColor14*	682
Pink	*dExteriorColor15*	236
Primer	*dExteriorColor16*	23
Purple	*dExteriorColor17*	187
Red	*dExteriorColor18*	4,967
Rust	*dExteriorColor19*	10
Silver	*dExteriorColor20*	1,762
Turquoise	*dExteriorColor21*	212
White	*dExteriorColor22*	3,558
Wood	*dExteriorColor23*	79
Yellow	*dExteriorColor24*	1,556
Total		**29,002**

Appendix 6. Auction house classifications

We classify all auctioneers in our sample into the following dummy variables. The auctioneers with more than or equal to 200 sales are assigned a unique dummy variable. The 51 auction houses with less than 200 sales (for a total of 2,386 sales) are assigned the 27th dummy variable, *dAuctionhouse27*. Except traditional auction houses, or dataset also includes sales though eBay and sales through a cooperation of eBay and Kruse.

Auction house	**# Obs.**	**Dummy**	**Auction house**	**# Obs.**	**Dummy**
Bonhams	4,726	*dAuctionhouse1*	Potts Auction Company	73	*dAuctionhouse27*
RM Auctions	4,536	*dAuctionhouse2*	Classic Motorcar Auctions	73	*dAuctionhouse27*
Barrett-Jackson	2,640	*dAuctionhouse3*	GAA	72	*dAuctionhouse27*
Mecum Auctions	2,542	*dAuctionhouse4*	The Finest	67	*dAuctionhouse27*
Silver Auctions	1,271	*dAuctionhouse5*	Twin Cities Auctions	65	*dAuctionhouse27*
Gooding & Co.	988	*dAuctionhouse6*	Brightwells	55	*dAuctionhouse27*
Christie's	899	*dAuctionhouse7*	Dragone	50	*dAuctionhouse27*
Kruse	863	*dAuctionhouse8*	Kruse/Leake	46	*dAuctionhouse27*
Worldwide Auctioneers	854	*dAuctionhouse9*	Spectrum	45	*dAuctionhouse27*
H&H; Auctions	777	*dAuctionhouse10*	Aumann Auctions	42	*dAuctionhouse27*
McCormick's	757	*dAuctionhouse11*	Anglia Car Auctions	40	*dAuctionhouse27*
Russo and Steele	727	*dAuctionhouse12*	Keenan Auction Co.	37	*dAuctionhouse27*
Artcurial	698	*dAuctionhouse13*	Petersen	36	*dAuctionhouse27*
Branson	675	*dAuctionhouse14*	Hershey Auction	31	*dAuctionhouse27*
Auctions America	576	*dAuctionhouse15*	B-J/Coys	28	*dAuctionhouse27*
Silverstone	431	*dAuctionhouse16*	Cheffins	28	*dAuctionhouse27*
Leake	426	*dAuctionhouse17*	US Auctioneers	28	*dAuctionhouse27*
RM Sotheby's	414	*dAuctionhouse18*	Barons	27	*dAuctionhouse27*
eBay	392	*dAuctionhouse19*	Premier	24	*dAuctionhouse27*
Brooks	281	*dAuctionhouse20*	Poulain Le Fur	21	*dAuctionhouse27*
Auctions America by RM	272	*dAuctionhouse21*	James G. Murphy Co.	20	*dAuctionhouse27*
eBay/Kruse	271	*dAuctionhouse22*	Specialty Auto Auctions	20	*dAuctionhouse27*
VanDerBrink Auctions	246	*dAuctionhouse23*	Sportscar Auctions	19	*dAuctionhouse27*
Coys	217	*dAuctionhouse24*	Girard	18	*dAuctionhouse27*
Bonhams & Brooks	200	*dAuctionhouse25*	Motley's Auction & Realty	15	*dAuctionhouse27*
Rick Cole Auctions	17	*dAuctionhouse26*	Pioneer Auto Auctions	13	*dAuctionhouse27*
Carlisle Events	186	*dAuctionhouse27*	G. Potter King	12	*dAuctionhouse27*
Collector Car Productions	137	*dAuctionhouse27*	Blackhawk	11	*dAuctionhouse27*
Dan Kruse Classics	135	*dAuctionhouse27*	CCA	8	*dAuctionhouse27*
Shannons	110	*dAuctionhouse27*	Kucera Auction Service	7	*dAuctionhouse27*
The Auction Inc.	109	*dAuctionhouse27*	B&T; Classic Car Auctions	7	*dAuctionhouse27*
MidAmerica	107	*dAuctionhouse27*	Higgenbotham	7	*dAuctionhouse27*
Kensington	99	*dAuctionhouse27*	Rich Penn	7	*dAuctionhouse27*
Vicari	98	*dAuctionhouse27*	MotoeXotica	6	*dAuctionhouse27*
Hollywood Wheels	89	*dAuctionhouse27*	Morphy	6	*dAuctionhouse27*
Lucky Collector Car Auct.	84	*dAuctionhouse27*	ICA	4	*dAuctionhouse27*
Motostalgia	78	*dAuctionhouse27*	Santiago	2	*dAuctionhouse27*
Total				**29,002**	

Appendix 7. Engine Type classifications

A total of 21 different engine types occur in our dataset. In most cases, these engine types are depicted by two characters: a letter followed by a number (for example 'V8'). The letter denotes the cylinder configuration. An explanation of these configurations is provided below under 'Feature(s)'. The second character indicates the number of cylinders. In our data set, engines with a single cylinder, up to engines with 16 cylinders exist. The dummy assigned to the I4 engine type serves as the reference category.

Engine Type	Dummy	# Obs.	Feature(s)
1-cylinder	*dEngineType1*	303	-
Electric	*dEngineType2*	32	Electric vehicles were already widely used in the late 1890's.
H12	*dEngineType3*	100	In an 'H'-engine, the cylinders are opposing each other vertically. Also called 'Boxer' engines. While not exactly an H-engine technically, we chose to classify all 'flat' engines also under the H-type
H2	*dEngineType4*	104	
H4	*dEngineType5*	981	
H6	*dEngineType6*	598	
H8	*dEngineType7*	1	
I2	*dEngineType8*	263	In an 'I'-engine, cylinders are next to each other in a straight-line configuration.
I3	*dEngineType9*	13	
I4	*dEngineType10**	3,887	
I5	*dEngineType11*	8	
I6	*dEngineType12*	5,666	
I8	*dEngineType13*	1,274	
Rotary	*dEngineType14*	18	Ingenious engine type that does not function based on reciprocating pistons, but on rotary movement.
Steam	*dEngineType15*	50	Steam engines were superior to combustion engines in the early 1900's.
V10	*dEngineType16*	8	In a 'V'-engine, cylinders are in pairs, placed in roughly a 60° to 90° angle. Both shorter and lighter in comparison to a straight engine.
V12	*dEngineType17*	1,866	
V16	*dEngineType18*	102	
V2	*dEngineType19*	37	
V4	*dEngineType20*	72	
V6	*dEngineType21*	564	
V8	*dEngineType22*	13,055	
Total		**29,002**	

Appendix 8. Regression results

This appendix presents the results of our general hedonic regressions. All models are estimated using OLS. Significance at the 10%, 5% and 1% level corresponds with respectively one, two and three asterisks. The nominal model uses the unadjusted auction price as the dependent variable, while the real model uses the deflated auction price. The table also reports relative price impacts and *t*-stats. Dummy base levels, which are not included in our regressions, are indicated with asterisks.

Variable	**Label**	**Coeff.**	**PI (%)**	**t-stat**	**Coeff.**	**PI (%)**	**t-stat**
			Nominal model			*Real model*	
*dYear1**	1998	n/a			n/a		
dYear2	1999	0,025	2,57	0,50	0,004	0,42	0,08
dYear3	2000	0,017	1,73	0,38	-0,036	-3,56	-0,80
dYear4	2001	-0,100**	-9,52	-1,99	-0,181***	-16,57	-3,60
dYear5	2002	0,059*	6,11	1,30	-0,038	-3,76	-0,84
dYear6	2003	0,059*	6,08	1,38	-0,062*	-5,97	-1,44
dYear7	2004	0,196***	21,59	4,72	0,05	5,11	1,20
dYear8	2005	0,412***	50,96	10,07	0,233***	26,29	5,70
dYear9	2006	0,567***	76,35	14,01	0,355***	42,64	8,77
dYear10	2007	0,609***	83,88	15,09	0,37***	44,82	9,17
dYear11	2008	0,72***	105,43	17,79	0,442***	55,61	10,92
dYear12	2009	0,689***	99,11	16,12	0,416***	51,56	9,73
dYear13	2010	0,63***	87,77	15,15	0,341***	40,60	8,19
dYear14	2011	0,699***	101,11	16,80	0,377***	45,84	9,07
dYear15	2012	0,688***	98,95	17,23	0,346***	41,36	8,67
dYear16	2013	0,893***	144,32	22,32	0,537***	71,11	13,42
dYear17	2014	0,954***	159,57	23,68	0,581***	78,77	14,42
dYear18	2015	1,065***	190,22	25,33	0,691***	99,53	16,42
dYear19	2016	0,954***	159,59	22,53	0,568***	76,52	13,42
dYear20	2017	0,953***	159,31	21,66	0,545***	72,42	12,38
dEra1	Veteran era	1,948***	601,53	27,26	1,948***	601,36	27,25
dEra2	Brass era	1,344***	283,47	27,38	1,344***	283,45	27,37
dEra3	Vintage era	0,805***	123,77	22,83	0,805***	123,73	22,82
dEra4	Pre-war	1,016***	176,27	36,63	1,016***	176,28	36,63
dEra5	Post-war era	0,739***	109,41	35,92	0,739***	109,42	35,91
*dEra6**	Modern classic	n/a			n/a		
dCond1	Condition = 1	1,252***	249,81	60,22	1,252***	249,83	60,22
dCond2	Condition = 2	0,817***	126,44	43,97	0,818***	126,49	43,98
dCond3	Condition = 3	0,397***	48,72	21,44	0,397***	48,77	21,45
*dCond4**	Condition = 4	n/a			n/a		
dCond5	Condition = 5	-0,09***	-8,60	-2,91	-0,09***	-8,61	-2,91
*dMake1**	Chevrolet	n/a			n/a		
dMake2	Ford	-0,143***	-13,36	-7,28	-0,144***	-13,37	-7,29
dMake3	Ferrari	1,448***	325,28	38,90	1,448***	325,47	38,90
dMake4	Jaguar	0,204***	22,61	6,99	0,204***	22,67	7,00
dMake5	Mercedes-Benz	0,591***	80,56	19,83	0,591***	80,57	19,83
dMake6	Porsche	1,056***	187,52	21,64	1,057***	187,73	21,65
dMake7	Rolls-Royce	0,522***	68,55	15,47	0,522***	68,57	15,47
dMake8	Cadillac	0,119***	12,60	3,76	0,119***	12,58	3,75
dMake9	Pontiac	-0,099***	-9,42	-3,20	-0,099***	-9,42	-3,20

Appendix 8. Regression results (Continued)

Variable	Label	Coeff.	PI (%)	t-stat	Coeff.	PI (%)	t-stat
		Nominal model			*Real model*		
dMake10	MG	-0,324***	-27,64	-8,12	-0,323***	-27,60	-8,10
dMake11	Buick	-0,202***	-18,28	-5,79	-0,202***	-18,30	-5,80
dMake12	Packard	-0,055*	-5,40	-1,38	-0,055*	-5,37	-1,37
dMake13	Plymouth	0,157***	16,96	4,40	0,157***	16,98	4,40
dMake14	Bentley	1,003***	172,73	25,41	1,004***	172,83	25,41
dMake15	Shelby	0,988***	168,60	27,22	0,988***	168,59	27,22
dMake16	Lincoln	-0,17***	-15,64	-4,38	-0,17***	-15,64	-4,38
dMake17	Volkswagen	0,028	2,85	0,43	0,029	2,89	0,44
dMake18	Dodge	-0,075**	-7,26	-1,99	-0,075**	-7,24	-1,99
dMake19	Oldsmobile	-0,188***	-17,15	-4,76	-0,188***	-17,17	-4,77
dMake20	Chrysler	0,041	4,15	0,99	0,041	4,19	1,00
dMake21	Maserati	0,955***	159,83	21,26	0,955***	159,99	21,27
dMake22	Fiat	0,138***	14,75	2,53	0,138***	14,79	2,53
dMake23	Mercury	-0,189***	-17,24	-4,04	-0,189***	-17,26	-4,05
dMake24	Lancia	1,057***	187,64	16,98	1,057***	187,82	16,99
dMake25	Triumph	-0,471***	-37,55	-8,68	-0,471***	-37,54	-8,67
dMake26	BMW	0,476***	60,96	8,24	0,477***	61,07	8,25
dMake27	Lamborghini	0,883***	141,71	13,27	0,883***	141,72	13,27
dMake28	Bugatti	1,538***	365,52	23,47	1,538***	365,52	23,47
dMake29	Studebaker	-0,327***	-27,89	-5,52	-0,328***	-27,94	-5,53
dMake30	Lotus	0,382***	46,55	5,74	0,383***	46,73	5,75
dMake31	Citroën	0,648***	91,10	9,39	0,648***	91,25	9,40
dMake32	Lagonda	0,764***	114,73	11,26	0,764***	114,73	11,26
dMake33	Duesenberg	1,769***	486,41	24,30	1,769***	486,60	24,30
dMake34	Cord	0,453***	57,27	6,22	0,453***	57,25	6,22
dMake35	Sunbeam	-0,154**	-14,29	-2,18	-0,153**	-14,22	-2,17
dMake36	Aston Martin	1,491***	344,06	19,92	1,491***	344,35	19,93
dMake37	Austin-Healey	-0,316***	-27,08	-4,13	-0,315***	-27,02	-4,12
dMake38	Isetta	0,431***	53,91	2,91	0,432***	53,96	2,91
dMake39	Morris	-0,375***	-31,24	-4,47	-0,374***	-31,23	-4,47
dMake40	Nash	-0,338***	-28,69	-4,17	-0,338***	-28,70	-4,18
dMake41	DeSoto	0,045	4,59	0,56	0,044	4,52	0,55
dMake42	Daimler	0,028	2,85	0,34	0,028	2,87	0,34
dMake43	Hudson	-0,031	-3,08	-0,38	-0,032	-3,10	-0,38
dMake44	Pierce-Arrow	0,068	7,05	0,80	0,069	7,10	0,80
dMake45	Toyota	0,48***	61,55	5,21	0,48***	61,54	5,21
dMake46	Delahaye	1,309***	270,36	15,25	1,309***	270,41	15,25
dMake47	Morgan	0,11	11,63	1,03	0,111	11,70	1,04
dMake48	Renault	0,151**	16,31	1,69	0,151**	16,29	1,69
dMake49	Datsun	-0,6***	-45,14	-6,85	-0,601***	-45,15	-6,85
dMake50	Alfa Romeo	0,783***	118,74	8,76	0,783***	118,75	8,75
dMake51	Willys	-0,17**	-15,66	-1,78	-0,169**	-15,58	-1,77
dMake52	Land Rover	0,034	3,41	0,32	0,034	3,41	0,32
dMake53	Riley	0,325***	38,34	3,41	0,324***	38,28	3,41
dMake54	Talbot-Lago	1,53***	362,05	16,31	1,53***	361,70	16,30
dMake55	DeTomaso	0,267***	30,55	2,84	0,267***	30,64	2,85
dMake56	Edsel	-0,388***	-32,14	-3,91	-0,388***	-32,15	-3,91

Appendix 8. Regression results (Continued)

Variable	Label	Coeff.	PI (%)	t-stat	Coeff.	PI (%)	t-stat
		Nominal model			*Real model*		
dMake57	AC	0,435***	54,46	4,13	0,435***	54,45	4,13
dMake58	Peugeot	0,47***	60,01	4,28	0,47***	60,08	4,28
dMake59	Jensen	-0,127	-11,94	-1,18	-0,127	-11,91	-1,18
dMake60	GMC	-0,089	-8,56	-0,80	-0,09	-8,58	-0,80
dMake61	Facel Vega	0,865***	137,48	7,75	0,865***	137,44	7,75
dMake62	Delage	0,702***	101,70	6,16	0,701***	101,60	6,16
dMake63	Messerschmitt	0,82***	127,07	3,89	0,82***	127,14	3,90
dMake64	International	-0,336***	-28,51	-2,86	-0,334***	-28,36	-2,84
dMake65	Volvo	-0,154*	-14,24	-1,29	-0,153	-14,17	-1,28
dMake66	Stutz	0,384***	46,80	3,22	0,383***	46,72	3,21
dMake67	Jeep	-0,178*	-16,33	-1,35	-0,178*	-16,32	-1,35
dMake68	Crosley	-0,423***	-34,52	-3,33	-0,424***	-34,56	-3,33
dMake69	Nash-Healey	0,133	14,24	1,04	0,132	14,07	1,03
dMake70	Vauxhall	0,545***	72,46	4,12	0,545***	72,52	4,13
dMake71	LaSalle	-0,308**	-26,53	-2,29	-0,31**	-26,64	-2,30
dMake72	DeLorean	0,731***	107,63	4,74	0,732***	107,83	4,74
dMake73	Kaiser-Darrin	0,17	18,55	1,25	0,17	18,55	1,25
dMake74	Imperial	-0,104	-9,91	-0,77	-0,105	-9,99	-0,77
dMake75	Panhard et Levassor	0,53***	69,93	3,46	0,53***	69,89	3,46
dMake76	Abarth	0,746***	110,90	5,29	0,747***	111,03	5,29
dMake77	Bristol	0,415***	51,37	2,95	0,415***	51,40	2,95
dMake78	Iso	0,439***	55,04	3,18	0,439***	55,14	3,18
dMake79	Locomobile	-0,066	-6,37	-0,43	-0,066	-6,42	-0,44
dMake80	Hispano-Suiza	1,193***	229,63	8,41	1,192***	229,43	8,41
dMake81	De Dion-Bouton	0,536***	70,90	3,45	0,536***	70,84	3,45
dMake82	Dual-Ghia	1,087***	196,54	7,75	1,088***	196,86	7,75
dMake83	Autobianchi	-0,133	-12,47	-0,86	-0,132	-12,39	-0,86
dMake84	Marmon	0,16	17,35	1,06	0,16	17,36	1,06
dMake85	Fiat-Abarth	1,047***	185,02	6,91	1,047***	185,02	6,91
dMake86	Rover	-0,522***	-40,69	-3,45	-0,524***	-40,76	-3,45
dMake87	Stanley	0,375*	45,53	1,63	0,374*	45,37	1,63
dMake88	Wolseley	-0,049	-4,75	-0,31	-0,048	-4,70	-0,31
dMake89	Honda	-0,226*	-20,24	-1,40	-0,226*	-20,21	-1,40
dMake90	Mini Cooper	0,41***	50,74	2,58	0,412***	50,92	2,59
dMake91	Talbot	0,004	0,35	0,02	0,003	0,35	0,02
dMake92	Isotta Fraschini	0,918***	150,49	5,63	0,918***	150,46	5,63
dMake93	Siata	0,899***	145,81	5,34	0,899***	145,62	5,33
dMake94	Hupmobile	-0,704***	-50,53	-4,17	-0,704***	-50,53	-4,17
dMake95	Rambler	-0,646***	-47,61	-3,76	-0,645***	-47,53	-3,75
dMake96	All other marques	0,28***	32,28	9,93	0,28***	32,31	9,93
dAuctionhouse1	Bonhams	0,122***	13,00	5,62	0,123***	13,06	5,64
dAuctionhouse2	RM Auctions	0,381***	46,42	18,09	0,382***	46,49	18,11
dAuctionhouse3	Barett-Jackson	0,142***	15,28	6,16	0,143***	15,43	6,21
*dAuctionhouse4**	Mecum Auction	n/a			n/a		
dAuctionhouse5	Silver Auctions	-0,655***	-48,08	-24,05	-0,655***	-48,05	-24,03
dAuctionhouse6	Gooding & Co.	0,76***	113,92	20,53	0,76***	113,80	20,51
dAuctionhouse7	Christie's	0,269***	30,87	8,14	0,27***	31,01	8,18

Appendix 8. Regression results (Continued)

Variable	Label	Coeff.	PI (%)	t-stat	Coeff.	PI (%)	t-stat
		Nominal model			*Real model*		
dAuctionhouse8	Kruse	-0,149***	-13,83	-4,63	-0,148***	-13,78	-4,61
dAuctionhouse9	Worldwide Auct.	0,1***	10,50	3,18	0,1***	10,57	3,20
dAuctionhouse10	H&H Auctions	-0,222***	-19,95	-6,56	-0,222***	-19,88	-6,54
dAuctionhouse11	McCormick's	-0,429***	-34,90	-12,05	-0,429***	-34,89	-12,05
dAuctionhouse12	Russo and Steele	-0,118***	-11,17	-3,52	-0,118***	-11,13	-3,51
dAuctionhouse13	Artcurial	0,421***	52,42	11,55	0,422***	52,53	11,57
dAuctionhouse14	Branson	-0,182***	-16,66	-5,19	-0,182***	-16,62	-5,18
dAuctionhouse15	Auctions America	-0,243***	-21,60	-6,70	-0,241***	-21,45	-6,65
dAuctionhouse16	Silverstone	0,132***	14,12	3,13	0,131***	14,04	3,11
dAuctionhouse17	Leake	-0,379***	-31,54	-9,13	-0,379***	-31,56	-9,13
dAuctionhouse18	RM Sotheby's	0,715***	104,37	16,33	0,715***	104,38	16,33
dAuctionhouse19	eBay	-0,577***	-43,86	-13,52	-0,578***	-43,91	-13,54
dAuctionhouse20	Brooks	-0,029	-2,82	-0,52	-0,028	-2,76	-0,51
dAuctionhouse21	AA by RM	-0,21***	-18,92	-4,17	-0,211***	-19,02	-4,19
dAuctionhouse22	eBay/Kruse	-0,044	-4,30	-0,77	-0,043	-4,18	-0,75
dAuctionhouse23	VanDerBrink Auct.	-0,936***	-60,76	-17,66	-0,933***	-60,67	-17,62
dAuctionhouse24	Coys	0,116**	12,26	2,05	0,115**	12,24	2,05
dAuctionhouse25	Bonhams & Brooks	-0,134**	-12,52	-2,07	-0,136**	-12,74	-2,11
dAuctionhouse26	Rick Cole Auctions	0,781***	118,38	4,16	0,784***	119,03	4,18
dAuctionhouse27	Other auctioneers	-0,287***	-24,97	-12,52	-0,287***	-24,92	-12,49
dType1	Buggy	0,636***	88,89	6,71	0,637***	89,00	6,71
dType2	Concept car	2,326***	924,06	17,76	2,326***	924,09	17,76
dType3	Convertible	0,636***	88,96	35,32	0,637***	88,99	35,33
dType4	Coupe	0,402***	49,48	21,92	0,402***	49,50	21,93
dType5	Cyclecar	0,749***	111,57	3,16	0,748***	111,28	3,16
dType6	Hatchback	0,51***	66,51	5,77	0,511***	66,62	5,78
dType7	Horseless carriage	0,294***	34,24	3,70	0,295***	34,29	3,70
dType8	Hot rod	0,378***	45,87	4,12	0,378***	45,90	4,12
dType9	Off-road	0,28***	32,28	2,35	0,28***	32,28	2,35
dType10	Limousine	0,513***	67,01	15,08	0,513***	67,06	15,09
dType11	Microcar	0,451***	57,01	3,57	0,451***	56,95	3,56
dType12	Pick-up	-0,034	-3,34	-1,01	-0,034	-3,33	-1,00
dType13	Racer	1,463***	331,83	40,87	1,463***	332,05	40,88
dType14	Roadster	0,935***	154,68	42,31	0,935***	154,72	42,31
dType15	Runabout	0,749***	111,47	7,38	0,751***	111,81	7,40
dType16	SUV	0,22***	24,59	2,96	0,22***	24,65	2,96
*dType17**	Sedan	n/a			n/a		
dType18	Station wagon	0,485***	62,37	14,04	0,485***	62,41	14,04
dType19	Targa	-0,125**	-11,72	-1,86	-0,124**	-11,69	-1,85
dType20	Tourer	0,779***	117,89	22,75	0,779***	117,94	22,75
dType21	Utility	0,21***	23,33	2,70	0,21***	23,41	2,71
dType22	Van	0,741***	109,72	11,83	0,741***	109,73	11,83
dExteriorColor1	Beige	-0,097***	-9,26	-3,16	-0,097***	-9,27	-3,16
*dExteriorColor2**	Black	n/a			n/a		
dExteriorColor3	Blue	-0,039**	-3,78	-2,25	-0,039**	-3,78	-2,25
dExteriorColor4	Bronze	-0,098**	-9,30	-1,90	-0,098**	-9,34	-1,91
dExteriorColor5	Brown	-0,185***	-16,91	-4,19	-0,185***	-16,90	-4,19

Appendix 8. Regression results (Continued)

Variable	Label	Coeff.	PI (%)	t-stat	Coeff.	PI (%)	t-stat
		Nominal model			*Real model*		
dExteriorColor6	Charcoal	-0,261**	-22,98	-2,07	-0,261**	-22,97	-2,07
dExteriorColor7	Copper	0,012	1,24	0,14	0,012	1,17	0,13
dExteriorColor8	Gold	-0,135***	-12,60	-3,23	-0,135***	-12,62	-3,23
dExteriorColor9	Gray	-0,086***	-8,24	-2,73	-0,086***	-8,25	-2,73
dExteriorColor10	Green	-0,023	-2,32	-1,24	-0,023	-2,31	-1,23
dExteriorColor11	Ivory	-0,034	-3,37	-1,04	-0,035	-3,42	-1,05
dExteriorColor12	Maroon	-0,047**	-4,58	-2,02	-0,047**	-4,58	-2,02
dExteriorColor13	Metal	0,043	4,37	0,59	0,042	4,26	0,57
dExteriorColor14	Orange	-0,009	-0,86	-0,27	-0,009	-0,88	-0,27
dExteriorColor15	Pink	0,036	3,71	0,70	0,036	3,65	0,70
dExteriorColor16	Primer	-0,264**	-23,22	-1,65	-0,264**	-23,20	-1,65
dExteriorColor17	Purple	-0,016	-1,56	-0,27	-0,016	-1,61	-0,28
dExteriorColor18	Red	-0,031**	-3,07	-1,89	-0,031**	-3,09	-1,89
dExteriorColor19	Rust	-0,461**	-36,95	-1,89	-0,461**	-36,94	-1,89
dExteriorColor20	Silver	0,017	1,72	0,77	0,017	1,73	0,77
dExteriorColor21	Turquoise	-0,039	-3,84	-0,72	-0,039	-3,85	-0,72
dExteriorColor22	White	0,032**	3,25	1,79	0,032**	3,24	1,79
dExteriorColor23	Wood	0,078	8,07	0,88	0,077	8,00	0,87
dExteriorColor24	Yellow	-0,118***	-11,17	-5,17	-0,119***	-11,20	-5,18
dUnique	Marque occurs once	-0,139***	-12,94	-2,72	-0,139***	-12,96	-2,73
dFormulaOne	F1 provenance	0,887***	142,74	6,50	0,887***	142,83	6,50
dIndy500	Indy500 proven.	0,02	1,97	0,13	0,018	1,83	0,12
dMilleMiglia	MM provenance	1,411***	310,16	8,99	1,413***	311,03	9,01
dLeMans	LM provenance	1,552***	371,86	16,44	1,552***	371,99	16,44
dMatchingNumbers	Matching numbers	0,1**	10,53	2,28	0,1**	10,49	2,27
dReplica	Replica car	-0,451***	-36,29	-12,78	-0,451***	-36,28	-12,77
dBeautifulDesign	In Top 10 designs	0,819***	126,89	28,13	0,819***	126,92	28,13
dGoodwood	Sold at Goodwood	0,293***	34,09	7,07	0,291***	33,79	7,02
dPebbleBeach	Sold at Pebble B.	0,075*	7,78	1,51	0,075*	7,81	1,52
dDisplacement1	(40 cc,1150 cc]	-0,153***	-14,20	-3,69	-0,153***	-14,21	-3,69
dDisplacement2	(1,150 cc; 2,050 cc]	0,063***	6,55	2,41	0,063***	6,54	2,41
*dDisplacement3**	(2,050 cc; 3,050 cc]	n/a			n/a		
dDisplacement4	(3,050 cc; 4,050 cc]	0,152***	16,41	6,77	0,152***	16,37	6,75
dDisplacement5	(4,050 cc; 5,550 cc]	0,269***	30,91	11,27	0,269***	30,87	11,26
dDisplacement6	(5,550 cc;, 7,050 cc]	0,413***	51,18	15,55	0,413***	51,15	15,54
dDisplacement7	(7,050 cc; 27,000 cc]	0,553***	73,86	17,53	0,553***	73,83	17,53
dRHD	Right-hand drive	0,037	3,73	0,84	0,037	3,73	0,84
dForcedInduction	Forced ind. engine	0,129***	13,82	6,91	0,129***	13,82	6,91
dPrototype	Prototype car	0,031	3,13	0,43	0,031	3,10	0,42
dThreeWheeler	3-wheeled car	-0,212*	-19,10	-1,38	-0,212*	-19,07	-1,37
dAutomatic	Auto transmission	-0,311***	-26,75	-24,00	-0,311***	-26,75	-24,00
dEngineType1	1-CYL engine	-0,381***	-31,66	-4,77	-0,381***	-31,70	-4,77
dEngineType2	Electric engine	-0,514***	-40,18	-3,60	-0,513***	-40,15	-3,60
dEngineType3	H12 engine	0,448***	56,49	5,02	0,447***	56,44	5,02
dEngineType4	H2 engine	-0,165**	-15,24	-1,91	-0,165**	-15,19	-1,90
dEngineType5	H4 engine	-0,292***	-25,34	-5,35	-0,293***	-25,36	-5,36
dEngineType6	H6 engine	0,154***	16,68	3,05	0,154***	16,64	3,04

Appendix 8. Regression results (Continued)

Variable	Label	Coeff.	PI (%)	t-stat	Coeff.	PI (%)	t-stat
		Nominal model			*Real model*		
dEngineType7	H8 engine	1,088*	196,91	1,41	1,092*	198,00	1,42
dEngineType8	I2 engine	-0,151***	-14,03	-2,49	-0,151***	-14,05	-2,49
dEngineType9	I3 engine	-0,049	-4,74	-0,23	-0,048	-4,70	-0,22
*dEngineType10**	I4 engine	n/a			n/a		
dEngineType11	I5 engine	0,244	27,66	0,90	0,245	27,76	0,90
dEngineType12	I6 engine	0,448***	56,46	17,36	0,448***	56,49	17,36
dEngineType13	I8 engine	0,745***	110,70	18,63	0,745***	110,68	18,63
dEngineType14	Rotary engine	0,208	23,07	1,13	0,207	22,94	1,12
dEngineType15	Steam engine	-0,438***	-35,46	-2,47	-0,436***	-35,34	-2,46
dEngineType16	V10 engine	0,843***	132,42	3,09	0,847***	133,31	3,11
dEngineType17	V12 engine	0,699***	101,11	17,50	0,699***	101,15	17,50
dEngineType18	V16 engine	0,907***	147,75	10,17	0,907***	147,73	10,17
dEngineType19	V2 engine	0,423**	52,65	2,26	0,423**	52,71	2,27
dEngineType20	V4 engine	-0,666***	-48,63	-6,53	-0,666***	-48,65	-6,53
dEngineType21	V6 engine	0,342***	40,73	7,69	0,342***	40,73	7,69
dEngineType22	V8 engine	0,431***	53,86	14,57	0,431***	53,91	14,58
*dMonth1**	Sold in January	n/a			n/a		
dMonth2	Sold in February	-0,093***	-8,88	-3,78	-0,096***	-9,16	-3,91
dMonth3	Sold in March	-0,13***	-12,19	-6,05	-0,134***	-12,56	-6,25
dMonth4	Sold in April	-0,314***	-26,96	-15,21	-0,32***	-27,40	-15,50
dMonth5	Sold in May	-0,118***	-11,14	-5,36	-0,126***	-11,82	-5,71
dMonth6	Sold in June	-0,253***	-22,34	-12,17	-0,262***	-23,09	-12,64
dMonth7	Sold in July	-0,286***	-24,84	-10,13	-0,297***	-25,69	-10,53
dMonth8	Sold in August	0,105***	11,10	5,26	0,09***	9,47	4,52
dMonth9	Sold in September	-0,244***	-21,65	-10,71	-0,26***	-22,91	-11,42
dMonth10	Sold In October	-0,238***	-21,21	-10,43	-0,257***	-22,64	-11,23
dMonth11	Sold in November	-0,155***	-14,34	-5,57	-0,171***	-15,76	-6,17
dMonth12	Sold in December	-0,215***	-19,33	-7,81	-0,235***	-20,93	-8,53
Constant		7,671***		128,19	8,083***		135,06

Appendix 9. Beautifully designed cars.

The table below present the 10 best-looking classic cars of all times, according to Total Car Score, an automotive research company that ranks and evaluates cars[27]. We also report the number of times that the corresponding model occurs in our sample.

Year	Make	Model	# Observations
1954	Mercedes-Benz	300SL	270
1961	Ferrari	250 GT	286
1963	Chevrolet	Corvette	186
1964	Aston Martin	DB5	12
1965	Jaguar	E-Type	26
1966	Ford	GT40	2
1967	Ferrari	275 GTB/4	2
1970	Dodge	Challenger R/T	44
1971	Lamborghini	Miura SV	63
1973	Porsche	911 Carrera RS	29
Total			**920**

[27] See https://www.cnbc.com/2012/08/17/The-10-Most-Beautiful-Cars-of-All-Time.html

Appendix 10. CCCA approved classics

The Classic Car Club of America defines a classic car as a *"a fine or distinctive automobile, either American or foreign built, produced between 1915 and 1948"* (CCCA, 2016). They publish the following list of 'approved classics' on their website (see References). A total of … cars in our sample occur in this list.

Marque	Approved models	Marque	Approved models
AC	All 1925-1940	Corinthian	All 1922-1923
Adler	1928-1934 Standard 8	Cunningham	All V Series from 1916
Alfa Romeo	All	Dagmar	1922-1926; 6-70; and Series 6-80
Alvis	Speed 20; 3.5 Litre; Speed 25; and 4.3 Litre	Daimler	All 8- and 12-cylinder; 6-cylinder 3.5 Litre and larger; all 1925-1934
Amilcar	Application considered	Daniels	All 1916-1924; 8-cylinder 1920-1926 Model D
Apperson	1925-1926 Straightaway Eight		
Armstrong-Siddeley	1924-1933 Model 30; 1933-1939 Special	Darracq	See Talbot
		Delage	1914-1926 GL and GLS; Model D8
Aston Martin	All 1927-1939	Delahaye	Series 135; 145; 148; 165
Auburn	All 8- and 12-cylinder	Delauney	All 6-cylinder
Austro-Daimler	All	Doble	All
		Duesenberg	All
Ballot	2LS; 2LT; 2LTS; RH; RH2; and RH3	DuPont	All 1919-1931
Benz	All 1925-1926; 10/30; 11/40; 16/50; 16/50 Sport	Elcar	1925-1933 8-80, 8-81, 8-90, 8-91, 8-92, 120, 130, and 140
Biddle	All 1915-1922	Excelsior	1919-1926 Adex Models; 1925-1932 Albert 1 (Premier)
Blackhawk	All	Farman	All 1925-1931
BMW	327; 328; 327/8; and 335		
Brewster	All 1915-1925 and 1934-1936	Fiat	1923-1927 Model 519; 1928-1931 Model 525; 1938-1940 Model 2800
Brough Superior	All 1934-1939	Fox	All 1921-1923
		Franklin	All except 1933-1934 Olympic
Bucciali	TAV 8; TAV 30; TAV 12; and Dubble Huit	Georges Irat	1922-1929 2 Litre and 3 Litre; 1930-1934 Lycoming 6- and 8-cylinder
Bugatti	All except types 52 and 68		
Buick	All 1931-1942 Series 90; all 1931-1933 and 1936-1939 Series 80; 1940 Series 80 Limited	Graham-Paige	1928-1929 835 and 837; 1930 837; all 1930 Custom 8; 1931 834
Cadillac	All 1915-1935; all 12 and 16; 1936-1948 63, 65, 67, 70, 72, 75, 80, 85 and 90; 1938-1947 60 Specials; 1940-1947 62 Series	Gardner	1925-1926 Line 8 and Model 8A; 1926-1927 Model 8B; 1927 Model 890 and Model 90; 1928 Model 8-85, 8-90, 130; 1928-1929 Models 85, 95; 1929 Models 125-135; 1930 Models 145, 150; 1930-1931 Model 150; 1931 Models 148-158
Chadwick	All 1915-1916		
Chrysler	1926-1932 Imperial and Series 80; 1932-1939 Custom Imperial Series; 1934-1937 Airflow Imperial Eight; 1940-1948 Crown Imperial; Newports and Thunderbolts; all 1941-1948 Town & Country	HAL	All 1916-1918
		Heine-Velox	All 1921-1922
		Hispano Suiza	H6 from 1919; All French models; Spanish models T56, T56BIS; T64
Cole	1915-1925 all 8-cylinder		
Cord	All	Horch	All

Appendix 10. CCCA approved classics (Continued)

Marque	Approved models
Hotchkiss	1929-1940 all 3 and 3.5 Litre, AM80(S), 620, 680, 686 Paris-Nice, 686 Grand Sport
Hudson	1929 Series L
Humber	1930 Pullman Model 6
Hupmobile	1930-1932, Series H and H-255, U and U237
Invicta	All through 1938
Isotta Fraschini	All from 1919 except Tip 8C Monterosa
Itala	All
Jaguar	1946-1948 2.5 and 3.5 Litre
Jensen	All 1936-1939 expect 2.25 Litre
Jordan	1929-1931 Models G, 90, Great Line 90 and Speed Way Series Z
Julian	All
Kissel	All 6 and 12-cylinder cars; all 1915-1924; 1923-1928 6-55; 1925-1927 8-75; 1928 8-90 and 8-90 White Eagle; 1929-1930 8-95 White Eagle; 1929-1931 8-126
Kleiber	1926 Model 212; 1927 Model 178; 1928 Model 133; 1929 Model 37
Lafayette	All
Lagonda	All models through 1940, except 1934-1940 Rapier, Two Post-War V12
Lanchester	1919-1931 Model 21, 23, 30, and 40
Lancia	1928-1939 Dilambda and Astura
LaSalle	All 1927 through 1933
Leach	All 1920-1923
Lincoln	L; From 1920 KA, KB and K; 1941168 H; and 1942 268 H
Lincoln Cont.	All
Locomobile	All 1915-1924; All LHD models 48 and all model 90; 1927-1929 Model 8-80; 1929 Model 8-88
Lozier	All 1915-1916
Marmon	All 1915-1924 Model 41, 48 and 34; All 12- and 16-cylinder; 1925-1926 D-74; 1927 E-75; 1928 75; 1930 Big 8; 1931 88 and Big 8
Maserati	Application considered
Maybach	All
McFarlan	All 1915-1924, TV6 and 8
Mercedes	All
Mercedes-Benz	All 230 and up; K, S, SS, SSK, SSKL; Grosser and Mannheim

Marque	Approved models
Mercer	All
MG	1935-1939 SA; 1938-1939 WA
Miller	All 1928 and 1932
Minerva	All except 4-cylinder
Nash	1930 Series 490; 1931 Series 890; 1932 Series 990 and 1090; 1933 Series 1190; 1934 Series1290; 1940 Sakhnoffsky Special Cabrio
National	All 1916-1919
Owen-Magnetic	All 1915-1921
Packard	All 1915-1924 except 116; All 6-cyl 226-233, 326-333, 426-433, 526-533; All 8-cyl 1923-1934; All 12-cyl 1932-1939; 1935 models 1200-1205, 1207 and 1208; 1936 Models 1400-1405, 1407 and 1408; 1937 Models 1500-1502, 1506-1508; 1938 Models 1603-1605, 1607 and 1608; 1939 Models 1703, 1705, 1707, 1708; 1940 Models 1803-1808; 1941 Models 1903-1908; 1942 Models2003-2008; 1946-1947 Models 2103, 2106, 2126; All Darrin-bodied
Paige	All 1916-1927 6-55, 6-66
Pathfinder	All 1916-1917
Peerless	1925 Series 67; 1926-1928 Series 69;
Pierce-Arrow	All 1915-1924; 1921 Series 32; 1922 and up Series 33; all from 1925
Railton	Application considered
Renault	45HP to 1928; 40HP Reinastella, Reinasport; 1929-1934 8-cyl Nervahuit, Nervastella, Nervasport (Suprastella)
REO	1931-1934, Royale 8-cylinder
ReVere	All 1918-1926
Richeleu	All 1922-1923
Roamer	All Rochester-Duesenberg 4-cyl; 1925 6-54E; 1925-1929 8-88; 1929-1931 8-125
Rohr	1928-1935 R, RA, F and FK
Rolls-Royce	All 1915-1948
Ruxton	All
Squire	All
SS and SS Jaguar	1932-1940 SS 1, SS 90, SS jaguar and SS Jaguar 100

Appendix 10. CCCA approved classics (Continued)

Marque	Approved models	Marque	Approved models
Simplex	All 1915-1924	Talbot	(GB) 105 and 110; (F), Darracq (GB); 1930-1935 Talbot-Lago (F) 8-cyl; 4 Litre 6-cyl 1936-1939; 4.5 Litre 1946-1948
Stearns Knight	All 1915-1924 6- and 8-cyl	Tatra	1927-1948 Models T70(A), T80, T77(A) and T87 with pre-war styling
Stevens Duryea	All 1915-1927	Templar	All 1915-1924
		Triumph	Dolomite 8 and Gloria 6
Steyr	1923-1929Type VI Sport; VI Klausen; SS Klausen; and Austria	Vauxhall	25-70 and 30-98
		Voisin	All
Studebaker	1928 8-cyl President; 1929-1933 President except Model 82	Wasp	All 1919-1924
		Wills Sainte Claire	All
Stutz	All except 1915 HCS	Willys-Knight	Series 66(A), 66B Custom
Sunbeam	8-cyl and 3 Litre Twin Cam	Winton	All 1915-1924

Appendix 11. Blue Chip classics cars

The following cars are part of Hagerty's Blue Chip index[28]. Hagerty's describes these cars as the "most sought-after automobiles of the post-war era".

Year(s)	Make	Model	# Observations
1967	Chevrolet	Corvette	236
1954-1957	Mercedes-Benz	300SL Gullwing	131
1966	Shelby	Cobra 427	1
1964	Shelby	GT350	1
1969	Toyota	2000GT	0
1959-1964	Maserati	5000GT Frua	10
1958	Ferrari	250 California LWB	
1954-1959	Lancia	Aurelia B24	31
1965-1972	Iso	Grifo	15
1970	Plymouth	'Cuda	88
1956-1959	Bentley	S1 Continental	8
1964	Alfa Romeo	TZ-2	0
1957-1963	Mercedes-Benz	300SL Roadster	138
1953	Chevrolet	Corvette	3
1963-1965	Aston Martin	DB5	12
1973	Porsche	911 Carrera RS 2..7	26
1948	Tucker	48	15
1963-1964	Shelby	Cobra 289	26
1954-1959	Jaguar	D-Type	22
1956-1959	Porsche	356A 1600	29
1963	Ferrari	250 California SWB	
1957	Rolls-Royce	Silver Cloud I	0
1966-1968	Ferrari	275 GTB/4	50
1957-1959	BMW	507	12
1967-1972	Lamborghini	Miura P400 SV	17
Total			**919**

[28] https://www.hagerty.com/apps/valuationtools/market-trends/collector-indexes/Blue_Chip

Appendix 12. Affordable classics cars

The following 12 cars are part of Hagerty's Affordable Classics index[29]. Hagerty's defines these as cars priced under $40,000 from the 1950's-1970's.

Year(s)	Make	Model	# Observations
1967	Volkswagen	Beetle	254
1969	American Motors	Javelin	1
1949	Buick	Roadmaster 76S	5
1967	Volkswagen	Karmann Ghia	42
1972	Porsche	914 2.0	53
1963	MG	MGB	121
1971	Datsun	240Z	26
1965	Chevrolet	Corvair Monza	80
1965	Ford	Mustang GT	94
1972	Triumph	TR6	69
1963	Studebaker	Avanti	26
1962	Studebaker	Lark Regal	1
1970	Chevrolet	Camaro SS	139
Total			**911**

[29] https://www.hagerty.com/apps/valuationtools/market-trends/collector-indexes/Affordable_Classics