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Fine wines in a diversified portfolio of collectibles

by Eric Le Fur

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Fine wines in a diversified portfolio of collectibles

Abstract

This article examines short- and long-run linkages between collectibles market indices and fine wines market between 2004 and 2019 using cointegration procedures and the Granger non-causality test. Results indicate that there are a relative number of significant causal linkages between these market indices, and a quasi no feedback. These relative causal linkages between collectibles market indices and the fine wines market would indicate that the expected returns by investors, collectors, or brokers may be high. These results also suggest that opportunities may be expected for portfolio diversification.

Keywords: cointegration; collectibles; diversification; wine market.

1. Introduction

The collectibles market is characterized by specific characteristics such as heterogeneity, illiquidity, market segmentation, information asymmetries, behavioral anomalies, lack of basic value, specific taxes, insurance, commissions for intermediaries, transport costs (Baumol, 1986). Because of these specificities, the market is structurally confronted with high uncertainty. The investment funds as well as the wealthiest households (UHNWI and HNWI¹) in the world have well understood the interest of diversifying their portfolio with these collectibles. Although the vast majority of their wealth remains concentrated in financial and real estate assets, these households are increasingly investing in collectible assets sometimes considered as luxury assets. These goods are as diverse as fine wines, classic cars, art, jewelry, watches, collectible stamps, rare coins or violins, Chinese ceramics, rare books, baseball cards, autographs or guitars.

Since the early 2000s, investing in these collectibles has become fashionable (Masset et al., 2016). This popularity is due in particular to the passion and hobbies generated by this alternative asset. Indeed, some collectors are passionate and even obsessive about purchasing unique objects in one way or another (Belk, 2013). They may be taxonomic (i.e. they have one copy of each type of a series of objects) or aesthetic (i.e. they simply collect a few copies of a particular type of object) (Belk, 1991). They can also be classified into four other categories²: passionate collectors (obsessive and willing to pay irrationally high prices), acquired collectors (who buy collectibles as an investment), amateur collectors (who simply collect for pleasure) and expressive collectors (who build collections that confirm their identity) (Saari, 1997).

Due to this rising interest by investors and collectors, collectibles market is broadly studied in the academic literature (Burton and Jacobsen 1999). Thus, in the past 20 years, a large academic effort has attempted to select and compute indices for each type of collectibles to estimate the

¹ HNWI are defined as having a net worth of at least \$1 million and the ultra-high net worth investors (UHNWI) are those whose net worth exceeds \$30 million excluding their primary residence.

² In the United States, the Internal Revenue Service distinguishes three categories of collectors: collectors (who buy items primarily for fun), investors (who want to make a long-term profit) and dealers (who buy and sell for the sole purpose of making a short-term profit). Conversely, some observers give a more restrictive definition, in which a collector is motivated to accumulate a series of similar objects whose instrumental function is not important and does not intend to dispose of them immediately. Thus, an individual who accumulates a variety of toasters but does not use them to make toast is a toaster collector (McIntosh and Schmeichel, 2004).

risk and return as well as expected gains to portfolio diversification. Although many different categories of collectibles³ are studied, art and wine are the most examined.

The first studies on determining the returns on investment in art⁴ date back to the mid-1970s (Anderson, 1974; Stein, 1977a). Although that investors estimate art investment as profitable confirmed by some auctions with record amounts, over a longer period of time, high prices are only partially reflected in the rates of return (Goetzmann, 1993). For example, considering all the additional risks and frictions in the art market, the return on investments in art does not exceed their opportunity cost (Baumol, 1986). Between 1900 and 2012, the annualized real return is 2.4% (6.4% in nominal terms). There were strong price appreciations in the late 1960s, early 1970s, late 1980s, and between 2004 and 2006. Prices fell significantly during the First World War, during the Great Depression, in the years following the 1973 oil crisis, during the recession of the early 1990s and during the financial crisis of 2008 (Dimson and Spaenjers, 2014). During the period 1957-2007, the real annual rate of return on investment in art is 3.9% and even sometimes negative during several years (Renneboog and Spaenjers, 2013). In comparison to financial assets, art presents lower returns than equities and higher returns than gold (Frey and Eichenberger, 1995; Campbell, 2008; Goetzmann et al., 2011; Renneboog and Spaenjers, 2013; Dimson and Spaenjers, 2014). The majority of studies show weakly positive correlation indices between art and financial markets (Mei and Moses, 2002; Pesando and Shum, 2008). Finally, there are significant interrelations between art and the main stock markets (Worthington and Higgs, 2003, 2004) and opportunities of diversification due to feedback phenomena and moderate causal links between art market indices (Le Fur, 2020).

Studies indicate that annual returns of fine wines⁵ are positive regardless of the wine-growing region : Australia (Byron and Ashenfelter, 1995; Fogarty, 2006; Wood and Anderson, 2006) Bordeaux (Ashenfelter et al., 1995; Burton and Jacobsen, 2001; Jones and Storchmann, 2001; Hadj Ali and Nauges, 2003; Sanning et al., 2008; Masset and Henderson, 2010; Dimson et al., 2015), California (Haeger and Storchmann, 2006), and Rhone (Lucey and Devine, 2015).

³ For example, antique firearms (Avery and Colonna, 1987), beanie babies (Burton and Jacobsen, 1999), ceramics (Keen, 1971; Stein, 1977b; Deutschman and Ballen, 1991), classic cars (Martin, 2016; Le Fur, 2019), coins (Kane, 1984; Koford and Tschoegl, 1998; Dickie et al., 2008), diamonds (Dohrman, 1981; Renneboog and Spaenjers, 2012), mettlach beer steins (Kelly, 1994), photographs (Pompe, 1996; Perloff, 1998; Burton and Jacobsen, 1999), stamps (Renneboog and Spaenjers, 2009), timber (Redmond and Cabbage, 1988) and violins (Ross and Zondervan, 1989). See also Le Fur (2021) for a review of contagion effect between financial and collectibles markets.

⁴ For a review of the literature on the determinants of art prices, anomalies in price formation in the art market, art auctions and price indices, see Ashenfelter and Graddy (2003) and Ginsburgh et al. (2006).

⁵ See Le Fur and Outreville (2019) for a review.

Exceptionally, an increase can be followed by a slight decrease. For example, between 1981 and 1985 the Bordeaux wine prices have increased by close 75% and then have declined by 15% between 1986 and 1992 (Di Vittorio and Ginsburgh, 1996). The academic literature also indicates the positive effect of portfolio diversification among fine wines (Kourtis et al., 2012). However, the benefits of diversification depend on the index used (Chu, 2014). In addition, the high returns on indirect investments via wine funds question the relevance of the selectivity and valuation methods used by the managers of these funds, their ability to anticipate the market and the volatility of the funds raise (Bocart and Hafner, 2015; Lucey and Devine, 2015; Masset and Weisskopf, 2015). The academic literature on wine returns in a mixed-asset portfolio context does not conclude on the supremacy of any asset. Results depend on the studied period, the used methodology and type of assets considered in the portfolio. However, it seems that portfolios with wine are most efficient than portfolios without wine (Aytac and Mandou, 2016). The role of wine as an alternative asset class has been the subject of controversial discussion for several decades (Storchmann, 2012). Two main trends emerge from these studies. First, many studies agree on the interest of including wine in a mixed asset portfolio (Sanning et al., 2008; Masset and Henderson, 2010 ; Fogarty and Jones, 2011; Bouri et al., 2018). Second, wine is considered as a safe haven (Bouri, 2014, 2015; Jureviciene and Jakavonyte, 2015; Bouri and Roubaud, 2016; Bouri et al., 2018). However, the benefits can be misleading depending on the construction of the index and the method used to measure diversification (Fogarty and Jones, 2011; Fogarty and Sadler, 2014; Faye and Le Fur, 2019; Outreville and Le Fur, 2020). Finally, there is high impact of financial markets on wine prices (Faye et al., 2015) as well as transmission and contagion of volatility from financial markets to wine market (Le Fur et al., 2016a, 2016b; Ben Ameer and Le Fur, 2020).

Despite the growing importance of collectibles in wealth management and portfolio diversification, the academic literature using cointegration on these market indices is poorly developed. Thus, the purpose of this paper is to test the linkages and speed of adjustment between fine wine market indices and the major other collectibles indices, using traditional cointegration methodology. We use a VAR-ECM model to explore short- and long-run dynamics between these market indices. The results indicate that there are moderated significant causal linkages between the collectibles markets and the fine wines market and practically no feedback between these markets. These relative weak causal linkages between collectibles markets and the fine wines markets would indicate that the expected returns by investors and collectors as well as brokers may be high. In addition, in case of no Granger

causality these results also suggest that there might be opportunities for portfolio diversification. This article contributes to the literature as it is the first to deal with the cointegration between fine wines and the other main collectibles used by investors.

The remainder of this article proceeds as follows: Section 2 describes the database used in further analysis. Section 3 outlines the methodology. Section 4 describes the results and then discusses them. We conclude in Section 5.

2. Data

There are many indices representative of collectibles. In this article, we wish to be as exhaustive as possible with regard to the categories selected. Within each category of collectibles we select the indices most used and representative in academic literature and by investors. Finally, 8 categories of collectibles and 39 indices are selected. We have a 16 years quarterly database from the period January 2004 to December 2019.

Wine indices come from Liv-ex. We observed the Liv-ex Fine Wine 1000⁶ and the seven sub-indices. The Liv-ex Fine Wine 1000 tracks 1,000 wines from across the world. It is rebased at 100 in December 2003. To qualify for the index, wines must have attracted a regular market on Liv-ex. They must also be physically available, so recent vintages that are only trading on an en primeur basis are ineligible. The Liv-ex 1000 is calculated using the Liv-ex Mid Price⁷ for each component wine. Regarding the sub-indices, the Bordeaux 500 contains the 10 most recent physical vintages for the top 50 Bordeaux chateaux, the Bordeaux Legends 50⁸ is a selection of 50 Bordeaux wines that are exceptional older vintages prior to 1982, the Burgundy 150 includes the ten most recently physical vintages of 15 white and red Burgundy wines, the Champagne 50 contains the most recently physical vintages of 12 Champagnes, the Rhone 100 is a selection of the ten most recently physical vintages of five Southern and five Northern Rhone wines, the Italy 100 contains the ten most recently physical vintages of the five Super Tuscans and five

⁶ The Liv-ex 1000 is price weighted at launch as follows: Bordeaux 500 (46%), Bordeaux Legends 50 (22%), Burgundy 150 (14%), Italy 100 (7%), Rhone 100 (4%), Rest of the World 50 (4%), and Champagne 50 (3%). In 2020, in order to take the evolution of the demand for fine wines across the globe into account, this distribution became the following: Bordeaux 500 (33%), Bordeaux Legends 50 (10%), Burgundy 150 (28%), Italy 100 (9%), Rhône 100 (4%), Rest of the World 50 (12%) and Champagne 50 (3%).

⁷ See the Liv-ex website for details of calculations.

⁸ In 2019, the Bordeaux 50 is became the Bordeaux 40, corresponding to a selection of 40 Bordeaux wines (from 1989).

other leading Italian producers, and the Rest of the World 50 is a selection of the ten most recently physical vintages of five wines from Australia, Portugal, Spain, and the USA.

Art data come from Artprice company⁹, a French company currently trading on the Paris Euronext Stock Exchange that owns the largest databases of fine art and catalogue auctions in the world. Indexed auction records are based on fine art and design catalogued auctions recorded by artprice.com. For all available indices, there is a base 100 in January 1998. Artprice provides a global index named Artprice Global Index (AGI), regional sub-indices (France, UK and USA), and sub-indices by category (19th century, contemporary, drawings, old masters, modern art, paintings, photography, post-war, prints, sculptures).

Although classic cars have existed for more than 100 years, scant long-term data are available. Index providers of classic cars have only been around for several decades. Data and information are available on their websites but often require a subscription¹⁰. Finally, since 1994 the Swiss dealer and consultant Kidston has provided indices recognized as references by collectors. As indicated on the Kidston website: “The K500 tracks the movement of the classic car market through tens of thousands of veritable and quantified auction sale results. [...]. Data in K500 is taken from some 30,000 constantly growing auction results [...]. We use verifiable saleroom transactions, rather than rumored private deals, to ensure transparent, unbiased market data. Each car in the K500 has been chosen for its historical and intrinsic interest to the collector, and only results from these cars are included in our Index and Average Values figures”. Database consists of the K500 indices: K500 Average Index, Affordable Classic, Ferrari (Pre-1958), Ferrari (1958–1973), Ferrari (Post-1973), Porsche, Pre-War American, Pre-War European, Post-War American, Post-War European and Post-War Racing Cars.

⁹ [Http://imgpublic.artprice.com/pdf/agi.xls](http://imgpublic.artprice.com/pdf/agi.xls)

Artprice has been developing highly sophisticated mathematical models based on the repeated sales method known as the homogeneous model developed by Mei and Moses in the early 1960s. In 1999, Artprice bought the Swiss Xylogic company, the only scientific company in the world to practice the method of repeated sales that had been developed by Mei and Moses. Today, Artprice applies this methodology on 6300 auction houses as well as on 30 million works and 630,000 artists. With 4.5 million subscribers, the company has become the world leader in information on the art market by producing a multitude of indices, statistics, algorithms and decision-making tools.

¹⁰ The HAGI offers different indices: a Top Index (which incorporates 50 cars with a monthly calculation in pounds); the HAGI-F Index for Ferrari (12 constituents); the HAGI-P Index (Porsche with 14 cars); and the HAGI-MB Index (Mercedes with 2 cars). Hagerty, a US insurance company, publishes a global market index (Hagerty Market Index) as well as sub-indices: 1950s American, Affordable Classic, Blue Chips, British Cars, Ferrari, German Collectibles and Muscle Cars. Since 2009, VDA, a German association of the automotive industry, has published the DOX Index, which is calculated once a year and incorporates 88 cars from seven different countries and 35 brands. Finally, since 1994 the Swiss dealer and consultant Kidston has provided indices recognized as references by collectors.

Stanley Gibbons Ltd., the world's leading stamp experts, has created two indices, the GB30 and the GB250 that are followed by professional money managers through Bloomberg Financial. The Stanley Gibbons GB250 tracks the performance of the top 250 traded investment grade British stamps over the last 12 years. It is accessible via The Bloomberg Professional service (STGIGB25) and is frequently quoted in the financial press as it provides a broad view of the investment market for British stamps. This is the largest stamps index in existence. This index includes watermark varieties, specimens, errors and Government officials. Stanley Gibbons also releases a GB200 Coin Index for investors which tracks the performance of a representative sample of 200 rare British coins, from the standard catalogue of British coins with data tracked back 10 years. Stanley Gibbons has also composed an index of 30 first editions of 20th-century classics, named the Rare Book Index.

The 42 Guitar Index tracks since 1991 the cumulative value of 42 vintage instruments from Gibson, Fender and Martin. The index is published by Vintage Guitar magazine. The Harmonized Index of Consumer Prices category "Jewelry, Clocks, and Watches" is an American classification of durable goods that includes precious stones and metals and jewelry fashioned out of such stones and metals; costume jewelry, cuff-links and tie-pins, clocks, watches, stop-watches, alarm clocks, travel clocks, and repair of such articles.

Table 1 presents the main descriptive statistics and Table 2 the correlations between the fine wine and other collectibles indices. Although the correlations are globally high, inflation factor variance tests do not indicate multicollinearity between variables. Some indices show negative correlations, notably the Pre-war American and about half of the art indices. There are also high correlations among wine indices.

Table 1. Descriptive statistics

	Minimum	Maximum	Mean	Median	SD	Skweness	Kurtosis	Jarque-Bera
Bordeaux 500	100.00	322.30	214.88	237.50	65.64	-0.48	-0.88	8.123
Bordeaux Legends 50	100.00	385.00	257.22	281.50	82.64	-0.68	-0.58	12.439
Burgundy 150	100.00	408.10	229.52	230.94	89.26	0.15	-0.96	4.283
Champagne 50	100.00	355.30	223.46	235.88	68.98	-0.17	-0.81	5.477
Rhone 100	100.00	191.40	146.39	154.50	27.55	-0.40	-1.21	6.124
Italy 100	98.22	268.40	176.77	187.09	49.92	-0.11	-1.18	5.059
Rest of the World 50	96.42	284.90	172.42	172.86	54.42	0.25	-0.92	3.518
Liv-ex Fine Wine 1000	100.00	330.00	214.64	243.50	65.75	-0.40	-0.86	7.495
Artprice Global	99.35	180.13	133.10	130.08	21.48	0.30	-0.92	2.777
Art Global Index (EUR)	86.04	156.88	122.61	119.92	15.60	0.21	-0.52	0.430
Paintings	89.17	167.69	120.85	120.66	19.30	0.54	0.26	0.018
Prints	98.74	157.61	116.80	115.05	13.62	1.41	1.99	14.196

Sculptures	86.82	157.10	117.38	115.12	18.07	0.59	-0.29	1.271
Photography	100.00	171.04	127.33	123.21	16.62	0.79	0.27	1.635
Drawings	86.83	209.83	135.73	119.84	38.61	0.69	-1.01	5.332
Old Masters	57.28	132.86	99.28	104.19	19.16	-0.59	-0.56	8.419
19th Century	56.98	135.59	93.95	91.56	22.06	0.17	-0.92	2.361
Modern Art	82.72	163.41	115.41	114.61	20.05	0.49	0.08	0.189
Post-war	100.00	206.19	161.67	167.59	28.25	-0.44	-0.79	5.571
Contemporary	100.00	227.02	164.14	159.28	28.09	0.19	-0.42	0.871
Art USA (in USD)	100.00	154.24	121.38	119.66	12.94	0.77	0.41	1.769
Art UK (in GBP)	99.07	143.23	123.74	127.17	13.55	-0.44	-0.98	4.990
Art France (in EUR)	78.80	127.53	101.30	100.15	11.96	0.35	-0.23	0.207
K500	100.00	295.20	202.83	173.92	61.55	0.17	-1.42	3.500
Pre-War European	100.00	195.44	151.14	144.21	31.24	0.06	-1.55	5.159
Pre-War American	53.24	117.25	84.53	83.91	15.11	0.11	-0.44	1.462
Ferrari (Pre-1958)	100.00	457.06	275.53	220.70	126.77	0.23	-1.57	4.273
Ferrari (1958-1973)	100.00	353.95	222.32	202.13	85.92	0.21	-1.43	4.104
Ferrari (Post-1973)	100.00	378.65	181.90	124.12	92.50	0.99	-0.57	7.767
Post-War European	100.00	253.58	176.27	172.16	34.70	-0.29	-0.18	7.630
Post-War American	100.00	261.73	193.43	180.40	44.40	-0.12	-1.05	3.063
Porsche	100.00	345.44	222.60	211.43	76.86	0.15	-1.31	3.348
Post-War Racing Cars	100.00	268.71	189.97	177.52	54.44	-0.01	-1.38	3.930
Affordable Classics	100.02	227.82	153.61	148.42	33.60	0.53	-0.67	1.620
42 Guitar	100.00	260.53	186.55	199.67	43.32	-0.60	-0.54	9.196
GB 250 rare stamps	100.00	373.33	252.43	268.33	91.94	-0.27	-1.37	6.195
CPI Jewellery clocks and watches	98.66	159.38	129.10	130.28	21.33	-0.14	-1.61	6.360
Rare Book	100.00	275.00	176.66	160.63	54.80	0.42	-1.26	4
GB 200 rare coins	100.00	240.00	195.99	216.25	45.47	-0.91	-0.67	11.588

Table 2. Correlations between the fine wine indices and the other indices

	Bordeaux 500	Bordeaux Legends 50	Burgundy 150	Champagne 50	Rhone 100	Italy 100	Rest of the World 50	Liv-ex Fine Wine 1000
Bordeaux 500	1.000	0.989	0.950	0.969	0.965	0.938	0.917	0.997
Bordeaux Legends 50	0.989	1.000	0.908	0.945	0.928	0.896	0.869	0.982
Burgundy 150	0.950	0.908	1.000	0.987	0.970	0.990	0.992	0.968
Champagne 50	0.969	0.945	0.987	1.000	0.966	0.979	0.973	0.984
Rhone 100	0.965	0.928	0.970	0.966	1.000	0.975	0.951	0.973
Italy 100	0.938	0.896	0.990	0.979	0.975	1.000	0.990	0.959
Rest of the World 50	0.917	0.869	0.992	0.973	0.951	0.990	1.000	0.942
Liv-ex Fine Wine 1000	0.997	0.982	0.968	0.984	0.973	0.959	0.942	1.000
Artprice Global	0.305	0.329	0.158	0.208	0.261	0.149	0.091	0.271
Art Global Index (EUR)	0.396	0.384	0.372	0.377	0.395	0.363	0.347	0.391
Paintings	-0.133	-0.043	-0.379	-0.279	-0.271	-0.406	-0.468	-0.189
Prints	-0.072	-0.002	-0.263	-0.180	-0.214	-0.316	-0.344	-0.117
Sculptures	-0.055	0.038	-0.310	-0.210	-0.202	-0.337	-0.398	-0.111
Photography	-0.222	-0.140	-0.390	-0.309	-0.360	-0.438	-0.460	-0.260
Drawings	0.584	0.534	0.577	0.553	0.650	0.592	0.556	0.580
Old Masters	-0.481	-0.423	-0.656	-0.596	-0.506	-0.655	-0.716	-0.526
19th Century	-0.663	-0.595	-0.831	-0.772	-0.763	-0.849	-0.876	-0.708
Modern Art	-0.258	-0.163	-0.499	-0.400	-0.391	-0.522	-0.582	-0.313
Post-war	0.547	0.599	0.385	0.470	0.442	0.367	0.310	0.518
Contemporary	0.450	0.495	0.299	0.373	0.350	0.261	0.207	0.419
Art USA (in USD)	0.150	0.236	-0.034	0.068	-0.028	-0.079	-0.096	0.116
Art UK (in GBP)	0.838	0.833	0.805	0.818	0.776	0.766	0.766	0.836

Art France (in EUR)	-0.445	-0.354	-0.663	-0.573	-0.589	-0.691	-0.728	-0.496
K500	0.852	0.808	0.954	0.938	0.879	0.940	0.957	0.883
Pre-War European	0.834	0.784	0.918	0.894	0.887	0.910	0.910	0.858
Pre-War American	-0.205	-0.209	-0.077	-0.123	-0.252	-0.146	-0.058	-0.180
Ferrari (Pre-1958)	0.861	0.816	0.960	0.944	0.900	0.957	0.967	0.892
Ferrari (1958-1973)	0.882	0.838	0.973	0.955	0.910	0.966	0.979	0.911
Ferrari (Post-1973)	0.639	0.574	0.827	0.779	0.687	0.809	0.867	0.687
Post-War European	0.819	0.812	0.852	0.880	0.831	0.851	0.834	0.840
Post-War American	0.806	0.782	0.877	0.883	0.829	0.863	0.860	0.831
Porsche	0.894	0.856	0.974	0.964	0.918	0.973	0.979	0.922
Post-War Racing Cars	0.887	0.851	0.964	0.955	0.911	0.958	0.963	0.914
Affordable Classics	0.820	0.792	0.907	0.897	0.802	0.880	0.915	0.849
42 Guitar	0.828	0.858	0.722	0.786	0.751	0.710	0.675	0.816
GB 250 rare stamps	0.939	0.906	0.982	0.981	0.967	0.991	0.978	0.959
CPI Jewellery c&w	0.893	0.836	0.974	0.941	0.954	0.975	0.975	0.917
Rare Book	0.832	0.783	0.949	0.927	0.867	0.947	0.970	0.868
GB 200 rare coins	0.972	0.962	0.950	0.977	0.957	0.949	0.922	0.978

3. Methodology

In this study we investigate the short- and long-run dynamics of technical efficiency in collectibles market indices. Before running the cointegration analysis, we need to analyze the properties of our time series by running tests for unit roots in all market indices, which are defined as logs. Indeed, when variables are not stationary, conventional hypotheses for asymptotic analysis do not hold. To test the statistical stationarity of the variables we applied the ADF test which examines whether a time series follows a unit-root-process such as a random walk. According to the null hypothesis the time series contains a unit root, and the alternative assumes that the time series is generated by a stationary process (Dickey and Fuller, 1979). The maximal lag included in the equation test is determined following recommendations by Schwert (1989). The estimated model is as follows:

$$\Delta y_t = \alpha + \beta t + \phi y_{t-1} + \sum_{i=1}^p \gamma_i \Delta y_{t-i} + u_t \quad (1)$$

where y_t is the log of financial series at time t ; α is a constant; β is the coefficient of a trend time; and u_t is the contemporaneous error term. The lag length p in all the tests was selected according to the Akaike Information Criteria (AIC). The null hypothesis is $H_0: \Phi = 0$, i.e., the series has a unit root and is integrated of order 1, that is, stationary. Empirical evidence of

stationarity in the first difference justifies the cointegration analysis proposed by Johansen and Juselius (1990).

Next we apply an empirical two-stage analysis. The first step is to employ the VAR methodology in order to determine the lag length of the model. The choice of order p of the vector autoregression is based on standard information criteria. The second step is to determine the number of cointegrating vectors. Johansen (1988) proposed the Trace test (3) and the maximum Eigenvalue test (4). Both tests are constructed as follows (Johansen, 1991):

$$Trace(r/n) = -T^* \sum_{i=r+1}^n \log(1 - \hat{\lambda}_i) \quad (2)$$

$$Eigenvalue(r/n + 1) = -T^* \log(1 - \hat{\lambda}) \quad (3)$$

where $\hat{\lambda}_i$ is the estimated value for the i th ordered eigenvalues from matrix Π . The Trace statistic tests the null hypothesis for numbers of cointegrating vectors less than or equal to r . The maximum Eigenvalue statistic tests the null hypothesis of r against the alternative of $r + 1$ cointegrating relations.

Finally we conducted an empirical analysis of causality between variables using the standard Granger non-causality test (Granger, 1969). The procedure involves estimating the $VAR(p)$ model and imposing restrictions on parameters. The null non-causality can be tested by a standard Wald test. If the p -value of the Chi-Square statistic is less than 5%, the null hypothesis of non-causality in the Granger sense should be rejected.

4. Results and comments

Unit roots determine the order of integration of the variables. Table 3 presents the Augmented Dickey Fuller unit root tests. These tests can be perceived as a way to discriminate between different indices. All series are in log. The unit root tests have been applied using a model with constant and a model with constant and linear trend. The lag length has been selected according to the Schwartz Information Criteria. The null hypothesis that the indices have a unit root in levels can be rejected at the 5% significance level for all observed time series. Based upon these results, there is evidence that the collectibles indices are non-stationary at the conventional level

of significance and are integrated of order I(1): the series are stationarity in first difference. Hence, we can process to test for cointegration of the collectibles indices.

Table 3. Augmented Dickey Fuller unit root test results

Series	t-stat. in level	t-stat. in first difference	Series	t-stat. in level	t-stat. in first difference
19th Century	-0.069	4.799***	Italy 100	-0.7388	-7,6933***
42 Guitar	-2.7712*	-11.4270***	K500	-1.3699	-3,1475**
Affordable Classics	-1.3972	-2.8073*	Liv-ex Fine Wine 1000	-1.5800	-3,8904***
Art France	-1.4333	-2,8346*	Modern Art	-0.5982	-4,6551***
Art Global Index	-2.4704	-2,9255**	Old Masters	-0.6443	-3,8055***
Art UK	-2.4275	-4,0490***	Paintings	-1.1915	-4,8238***
Art USA	-3.8504**	-5,1841***	Photography	-2.6185*	-2,9577**
ArtPrice Global	-2.2846	-4,4754***	Porsche	-1.3506	-3,5176***
Bordeaux 500	-1.6225	-4,0289***	Post-War	-2.4719	-3,7453***
Bordeaux Legends	-1.9964	-4,1823***	Post-War American	-2.3115	-4,8775***
Burgundy 150	-0.7352	-4,3707***	Post-War European	-2.6445*	-11,3766***
Champagne 50	-1.9200	-4,7652***	Post-War Racing Cars	-1.7278	-3,1561**
Contemporary	-2.2057	-4,0102***	Pre-War American	-1.7709	-5,9840***
CPI Jewellery	-0.5731	-4,2184***	Pre-War European	-1.1423	-3,0780**
Drawings	-1.9799	-5,5486***	Prints	-2.3466	-3,4098***
Ferrari 1958-1973	-1.5285	-2,7017*	Rare Book	-0.2875	-2,9773**
Ferrari Post-1973	-1.5555	-2,7720*	Rest of the World 100	-0.3402	-7,7147***
Ferrari Pre-1958	-1.6656	-3,2397**	Rhone 100	-1.1129	-5,2425***
GB 200 Rare Coins	-1.3895	-2,7372*	Sculptures	-1.3982	-5,6960***
GB 250 Rare Stamps	-2.2444	-2,7248*			

Notes: All series are in logs; ***, **, * denotes respectively significance at 1%, 5% and 10% level using t-stat approach.

We aim to analyze the linkage between the wine market and other collectibles markets to determine how collectibles markets influence the wine market. Table 4 reports the results of the Johansen procedure. The first column represents the number of cointegration relations under the null hypothesis. The second column is the ordered Eigenvalue for matrix Π . The third column represents the test statistic. Finally, the fourth column is the Max-Eigen statistic. Only significant results are presented. Table 4 indicates that there are 62 significant causal links between the wine market and the rest of collectibles indices.

All wine markets are influenced by other collectibles markets. Some are more so than others. There are two main categories that are representative of the importance of indices in the valuation of the overall index. The first is made up of Burgundy, the Rhone, Italy and the Rest of the World, which offers opportunities for diversification. A second is composed of Bordeaux, Champagne and the global index. Thus, the most influenced wine markets are the most "luxurious" markets: Bordeaux and Champagne as well as the general index which is essentially composed of Bordeaux. Holding great Bordeaux wines in its portfolio seems to reduce the

diversification possibilities of a portfolio composed of different collectibles. However, this leaves a great room of maneuver to compose another diversified portfolio with great non-Bordeaux wines and collectibles from very diverse horizons.

With the exception of the rare books, all markets more or less influence the wine market. For example, not all art markets influence the wine market, notably global indices (AGI and global artprice) and most time indices (contemporary¹¹, modern art¹², old masters¹³ and post-war¹⁴). This result is very interesting for an investor holding works of art by artists born before 1760 and after 1860. He may consider diversifying his portfolio with great wines. On the other hand, diversifying your portfolio containing great wines with technical indices of art (drawings¹⁵, photography¹⁶, prints¹⁷) does not seem a good opportunity. Auctions in Paris do not influence the wine market in the opposite way to those in London and New York. The main reason is undoubtedly linked to the much higher volumes traded in these last two cities than in the French capital. This is also true for auction sales of great wines.

The vast majority of classic car indices have no influence on wine indices. It would therefore be interesting to diversify a portfolio with great wines and classic cars from before the Second World War, or Ferrari or more affordable cars. However, the most-known German brand, Porsche, is cointegrated with all wine markets indices. The explanation comes from maybe in the internationally recognized brand whose sales are spread across all continents. However, Ferrari is also an internationally recognized brand throughout the world and has no connection with wine indices. Finally, Post-War European is cointegrated with the Bordeaux, Champagne and the Liv-ex 1000. It therefore seems that there is an important link between the French wine market and European classic cars built since the Second World War.

Watches and rare stamps have several long-term causal links with the great wine markets. For example, there is a strong link between English stamps and Bordeaux and Champagne. The

¹¹ Artists born since 1945

¹² Artists born between 1860 and 1920

¹³ Artists born before 1760

¹⁴ Artists born between 1920 and 1945

¹⁵ Art or technique of representing an object or outlining a figure, plan, or sketch by means of lines. Form of visual art in which a person uses various drawing instruments to mark paper or another two-dimensional medium.

¹⁶ Practice of creating durable images by recording light or other electromagnetic radiation, either electronically or chemically.

¹⁷ Prints are not a reproduction. Artwork that has been manually printed by the artist or under the artist's direct supervision. The artist will have created an image on a block, stone, plate or screen from which the final print is produced. They will choose the paper that the image is printed on and will determine the edition size for the print (the number of copies printed).

indices of the rare coins and guitars are practically not co-integrated with those of the great wines. Very interesting diversification opportunities therefore exist with these two types of investments.

Table 4. Johansen cointegration tests

Series: Bordeaux 500 vs. 42 Guitar					Series: Bordeaux 500 vs. Art UK					Series: Bordeaux 500 vs. Art USA				
Hyp. CE(s)	No. of	Eigenvalue	Trace Statistic	Max-Eigen Stat.	Hyp. CE(s)	No. of	Eigenvalue	Trace Statistic	Max-Eigen Stat.	Hyp. CE(s)	No. of	Eigenvalue	Trace Statistic	Max-Eigen Stat.
None		0.143383	11.75854	8.512045	None*		0.253515	18.11814**	16.08092**	None		0.214405	14.73714*	13.27227*
At most 1		0.057319	3.246491*	3.246491*	At most 1		0.036367	2.037489	2.037489	At most 1		0.026282	1.464872	1.464872
Series: Bordeaux 500 vs. CPI Jewellery Clothes & watches					Series: Bordeaux 500 vs. GB 250 Rare stamps					Series: Bordeaux 500 vs. Photography				
Hyp. CE(s)	No. of	Eigenvalue	Trace Statistic	Max-Eigen Stat.	Hyp. CE(s)	No. of	Eigenvalue	Trace Statistic	Max-Eigen Stat.	Hyp. CE(s)	No. of	Eigenvalue	Trace Statistic	Max-Eigen Stat.
None*		0.189888	17.48368**	11.58206	None		0.163688	15.48320*	9.831455	None*		0.236969	15.91283**	14.87511**
At most 1		0.101746	5.901620**	5.901620**	At most 1*		0.097656	5.651744**	5.651744**	At most 1		0.018691	1.037720	1.037720
Series: Bordeaux 500 vs. Post-War European					Series: Bordeaux 500 vs. Prints					Series: Bordeaux 500 vs. Porsche				
Hyp. CE(s)	No. of	Eigenvalue	Trace Statistic	Max-Eigen Stat.	Hyp. CE(s)	No. of	Eigenvalue	Trace Statistic	Max-Eigen Stat.	Hyp. CE(s)	No. of	Eigenvalue	Trace Statistic	Max-Eigen Stat.
None		0.147590	14.29834*	8.782835	None*		0.249389	17.23213**	15.77702**	None*		0.218723	17.71216**	13.57537**
At most 1*		0.065418	5.515509**	5.515509**	At most 1		0.026110	1.455416	1.455416	At most 1*		0.072455	4.136787**	4.136787**
Series: Bordeaux Legends vs. 42 Guitar					Series: Bordeaux Legends vs. Art UK					Series: Bordeaux Legends vs. Art USA				
Hyp. CE(s)	No. of	Eigenvalue	Trace Statistic	Max-Eigen Stat.	Hyp. CE(s)	No. of	Eigenvalue	Trace Statistic	Max-Eigen Stat.	Hyp. CE(s)	No. of	Eigenvalue	Trace Statistic	Max-Eigen Stat.
None*		0.189007	16.01590**	11.52224	None*		0.271684	20.65032***	17.43533**	None		0.193828	14.26315*	11.85021
At most 1*		0.078454	4.493653**	4.493653**	At most 1*		0.056789	3.214997*	3.214997*	At most 1		0.042932	2.412938	2.412938
Series: Bordeaux Legends vs. CPI Jewellery Clothes & watches					Series: Bordeaux Legends vs. Drawings					Series: Bordeaux Legends vs. Prints				
Hyp. CE(s)	No. of	Eigenvalue	Trace Statistic	Max-Eigen Stat.	Hyp. CE(s)	No. of	Eigenvalue	Trace Statistic	Max-Eigen Stat.	Hyp. CE(s)	No. of	Eigenvalue	Trace Statistic	Max-Eigen Stat.
None*		0.228958	16.39969**	14.30069**	None		0.173989	13.84072*	10.51311	None*		0.243902	18.46552**	15.37715**
At most 1		0.037445	2.098998	2.098998	At most 1		0.058708	3.320671**	3.320671**	At most 1		0.054605	3.088376*	3.088376*
Series: Bordeaux Legends vs. GB 200 Rare coins					Series: Bordeaux Legends vs. GB 250 Rare stamps					Series: Bordeaux Legends vs. Photography				
Hyp. CE(s)	No. of	Eigenvalue	Trace Statistic	Max-Eigen Stat.	Hyp. CE(s)	No. of	Eigenvalue	Trace Statistic	Max-Eigen Stat.	Hyp. CE(s)	No. of	Eigenvalue	Trace Statistic	Max-Eigen Stat.
None*		0.218276	18.97480**	13.54398*	None		0.162879	15.42171*	9.777702	None*		0.231065	16.07239**	14.45120**
At most 1*		0.094021	5.430818**	5.43818**	At most 1*		0.097529	5.644005**	5.644005**	At most 1		0.029046	1.621190	1.621190
Series: Bordeaux Legends vs. Porsche					Series: Bordeaux Legends vs. Post-War American					Series: Bordeaux Legends vs. Post-War European				
Hyp. CE(s)	No. of	Eigenvalue	Trace Statistic	Max-Eigen Stat.	Hyp. CE(s)	No. of	Eigenvalue	Trace Statistic	Max-Eigen Stat.	Hyp. CE(s)	No. of	Eigenvalue	Trace Statistic	Max-Eigen Stat.
None*		0.244678	18.82655**	15.43329**	None		0.146775	13.49622*	8.730251	None		0.148577	14.91828*	8.846536
At most 1		0.059826	3.392958*	3.392958*	At most 1*		0.083006	4.765966**	4.765966**	At most 1*		0.104120	6.071746**	6.071746**
Series: Burgundy 150 vs. Art UK					Series: Burgundy 150 vs. Art USA					Series: Burgundy 150 vs. 19th Century				
Hyp. CE(s)	No. of	Eigenvalue	Trace Statistic	Max-Eigen Stat.	Hyp. CE(s)	No. of	Eigenvalue	Trace Statistic	Max-Eigen Stat.	Hyp. CE(s)	No. of	Eigenvalue	Trace Statistic	Max-Eigen Stat.
None*		0.309967	21.15090***	20.40589***	None*		0.244214	16.16618**	15.39982**	None		0.217628	13.73348*	13.49839*
At most 1		0.013454	0.745013	0.745013	11.9817		0.013837	0.766366	0.766366	At most 1		0.004265	0.235089	0.235089
Series: Burgundy 150 vs. Photography					Series: Burgundy 150 vs. Porsche					Series: Burgundy 150 vs. Prints				
Hyp. CE(s)	No. of	Eigenvalue	Trace Statistic	Max-Eigen Stat.	Hyp. CE(s)	No. of	Eigenvalue	Trace Statistic	Max-Eigen Stat.	Hyp. CE(s)	No. of	Eigenvalue	Trace Statistic	Max-Eigen Stat.
None*		0.294426	19.54641**	19.18088***	None*		0.216489	19.40668***	13.414.14*	None*		0.257842	16.52434**	16.40065**
At most 1		0.006624	0.365533	0.365533	At most 1*		0.098980	5.732538**	5.72538**	At most 1		0.002065	0.113690	0.113690
Series: Champagne 50 vs. Art UK					Series: Champagne 50 vs. Art USA					Series: Champagne 50 vs. CPI Jewellery Clocks and Watches				
Hyp. CE(s)	No. of	Eigenvalue	Hyp. CE(s)	No. of	Eigenvalue	Trace Statistic	Max-Eigen Stat.	Trace Statistic	Max-Eigen Stat.	Hyp. CE(s)	No. of	Eigenvalue	Trace Statistic	Max-Eigen Stat.
None*		0.3075	None*		0.2434	15.9236**	15.3435**	16.7955**	13.4698*	None		0.1975	15.3020*	12.1042
At most 1*		0.0688	At most 1		0.0104	0.5801	0.5801	3.3257*	3.3257*	At most 1		0.0564	3.1977	3.1977
Series: Champagne 50 vs. Photography					Series: Champagne 50 vs. GB 250 Rare Stamps					Series: Champagne 50 vs. Porsche				
Hyp. CE(s)	No. of	Eigenvalue	Trace Statistic	Max-Eigen Stat.	Hyp. CE(s)	No. of	Eigenvalue	Trace Statistic	Max-Eigen Stat.	Hyp. CE(s)	No. of	Eigenvalue	Trace Statistic	Max-Eigen Stat.
None*		0.2775	20.3330***	17.8831**	None*		0.2055	15.7934**	12.6544*	None*		0.2719	20.5916***	17.4531**
At most 1		0.0435	2.4499	2.4499	At most 1		0.0554	3.1389	3.1389	At most 1		0.0554	3.1381	3.1381

Series: Champagne 50 vs. Post-war European				Series: Champagne 50 vs. Prints				Series: Italy 100 vs. Prints			
Hyp. No. of CE(s)	Eigenvalue	Trace Statistic	Max-Eigen Stat.	Hyp. No. of CE(s)	Eigenvalue	Trace Statistic	Max-Eigen Stat.	Hyp. No. of CE(s)	Eigenvalue	Trace Statistic	Max-Eigen Stat.
None	0.1739	13.7312*	10.5090	None*	0.2635	19.5521**	16.8276**	None*	0.2566	16.9103**	16.3138**
At most 1	0.0569	3.2222	3.2222	At most 1	0.0483	2.7244	2.7244	At most 1	0.0107	0.5965	0.5965
Series: Italy 100 vs. Art UK				Series: Italy 100 vs. Art USA				Series: Italy 100 vs. CPI Jewellery Clocks and Watches			
Hyp. No. of CE(s)	Eigenvalue	Trace Statistic	Max-Eigen Stat.	Hyp. No. of CE(s)	Eigenvalue	Trace Statistic	Max-Eigen Stat.	Hyp. No. of CE(s)	Eigenvalue	Trace Statistic	Max-Eigen Stat.
None*	0.2362	16.0337**	14.8232**	None	0.2010	13.6557*	12.3473*	None	0.2056	13.7527*	12.6628*
At most 1	0.0217	1.2104	1.2104	At most 1	0.0235	1.3083	1.3083	At most 1	0.0196	1.0899	1.0899
Series: Italy 100 vs. Photography				Series: Italy 100 vs. Porsche				Series: Liv-ex 1000 vs. Art UK			
Hyp. No. of CE(s)	Eigenvalue	Trace Statistic	Max-Eigen Stat.	Hyp. No. of CE(s)	Eigenvalue	Trace Statistic	Max-Eigen Stat.	Hyp. No. of CE(s)	Eigenvalue	Trace Statistic	Max-Eigen Stat.
None*	0.2914	20.7219***	18.9509***	None	0.2275	17.4044**	14.2024	None*	0.2593	18.2742***	16.5153**
At most 1	0.0316	1.7710	1.7710	At most 1	0.0565	3.2019	3.2019	At most 1	0.0314	1.7588	1.7588
Series: Liv-ex 1000 vs. CPI Jewellery Clocks and Watches				Series: Liv-ex 1000 vs. GB 200 Rare Coins				Series: Liv-ex 1000 vs. Art USA			
Hyp. No. of CE(s)	Eigenvalue	Trace Statistic	Max-Eigen Stat.	Hyp. No. of CE(s)	Eigenvalue	Trace Statistic	Max-Eigen Stat.	Hyp. No. of CE(s)	Eigenvalue	Trace Statistic	Max-Eigen Stat.
None*	0.2346	16.3249**	0.2346**	None	0.1753	14.7006*	10.6042	None	0.2140	14.7695*	13.2502*
At most 1	0.0289	1.6172	1.6172	At most 1*	0.0717	4.0962	4.0962	At most 1	0.0272	1.5193	1.5193
Series: Liv-ex 1000 vs. Photography				Series: Liv-ex 1000 vs. Porsche				Series: Liv-ex 1000 vs. GB 250 Rare Stamps			
Hyp. No. of CE(s)	Eigenvalue	Trace Statistic	Max-Eigen Stat.	Hyp. No. of CE(s)	Eigenvalue	Trace Statistic	Max-Eigen Stat.	Hyp. No. of CE(s)	Eigenvalue	Trace Statistic	Max-Eigen Stat.
None*	0.2463	14.4645**	15.4857**	None*	0.2353	18.8060**	14.7597**	None	0.1629	15.3525*	9.7861
At most 1	0.0176	0.9787	0.9787	At most 1*	0.0709	4.0462	4.0462	At most 1*	0.0962	5.5664	5.5664
Series: Liv-ex 1000 vs. Prints				Series: Liv-ex 1000 vs. Post-War European				Series: Rest of the World 50 vs. Prints			
Hyp. No. of CE(s)	Eigenvalue	Trace Statistic	Max-Eigen Stat.	Hyp. No. of CE(s)	Eigenvalue	Trace Statistic	Max-Eigen Stat.	Hyp. No. of CE(s)	Eigenvalue	Trace Statistic	Max-Eigen Stat.
None*	0.2527	17.5528**	16.0246**	None	0.1476	14.5658*	8.7845	None*	0.2933	19.1299**	19.0987***
At most 1	0.0274	1.5282	1.5282	At most 1*	0.0833	4.7839	4.7839	At most 1	0.0005	0.0312	0.0312
Series: Rest of the World 50 vs. Porsche				Series: Rest of the World 50 vs. 19th Century				Series: Rest of the World 50 vs. Art UK			
Hyp. No. of CE(s)	Eigenvalue	Trace Statistic	Max-Eigen Stat.	Hyp. No. of CE(s)	Eigenvalue	Trace Statistic	Max-Eigen Stat.	Hyp. No. of CE(s)	Eigenvalue	Trace Statistic	Max-Eigen Stat.
None*	0.1968	17.0362**	12.0563	None	0.2425	15.2832*	15.2790**	None*	0.3048	20.1266***	20.0026***
At most 1*	0.0865	4.9798	4.9798	At most 1	7.65E-05	0.0042	0.0042	At most 1	0.0022	0.1239	0.1239
Series: Rest of the World 50 vs. Art USA				Series: Rest of the World 50 vs. Photography				Series: Rhone 50 vs. Prints			
Hyp. No. of CE(s)	Eigenvalue	Trace Statistic	Max-Eigen Stat.	Hyp. No. of CE(s)	Eigenvalue	Trace Statistic	Max-Eigen Stat.	Hyp. No. of CE(s)	Eigenvalue	Trace Statistic	Max-Eigen Stat.
None*	0.2757	17.8473**	17.7468**	None*	0.3600	24.6844***	24.5519***	None*	0.2424	16.0381**	15.2721**
At most 1	0.0018	0.1004	0.1004	At most 1	0.0024	0.1329	0.1329	At most 1	0.0138	0.7659	0.7659
Series: Rhone 50 vs. Porsche				Series: Rhone 50 vs. Art UK				Series: Rhone 50 vs. CPI Jewellery Clocks and Watches			
Hyp. No. of CE(s)	Eigenvalue	Trace Statistic	Max-Eigen Stat.	Hyp. No. of CE(s)	Eigenvalue	Trace Statistic	Max-Eigen Stat.	Hyp. No. of CE(s)	Eigenvalue	Trace Statistic	Max-Eigen Stat.
None*	0.2726	19.6501**	17.5068**	None*	0.2363	16.4077**	14.8313**	None*	0.2363	16.3393**	14.8278**
At most 1	0.0382	2.1432	2.1432	At most 1	0.0282	1.5763	1.5763	At most 1	0.0271	1.5114	1.5114
Series: Rhone 50 vs. Drawings				Series: Rhone 50 vs. Photography							
Hyp. No. of CE(s)	Eigenvalue	Trace Statistic	Max-Eigen Stat.	Hyp. No. of CE(s)	Eigenvalue	Trace Statistic	Max-Eigen Stat.				
None*	0.2670	17.9673**	17.0864**	None*	0.2673	18.2140**	17.1076**				
At most 1	0.0158	0.8809	0.8809	At most 1	0.0199	1.1063	1.1063				

Notes: All series are in logs; ***, **, * denotes respectively significance at 1%, 5% and 10% level using t-stat approach.

Granger causality tests

Granger (1988) specifies that causality must exist in at least one direction when two variables are cointegrated. To ensure the robustness of our results, we therefore apply Granger causality tests to verify whether cointegration relationships are associated with collectibles market causalities in wine markets. Tables 5 and 6 present the Granger causalities between the collectibles indices and the wine market. Tests indicate Granger causality by row to column. For example, in Table 6, the row Italy 100 indicates that this latter market influences (or causes) photography, art UK, Ferrari (1958-1973), Post-War European and the Liv-ex 1000 indices. The finding of causality has an implication for investors because there is no gain from pairwise portfolio diversification between those specific market indices. On the other hand, operators could anticipate that there are sufficient short-run differences between some market indices to gain portfolio diversification in the case of the absence of Granger causality. Understandably these linkages are not entirely due to the markets themselves. Indeed, some economic, social, sociologic, or financial elements could be expected to vary across markets and throughout time: for example, the rate of donations and bequests to museums, differences in fashions and tastes, wealth and income effects, forecasting of the future, or world growth.

Surprisingly, there is very little feedback between the collectibles and wine markets. Feedback occurs when one market influences another and the latter influences first. This is very interesting for investors who may consider that there is a very strong opportunity for investment and portfolio diversification. Indeed, only four cointegrations present feedbacks: affordable classics with wines from the rest of the world and auctions in London with Bordeaux wines and Liv-ex 1000. One can therefore imagine that Bordeaux represents a large part of the sales made on the London market.

The wine market causes more other collectibles markets than the reverse. For example, watches, auctions in Paris and London are influenced by almost all wines. Table 5 indicates that there are fewer short-term causal relationships than long-term ones. Indeed, about half of the collectibles indices do not influence those of wines. Consequently, these specific collectibles prices have an impact on the prices of fine wines. In other words, we can partly predict the prices of fine wines using all available information on these collectible market prices. The results confirm the partial transmission of price fluctuations from the collectibles markets to the fine wines market in the short and medium term. For example, no Italian wine is influenced by

a collectible. In other words, in the short term, there is a real possibility of portfolio diversification composed of collectibles by investing in great Italian wines. However, this finding is not confirmed in the long term by Table 4.

Table 5. Granger causality tests when wines are influenced by other collectibles

Causes	Bordeaux 500	Bordeaux Legends 50	Burgundy 150	Champagne 50	Rhone 100	Rest of the World 50	Liv-ex Fine Wine 1000	Total
Artprice Global	**	**			*		**	4
GB 200 rare coins	**	*	*				**	4
Art UK (in GBP)	**	***					**	3
Paintings	*			*			*	3
Drawings	**				***		**	3
Post-war	**	*					**	3
Affordable Classics			**	**		**		3
Prints	*						*	2
Art Global Index (EUR)	*							1
Old Masters						*		1
Ferrari (Post-1973)					*			1
Porsche						*		1
Post-War Racing Cars						**		1
Rare Book					*			1
Total	8	4	2	2	4	4	7	31

Notes: All series are in logs; ***, **, * denotes respectively significance at 1%, 5% and 10% level using t-stat approach.

Table 6. Granger causality tests when wine is influential to the other collectibles

Causes	CPI Jewelry clocks and watches	Art UK (in GBP)	Art France (in EUR)	Photography	19th Century	Modern Art	GB 250 rare stamps	Sculptures	Ferrari (1958- 1973)	Post-War European	Paintings	Art USA (in USD)	K500	Pre-War European	Pre-War American	Post- War Racing Cars	Affordable Classics	42 Guitar	Total
Bordeaux 500	***	**	***	*	*	*	*												7
Bordeaux Legends 50	***	***	**		*		*											*	6
Burgundy 150	***	**	**		***	**	*												6
Champagne 50	***	***	***	**	*	**	***	*											8
Rhone 100	***	*		*					*				*	*		*			7
Italy 100	***	**		**					**	**									5
Rest of the World 50	*	**	**	***		**		**	***		*	*			**		*		11
Liv-ex Fine Wine 1000	***	**	***	*	*	*	*	*											8
Total	8	7	6	6	5	5	5	3	3	2	1	1	1	1	1	1	1	1	58

Notes: All series are in logs; ***, **, * denotes respectively significance at 1%, 5% and 10% level using t-stat approach.

5. Conclusion

This paper investigates long- and short-run relationships between collectibles indices and fine wines market from 2004 to 2019. This work is relevant in the current literature because it sheds light on the complexity of the collectibles market. We explore its structure as well as its influence on the fine wine market and suggest that there is a relatively integration among the different indices. Our results indicate that there are different linkages on the short-term and long-term. Notably, our study finds that there is a quasi no feedback between these indices. Bordeaux wines and Champagne are the most influenced indices and as expected, because they contain mainly Bordeaux wines, the Liv-ex 1000 as well.

The findings obtained in this paper have implications for investors and collectors, notably in terms of benefits of portfolio diversification among the alternative collectibles markets. Indeed, the relative causal linkages between collectibles markets and fine wines market suggest that opportunities may expected for diversification. In addition, these results would indicate that the expected returns by investors and collectors may be high. In our study, we only consider co-movements through the trend transmission between collectibles market indices, but contagion may also be considered through the volatility transmission. This type of future study could interest investors as well as financial professionals in their investments hedging. In addition, it could be interesting to study the impact of the Chinese market on your results. Indeed, in recent years, both Chinese investors and collectors have become major actors on the international collectibles market. We can also imagine that Brexit as well as pandemic crisis might influence investor and collector behavior on the collectibles market.

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