Watches and Finance: Can hobby with an investment strategy beat the market?

Master's thesis 2019

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Defense Date:	August 30, 2019

Abstract

The thesis investigates a performance of luxury watches portfolio, which contains 72 various models, between May 2016 and May 2019. By means of hedonic regression model, several price indices were constructed, allowing for a risk-return analysis. Research also accounted for unavoidable insurance and storing costs of the high-end watches collection. Moreover, hedonic pricing regression depicted also which characteristics of watches mostly influence their prices, indicating a significant contribution of a brand, water resistance, power reserve, case material, and others. Watches portfolio yielded monthly 0.52% and 0.34%, respectively in real and in nominal terms. After estimating transaction costs, these returns decreased by 0.08%. The examined asset class, on a Sharpe ratio basis, outperformed broad MSCI World equity index, corporate bonds, and other emotional assets such as art or wine. Additionally, returns on luxury watches are negatively correlated with those on equities, bonds, and other collectible investments.

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1. Introduction

Collectibles environment brings together not only gatherers or high net worth individuals, but also investors. While former mainly attach the importance of an "emotional dividend" or social status fulfillment (Satchell, 2011), latter seek potential capital gains and portfolios diversification. Emotional assets market shares common features with financial one, allowing its participants for investment opportunities, simultaneously exposing them to busts and turmoil. These state of affairs led to a vast range of research, including collectibles such as wine (Dimson, Rousseau & Spaenjers, 2015; Lucey & Devine, 2014), art (Renneboog & Spaenjers, 2009; Goetzmann, Renneboog & Spaenjers, 2010), cars (Laurs & Renneboog, 2018), collectible stamps (Dimson & Spaenjers, 2011), and fine pens (Tomkovick & Dobie, 1995). However, very little academic research exists when luxury watches[1] are considered as a source of alternative investments.

Abundant reports from famous auction houses, like Sotheby's or Phillips, regarding sales records set by high-end watches, contribute to increasing popularity of subject field. Currently, a new record for the highest price ever achieved belongs to Paul Newman's Rolex Daytona, sold for $15.5 million at Phillips auction house in New York. The previous record, amounting to $11 million, belonged to Patek Philippe timepiece, reference number 1518. Therefore, more and more curiosity appears among luxury watches, especially while considering them as attractive investment candidates. Hence, potential investors are plied for trade, by for example the Watch Fund, an investment vehicle which by the use of investment-grade watches delivers its investors 20-30% net yearly return. Additionally, recent flowering of international marketplaces for luxury watches, like Chrono24 or Crown & Caliber, was contributory to making this market segment significantly more transparent. Despite rapid popularization and indrawn performance of high-end watches, it is insufficiently backed by source literature, therefore thesis fills this gap by investigating if luxury watches portfolio viably outperforms equity, bonds, and other emotional assets in terms of risk-return tradeoffs. Furthermore, study estimates what are the major determinants of high-end watches prices, examining their distinguishing characteristics.

In order to solve this puzzle, as a first empirical approach, hedonic regression model was used. It was based on a large sample of monthly sale prices, obtained from Chrono24 marketplace,

[1] In thesis, terms "luxury watch", "high-end watch", and "watch" are often used interchangeably. Kapferer & Laurent (2014) investigated the upper boundary of luxury watches price to fluctuate around $200,000, and lower boundary was set to $1000 for thesis purpose.

of 12 luxury watch brands with 6 brand-new watches considered within each brand, resulting in 72 models in total. Research was undertaken in period of three years, beginning in May 2016, ending in May 2019, resulted in 2,664 observations, and took into account nine hedonic characteristics, such us for example a kind of movement or bracelet material. Besides constructing main price index of high-end watches, hedonic regression methodology modeled also two sub-indices, namely precious metals watch index and particular watch brands index, to reveal which make delivers highest returns. Alternatively, the repeat sales methodology was implemented as a comparative background for a hedonic regression.

Conducted research reports the following findings. According to hedonic regression, luxury watches portfolio appreciated, on average, 0.52% (0.34%) monthly in nominal (real) terms. Cumulatively, index gained 20.37% (12.96%) within studied period in nominal (real) terms. Furthermore, regression result implies that comparing with Rolex, most brands trade with discount, except Richard Mille and Patek Philippe. Collectors, who also aim capital gains, should certainly be gunning for limited edition watches, as they significantly outperform generally released models. Additionally, watches with higher water resistance, greater number of jewels in movement, and with longer power reserves tend to yield higher prices. Comparing with models made of steel – rose, white, and yellow gold models trade with a substantial premium, however, aluminum models also outperformed steel ones. The hedonic model, in both nominal and real values, captured 84% of the price variation and large majority of introduced variables were significantly different from zero at the 1% level. With the purpose of estimating portfolio returns as precisely as possible, also adjustment for storage and insurance costs was applied, which resulted in lowering the real average monthly return from 0.34% to 0.26%. As an alternative empirical approach, repeat sales regression yielded comparable with hedonic methodology index returns. When benchmarking high-end watches with other collectible investments, watches portfolio presents itself favorably. Despite lower average monthly returns, luxury watches outperformed wine and art investments on a Sharpe ratio basis. From a risk-adjusted perspective, watches portfolio also revealed better results than corporate or government bonds. S&P500 index returned a higher Sharpe ratio, however with only 0.01 difference, taking into account also dividends. Although, when a broader equity index – namely MSCI World was examined, it was beaten by high-end watches index on a risk-adjusted basis.

The thesis proceeds as follows. Section 2 outlines environment of collectible investments and introduces luxury watches as a matter of emotional investment assets. Section 3 describes gathered data and implemented research methodologies. Section 4 comprehensively introduces obtained results and comparison with other (financial) assets. The final section concludes.

2. Review of relevant literature

2.1 Collectible investments

In view of historically low interest rates, and also dissatisfying results of traditional investments, alternative investments appreciate among investors' portfolios. Yau, Schneeweis, Robinson, and Weiss (2007) divided available alternatives into traditional ones, such as real estate, private equity, commodities; and into modern like hedge funds, managed futures, distressed securities (Baker & Fillbeck, 2013). This classification can also be broadened by introducing "*alternative alternatives*" (Laurs & Renneboog, 2018) which include a range of exotic investments like investments in catastrophe-linked bonds or timberland, specifying also a subgroup of collectibles such as art, cars, wine, or stamps. To date, small literature exists while luxury watches are considered as a source of alternative investments, however many other collectibles were largely examined from this point of view.

Non-pecuniary nature of investment collectibles suggests that owners, besides capital gains, appreciate also enjoyment and pride of their investments. Emotional assets are marked by delivering nonfinancial ownership dividends in a similar way as for example participation in prestigious hedge funds or socially responsible mutual funds. This phenomenon was discovered by Dimson, Rousseau & Spaenjers (2014) while examining performance of wine investments. Authors using a value-weighted arithmetic repeat-sales regression demonstrated real financial returns to wine exceeded art, bonds, and stamps, however, underperformed equities (including cash dividends) over the past century period. Overall, between 1900 and 2012, an annualized real return of 5.3% was estimated, although taking into account storage and insurance costs it resulted in 4.1%. Moreover, Masset & Weisskopf (2010) noted that "*Neither the terrorist attacks in New York, nor the burst of the Internet bubble, nor the boycott of French goods after the Iraq invasion have had much effect on wine prices*."

Investigating the same wine investment field, Devine & Lucey (2014) alleged The Wine Investment Fund which invests in fine wines all around the world, generated a higher annual return than the Down Jones Industrial Average (DJIA) (13.62% vs. 5.82%), however DJIA had higher variance than The Wine Investment Fund (18.16% vs. 4.79%). Not only wines but also luxury watches are managed by specialized funds. The Watch Fund, ran by a watch expert – Dominic Koo, delivers to its investors 20-30% yearly return and allows them to hold and wear their entire portfolio from the first day of an investment[2]. The Watch Fund is analyzed broadly in the further part of this section.

Considering the environment of investments in collectibles, Laurs & Renneboog (2018) pioneered in the subject of classic cars. Researchers also alleged presence of specialized investment funds operating in market for collectibles, pointing out the closed-end WMG Collectible Car fund, with 3 years long time horizon and a 20% annual return target, similar to the Watch Fund's one. The influential paper also pointed out specific portfolios focusing on certain marques (e.g. Ferraris or Porsches), or specific countries (British or Italian cars), which were a touchstone for examining alike portfolios' subcategories in the following thesis. Predominantly, authors depicted hedonic pricing models, based on an extensive data set. Analysis enabled researches to investigate price-determining features of classic cars, including marque, documentation, racing history, or technical aspects. Handsome in watch features database used in the thesis also gathers an implementation of hedonic regression model, which is largely presented in Section 3.

Persistently and also broadly examined fraction of alternative investments is an art market. Goetzmann, Renneboog, Spaenjers (2010) constructed a novel art price index, being a contributor to designing a similar study in the thesis. They also shed a light on a behavioral aspect of pricing some collectibles by investors, pointing that "*the price of an art object is only limited by how much collectors are willing and able to pay for it*". Analogy might be found among Phillips auction house in New York, where a record for the highest price ever achieved for a wristwatch was set. On October 26, 2017, Paul Newman's Rolex Daytona was sold for $17.8 million (including buyer's premium of 12.5%), carrying an estimate of excessing one million dollars[3]. Auction's

[2] www.watchfund.com/the-concept
[3] www.hodinkee.com/articles/paul-newmans-paul-newman-daytona-hands-on

result is rather a moderate incident, because previous record for a wristwatch at auction was $11 million, also in Phillips, for a Patek Philippe reference number 1518[4].

Increased attention to art as an investment was in a great depth investigated by Renneboog & Spaenjers (2009) who, along similar lines to Laurs's & Renneboog's (2018) research on the subject of classic cars, also applied extensive hedonic pricing framework as an empirical approach to create a price index. A handsome number of hedonic characteristics in this case allowed for emerging advantages over a repeat-sales regression, which often is also affected by sample selection problems. Authors were trying to solve the puzzle if art is really "*an irresistible combination of pleasure and profit*" (Higgs and Worthington, 2005). Studying a similar empirical approach, thesis answers this question asked among plenty of luxury watches collectors and profiteers.

Nevertheless, investments in collectibles are not shorn of a dose of criticism. Watson & Thomas (2010) suggested that "*investors […] should keep their nest eggs free of collectibles*" if they intend to optimize their returns. They argue that investors often omit bore costs like insurance or storage of wines and that real investors' portfolios rarely reflect the performance of indices based on auction prices. Moreover, authors notice that major institutional investors do not even consider fine wine, 50 years old Scotch, or rare stamps as investments, mainly because markets for these collectibles are not large enough for such a big market participants. Quoted remark is justified by Satchell (2011) who precisely investigates collectibles mostly acquired by family offices for their clients, who are marked by valuing collectible investments as completion of a series, prestige itself, or participation in the network of collectors and experts in the field.

2.2 Luxury watches market

At the end of December 2018, worldwide Swiss watch inventory among retailers, estimated in Morgan Stanley's report, amounted to €16 billion[5]. The highest number of units sold belonged to Longines (1900 thousand), right after was Rolex (770 thousand) and Omega (730 thousand). However, when sales are considered in monetary terms, Rolex got into the first place with total

[4] www.forbes.com/sites/hylabauer/2017/10/26/paul-newmans-paul-newman-daytona-sells-for-15-5-million-a-record-for-a-wristwatch-at-auction/#29e68ee75313
[5] www.businessmontres.com/storage/app/media/BUSINESS%20MONTRES-%20COUP%20DE%20FOUET-MSEU20181205892053.pdf

sales amounting to CHF 3,900 million, followed by Omega with CHF 2,270 million and Cartier Watches with CHF 1,670 million. Of course, visible discrepancy results from differences in retail prices of several models, nonetheless it is not the only contributing factor. Report pays attention to the relevant issue of sales channels, adducing Rolex or Patek Philippe which are not sold directly online and are not allowed to be sold by third party retailers. Another key distinction captures Omega's distribution in over 4,000 retailers vs. 450 for Patek Philippe. Additionally, watch brands such as IWC, Piaget, Blancpain, Longines, or Omega are owned by listed companies (Swatch, Richemont, LVMH), when Audemars Piguet or Rolex stays private. In the end, operating margins of Audemars Piguet, Patek Philippe, and Rolex exceed 30%, those of Swatch or Richemont are 16.4% and 13.6% respectively. This state of affairs leads to multifarious understanding of luxury itself, when some Tag Heuer models are available discounted by 30%, and most Rolexes are unavailable to be bought without subscribing to 2-3 years long waiting list[6].

Large variety of polices among producers of luxury watches directly translates to the availability of and an appetence for some brands and models. Because of the potential barriers in coming into possession of the one's dreams watch straight from the retailer, many secondary markets have recently flourished. One of the leading resell platforms for luxury watches – Chrono24, which was used as a key database in thesis and was comprehensively examined in Section 3, helps with picking up market trends and pricing strategies. Cartier Tank Solo or Tag Heuer Aquaracer resold on the secondary market shrank by 15% to 25%, while Patek Philippe Nautilus surged by 22% (applied to brand new watches). Such big volatility of luxury watches market attracts thousands of scalpers and speculators, in the similar way like financial markets do. The rapid expansion of reselling platforms, and a resale phenomenon itself, gave rise to consider watches as traded assets and to analyze their financial performance in the thesis[7].

Who then mostly represents the clientele for a luxury watches market? Treating watches as a part of collectibles, according to Satchell (2011), identifies potential high net worth individuals as a market's target. Many of them are passionate and collectors, notwithstanding some also seek alternative investment opportunities and possible diversification of existing portfolios. With

[6] www.chronext.co.uk/journal/buyers-guide/what-watch-is-worth-waiting-decades-for-top-5-most-wanted-rolex-and-how-to-skip-the-queue-%E2%80%93-hulk-pepsi-baselworld-novelties-and-more
[7] www.ablogtowatch.com/how-scalpers-speculators-are-ruining-the-watch-purchasing-experience-for-many-consumers/

reference to Knight Frank's Wealth Report (2019), watches took third place among emotional assets collected worldwide by surveyed individuals who are active investors in collectibles. In the Middle East luxury watches were preferably pointed out in a first place, Asians placed them just behind art, and in Africa or Latin America watches took third place, right after art and cars. Based on Deloitte's Swiss Watch Industry Study (2017), tourism development in Switzerland leads to rapid increase in sales, as many travelers, especially from Asia, decide to purchase a luxury watch in the cradle of watch craftsmanship. Additionally, this tendency is also influenced by a rise in import taxes (from 30% to 60%) on luxury goods to China. Besides, 70% of watch executives surveyed by Deloitte do believe in a further increase in sales to tourists over the next 12 months, comparing it with only 21% in 2016.

Some may identify luxury watches market mainly focused on man, as historically watchmaking was targeted to them. However, female's segment, dominated by Cartier for a very long time, now increases and creates watches geared specifically to the women. Jaeger-LeCoultre or Patek Philippe develops female models with complications such as chronographs, calendars, and more. Comparing with men, women today own more than one luxury watch, similarly to different styles of jewelry worn depending on attire[8]. Referring to Deloitte's study mentioned above, younger generations are also attracted to high-end watches. When surveyed how would they spend a CHF 5,000 gift if it had to be spent on a watch, 77.8% of Chinese millennials picked one luxury watch instead of the latest release of a smartwatch, every year, for the next 10 years. In the United Kingdom and Italy, almost 70% of teenagers would make the same choice if they commanded given capital. Also the recent popularization of smartwatches makes a mark on the Swiss wristwatches market. Obviously, they dominate over luxury watches in quantity, however, Swiss watch executives in 72% do not expect smartwatches to have an impact on their sales and 14% see smartwatches even as an opportunity. As corroborating might be one of the latest watches issued by Tag Heuer, a Connected Modular model which is a smartwatch available in silver titanium for $1,450 (almost four times more than the latest smartwatch produced by Apple).

[8] www.wpdiamonds.com/watches/guides/a-guide-to-the-luxury-watch-market/

2.2.1 Vintage watches phenomenon

Besides that thesis' empirical research takes only brand new watches into consideration, mainly not to control for a subjective evaluation of model's condition which to a large extent influences the price, luxury watches market largely consists of vintage models. Generally, vintage watch is described as a handmade, mechanical piece produced around the turn of the century through the 1950s (Branch, 1997). Stewart Unger, author of "American Wristwatches: Five Decades of Style and Design" notes that models "[…] *in the high-end vintage market are going absolutely nuts*". The truth of those words might be confirmed among Christie's auction records where lots with highest prices belong to vintage watches from circa second part of the previous century, giving examples of 18K gold Patek Philippe made in 1930 (sold for $708,500) or Patek Philippe perpetual chronograph from 1944 (sold for $912,500). "*Whole market is based on status*", said Daryn Schnipper, director of Sotheby's watch department asked why many collectors focus mainly on few brands. He also describes an increase in popularity of collecting vintage watches as: "*It's very much like collecting cars, expect you can't take a car into the board room or restaurant, but a Rolex goes with you.*" Interestingly, rarity and condition, not necessarily materials like 18K gold or platinum, are crucial in vintage market. For example, a stainless-steel Patek Philippe from 1955 was sold at Sotheby's for about 10% more than the gold equivalent from the same maker. This dependence is also examined in Section 4, however, as mentioned before, on the basis of brand new watches dataset.

While considering investment in vintage watches, ones have to keep in mind differences from the brand new ones. Checking the condition, not only from the outside but also inside the mechanism, is essential. Restoring makes vintage pieces significantly less of an art object, however when they are left with a ruddy or cloudy face they are neither supposed to be a profitable investment. According to Branch (1997), no matter how attractive Patek Philippe is, if has a replaced bracelet it brings the watch's price down by 25%. Ones should also be wary of counterfeiters, who are increasingly clever and even use genuine gold or serial numbers to create knockoffs. At the other end of the spectrum, auction houses such as Sotheby's and Christie's collect handsome fees (between 12%-25%, based on the hammer price) and do not provide any guarantees. All mentioned problems have to be taken into account by a rational investor tempted by vintage watches' financial performance.

2.4 Luxury watches as a matter of investment assets

Having regard to moderate empirical research on the subject of luxury watches as collectible investments, it makes them crucial to be examined against the background of other alternative investments and financial assets.

Equities and bonds may be imitatively traded on a stock exchange, properties also can be bought or sold on the secondary market, and so do watches can. Timepieces have been traded for ages in auction houses like Christie's or Sotheby's both intramurally and online, in the same way as art, wines, or cars. As noticed by Morgan Stanley's report examining Swiss watch industry (2017), recent development of online shopping contributed particularly to formation of online markets for watches, such as Watchfinder, Crown & Caliber, or Chrono24 – source of thesis' dataset. All of mentioned platforms allow both parties, buyer and seller, for an execution of their intentions in terms of sale. Moreover, watch marketplaces listed above protect an interest of both, buyer and seller, by securing the transaction via escrow accounts. Additionally, services provide an authenticity guarantee of every watch which is listed by a detailed investigation before displaying offers. However, those markets are not monitored to the same extent as for example New York Stock Exchange is monitored by U.S. Securities and Exchange Commission.

Emotional assets, in comparison with some financial ones, deliver to their owners an "*aesthetic dividend*" (Campbell, 2008), rather than a typical income stream. Immeasurability of viewing pleasure of artistic skill or genius may be one of the reasons why many collectibles reach unbelievably high prices on the secondary market (Spaenjers, 2015). Also, Laurs & Renneboog (2018) argued that broadening portfolio with collectibles enables transferring consumption value in time, which leads to a larger utility than more traditional investments. Moreover, Belk (1995) and Burton and Jacobsen (1999) noticed that collecting has psychological and social benefits to investors as often it becomes sense and purpose of their life. Furthermore, investing in collectibles may lead to a sense of belonging to a specific social group, in which success in competing with other collectors may lead to obtaining a special status (Storr, 1983).

Even if a particular collectible does not provide an investor with an immediate monetary gain, it can still improve his portfolio's performance by reducing risk in terms of diversification. Most researchers evidenced a low correlation of collectibles with other financial assets, pointing out also a minor correlation between collectibles themselves. While examining investment

performance of fine violins, Graddy and Margolis (2011) found a negative correlation between researched objects and S&P 500. Applied by Sanning et al. (2007) Fama-French three-factor model to the wine prices resulted in discovering only a minor covariance with stock market returns. Also Dimson and Spaenjers (2011) reported a low equity beta's for investments in collectible stamps.

Collectibles should also be considered by rational investors because of possible hedging benefits. Diamonds, stamps, and coins can assure security against market downturns and inflation because of their "*store of value*" nature (Dimson and Spaenjers, 2011). Also diamonds' returns, examined by Renneboog and Spaenjers (2012,) turned out to be significantly above inflation. When it comes to stamps, often called as "*paper gold*" (Wagenheim, 1976), they are also regarded as a solid inflation hedge.

Specialized investment funds operate not only in financial assets field but also in every large market for collectibles. They gather financial resources, similarly to private equity funds, and invest in collectibles. For example, the closed-end WMG Collectible Car fund raised £50 million of equity and invest in 10-15 classic cars for a holding period of about 3 years, with a target of 20% annual return (Laurs & Renneboog, 2018). The Watch Fund, founded in 2013 and managed by the watch expert – Dominic Khoo, precisely selects investment-grade watches and allocates capital among them[9]. Facing minimum investment amount of $250,000, 5% purchase fees, and 10% of profit or 5% of total sales price (whichever is higher), investor can anticipate 20-30% net yearly return with no lock-down period or annual fees too. Fund's worst performing portfolio returned a net gain of 11% in 364 days, and best performing one gained 216%. Watch Fund attracts not only purely financially-oriented investors, but also passionate collectors, as it allows them to personally hold their portfolios and benefit from non-pecuniary dividend (regarding potential damages, original manufacturers take care of them at the investor's cost).

Inseparable property of every investment is its cost (Miller, 2002). Many collectibles transactions are conducted through auction houses or secondary marketplaces, where substantial fees are charged. Regarding auction houses, not only seller but also buyer is faced with a cost of respectively, commission and premium. High transaction costs often consequence in longer average holding periods when it comes to collectible investments. Thus market of collectibles is

[9] www.watchfund.com

also more illiquid than traditional one of financial assets (Laurs & Renneboog, 2018). One of the reasons is that auctions are not held continuously, however, recent blossom of online secondary marketplaces seem to diminish this inequality. Chrono24 boasts 10-12 million visits per month and 1 billion euros in transaction volume generated (2017)[10]. Comparably to other collectibles like art or cars, luxury watches are also likely to be counterfeited. Investment in a watch bought from an unverified source may drive investor into immediate loss, therefore marketplaces like StockX or Chrono24 implemented a "Trusted Checkout" service which transfers the whole responsibility for a transaction to the online platform. However, luxury watches do not face as high holding costs as cars, mainly due to difference in size. Also, when it comes to wines or art, watches do not have to be stored with controlled humidity and temperature, or light exposure. Nonetheless, similarly to other collectibles, insurance costs and taxes must be taken into account also in luxury watches investments.

3. Data and methodology

3.1 Data

The starting point of thesis is an online database, accessible to the registered users of Chrono24 (https://www.chrono24.com), one of the world's largest marketplaces for luxury watches. The main reason why particular dataset was used is its unique feature of estimating average monthly prices of every watch sold via website, and making it transparent for the subscribers. It also allows to choose a relevant currency of the price changing history, and thesis set it in United States Dollars (USD). Additionally, broad database displays particular properties of every watch, such as movement, case material, water resistance, and more (see details regarding characteristics in *3.2.1 Hedonic characteristics*).

Despite being a well-established marketplace since 2003, Chrono24 introduced a price tracking feature just in 2018, which results, unfortunately, in an incompleteness of some data regarding prices and periods. To keep the selection of examined models as broad as possible, after a detailed analysis of the dataset, three years long period of monthly sales was assumed in the study, adopting it as an acceptable by the example of Krasker (1979), who examined wine

[10] www.luxurysociety.com/en/articles/2018/05/ambitious-plan-chrono24/

portfolios performance based on a similar period of four years auction data. In addition to this, some nowadays significant luxury watches, as for example Omega Speedmaster Apollo 13 Silver Snoopy Award (issued in 2015), have not been released before. The data browsing process resulted in a sample period beginning May 2016, ending May 2019.

Examined sample consists of twelve luxury watch brands, namely: Audemars Piguet, Breguet, Breitling, IWC, Omega, Panerai, Patek Philippe, Richard Mille, Rolex, Tag Heuer, Tudor, Vacheron Constantin, and each brand is represented by six watches (a complete overview with average real prices is presented in Table 1) . All of the included brands are Swiss, except for French Breguet and Italian Panerai.

[Insert Table 1 near here]

While considering sample selection, to set the lower boundary, luxury watch brand was assumed to be a brand which offers its cheapest watch for a price exceeding $1000. This distinction resulted in excluding such brands, as for example, Longines but including then a Tag Heuer[11]. When setting the upper boundary, to exclude brands famous for very limited releases only, or ridiculously expensive ones, luxury consumption research (Kapferer & Laurent, 2014) emerged to be crucial. It investigated the upper limit for luxury watches price to fluctuate around $200,000, thus none of the models exceeding this threshold was included in a sample. To provide as wide variety of the sample as possible, thesis' author self-selected models which factor into different types, are made of different material, have distinct movements, power reserve, and so on (see Table 2 for descriptive statistics).

[Insert Table 2 near here]

To omit a possible condition bias, which might significantly influence the prices, only brand new/unworn watches are studied. The selection process resulted in a comprehensive set of 2,664 sales records.

In order to obtain real sales prices in May 2019, US CPI numbers were collected via Federal Reserve Economic Data (FRED). Additionally, returns on the following financial and real assets

[11] For Longines, "Conquest" in stainless steel is the cheapest model, available at www.shop.us.longines.com for $750. In Tag Heuer's case, the cheapest model available via www.tagheuer.com/en-us/watches is "Formula 1" for $1,150.

were introduced: three-year US treasury notes (source: FRED), Dow Jones corporate bonds, S&P500, MSCI World Index, S&P GSCI Precious Metals (source: Thomson Reuters DataStream), Liv-ex Fine Wine 100 (source: www.liv-ex.com), and Art Price Global Index (www.artprice.com). S&P500 and MSCI World Index are plotted as Total Return Indices, meaning they take into account both capital gains and dividends.

3.2 Methodology

Capturing specific hallmarks of objects, such as art (Renneboog & Spaenjers, 2009) or wine (Devine & Lucey, 2014), was frequently a tall order for many researchers, largely because of a lack of quantifiable variables. However, more technically specified items, like cars or watches, allow for depicting their more observable characteristics, if a broadly-based dataset is accessible. Predominantly, methods used in constructing price indices for other financial assets cannot be used regarding collectibles, mostly because of heterogeneity and illiquidity among them. Therefore, with respect to Rosen (1974), and an abundant database, hedonic regression model, which assumes "*that goods are valued for their utility bearing attributes or characteristics*", was implemented.

While constructing hedonic indices, two main approaches are distinguished: the hedonic imputation index (HI), and the time-dummy hedonic index (DTH). The disparity between both methods implies that HI approach allows for observing changes in taste over time, having regard to long time series spanning several decades (Heravi & Silver, 2007), which is misaligned in terms of research period studied in thesis. Moreover, time dummies enable capturing the pure time effect. Therefore, analysis was based on the DTH methodology, used in the following hedonic model:

$$lnP_{kt} = \sum_{m=1}^{M} \alpha_m X_{mkt} + \sum_{t=1}^{T} \beta_t \delta_{kt} + \varepsilon_{kt} \qquad (1)$$

where lnP_{kt} indicates natural logarithm of the inflation-adjusted price of a watch k at the time t, X_{mkt} represents the value of hedonic characteristic m of watch k at the time t, and δ_{kt} is a time dummy variable which equals one if watch k was sold in period t (0 otherwise). Additionally, Breusch-Pagan test (Breusch & Pagan, 1979) was conducted to test for heteroscedasticity in the model. Reporting p-value amounting to 0.5546, null hypothesis of constant variance could not be rejected. Also, according to Koerts and Teekens (1972), least-squares estimation of log-linear

models allows for unbiased estimates of the parameters. DTH index was calculated using the following formula:

$$K_t = \exp(\beta_t) * 100 \quad (2)$$

where K_t represents the watch price DTH index at time t, and β_t is a time dummy of equation (1), corresponding to time t. In addition to this, May 2016 was set as 100, $\beta_{May-2016}$ has value of zero. As far as index yielded geometric returns, correction for the logarithmic transformation bias or Jensen's inequality (Triplett, 2004) had to be conducted:

$$K_t^* = K_t * \exp(\frac{{SE_\beta}_t^2}{2}) \quad (3)$$

where K_t^* is corrected and K_t uncorrected index levels at the time t, and ${SE_\beta}_t^2$ is squared standard error of the dummy coefficient corresponding to period t.

Alternatively, when examining performance of some collectibles, also repeat sales methodology (Bailey, Muth, Nourse, 1963) is often implemented. It allows for estimating average returns on items based on purchase and sale prices, indicating that it must be sold at least twice. As long as dataset examined in thesis considers every-month sales, repeat sales regression was also introduced, mainly as a comparative background for a hedonic regression. For each pair of month-by-month sale, log-price difference was calculated, and as a result, regressed using OLS regression on dummy variables (-1 for first sales month, 1 for the second sales month). As in case of hedonic regression, Breusch-Pagan test was introduced, resulting in a p-value amounting to 0.2859 – meaning that null hypothesis could not be rejected. No dummy variable was included in May 2016, which was set as a base month of index. Additionally, a substantial advantage of repeat sales methodology is that it controls for each specific asset and eliminates differences between them (in this case brands, case materials, number of jewels, etc.).

3.2.1 Sub-indices

Some collectors, or possible investors, might be specifically attached to a particular high-end watch brand. Patek Philippe enthusiasts appreciate its elegance and simplicity rather than flashy design as with Richard Mille, and Rolex fans may adore functional watches, not only as a piece of jewellery or decoration. Therefore, 12 sub-indices were introduced for each presented in

the main index brand. The methodology of yielding the brand indices was also based on equations (1) – (3), however, in all sub-index regressions robust standard errors had to be used with the aim of overcoming heteroscedasticity.

Besides brands, probably also case materials are determinants of investment decisions. To investigate if watches made of precious metals generated higher returns than those made of steel, two relevant indices were created, in the same way as brand indices, and in both cases robust standard errors were used too. Precious metals index consists of watches which cases were made of platinum, rose gold, white gold, yellow gold, or titanium.

3.2.2 Hedonic characteristics

To meet a crucial assumption of any hedonic regression, that a large proportion of the variance in the dependent variable is captured by the hedonic characteristics, the following set of watch characteristics was included in the model.

Mechanical. After the "Quartz crisis" in the 1970s, watchmaking industry was penetrated by the expansion of low-cost, battery-powered quartz movements. However, most well established brands decided to continue producing mechanical watches, despite larger capital requirements. Nowadays, luxury watches are mostly powered by mechanical movements, although some brands still use quartz technology[12]. *Mechanical* is a dummy variable which equals one when watch has a mechanical movement (65 observations).

Brand dummies. Since certain brands are marked by outstanding quality and prestigious reputation, they also differ in the price range of offered models. 12 different brands (see all in *3.1 Data* section) were introduced as dummy variables and Rolex was set as a base category (most searched luxury watch brand as of 2018[13]).

Water_resistance. If a particular brand means to classify its watch as a "waterproof", it first has to meet ISO 2281 standard, which specifies detailed testing procedures to be met. *Water_resistance* variable determines waterproofness of a watch expressed in atmospheres (ATM).

[12] Tag Heuer, for example, offers Aquaracer model with quartz movement for $2,300, while the same model with mechanical movement costs $4,250

[13] www.statista.com/statistics/288276/most-searched-luxury-watch-brands/

#Jewels. Every watch movement, mechanical or quartz, consists of jewels (mostly made of diamonds, sapphires, rubies), and their amount varies across brands and models. Their main usage is to reduce the frictions at most vulnerable pivoting points, preventing too often servicing needs. Variable *#Jewels* quantifies the number of jewels implemented in a watch's movement.

Power_reserve. Every mechanical watch is powered by kinetic energy, which is accumulated on a spring and propels the movement. Depending on a movement, accumulated energy can last for a different length of time. Expressed in hours, variable *Power_reserve* indicates how many units can be accumulated by a movement. Note that this feature only attributes to mechanical watches, in case of quartz watches this characteristic is set to zero (quartz movement cannot accumulate any energy when deprived of energy source – battery).

Limited_edition. For special occasions or important events, some watch brands decide to issue selected models as limited editions (Omega Speedmaster Apollo 11 50th Anniversary or Tag Heuer Monaco issued for 50th birthday of the model). To capture an impact of limiting on a watch price, implemented *Limited_edition* dummy variable equals one if a particular model belongs to a "limited edition" category (5 observations).

Case material dummies. To account for a variety of materials of watches' cases, the following dummy variables were introduced: *case_aluminum* (1 observation) equals one if case is made of aluminum, *case_carbon* equals one if case is made of carbon (1 observation), and the other dummy variables, namely *case_ceramic* (5 observations), *case_platinum* (1 observation), *case_rose_gold* (7 observations), *case_steel* (44 observations), *case_titanum* (8 observations), *case_white_gold* (2 observations), *case_yellow_gold* (3 observations), were introduced in the same way. Steel was used as a benchmark case material.

Bracelet material dummies. Not only cases but also bracelets are be made of different precious metals. To account for them, six dummy variables indicates particular material of a bracelet, namely *bracelet_ceramic* (1 observation), *bracelet_leather* (implying a leather strap, 22 observations), *bracelet_rose_gold* (2 observations), *bracelet_rubber* (implying a rubber strap, 19 observations), *bracelet_steel* (25 observations), *bracelet_titanum* (3 observations). Similarly to a previous set of variables, also steel was set as a benchmark bracelet material.

Additional feature dummies. Beyond time-telling, watches offer many complications or additional features which are valued by specific clienteles. *Chronograph*, once used mainly in motorsports and aeronautics, is a dummy variable which equals one if a watch has a chronograph feature (24 observations). *Genevian_seal* is a mark proclaiming exquisite movement and finest quality of finishing, and equals one if a watch is marked by it (3 observations). *GMT* (Greenwich Mean Time), originally established for travelers, allows for displaying one additional time zone by the use of an extra hand on a dial (7 observations). *Rotating_bezel* equals one if a watch comes complete with a spinning scaled ring, mostly used in diving industry, which allows for admeasuring minutes with no special movement complication (11 observations). One of the most prestigious complications is *Tourbillion*, which offsets effect of gravity on the movement, and is equal to one if a relevant watch has it (6 observations). The base category is *None* if watch does not present any additional feature besides displaying time and date (18 observations).

4. Empirical results

4.1 Hedonic regression results

Two main hedonic regression models were conducted in order to reveal nominal and inflation-adjusted return series. Both of them included the same set of variables, namely: 12 brand dummies, movement dummy, water resistance, number of jewels, power reserve, limited edition dummy, 9 case material dummies, 6 bracelet material dummies, and 6 additional feature dummies. Most variables were statistically significant at 1% level. In both cases, models included year dummies and introduced variables explained almost 85% of the price variation, where R^2 amounted subsequently to 0.844 and 0.843 in real and nominal model. Detailed findings regarding framed models are presented in Table 3.

[Insert Table 3 near here]

While considering brand as a significant price indicator, only Richard Mille and Patek Philippe traded with a price premium comparing to Rolex, where former increased the price almost 4.5 times more than latter. Breitling, IWC, Tag Heuer, and Tudor were over 100% less costly on average, comparing to Rolex brand. Somewhat surprisingly, mechanical watches fetched lower prices than quartz ones, presumably due to sample limitation. Table 3 indicates a positive

relationship between price and water resistance, however implying a modest economic significance of 0.2%. Furthermore, models with a greater number of jewels inside their movements yielded higher price, but likewise with a moderate economic significance of 1.5%. Watches which movements accumulate larger power reserves were also correlated with premiums, however to a lower extent. Although, unsurprisingly abundant premium, of more than 30%, was paid for limited edition watches. Regarding case material dummies, which are both statistically and economically strongly significant, it is clear from regression that cases made of precious metals influenced price greater than steel cases. In contrast, considering bracelet materials, none of them was priced higher than steel, except for rubber (which was not statistically significant). Examining additional features of a watch, not all of them yielded price appreciation. Chronographs (however not statistically significant) and diving watches endowed in rotating bezels, resulted in significant discounts. Nevertheless, GMT models, or ones marked with genevian seal, increased price by as much as 45% on average.

4.2 Luxury watches price index

4.2.1 Hedonic price index

Month dummies included in conducted hedonic regressions allowed for constructing luxury watches price index and determining monthly returns in both, nominal and real terms. Within examined time period, watch portfolio yielded a result of 20.37% (nominal) and 12.96% (real). On average, index appreciated 0.52% (nominal), 0.34% (real) monthly and 6.21% (nominal), 4.08% (real) annually. Table 4 depicts also volatility of obtained returns, presenting standard deviation of annual nominal returns amounting to 5.77%, and 5.85% in terms of real returns.

[Insert Table 4 near here]

Constructed indices were plotted in Figure 1. Both of them started in May 2016 (which was set to 100) and presented a beginning of a strong, upward trend from the first months of 2017.

[Insert Figure 1 near here]

4.2.2 Repeat sales price index

Repeat sales regression, as an alternative empirical approach, yielded very similar results in terms of nominal and real indices. Watch portfolio appreciated by 20.1% (12.75%) during the whole research period in nominal (real) values. Monthly returns were also closely corresponding to the ones revealed by hedonic regression, namely 0.51% and 0.34% in nominal and real terms. However, repeat sales methodology, compared with hedonic one, reported slightly higher volatility of indices generating standard deviation of annual nominal (real) returns equal to 5.91% (5.97%). Table 5 and Figure 2 summarize findings in the matter of repeat sales price index.

[Insert Table 5 and Figure 2 near here]

4.2.3 Correction for insurance and storage costs

As mentioned in 2.4 Section, investments in luxury watches, as in other collectibles or even financial assets, are not deprived of inherent costs. Two main expenditures which a potential, rational investor has to face are namely insurance, and storage costs. Growing popularity of collecting valuable items contributed to flowering of insurance products, offered by major insurers. To protect investors against all possible circumstances, Axa for example introduced all-risks policy, accounting even for a "simple loss and mysterious disappearance" of watch collection[14]. When it comes to assessing exact insurance coverage cost, sources quote value of around 1.5% of the watch value per annum[15]. For an average luxury watch included in examined portfolio, this cost amounts to $2.86 per month. In investor's best interest is also paying attention to a regular revaluation of the underlying portfolio by insurer, as its value significantly changes over time.

One, to prevent hazardous events and long-lasting insurance payout procedures, should equivalently take care of storing his watch portfolio. To account for storing cost, safety deposit boxes offered by Chase Bank were examined, mainly because bank offers them for a fixed price in all branches. The biggest available safety box measures 10 by 10 by 10 inches, costs $190 annually ($15.83 monthly) and easily accommodates sizeable collection[16]. Alternatively, a

[14] www.axaxl.com/fast-fast-forward/articles/time-to-think-about-fine-watch-insurance
[15] www.crownandcaliber.com/pages/watch-insurance
[16] www.valuepenguin.com/banking/average-cost-of-safety-deposit-box

sophisticated investor can consider a purchase of special, high-end watch safe, however its doubtful lifespan makes cost estimation inaccurate.

For an average watch included in a studied portfolio, monthly costs amounted to $18.69 in total, resulting in 0.08% of watch value. By this number, returns on main hedonic real price index were corrected and depicted in Figure 3. After costs adjustment, average monthly return decreased from 0.34% to 0.26%. Despite the fact that thesis examines only brand new watches, potential investors might also be interested in obligatory servicing costs, which must be borne in every 3-4 years, if they decide to physically exploit their investments. Average service fees with descriptions were summarized in Appendix 1.

[Insert Figure 3 near here]

4.2.4 Sub-indices

To control for different tastes and attachments of collectors, two previously mentioned sub-indices were constructed. First, 12 brand indices were created from pooled in thesis dataset. Results are depicted in Figure 4 (Figure 5) in terms of best (worst) real price performing brand indices.

[Insert Figure 4 and 5 near here]

Within the sample period, none of the best performing brand portfolios yielded a negative return. Index took into account the following brands: Audemars Piguet, Breitling, Omega, Patek Philippe, Richard Mille, and Rolex. Rolex portfolio appreciated most, by almost 51%, and Breitling portfolio least, by 9.5%. Acknowledging volatility of monthly returns, Breitling portfolio resulted in highest standard deviation amounting to 2.9%, when lowest volatility of 0.93% marked Audemars Piguet portfolio. By contrast, Figure 5 presents worst price performing brand indices, including Breguet, IWC, Panerai, Tag Heuer, Tudor, and Vacheron Constantin. Only Tag Heuer and Vacheron Constantin indices generated positive returns among studied period, with a monthly volatility equaled subsequently to 1.05% and 0.78%. Worst price performance was assigned to Tudor portfolio, which on (arithmetical) average decreased by 0.2% each month and its monthly volatility amounted to 1.01%.

Second group of sub-indices examined performance of luxury watches, also in the real terms, through the prism of their case materials. Index of precious metal watches consisted of the

following materials: platinum, rose gold, white gold, yellow gold, titanium. On the other hand, only watches made of steel were included in a contrasting index. Potential investor might also be in doubt if performance of watches made of precious metals was to some extent related to the performance of precious metals in general. To resolve doubts, also monthly returns on S&P GSCI Precious Metals index was plotted in Figure 6.

[Insert Figure 6 near here]

From Figure 6 it can be inferred that over the sample period, precious metal watches slightly outperformed steel ones, by around 4%. On arithmetic average, steel case watches appreciated monthly by 0.29% when precious metal case watches yielded 0.39%. However, studying the evolution of precious metals index, it is clear that it did not perform in line with precious metals watches, which presented a strong, upward trend and significantly lower volatility.

4.3 Comparison with other (financial) assets.

This section concerns the most meaningful takeaway for investors from presented research, as well as answers the title hypothesis. Over the examined time period, the performance of luxury watches real price index, corrected for insurance and storage costs, was benchmarked with performance of other financial assets and collectibles. Moreover, section concludes with Table 6 which summarizes monthly average returns, volatilities, and the Sharpe ratios of comparable assets.

Figure 7 shows comparison of the constructed index with the S&P 500 and MSCI World indices. Both of them are total return indices, indicating that they involve both capital gains and cash distributions, such as dividends.

[Insert Figure 7 near here]

Both equity indices clearly outperformed luxury watches index in terms of the average monthly returns, however, in line with significantly higher volatility. Standard deviation of S&P500 and MSCI World indices was almost 6.5 times higher than the one of constructed index, indicating that luxury watches investment might lure more risk averse investors which find equity markets too volatile. Although equity indices resulted in higher average monthly returns, at the end of examined period they cumulatively appreciated by only about 2%, when watches index

cumulatively increased by 9.77%. Using the Sharpe ratio as a comparison tool, luxury watches index yielded 0.31 result, S&P500 0.32, and MSCI World 0.28.

The picture of luxury watches index, versus both corporate and government bonds, presents itself pretty brightly. Watches portfolio slightly underperformed Dow Jones Corporate Bond index in terms of average monthly returns (0.26% versus 0.29%), however it certainly recovered while measuring reward-to-variability, constructed index resulted in Sharpe ratio equaling 0.31 while corporate bonds index yielded only 0.15. As presented in Figure 8, three-year US treasury notes substantially underperformed watch index, resulting even in a negative Sharpe ratio.

[Insert Figure 8 near here]

When comparing average returns on luxury watches with those on other popular collectibles, namely art and wine, ambiguous results were discovered. In terms of average monthly returns, both art pieces and wines fetched higher gains for investors, however with a considerably greater volatility. Moreover, wine tracking index was not corrected for essential costs, which were captured for example by Dimson, Rousseau & Spaenjers (2014). Having regard to a salient comparison measure used – Sharpe ratio, luxury watches portfolio outperformed both alternative collectible investments (0.31 versus 0.07 and 0.015). However, one can argue that emotional dividend delivered by art portfolio compensates its abundant volatility, but so does watches portfolio, and even with a significantly lower standard deviation.

[Insert Figure 9 and Table 6 near here]

The correlation matrix of returns on compared assets can be found in Table 7. Results confirm ability of luxury watches investments to prominently diversify investors' portfolios, whereas watches yielded a negative correlation with equities and other classes of emotional assets.

[Insert Table 7 near here]

5. Conclusion and discussion

Being influenced by words of Benjamin Franklin that "*Time is Money*", presented in an essay "Advice to a Young Tradesman" (1748), thesis shed a light on a question if also time admeasuring tools share the idea of a quoted concept. Nowadays high-end watches, besides mentioned feature, increasingly fit in environment of collectibles and arouse investors' interest as attractive assets and portfolio diversifying tools. As of December 2018, according to Morgan Stanley, worldwide Swiss watch market amounted to €16 billion, however hardly any scrutiny was conducted in order to examine this topic. Almost pioneering in the research field, thesis depicts a hedonic regression index of luxury watches between May 2016 and May 2019, accounting also for unavoidable insurance and storage costs. Over the span of investigated period, watches portfolio appreciated, on average, 0.52% (0.34%) monthly in nominal (real) terms and cumulatively gained 20.37% in nominal terms, which is equivalent to 12.96% in real terms. With regard to obtained results, high-end watches yielded very modest volatility, outperforming in this measure main equity indices, corporate bonds, and other collectible investments such as art or wine. On a risk-adjusted basis, constructed index shown also favorable Sharpe ratio, beating corporate bonds, MSCI World Index, art, and wine. Moreover, by the use of hedonic pricing model, thesis gathered main value drivers of luxury watches. Handsome premiums are then paid for such names as Patek Philippe or Richard Mille. Models with higher water resistance, with greater number of jewels inside movements, and longer power reserve enticed collectors to higher prices. Additionally, significant premiums are accredited to models made of precious metals like rose, white, and yellow gold. Inviolable is also phenomenon of "emotional dividend" which seduces so many collectors and investors by giving them an immeasurable joy and pride of owning outstanding watch portfolios. Thus, the reflection that high-end watches are "*an irresistible combination of pleasure and profit*" (Higgs and Worthington, 2005) seems to be accurate.

Further discussion regarding examined subject may head the direction of pre-owned, vintage watches, for which demand is currently augmenting. The evaluation of models' condition could yield new, additional variables which inclusion in hedonic pricing model would show the extent to which collectors judge their investments through the prism of technical condition. Studying this question, essential would be accounting for servicing costs, which are available in an Appendix section. Moreover, if a longer research period was available, adjacent regression methodology (Triplett, 2004) could be implemented to study whether investor preferences change

or remain stable over time. Also when more sophisticated collectors are considered, their portfolios might bare significantly higher storage costs, mainly because of a wide gamut of watch safes used in the industry. Overall, further scrutiny of topic would contribute to acknowledging the viability of examined niche asset class from different perspectives.

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TABLES

Table 1. Average prices of luxury watches with reference to brands and models

Using US CPI series, average prices were converted to real May 2019 dollars. All average prices were captured among 3 years old sample period (May 2016 – May 2-019).

Brand	Model	Reference number	Average price (USD May 2019)
Audemars Piguet	Royal Oak Extra-Thin	15202ST.OO.1240ST.01	$28,146
	Royal Oak Jumbo	15400ST.OO.1220ST.01	$17,621
	Royal Oak Offshore Chronograph	26470ST.OO.A101CR.01	$21,787
	Royal Oak Offshore Chronograph	26401.RO.OO.A002.CA.01	$42,379
	Royal Oak Offshore Michael Schumacher	26568OM.OO.A004CA.01	$104,317
	Royal Oak Quartz	67650ST.OO.1261ST.01	$10,636
Breguet	Big Date Marine	5817ST/12/5V8	$12,351
	Le Reveil du Tsar Classique	5707BA/12/9V6	$31,473
	Marine Royale	5847BR/Z2/5ZV	$33,812
	Type XX Chronograph „Aéronavale”	3800	$5,300
	Type XXI Chronograph	3810ST/92/9ZU	$8,972
	Type XXII Flyback	3880ST/H2/3XV	$15,598
Breitling	Aerospace Evo	E7936310/BC27/152E	$3,283
	Colt Quartz	A7438811.C907.173A	$2,390
	Navitimer 01	AB012012/BB01	$6,516
	Super Avenger	A13370	$7,721
	Superocean Heritage	A17320	$3,443
	Transocean Chronograph Unitime	AB0510U4/BB62	$8,266
IWC	Aquatimer	IW329001	$4,462
	Aquatimer Chronograph Galapagos Island	IW376705	$5,637
	Da Vinci Perpetual Calendar	IW3750	$4,462
	Ingenieur Double Chronograph	IW376501	$8,446
	Portofino	IW356501	$3,793
	Portugieser Chronograph	IW371447	$6,319
Omega	Constellation	123.15.27.60.51.001	$4,638
	Seamaster 300 "Spectre"	233.32.41.21.01.001	$9,414
	Seamaster Ploprof 1200 M	224.30.55.21.01.001	$7,017
	Speedmaster Apollo 13 Silver Snoopy Award	311.32.42.30.04.003	$16,331
	Speedmaster Apollo Soyuz	311.30.42.30.99.001	$9,151
	Speedmaster "From the Moon to Mars"	3577.50.00	$5,502

Table 1. Average prices overview (continued)

Brand	Model	Reference number	Average price (USD May 2019)
Panerai	Luminor 1950 3 Days GMT Ceramica	PAM00438	$12,251
	Luminor GMT Automatic Acciaio	PAM00088	$6,585
	Luminor Marina	PAM00104	$5,926
	Luminor Marina 1950 3 Days Acciaio	PAM00312	$6,443
	Luminor Submersible 1950 3 Days	PAM00305	$7,956
	Radomir Black Seal Ceramica	PAM00292	$7,129
Patek Philippe	Annual calendar chronograph	5960P-001	$63,684
	Aquanaut	5167A-009	$32,050
	Aquanaut travel time	5164A-001	$36,540
	Calatrava	5119J-1001	$16,945
	Naitilus	5711/1A-010	$44,871
	Naitilus	5711/1R-001	$59,180
Richard Mille	Bubba Watson	RM055	$116,185
	Diver	RM028	$71,522
	Felipe Massa	RM011	$115,851
	Rafael Nadal NTPT RM 35-01	RM 35-01	$130,859
	Rafael Nadal RM035	RM 035 AL ALMG	$92,521
	Yohan Blake	RM61-01	$113,858
Rolex	Daytona	116520	$19.025
	Daytona	116505	$31,579
	GMT-Master II	116710BLNR	$10,910
	Sea-Dweller Deepsea	116660	$12,473
	Submariner	116610LV	$10,793
	Submariner	16610LV	$14,087
Tag Heuer	Carrera Calibre 5	WAR201E.BA0723	$2,048
	Carrera Chronograph McLaren	CAR2080.FC6286	$8,370
	Carrera Quartz	WV1410.BA0793	$2,468
	Link Chronograph	CAT2010.BA0952	$3,485
	Monaco Steve McQueen	CAW2111.FC6183	$4,156
	Tourbillion H02T	CAR5A8Y.FC6377	$13,492
Tudor	Fastrider Black Shield	42000CN	$4,097
	Fastrider Ducati	42000D	$3,056
	Grantour	20530N	$3,171
	Heritage Black Bay	79220R	$2,897
	Heritage Ranger	79910	$2,414
	Pelagos	25600TB	$3,763

Table 1. Average prices overview (continued)

Brand	Model	Reference number	Average price (USD May 2019)
Vacheron Constantin	Historiques American 1921	82035/000R-9359	$28,221
	Malte Ladies	25530/000G-9741	$19,076
	Overseas Automatic	4500V/110A-B128	$17,018
	Overseas Chronograph	49150/B01A-9097	$17,215
	Patrimony Contemporary	85180/000G-9230	$22,095
	Patrimony Traditionelle	25155/000R-9585	$11,470

Table 2. Overview of descriptive statistics

Average monthly sale prices were converted to real May 2019 dollars using US CPI series. *N* indicates the number of observations for each characteristic. In case of *Number of jewels* and *Power reserve* variables, and their continuous character, Table 2 presents them in ranges, however in the regression models no ranges were used for both variables.

Characteristic	Type	N	Percentage	Average price (USD May 2019)
Brand	Audemars Piguet	6	8.33%	$37,481
	Breguet	6	8.33%	$17,918
	Breitling	6	8.33%	$5,270
	IWC	6	8.33%	$5,520
	Omega	6	8.33%	$8,675
	Panerai	6	8.33%	$7,715
	Patek Philippe	6	8.33%	$40,939
	Richard Mille	6	8.33%	$106,799
	Rolex	6	8.33%	$16,478
	Tag Heuer	6	8.33%	$5,670
	Tudor	6	8.33%	$3,233
	Vacheron Constantin	6	8.33%	$19,182
Mechanical	YES	65	90.28%	$23,125
	NO	7	9.72%	$21,418
Water resistance	3	12	16.67%	$22,293
	5	11	15.28%	$25,446
	10	26	36.11%	$25,376
	15	6	8.33%	$10,742
	20	3	4.17%	$24,916
	30	11	15.28%	$27,759
	50	1	1.39%	$3,763
	120	2	2.77%	$37,177
Number of jewels	1-20	12	16.67%	$21,418
	21-40	52	72.22%	$23,125
	41+	8	11.11%	$27,172
Power reserve	0	7	9.72%	$21,418
	1-40	8	11.11%	$22,015
	41-60	47	65.28%	$23,140
	61+	10	13.89%	$22,455
Limited edition	YES	5	6.94%	$26,472
	NO	67	93.06%	$22,907
Case material	Aluminum	1	1.39%	$92,521
	Carbon	1	1.39%	$130,859
	Ceramic	5	6.94%	$34,318

Table 2. Descriptive statistics (continued)

Characteristic	Type	N	Percentage	Average price (USD May 2019)
	Rose gold	7	9.72%	$22,998
	Steel	44	61.11%	$23,140
	Titanium	8	11.11%	$25,794
	White gold	2	2.78%	$20,586
	Yellow gold	3	4.17%	$10,848
Bracelet material	Ceramic	1	1.39%	$12,251
	Leather	22	30.56%	$22,981
	Rose gold	2	2.78%	$63,328
	Rubber	19	26.39%	$24,363
	Steel	25	34.72%	$23,140
	Titanium	3	4.16%	$25,794
Additional feature	Chronograph	26	36.11%	$23,239
	Genevian seal	3	4.17%	$22,445
	GMT	7	9.72%	$27,921
	Rotating bezel	11	15.28%	$23,978
	Tourbillon	6	8.33%	$42,982
	None	19	26.39%	$22,907

Table 3. Hedonic regression results

Below, both nominal and real models are presented. Nominal model takes into account unadjusted monthly sales prices, whereas real models uses deflated sales prices (USD May 2019). Reference category of variable, where applicable, is marked with a #. ***, **, and * denote significantly different from zero at the 1%, 5%, and 10% level respectively.

Type of data considered	**Coefficient** *Nominal model*	**t-stat** *Nominal model*	**Coefficient** *Real model*	**t-stat** *Real model*
Brand dummies				
Rolex#	n/a		n/a	
Audemars Piguet	-0.208***	-3.56	-0.208***	-3.56
Breguet	-0.581***	-11.40	-0.581***	-11.40
Breitling	-1.316***	27.57	-1.316***	-27.57
IWC	-1.118***	-18.19	-1.118***	-18.19
Omega	-0.973***	-18.64	-0.973***	-18.64
Panerai	-0.902***	-14.58	-0.902***	-14.58
Patek Philippe	0.342***	5.63	0.342***	5.63
Richard Mille	1.525***	16.94	1.525***	16.94
Tag Heuer	-1.238***	-21.44	-1.238***	-21.44
Tudor	-1.211***	-22.88	-1.211***	-22.88
Vacheron Constantin	-0.991***	-14.49	-0.991***	-14.49
Mechanical	-0.551***	-7.16	-0.551***	-7.16
Water resistance	0.002***	3.56	0.002***	3.56
Number of jewels	0.015***	10.69	0.015***	10.69
Power reserve	0.008***	5.99	0.008***	5.99
Limited edition	0.308***	6.16	0.308***	6.16
Case material dummies				
Steel#	n/a		n/a	
Aluminum	0.451***	4.81	0.451***	4.81
Carbon	-0.259*	-2.81	-0.259*	-2.81
Ceramic	-0.148*	-2.73	-0.148*	-2.73
Platinum	0.816***	8.97	0.816***	8.97
Rose gold	0.994***	20.50	0.994***	20.50
Titanium	-0.206***	-4.28	-0.206***	-4.28
White gold	1.206***	16.49	1.206***	16.49
Yellow gold	0.493***	9.76	0.493***	9.76

Table 3. Hedonic regression result (continued)

Type of data considered	**Coefficient** *Nominal model*	**t-stat**	**Coefficient** *Real model*	**t-stat**
Bracelet material dummies				
Steel#	n/a		n/a	
Ceramic	-0.160	-1.45	-0.160	-1.45
Leather	-0.233***	-7.25	-0.233***	-7.25
Rose gold	-1.577***	-19.43	-1.577***	-19.43
Rubber	0.020	0.50	0.020	0.50
Titanium	-0.585***	-7.41	-0.585***	-7.41
Additional feature dummies				
None#	n/a		n/a	
Chronograph	-0.026	-0.76	-0.026	-0.76
Genevian seal	0.426***	6.10	0.426***	6.10
GMT	0.491***	11.08	0.491***	11.08
Rotating bezel	-0.199***	-4.29	-0.199***	-4.29
Tourbillon	-0.062	-0.80	-0.062	-0.80
Constant	9.444***	126.99	9.508***	127.85
Year dummies	Yes		Yes	
Number of observations	2664		2664	
Rsquared	0.8436		0.8433	

Table 4. Nominal and real returns on luxury watches (obtained from hedonic regression)

Table presents nominal and real price indices, obtained from hedonic regression, of luxury watches. May 2016 was set equal to 100. In nominal model, dependent variable is the natural log of the unadjusted price, while real model uses deflated prices. Index levels are corrected according to equation (3).

Month	Coefficient	Index	Return	Coefficient	Index	Return
		Nominal model			*Real model*	
May-16	n/a	100.00		n/a	100.00	
Jun-16	-0.004	99.82	-0.18%	0.000	99.53	-0.47%
Jul-16	-0.003	99.94	0.12%	-0.007	99.66	0.13%
Aug-16	-0.002	100.10	0.16%	-0.006	99.63	-0.03%
Sep-16	-0.003	99.95	-0.16%	-0.006	99.29	-0.34%
Oct-16	-0.007	99.57	-0.37%	-0.010	98.66	-0.64%
Nov-16	-0.001	100.19	0.61%	-0.016	99.12	0.47%
Dec-16	-0.003	99.97	-0.22%	-0.011	98.61	-0.52%
Jan-17	0.000	100.28	0.32%	-0.017	98.51	-0.10%
Feb-17	0.000	100.28	-0.01%	-0.018	98.43	-0.08%
Mar-17	0.001	100.32	0.05%	-0.018	98.56	0.13%
Apr-17	0.006	100.90	0.58%	-0.017	99.01	0.45%
May-17	0.008	101.06	0.15%	-0.013	99.20	0.19%
Jun-17	0.011	101.38	0.31%	-0.011	99.42	0.22%
Jul-17	0.013	101.55	0.17%	-0.008	99.50	0.09%
Aug-17	0.015	101.76	0.21%	-0.008	99.34	-0.16%
Sep-17	0.020	102.30	0.53%	-0.009	99.41	0.07%
Oct-17	0.027	103.01	0.70%	-0.009	100.04	0.63%
Nov-17	0.037	104.06	1.02%	-0.002	100.75	0.71%
Dec-17	0.038	104.10	0.03%	0.005	100.55	-0.20%
Jan-18	0.046	104.97	0.84%	0.003	101.00	0.44%
Feb-18	0.053	105.71	0.71%	0.007	101.51	0.51%
Mar-18	0.062	106.64	0.88%	0.012	102.35	0.83%
Apr-18	0.068	107.37	0.68%	0.021	102.86	0.49%
May-18	0.079	108.47	1.03%	0.026	103.63	0.75%
Jun-18	0.084	109.01	0.49%	0.033	103.94	0.29%
Jul-18	0.093	109.99	0.91%	0.036	104.69	0.72%
Aug-18	0.094	110.19	0.18%	0.043	104.76	0.07%
Sep-18	0.111	112.00	1.64%	0.044	106.42	1.58%
Oct-18	0.122	113.31	1.17%	0.060	107.33	0.86%
Nov-18	0.129	114.07	0.68%	0.068	108.07	0.69%
Dec-18	0.137	115.01	0.82%	0.075	108.97	0.83%
Jan-19	0.141	115.47	0.40%	0.083	109.43	0.42%
Feb-19	0.148	116.22	0.65%	0.088	109.95	0.47%
Mar-19	0.162	117.92	1.47%	0.092	111.11	1.05%

Table 4. Returns on luxury watches (continued)

Month	Coefficient	Index	Return	Coefficient	Index	Return
		Nominal model			*Real model*	
Apr-19	0.172	119.10	1.00%	0.103	111.87	0.68%
May-19	0.183	120.37	1.06%	0.109	112.96	0.98%
Monthly arithmetic mean return			**0.52%**			**0.34%**
Annual arithmetic mean return			**6.21%**			**4.08%**
Standard deviation of annual returns			**5.77%**			**5.85%**

Table 5. Nominal and real returns on luxury watches (obtained from repeat sales regression)

Table presents nominal and real price indices, obtained from repeat sales regression, of luxury watches. May 2016 was set equal to 100. In nominal model, dependent variable is the natural log of the difference of unadjusted prices between two sales months, while real model uses deflated prices.

Month	Coefficient	Index	Return	Coefficient	Index	Return
		Nominal model			*Real model*	
May-16	n/a	100.00		n/a	100.00	
Jun-16	-0.004	99.60	-0.40%	-0.007	99.30	-0.70%
Jul-16	-0.003	99.70	0.10%	-0.006	99.40	0.10%
Aug-16	-0.002	99.80	0.10%	-0.006	99.40	0.00%
Sep-16	-0.003	99.70	-0.10%	-0.010	99.00	-0.40%
Oct-16	-0.007	99.30	-0.40%	-0.016	98.41	-0.60%
Nov-16	-0.001	99.90	0.60%	-0.011	98.91	0.50%
Dec-16	-0.003	99.70	-0.20%	-0.016	98.41	-0.50%
Jan-17	0.002	100.02	0.32%	-0.017	98.31	-0.10%
Feb-17	0.001	100.01	-0.01%	-0.018	98.22	-0.10%
Mar-17	0.001	100.10	0.09%	-0.017	98.31	0.10%
Apr-17	0.006	100.60	0.50%	-0.012	98.81	0.50%
May-17	0.008	100.80	0.20%	-0.010	99.00	0.20%
Jun-17	0.011	101.11	0.30%	-0.008	99.20	0.20%
Jul-17	0.013	101.31	0.20%	-0.007	99.30	0.10%
Aug-17	0.015	101.51	0.20%	-0.009	99.10	-0.20%
Sep-17	0.020	102.02	0.50%	-0.008	99.20	0.10%
Oct-17	0.027	102.74	0.70%	-0.002	99.80	0.60%
Nov-17	0.037	103.77	1.01%	0.005	100.50	0.70%
Dec-17	0.038	103.87	0.10%	0.003	100.30	-0.20%
Jan-18	0.046	104.71	0.80%	0.008	100.80	0.50%
Feb-18	0.053	105.44	0.70%	0.013	101.31	0.50%
Mar-18	0.062	106.40	0.90%	0.021	102.12	0.80%
Apr-18	0.068	107.04	0.60%	0.026	102.63	0.50%
May-18	0.079	108.22	1.11%	0.034	103.46	0.80%
Jun-18	0.084	108.76	0.50%	0.037	103.77	0.30%
Jul-18	0.093	109.75	0.90%	0.044	104.50	0.70%
Aug-18	0.094	109.86	0.10%	0.045	104.60	0.10%
Sep-18	0.111	111.74	1.71%	0.060	106.18	1.51%
Oct-18	0.122	112.98	1.11%	0.069	107.14	0.90%
Nov-18	0.129	113.77	0.70%	0.076	107.90	0.70%
Dec-18	0.137	114.68	0.80%	0.084	108.76	0.80%
Jan-19	0.141	115.14	0.40%	0.088	109.20	0.40%
Feb-19	0.148	115.95	0.70%	0.093	109.75	0.50%
Mar-19	0.162	117.59	1.41%	0.104	110.96	1.11%

Table 5. Returns on luxury watches (continued)

Month	Coefficient	Index	Return	Coefficient	Index	Return
		Nominal model			*Real model*	
Apr-19	0.172	118.77	1.01%	0.110	111.63	0.60%
May-19	0.183	120.08	1.11%	0.120	112.75	1.01%
Monthly arithmetic mean return			**0.51%**			**0.34%**
Annual arithmetic mean return			**6.13%**			**4.02%**
Standard deviation of annual returns			**5.91%**			**5.97%**

Table 6. Luxury watches index versus other assets

Table compares average returns and volatility of the constructed luxury watches index, with insurance and storage costs accounted for, with other (financial) assets indices within May 2016 – May 2019 time period. All measures are expressed in monthly terms. To calculate Sharpe ratio, as a risk free rate, averaged 3-month Treasury bill rate was applied and expressed in monthly terms.

	Luxury Watches	S&P500	MSCI World	T-bills	Corporate bonds	Wine	Art
Average return	0.26%	1.18%	0.98%	0.05%	0.29%	0.60%	0.72%
Volatility	0.49%	3.37%	3.06%	0.16%	1.21%	3.17%	8.52%
Sharpe ratio	0.31	0.32	0.28	-0.38	0.15	0.15	0.07

Table 7. Correlation matrix of returns

Table shows the correlation matrix of the monthly returns on luxury watches index, with insurance and storage costs accounted for, and other (financial) assets between May 2016 and May 2019. Details regarding used indices are presented in Section 3.1.

	Luxury Watches	**S&P500**	**MSCI World**	**Corporate bonds**	**Wine**	**Art**
Luxury Watches	1.00					
S&P500	-0.06	1.00				
MSCI World	-0.11	0.95	1.00			
Corporate bonds	0	-0.11	-0.13	1.00		
Wine	-0.16	0.07	0.10	-0.12	1.00	
Art	-0.13	-0.23	-0.06	0.16	0.13	1.00

FIGURES

Figure 1. Luxury watches hedonic price index

Figure 1 illustrates hedonic price index, in nominal and real terms since May 2016, when index value was set equal to 100. Nominal returns are adjusted to real ones (USD May 2019) using the US CPI index.

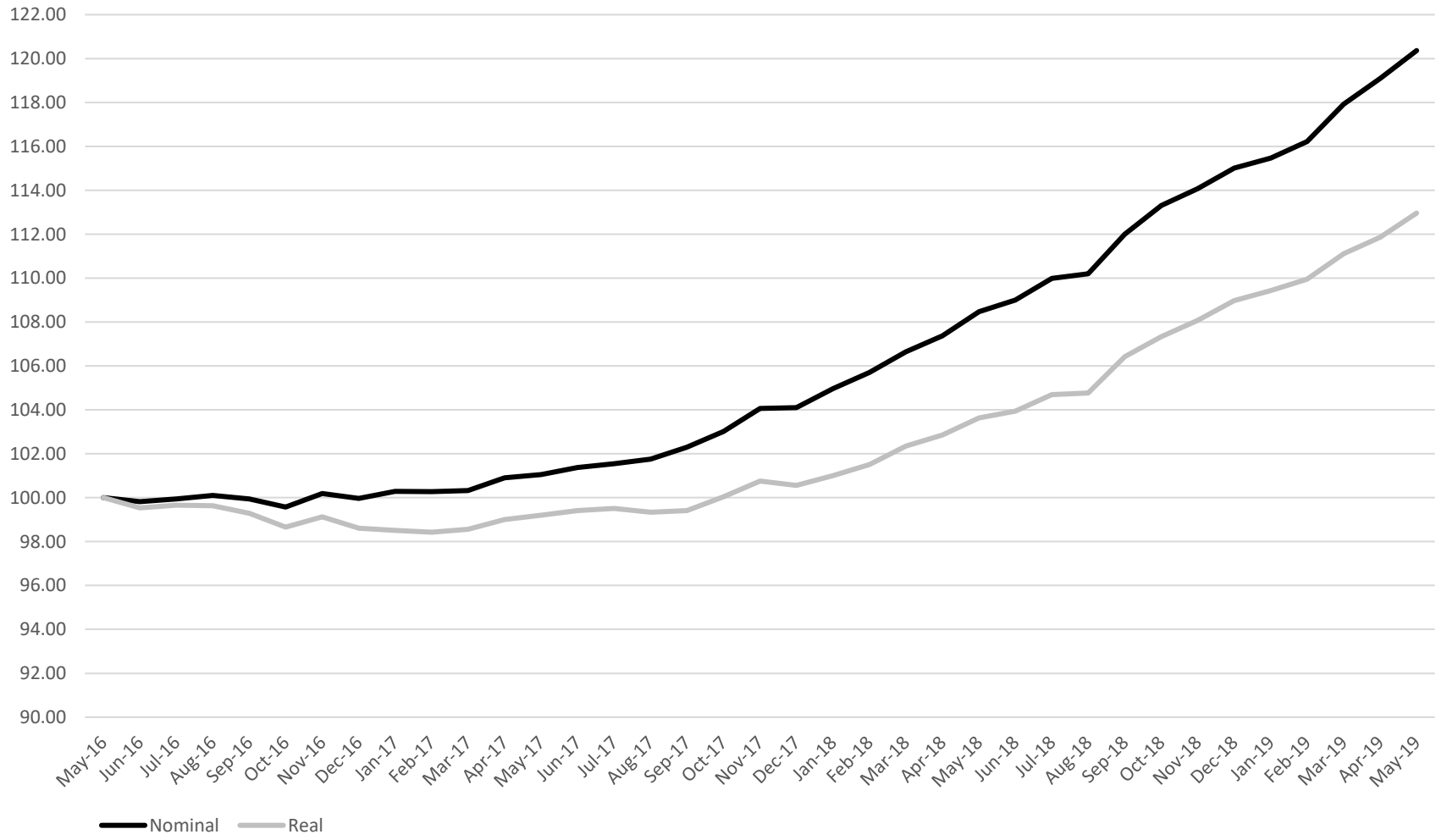


Figure 2. Luxury watches repeat sales price index

Figure 2 illustrates repeat sales price index, in nominal and real terms since May 2016, when index value was set equal to 100. Nominal returns are adjusted to real ones (USD May 2019) using the US CPI index.

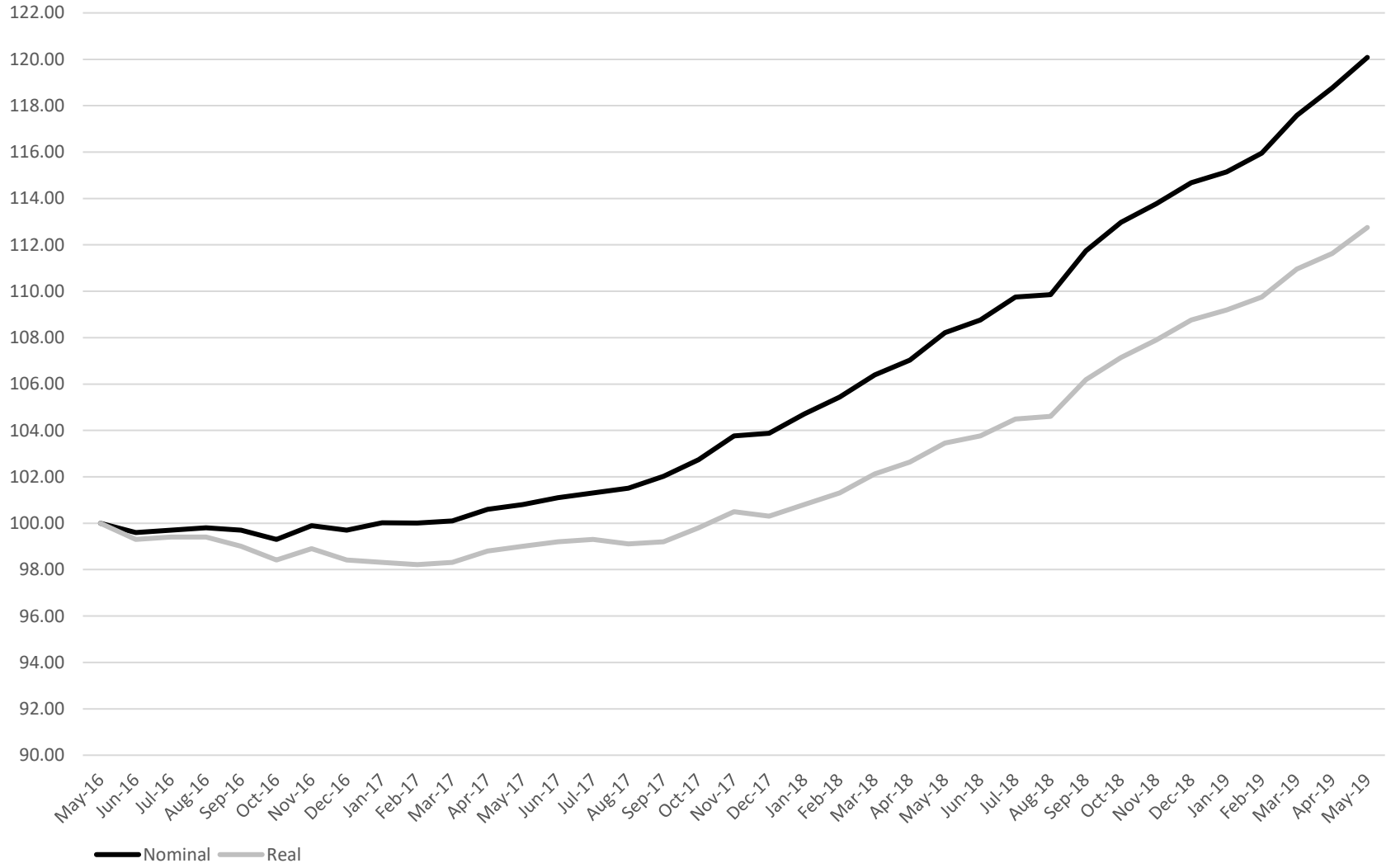


Figure 3. Luxury watches hedonic real price index after costs adjustment

Figure 3 illustrates hedonic real price index, adjusted for insurance and storage costs, since May 2016, when index value was set equal to 100. Nominal returns are adjusted to real ones (USD May 2019) using the US CPI index.

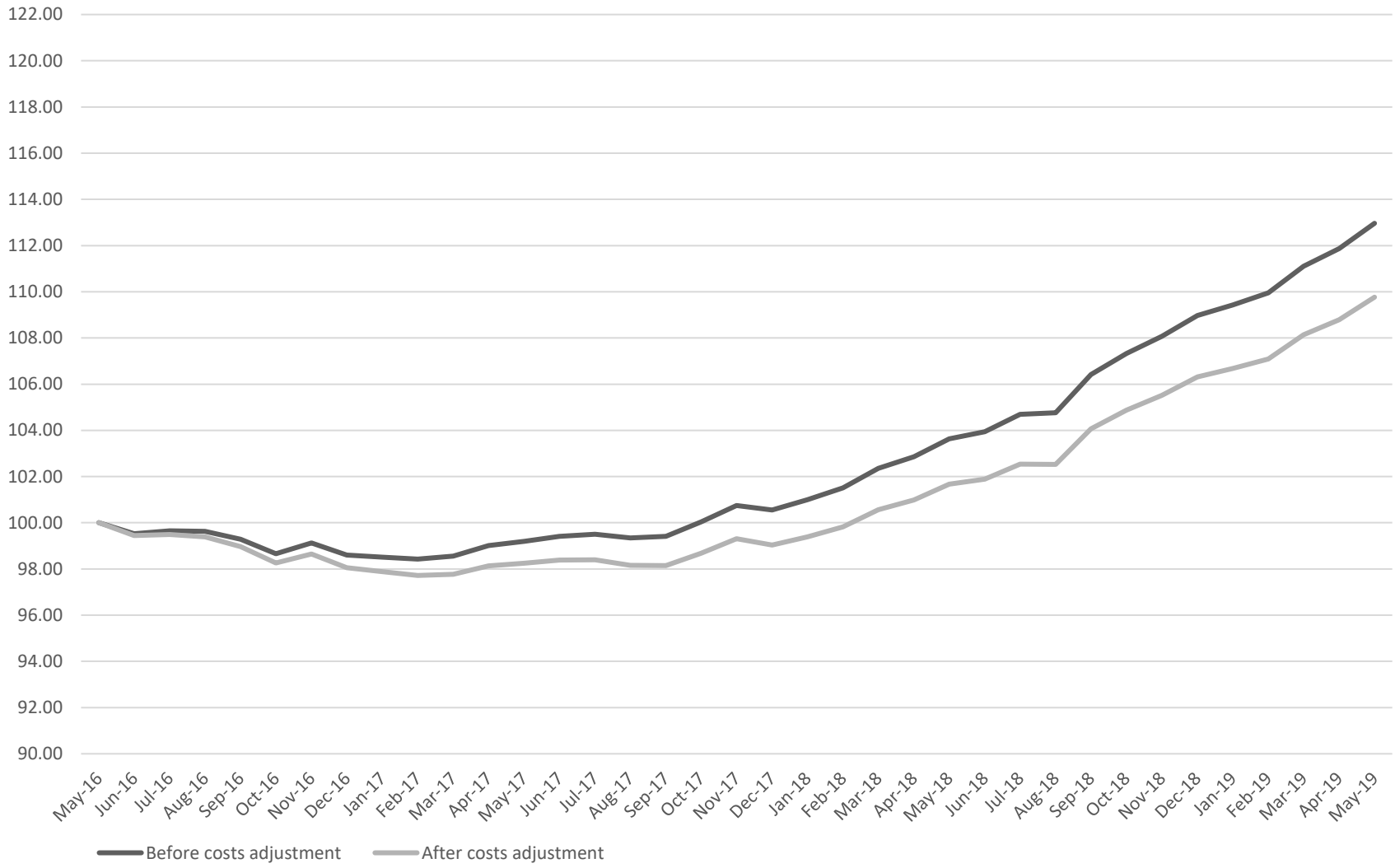


Figure 4. Hedonic indices for best price performing brands

Figure 4 illustrates, in the real terms (USD May 2019), best price performing luxury watch brands, namely: Audemars Piguet, Breitling, Omega, Patek Philippe, Richard Mille, and Rolex. All of six indices were set equal to 100 in May 2016.

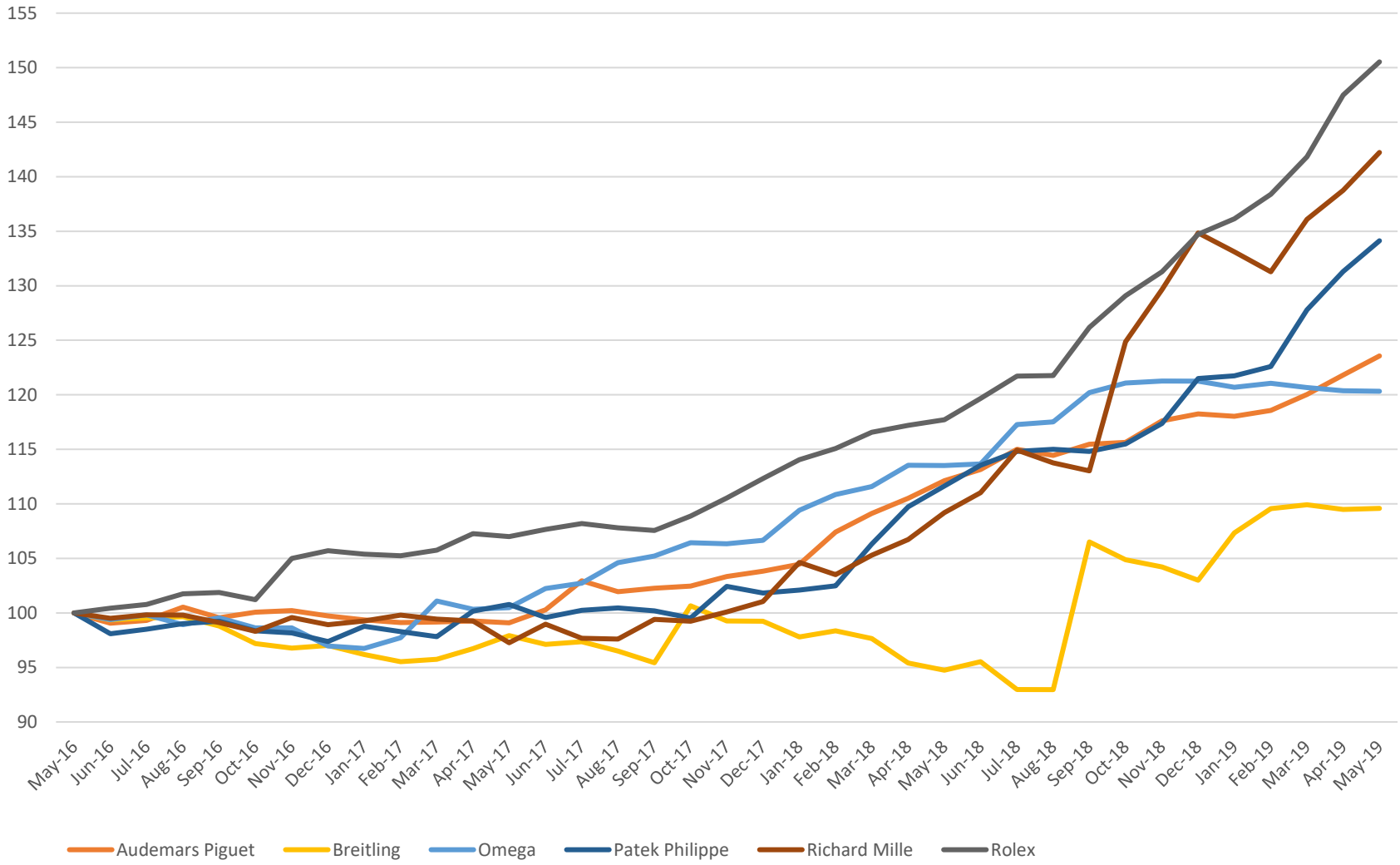


Figure 5. Hedonic indices for worst price performing brands

Figure 5 illustrates, in the real terms (USD May 2019), worst price performing luxury watch brands, namely: Breguet, IWC, Panerai, Tag Heuer, Tudor, and Vacheron Constantin. All of six indices were set equal to 100 in May 2016.

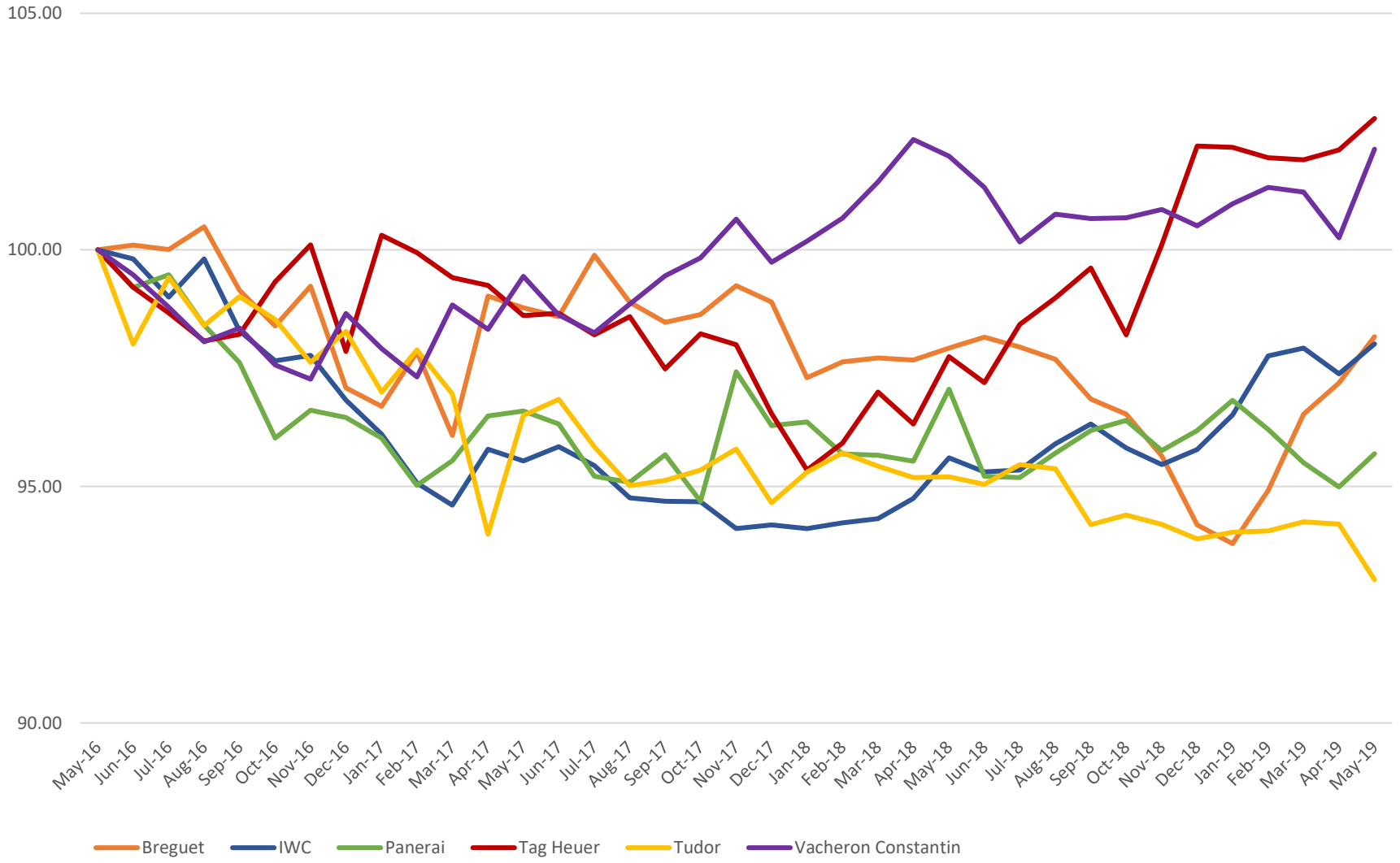


Figure 6. Hedonic price indices for steel vs. precious metals watches

Figure 6 compares steel watches versus those made of precious metals. Both indices are based on real prices (USD May 2019) and are set equal to 100 in May 2016. Also, S&P GSCI Precious Metal Index, obtained from Thomson Reuters DataStream, was plotted as a background for precious metals watches index.

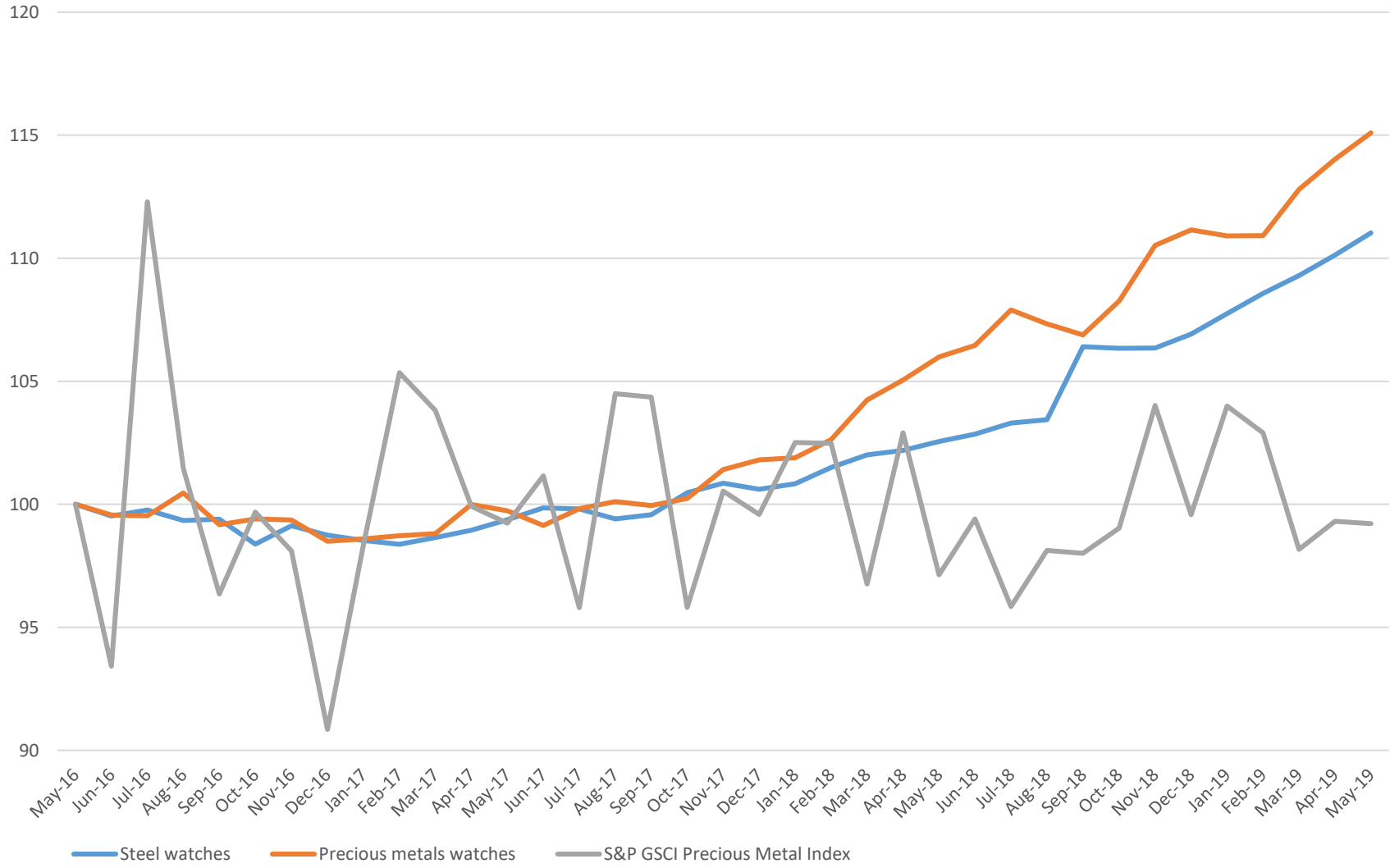


Figure 7. Luxury watches vs. S&P500 and MSCI World total return indices

Figure 7 compares luxury watches hedonic real price index, adjusted for insurance and storage costs, versus S&P500 and MSCI World total return indices. All indices are set equal to 100 in May 2016.

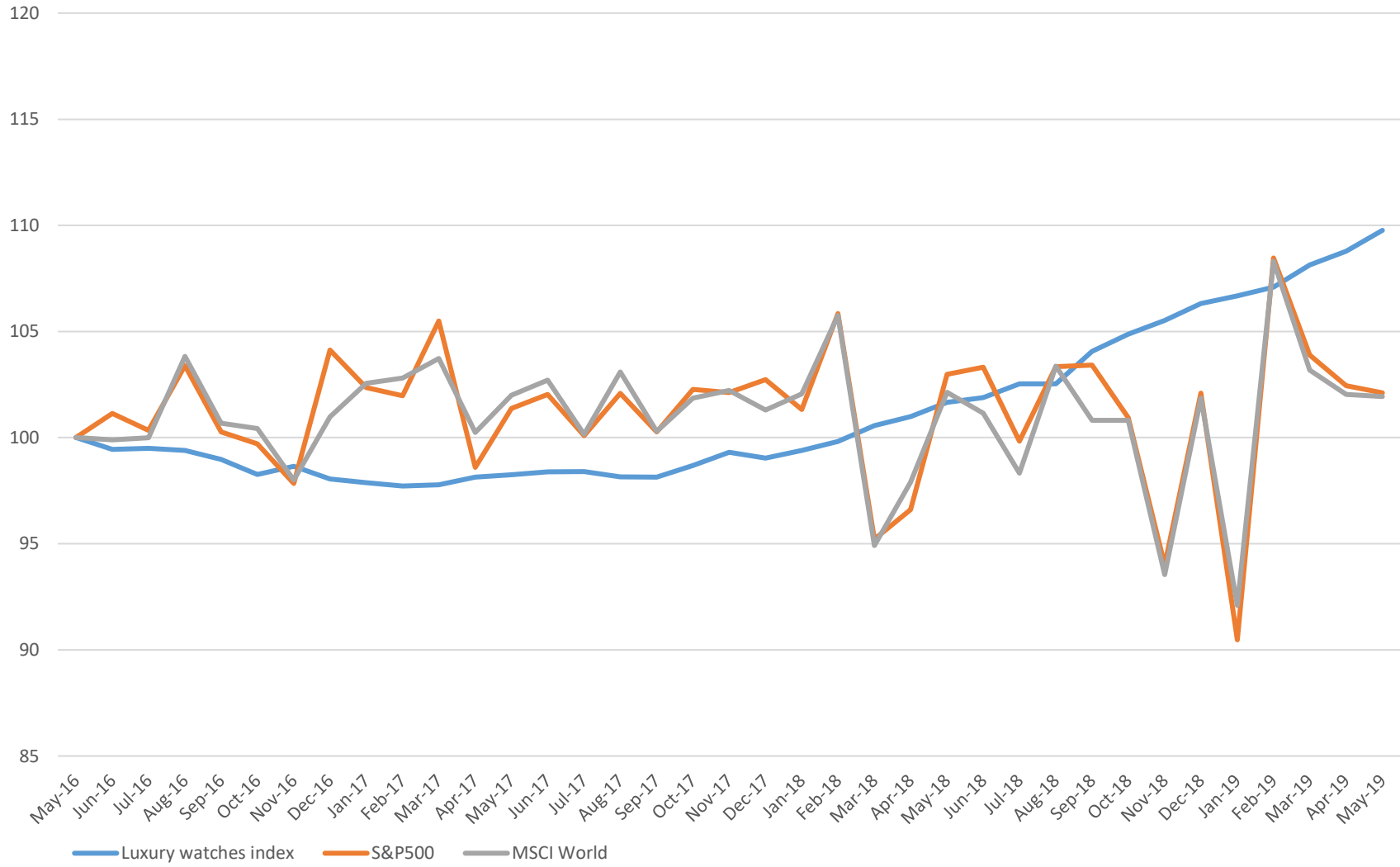


Figure 8. Luxury watches vs. Dow Jones Corporate Bonds Index and 3-year Treasury index

Figure 8 compares luxury watches hedonic real price index, adjusted for insurance and storage costs, versus Dow Jones Corporate Bond Index and 3-year Treasury index. All indices are set equal to 100 in May 2016.

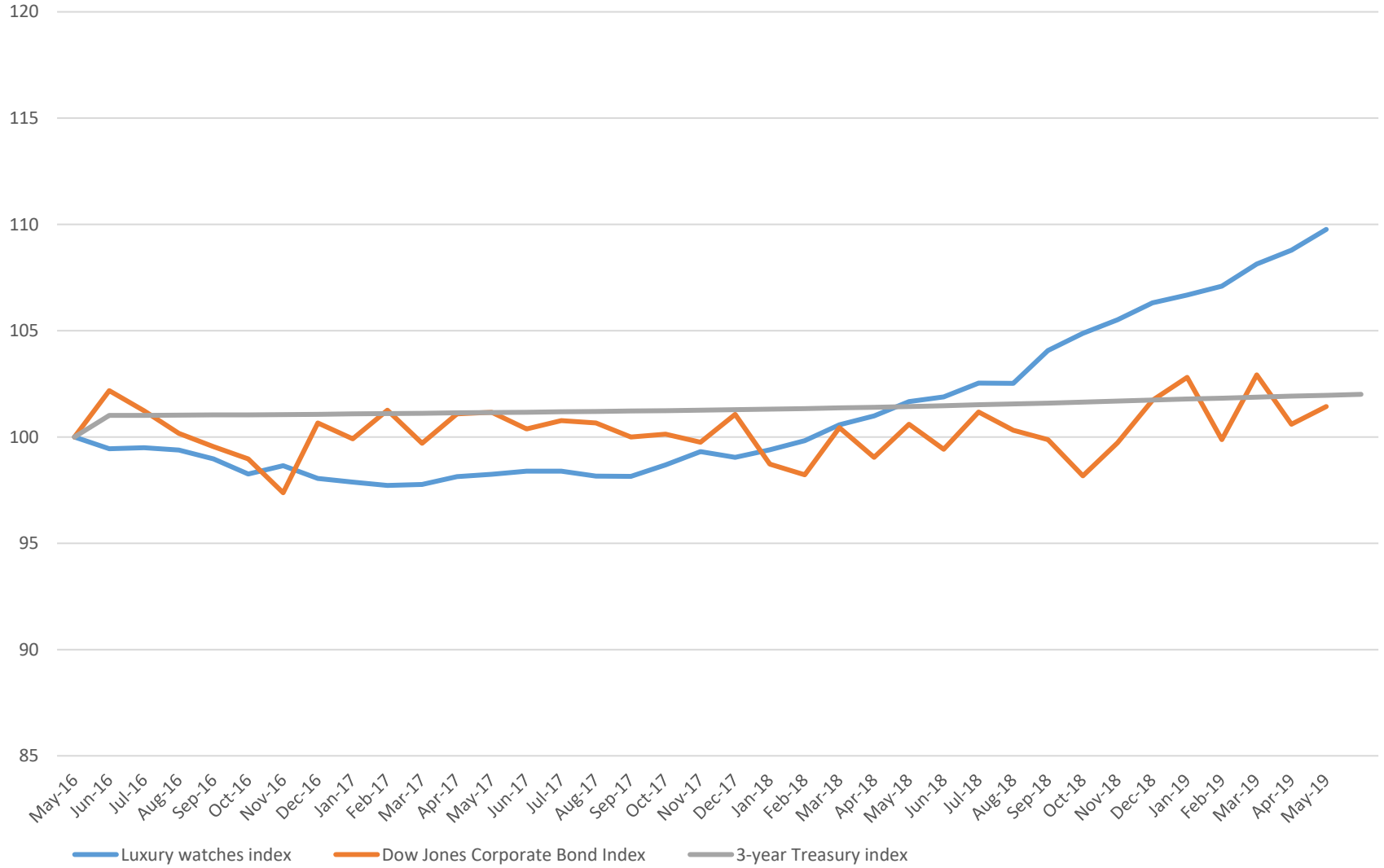
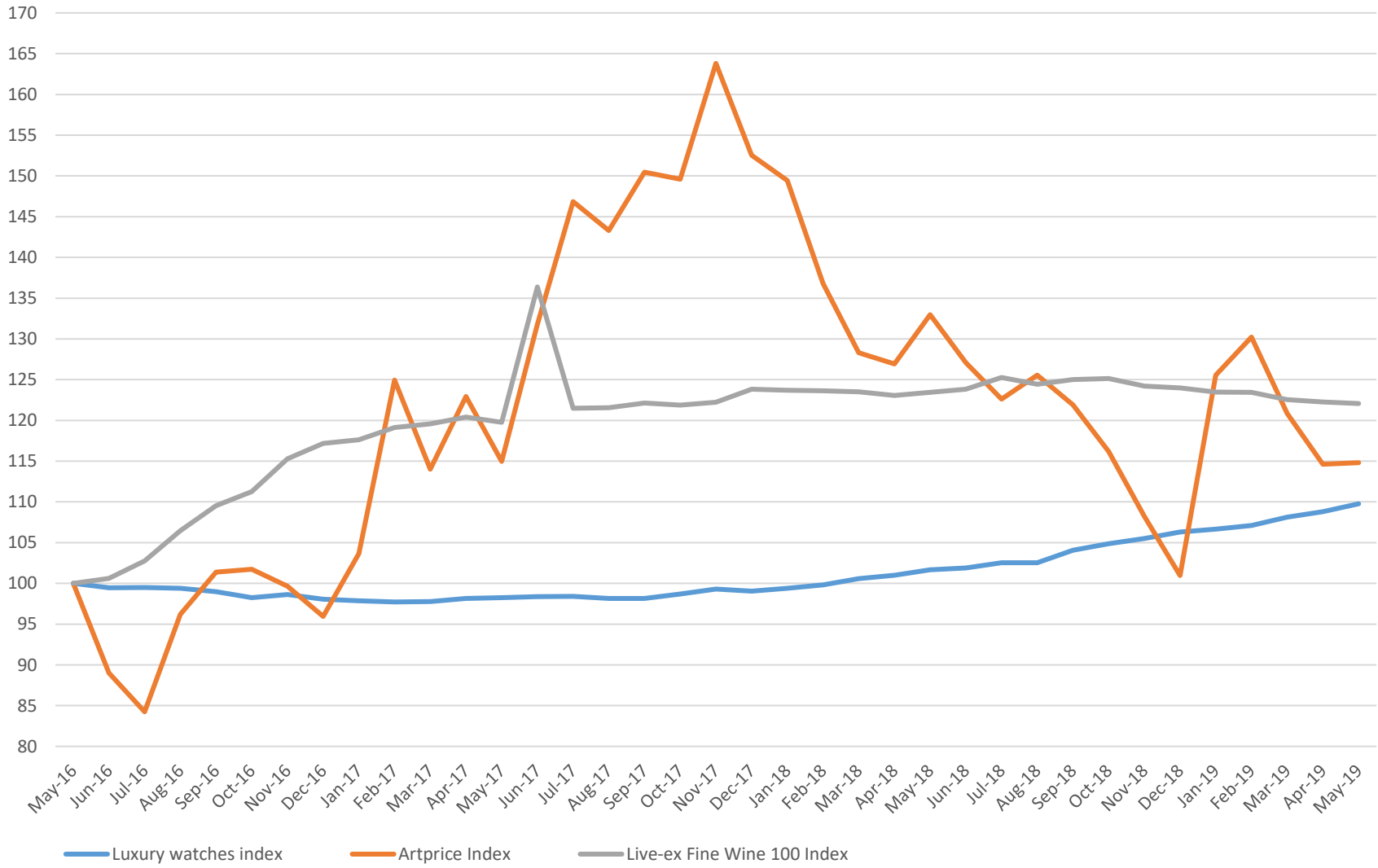


Figure 9. Luxury watches vs. the Artprice Index and Live-ex Fine Wine 100 Index

Figure 9 compares luxury watches hedonic real price index, adjusted for insurance and storage costs, versus the Artprice Index and Live-ex Fine Wine 100 Index. All indices are set equal to 100 in May 2016.



APPENDIX

Appendix 1. Luxury watches service costs

Below average service costs, for all included in thesis dataset watch brands, were summarized. All service prices come from brands' official websites or catalogues, except for Rolex and Tudor. Those two brands (set up by the same founder) do not testify fixed service prices, which vary depending on location. Thus, Rolex service cost was estimated by using a proxy of Daytona model, serviced by Rolex Service Center Dallas in February 2018. To estimate Tudor service costs, Black Bay model with ETA movement was used as a proxy, serviced by Rolex Service Center Beverly Hills.

Brand	Average Cost	Service Description
Audemars Piguet	$,1077	Opening of the watch, prewashing of the movement, dismantling of every component of the movement, preventive replacement of those subject to wear and damaged, washing of all the components, assembling of the movement and complete lubrication, timing, casing up, final control.
Breguet	$1,434	Dismantling, cleaning, oiling of the watch movement. Repair or replacement of worn or damaged movement parts. Replacement of crown, push-buttons, gaskets. Refurbishment of case and bracelet.
Breitling	$571	Refurbishment of the case and metal bracelet, changing all seals, partial changing of hands and checking of water resistance. Disassembly, cleaning and replacing of standard movement parts, assembly, lubrication, adjustment and setting of movement function parameters
IWC	$762	It involves a full overhaul of the timepiece. A specialist completely dismantles the movement, meticulously checks every part and repairs or replaces it, as required.
Omega	$650	Dismantling, cleaning, oiling of the watch movement. Repair or replacement of worn or damaged movement parts. Replacement of crown, push-buttons, gaskets. Refurbishment of case and bracelet.
Panerai	$637	Watch dismantling and washing, case and bracelet polishing, case assembly, movement dismantling and washing, movement assembly and lubrication

Appendix 1. Service costs (continuation)

Patek Philippe	$2,067	Seals, complete hand set, crown, mainspring barrel and certain movement parts are replaced
Richard Mille	$3,025	Dismantling of the case, replacing crystals and gaskets. Brushing case back, middle case and bezel. Case rebuilding, checking of all functions. Technical and aesthetic final inspection.
Rolex	$,1327	Full service, water resistance test, ultrasonic cleaning, replace crown, sapphire crystal and gasket
Tag Heuer	$429	Water-resistance test, cleaning of movement or change of movement, refurbishment of case and bracelet, control of function of the movement, check of accuracy
Tudor	$525	washing of case and movement parts and oiling of movement, replacement of movement parts if worn out, polishing/brushing of case and bracelet
Vacheron Constantin	$1,518	Complete service