SENSITIVITY OF THE ART MARKET TO PRICE VOLATILITY

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Abstract

The purpose of the article: The art market becomes very popular among investors, when there is strong turbulence on the stock market. In times of calm, the art market is used by investors to diversify risk and build more efficient investment portfolios according to the Markovitz's theory. The aim of this paper is to: (i) present the peculiarity of investment on the art market, represented by art market indexes in comparison to traditional investments in other financial market segments (money market, equity indexes and commodity market), (ii) to verify the hypothesis of normality of the distribution of rates of return of the analyzed art market indices as well as (iii) to analyze calendar effects occurrence on the art market.
Methodology: Comparison of rates of return on the stock, bond, commodity and money markets with rates on the art market in four different time intervals. For each of the analyzed periods, an income-risk map was presented, taking into account the spectrum of financial instruments, including six art indexes: Old Masters, 19th Century, Modern art, Post War art, Contemporary art and Global art. The hypothesis of normality of the distribution of rates of return of the art market indices for four analyzed periods was verified with the use of Jarque-Bera test.
Results of the research: Comparison of rates of return on the stock market and art market leads to the conclusion that their relationship depends on the period chosen. For two of the analyzed periods, the rates of return on the stock market were higher than on the art market, but for others periods, the opposite. The distribution of quarterly rates of return resulted to be a normal distribution for almost all of analyzed indices and time periods. Calendar effects were observed in the case of four analyzed indexes.

Keywords: art market, art indexes, financial market efficiency, normal distribution.

JEL Class: G10, G14.

INTRODUCTION

Taking the perspective of financial economics, works of art may be treated as investments. In this approach the purchase of a work of art is aimed at achieving positive returns of the investment in the future. Investments on the art market may be confronted to other forms of investment, i.e. investing in: securities, real estates, precious metals (gold, platinum, silver), precious stones (diamonds), investable alcohols (wine, whisky) as well as in numerous collectors' items. Consequently, many authors have studied the returns of the art market, as well as their correlation with the returns of more conventional assets such as equities and bonds, in order to assess the potential benefits of investing versus such alternatives.

Downturn of economy results in reduction of confidence in intangible financial instruments, and thus investment on the art market may gain on importance. Art, as tangible investment, represents a value storage mean; having the ability to maintain the value in unfavorable external conditions.

A key challenge to study returns in this market is that the relevant prices are not as clearly defined as in other markets. Taking stocks into consideration: the return r between t_1 and t_2, may be expressed as: $\frac{P_2}{P_1} - 1$, where P_1 and P_2 represent the corresponding stock prices. Thus returns on the stock market may be considered as well-defined quantities. A return computed in such a way is the real (*ex post*) return; it is not an estimate, because P_1 and P_2 are observed prices at the times of interest. Hence, there is no error associated with r computing. It seems that the same reasoning may be the use in case of art market indexes instead of prices of individual works of art.

Art market is characterized by features differentiating it from the securities market, e.g. features of objects of investment, necessity to ensure special maintenance conditions, classification of objects of investment, character of ownership, market classification (primary, secondary), institutional markets (auctions, stock exchanges) and informal markets, frequency of organizing auctions and stock exchange sessions, availability of information on prices of concluded transactions, price indices used for art markets and securities markets [Białynicka-Birula 2013, access 7.11.2019].

The aim of this paper is to present the peculiarity of investment on the art market, represented by art market indexes in comparison with traditional investments in other financial market segments (money market, equity indexes and commodity market). Special attention will be paid to basic categories related to any investment, namely risk and rates of return. Risks connected with works of art will be identified with respect to the concept of system approach to art market. Another aim of the paper is verification of the hypothesis of normality of

the distribution of rates of return of the analyzed art market indices as well as the analysis of the calendar effects for art market indexes.

In the scientific literature, there are very few studies on the normality of distribution rates of return and calendar effects on the art market. In the following article the use of art market indexes made it possible to conduct an analysis of the normality of the distribution of rates of return of these indexes, as well as allowed to conduct an analysis regarding the effectiveness of the art market in terms of the occurrence of calendar effects.

1. LITERATURE REVIEW

Anderson was the first researcher who explored the art market with the use of econometric tools [Anderson 1974: 13–26]. Using sales data for the period of 1643–1970, he presented the model based on the art market returns as well as on the common stocks returns. He also suggested that art market returns were higher compared to returns assessed for stocks in recent years, but emphasized that there were important differences depending on the artists and the type of school or movement.

Hsieh et al. [2010, access 7.06.2020] proved that in the period from 2000 to 2009 Asian Contemporary and Modern Art had a positive performance (8.39%) and outperformed returns of four stock markets, including the Hang Seng Total Return Index (HK), –0.67%, the Shanghai Stock Market Comprehensive Stock Price Index (SH), 1.58%, the S&P 500 Stock Index (SP), –7.01%, and the Taiwan Stock Exchange Corporation Weighted Index (TW), –4.46%.

Kraeussl and Logher analyzing performance and risk-return characteristics of three major emerging art markets: Russia, China, and India, on the basis of the hedonic index, proved that the geometric annual returns were equal to 10.00%, 5.70%, and 42.20% for Russia (1985–2008), China (1990–2008), and India (2002–2008), respectively (The period covered by the analysis is shown in brackets) [Kraeussl and Logher 2010: 301–318]. The rates of return on the art market in Russia and India were higher than the rates of return of the S&P 500 index at the same time intervals. The situation on the Chinese art market was different.

Baumol [1986: 10–14] contrasted the painting market to the stock market and underlined that in the case of stocks the intrinsic value is known whereas in the art market such concept is imprecise. On the basis of the data for 640 painting transactions between 1652 and 1961, he concluded that returns on the art market were lower compared with those of government securities and exhibited a remarkable degree of variability. According to the author the process of predicting art market prices was extremally difficult. Broad academic literature found that than the returns on the art market are lower than those on stocks, confirming earlier works of Baumol [Frey and Eichenberger 1995: 528–537;

Burton and Jacobsen 1999: 193–212]. Higgs constructed a quarterly hedonic price index for 64,203 artworks, created by seventy-one well-known modern and contemporary Australian artists, sold at auction houses over the period 1986–2009 [Higgs 2012: 189–209]. The study proved that that over the entire period the art market only marginally underperformed the stock and housing markets. Worthington and Higgs examining the short and long-term price linkages among major art (Contemporary Masters, French Impressionists, Modern European, 19th Century European, Old Masters, Surrealists, 20th Century English and Modern US paintings) and equity markets (S&P 500) over the period 1976–2001, found that returns on paintings are much lower and the risks much higher than in conventional financial markets [Worthington and Higgs 2003: 649–669]. David [2014, access 6.06.2020] argues that, except under very specific circumstances, art does not provide a „safe haven" for investment during times of crisis. Constructing an art price index for the French art market during, and just after the WW1 period (1911–1925), she found that, in terms of risk weighted return, gold, real-estate, bonds and stocks, outperformed art.

Renneboog and Spaenjers [2013: 36–53], built an art index that exhibited 3.97% real annual return in US dollars covering the period 1957–2007. That is, a performance similar to that of corporate bonds but characterized by higher risk. Mandel [2009: 1653–1663] published similar results for the period 1950–1999, indicating that the art returns resulted to be lower than both the S&P 500 and the Dow Jones Industrial Index, but with higher volatility. Worthington and Higgs [2004: 257–272], applying data of some specific art market segments (Old Masters, Surrealists, Impressionists, 19th Century European, etc.) found that painting returns were lower but volatility was higher when compared with more conventional assets. The results of Worthington and Higgs research confirmed conclusions presented by the many authors [Renneboog and Van Houte 1999: 331–357; Ashenfelter and Graddy 2003: 763–786; Agnello 2006, access 12.02.2020]. Campbell [2008: 64–81] summarizes art market returns obtained by different authors for different segments and time-periods. A comprehensive literature review regarding returns can be found in the paper by Renneboog and Spaenjers [Renneboog and Spaenjers 2013: 36–53].

A big set of recent studies proved that there may be value in including art in investment portfolios, due to negative correlation with other assets returns [Ashenfelter and Graddy 2003: 763–786; Mei and Moses 2002: 1656–1668; Taylor and Coleman 2011: 1519–1529]. Boyer found that there was a negative relationship between stock market performance and the art price index on the US market [Boyer 2011: 77–83]. She developed the „diversity hypothesis" suggesting that in the periods when stocks perform well, people invest less in art. However, when the stock market index is lagged by two months, its relationship with the art price index is positive.

Goetzmann et al. created an art price index of repeated sales for the period of 1765–2007 [Goetzmann et al. 2009]. Moreover they also built an index of British

stock price returns for the analyzed period that covered dividend return, total return and capital appreciation, which was then compared to the art market returns. Results indicated a strong relationship between art and equity markets and that art prices are driven by capital gains and losses. Financial markets react quickly to economic shocks, and that the profits generated on these markets may be invested in art. Botha et al. analyzed the Citadel art price index in relation to the movement of the FSTE/JSE All Share Index, the Absa house price index, and the South African government bond index [Botha et al. 2016: 358–368]. They came to the conclusion that when there are increased returns on the stock markets in the preceding period and wealth increases, there is a change in the Citadel art price index in the same direction. Of the four asset classes, investing in art seems to be the most risky, followed by shares.

The findings regarding correlation between art returns and the returns experienced by more traditional assets seem to be more ambiguous. For example, many authors found that the art market and equities returns were highly correlated [Mandel 2009: 1635–1663]. This is in contrast with Mei and Moses [2002: 1656–1668], who concluded that paintings returns were lowly correlated with equity returns (S&P 500), as well as treasuries and corporate bonds returns. Campbell also found low correlation between art returns in general and both, stocks (MSCI world stock index), and bonds (treasury and corporates) [Campbell 2008: 64–81]. Worthington and Higgs detected a 16% correlation between art and large capitalization stocks and a –31% correlation between art and small caps [Worthington and Higgs 2004: 257–272]. Renneboog and Spaenjers reported a –3% correlation between art and the S&P 500 index, a 20% value in the case of global stocks, and somewhat higher values (in the 30–45% range) when comparing commodities and real estate indexes [Renneboog and Spaenjers 2013: 36–53]. Clearly, some of these discrepancies may be explained by different time periods, different art market segments, and the application of different techniques to estimate returns. However, it is difficult to make solid statements regarding the correlation between the art market (or some segments of it) and broader market indexes.

Charlin and Cifuentes estimated the correlation between the returns of the S&P 500 index based portfolio and paintings of two artists: Picasso and Renoir and two groups of artists (Surrealists and Impressionists) in the period of March 1985−December 2014 [Charlin and Cifuentes 2017: 128–131]. Unlike previous studies that relied on single-point estimates of the correlation to explore the merits of adding art assets to a portfolio of stocks, the authors relied on a wild bootstrap algorithm to determine confidence intervals for the correlation estimates. The authors found that these confidence intervals were so wide that it seemed impossible to make absolute remarks about the merits of adding art-related assets to stocks portfolios.

According to Renneboog and Spaenjers the Sharpe ratio for art market returns does not surpass that calculated for stock and bond returns, it is higher than for

other popular alternative asset classes, e.g. commodities and real estate [Renneboog and Spaenjers 2013: 36–53].

Using a large database with more than a million observations, David et al. [2013: 23–25] applied four tests to assess the weak form of efficiency in the art market. Results show that the art market is not even weakly efficient, since net returns are highly auto-correlated. According to the authors it is structurally impossible for auction prices to be efficient. Potential investors in the art market thus should be aware of this bias, which benefits those with insider information on reserve prices.

Kompa and Witkowska [2014: 414–428] on the basis of 750 object prices, applying hedonic index methodology to estimate returns on the Polish art market in the period 2007–2010, justified the opinion that art can be treated as safe asset class, especially in comparison to equity market.

Lucinska [2015: 67–79] calculated quarterly hedonic price indices and rates of return using 1708 auction records covering the sale of paintings by 30 painters obtained from Polish art websites at www.artinfo.pl and www.agraart.pl. She analyzed the relationship between the hedonic index and the rates of return of European (i.e. French and British) art indices. This study proved that returns on Polish art averaged 5.51 % in nominal terms over the period 2008–2012 with a standard deviation of 8.34 %. In the analyzed period the art market in Poland proved to be more profitable and more variable in comparison with European art markets.

2. DESCRIPTION OF THE RESEARCH APPROACH

The increased interest in the art market has contributed to the creation of specialized indexes, however, due to the specific features of this market presented in the previous parts of the paper, in particular the low liquidity and heterogeneous nature of trading objects, the construction of the art market index is a more complex task than in the case of classic assets. Among the existing methods of constructing art market indexes, two main approaches are distinguished, namely repeat sales models that consider price changes of objects sold at least twice, and hedonic models that allow estimating changes in the value of a work resulting from the passage of time.

There are many analytical websites publishing this type of art market indicators, the most important include AMR, Artprice, Artnet, Sotheby's Mei& Moses. For the purpose of this work, indexes from the Artprice website will be used. In addition to developing indicators, the company also publishes reports on the condition of the art market as well as analyzes of individual artists. The choice of this site was dictated primarily by the availability of one of the most extensive

databases, as Artprice reported over 30 million auction results from 4,500 auction houses from around the world [www1, access 7.11.2019].

For the purpose of this paper, the Global Art Index and the following indexes representing individual segments in art will be used [www2, access 7.11.2019; *Art Market Trends 2010*, access 7.11.2019; *The Art Market in 2018*, access 7.10.2019]:

1) Old Masters – referring to the works of artists born before 1760;

2) 19th Century (19th Century works) – referring to the works of artists born between 1760 and 1860;

3) Modern art – referring to works of artists born between 1860 and 1920;

4) Post War art (post-war works) – referring to the works of artists born between 1920 and 1945;

5) Contemporary art – referring to works of artists born after 1945.

All of the analyzed indexes are repeated sales indexes.

The Artprice indexes are constructed on the basis of public auctioning. Auction turnover covers about half of all transactions on the art market. In addition, the premium paid by the buyer is not included in the process of building Artprice indicators, which could lead to distorted results. Considering the imperfections of the art market, it should be remembered that art indexes that have some disadvantages may not fully represent the real situation of this market. Nevertheless, they are one of the best tools illustrating the condition of the art market and enabling comparison of this market with others in terms of investment efficiency.

In order to compare the art market with the traditional market, the following equity indexes were used for the analysis:

1) CAC40, Nikkei225, DAX, UK100, WIG20, NASDAQ, DJIA,

2) LCS – MSCI USA Large Cap Index (published by Morgan Stanley),

3) SMID – MSCI USA Small and Mid Cap Index (published by Morgan Stanley).

In addition, money market indices and inflation indicator were applied:

1) GB – ICE BofA Current 10-Year Treasury Index mapping the prices of 10-year US Treasury bonds.

2) CB – ICE BofA Corporate Index, reflecting the prices of USD--denominated investment grade corporate bonds (Moody's, S&P, Fitch).

3) CPI – US inflation rate.

The following commodity prices were also analyzed: BRENT oil, gold, silver and copper.

3. METHODOLOGY

The study was divided into the following parts:

1) Four periods were chosen:
   (i) T1 – before the financial crisis (Q4 2001–Q4 2007),
   (ii) T2 – financial crisis (Q1 2008–Q2 2009),
   (iii) T3 – after the financial crisis (Q3 2009–Q4 2018),
   (iv) T4 – the entire available data in the database (Q4 1997–Q4 2018).

The beginning of the first period was set at a time when the stock market stabilized after the depreciation of internet companies' rally (March 2000–July 2001).

The second period represents the 2008–2009 financial crisis and the third period covers the increase of prices on equity markets (the lowest prices on the equity markets were registered in the beginning of 2009).

Logarithmic returns, as well as standard deviation coefficients were calculated for each financial instruments in each of the four periods.

The values of the art indexes in the database are calculated on a quarterly basis. Therefore, it was necessary to annualize the rates of return and standard deviations for all analyzed financial instruments, e.g. (art indexes, equity indexes, money markets instruments and inflation).

2) Based on the obtained results, return-risk maps were constructed for each of the four periods.

3) The hypothesis of normality of the distribution of rates of return of the art market indices for four analyzed periods was verified. For this purpose, the Jarque-Bera test was implemented.

4) For all analyzed art market indexes, a study was conducted regarding the occurrence of calendar effects. In this case, two hypotheses were verified:

H_0: average quarter return of a given art market index is equal to the average return of the same index in the three remaining quarters (for example, the average quarterly rate of return in the first quarter is equal to the average quarterly rate of return, calculated for data from the second, third and fourth quarters),

H_1: average quarter return of a given art market index is not equal to the average return of the same index in the three remaining quarters.

4. RESULTS

4.1. Analysis of annualized returns and standard deviation coefficients

A list of annualized returns and standard deviation coefficients for the four analyzed periods is presented in Table 1.

The average rates of return were:

a) In the first period – positive for all art indexes. The highest rate of return among the art market indexes was recorded for: Post War (15.33%), and the lowest for Old Masters (5.95%);

b) In the second and third periods – negative for all art indexes. The highest rate of return among the art market indexes for the second and third period was recorded for: Old Masters (–5.13%) and Post War (–2.17%), respectively. And the lowest for 19th Century (–27.09%) and Old Masters (–7.48%), respectively;

c) In the fourth period – negative for all art indexes, except for the Post War and Contemporary indexes. The highest rate of return among the art market indexes was recorded for: Post War (2.28%), and the lowest for Old Masters (–3.07%).

On the basis of the research it can be concluded that in the overwhelming number of cases, rates of return on the art market were higher than on the stock market for the first two analyzed periods, and lower for the other two. For the art and commodity markets, the rate of return on this first market was lower than on the second.

Analysis of the volatility of the art market indexes returns allows to draw the following conclusions:

1) The most risky art index in all time intervals resulted to be Global Art;

2) The least risky index in all time intervals, except for the second period, was Modern Art. In the second period, the least risky art index was Post War.

The ranking of rates of return (1 – the highest rate of return and 22 – the lowest) for individual periods and financial instruments bring the following conclusions (see Table 2):

1) In period I, the art index with the highest rate of return was placed in the 10th place, and the lowest in the 20th place;

2) For the other periods the classification may pe presented as follows:

a) II: 11th and 21st,

b) III: 3rd and 20th,

c) IV: 9th and 20th.

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Table 1. Nominal returns and standard deviations coefficients for four analyzed periods

Period	Category	LCS	SMID	GB	CB	Global Art Index	Old Masters	19th Century	Modern Art	Post War	Contemporary	CPI	CAC40	Nikkei225	DAX	UKI100	WIG20	Nasdaq	DJIA	Oil BRENT	Gold	Silver	Copper
I period	Risk	13.65	15.23	7.09	4.26	15.02	10.01	7.34	5.90	9.22	12.24	1.15	20.85	16.52	27.97	13.63	16.35	19.62	13.71	22.49	10.76	24.85	24.98
I period	Return	3.22	8.23	5.07	5.93	9.80	5.95	6.64	9.85	15.33	14.91	2.98	1.39	4.38	4.33	2.89	16.16	3.83	4.18	24.09	18.71	19.33	22.50
II period	Risk	23.15	30.06	13.65	10.66	21.31	19.88	9.89	9.80	7.65	11.89	3.45	21.52	32.12	25.78	15.61	30.43	28.44	19.41	85.98	9.61	34.32	71.34
II period	Return	−33.05	−34.78	5.20	0.62	−23.56	−5.13	−27.09	−21.15	−21.38	−21.35	0.99	−41.15	−33.90	−37.87	−29.14	−45.90	−28.86	−32.07	−96.82	6.34	−13.36	−60.21
III period	Risk	12.90	16.28	7.14	4.40	25.95	10.51	9.87	5.96	7.06	14.41	0.75	16.65	19.02	18.39	13.16	16.78	14.96	12.44	33.59	15.59	28.00	22.30
III period	Return	9.51	10.04	3.04	5.20	−4.74	−7.48	−5.92	−4.24	−2.17	−3.94	1.71	2.82	5.51	6.49	3.96	0.65	12.38	9.91	−11.64	2.11	−2.56	−0.94
IV period	Risk	16.66	20.36	7.85	4.95	21.08	13.27	9.73	7.29	9.49	14.67	1.30	22.20	21.08	25.71	15.14	24.10	25.92	15.71	37.96	13.58	25.75	29.57
IV period	Return	2.73	4.34	4.18	5.17	−0.68	−3.07	−2.54	−0.31	2.48	1.12	2.11	−0.47	−1.02	0.69	0.11	−1.03	3.22	3.88	−7.02	6.13	1.07	0.02

Source: own calculations.

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Table 2. The ranking of rates of return and standard deviations coefficients (1 – the highest rate of return and 22 – the lowest)

Category		LCS	SMID	GB	CB	Global Art Index	Old Masters	19th Century	Modern Art	Post War	Contemporary	CPI	CAC40	Nikkei225	DAX	UK100	WIG20	Nasdaq	DJIA	Oil BRENT	Gold	Silver	Copper
period I	Risk	13.65	15.23	7.09	4.26	15.02	10.01	7.34	5.90	9.22	12.24	1.15	20.85	16.52	27.97	13.63	16.35	19.62	13.71	22.49	10.76	24.85	24.98
period I	Return	3.22	8.23	5.07	5.93	9.80	5.95	6.64	9.85	15.33	14.91	2.98	1.39	4.38	4.33	2.89	16.16	3.83	4.18	24.09	18.71	19.33	22.50
period II	Risk	23.15	30.06	13.65	10.66	21.31	19.88	9.89	9.80	7.65	11.89	3.45	21.52	32.12	25.78	15.61	30.43	28.44	19.41	85.98	9.61	34.32	71.34
period II	Return	-33.05	-34.78	5.20	0.62	-23.56	-5.13	-27.09	-21.15	-21.38	-21.35	0.99	-41.15	-33.90	-37.87	-29.14	-45.90	-28.86	-32.07	-96.82	6.34	-13.36	-60.21
period III	Risk	12.90	16.28	7.14	4.40	25.95	10.51	9.87	5.96	7.06	14.41	0.75	16.65	19.02	18.39	13.16	16.78	14.96	12.44	33.59	15.59	28.00	22.30
period III	Return	9.51	10.04	3.04	5.20	-4.74	-7.48	-5.92	-4.24	-2.17	-3.94	1.71	2.82	5.51	6.49	3.96	0.65	12.38	9.91	-11.64	2.11	-2.56	-0.94
period IV	Risk	16.66	20.36	7.85	4.95	21.08	13.27	9.73	7.29	9.49	14.67	1.30	22.20	21.08	25.71	15.14	24.10	25.92	15.71	37.96	13.58	25.75	29.57
period IV	Return	2.73	4.34	4.18	5.17	-0.68	-3.07	-2.54	-0.31	2.48	1.12	2.11	-0.47	-1.02	0.69	0.11	-1.03	3.22	3.88	-7.02	6.13	1.07	0.02

Source: own calculations.

Performance of individual financial instruments and indexes in the analyzed period (Q4 1997–Q4 2018) is presented in Appendix.

4.2. Analysis of correlation coefficients

The values of correlation coefficients of rates of return on the art market and rates of return in other segments of the financial market, in analyzed time intervals, are presented in Tables 3–6.

In the first period, the lowest value of the correlation coefficient was minus 0.49 (Contemporary), and the highest 0.25 (Old Masters). A significant percentage of correlation coefficients were grouped in the ranges (–0.5; –0.1), (–0.1; 0.1) and (0.1; 0.5). The values of correlation coefficients were negative up to 14 times for the Contemporary index.

In the second period, the highest value of the correlation coefficient mounted to 0.94 (Global Art Index), while the lowest was equal to minus 0.23 (Contemporary). For this time interval, a significant percentage of correlation coefficients were higher than 0.5 or belonged to the range (0.1; 0.5). Correlation coefficient were 6 times negative for the Contemporary sector.

In the third period, the highest value of the correlation coefficient reached the level of 0.44 (Modern Art Index), while the lowest was equal to minus 0.15 (Global Art Index). As in the first time interval, a significant percentage of correlation coefficients were grouped in three ranges (–0.5; –0.1), (–0.1; 0.1) and (0.1; 0.5). Correlation coefficient values were negative 12 times for the Global Art Index.

Throughout all analyzed period (e.g. the fourth period), correlation coefficients were concentrated in the ranges (–0.1; 0.1) and (0.1; 0.5). The lowest correlation coefficient (–0.03) was recorded for the Global Art Index, and the highest (0.43) for the Modern Art index. The correlation coefficient was three times lower than zero for the Modern Art index.

The correlation coefficients calculated for the rates of return of stock indexes and the art market were low (except for the second period) in all analyzed periods.

The correlation coefficients of returns between art market indexes are also noteworthy to mention. The highest value of this type of coefficients, equal to 0.69, was recorded for the Contemporary and Post War pair, and the lowest equal to minus 0.05 for the Contemporary and Old Masters pair.

Table 3. Correlation coefficients in the first analyzed period

Category	LCS	SMID	GB	CB	Global Art Index	Old Masters	19th century	Modern Art	Post-war	Contemporary	CPI	CAC40	Nikkei225	DAX	UK100	WIG20	Nasdaq	DJIA	Oil BRENT	Gold	Silver	Copper
Global Art Index	−0.20	−0.07	0.03	−0.01	1.00	0.36	0.18	0.57	0.60	0.45	0.20	−0.10	−0.16	−0.15	−0.13	0.00	−0.13	−0.22	0.20	0.06	0.08	−0.02
Old Masters	0.15	0.21	0.03	0.19	0.36	1.00	−0.31	0.21	0.22	−0.07	0.08	0.13	−0.08	0.07	0.15	0.25	0.19	0.15	0.03	0.21	0.03	0.04
19th century	−0.17	−0.22	0.10	0.01	0.18	−0.31	1.00	0.44	0.33	0.24	−0.06	−0.29	−0.36	−0.30	−0.33	−0.39	−0.15	−0.12	0.00	−0.16	−0.05	−0.01
Modern Art	0.15	0.18	−0.18	−0.10	0.57	0.21	0.44	1.00	0.56	0.39	−0.15	0.08	−0.21	0.06	0.10	−0.01	0.21	0.19	−0.06	0.01	0.01	−0.03
Post-war	−0.05	0.08	0.09	0.11	0.60	0.22	0.33	0.56	1.00	0.71	−0.10	−0.05	−0.13	−0.08	−0.09	−0.02	−0.05	−0.04	0.05	−0.24	−0.03	−0.05
Contemporary	0.05	0.13	−0.12	−0.17	0.45	−0.07	0.24	0.39	0.71	1.00	0.08	0.08	−0.01	0.08	0.03	0.06	0.05	0.05	0.07	−0.49	−0.33	−0.07

Source: own calculations.

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Table 4. Correlation coefficients in the second analyzed period

Category	LCS	SMID	GB	CB	Global Art Index	Old Masters	19th century	Modern Art	Post-war	Contemporary	CPI	CAC40	Nikkei225	DAX	UK100	WIG20	Nasdaq	DJIA	Oil BRENT	Gold	Silver	Copper
Global Art Index	0.66	0.71	−0.48	0.83	1.00	0.41	0.49	0.48	0.37	0.19	0.26	0.67	0.85	0.75	0.94	0.55	0.64	0.52	0.54	0.17	0.44	0.28
Old Masters	0.74	0.74	−0.58	0.08	0.41	1.00	0.76	0.75	0.39	0.05	0.82	0.62	0.54	0.57	0.46	0.60	0.58	0.76	0.67	−0.12	−0.05	0.47
19th century	0.58	0.62	−0.47	0.31	0.49	0.76	1.00	0.95	0.89	0.66	0.74	0.37	0.44	0.28	0.37	0.41	0.46	0.53	0.77	0.55	0.57	0.76
Modern Art	0.72	0.73	−0.55	0.43	0.48	0.75	0.95	1.00	0.86	0.59	0.74	0.53	0.51	0.41	0.45	0.62	0.59	0.70	0.80	0.48	0.53	0.81
Post-war	0.37	0.43	−0.36	0.38	0.37	0.39	0.89	0.86	1.00	0.91	0.54	0.16	0.29	0.04	0.21	0.24	0.33	0.28	0.70	0.84	0.85	0.83
Contemporary	0.07	0.15	−0.23	0.24	0.19	0.05	0.66	0.59	0.91	1.00	0.36	−0.12	0.10	−0.23	−0.02	−0.08	0.12	−0.07	0.55	0.92	0.93	0.75

Source: own calculations.

Table 5. Correlation coefficients in the third analyzed period

Category	LCS	SMID	GB	CB	Global Art Index	Old Masters	19th century	Modern Art	Post-war	Contemporary	CPI	CAC40	Nikkei225	DAX	UK100	WIG20	Nasdaq	DJIA	Oil BRENT	Gold	Silver	Copper
Global Art Index	−0.06	−0.05	−0.32	−0.36	1.00	−0.11	0.28	0.26	0.33	0.28	0.07	−0.14	0.11	0.00	−0.02	−0.02	−0.15	−0.01	0.05	−0.14	−0.12	0.16
Old Masters	−0.07	0.02	0.05	0.05	−0.11	1.00	−0.07	0.08	−0.24	−0.16	0.21	0.01	−0.09	0.02	−0.07	−0.01	−0.12	−0.05	0.29	0.05	0.13	−0.11
19th century	0.20	0.24	−0.29	−0.05	0.28	−0.07	1.00	0.49	0.52	0.40	0.41	0.17	0.09	0.05	0.28	0.20	0.19	0.12	0.34	0.07	0.29	0.32
Modern Art	0.44	0.51	−0.56	−0.18	0.26	0.08	0.49	1.00	0.60	0.70	0.35	0.43	0.28	0.36	0.42	0.38	0.40	0.43	0.44	0.02	0.36	0.41
Post-war	0.37	0.44	−0.43	−0.10	0.33	−0.24	0.52	0.60	1.00	0.82	0.17	0.30	0.19	0.27	0.36	0.26	0.30	0.35	0.22	0.05	0.34	0.43
Contemporary	0.39	0.46	−0.47	−0.17	0.28	−0.16	0.40	0.70	0.82	1.00	0.29	0.29	0.21	0.26	0.33	0.18	0.36	0.37	0.40	0.07	0.37	0.38

Source: own calculations.

Table 6. Correlation coefficients in the fourth analyzed period

Category	LCS	SMID	GB	CB	Global Art Index	Old Masters	19th century	Modern Art	Post-war	Contemporary	CPI	CAC40	Nikkei225	DAX	UK100	WIG20	Nasdaq	DJIA	Oil BRENT	Gold	Silver	Copper
Global Art Index	−0.06	−0.05	−0.32	−0.36	1.00	−0.11	0.28	0.26	0.33	0.28	0.07	−0.14	0.11	0.00	−0.02	−0.02	−0.15	−0.01	0.05	−0.14	−0.12	0.16
Old Masters	−0.07	0.02	0.05	0.05	−0.11	1.00	−0.07	0.08	−0.24	−0.16	0.21	0.01	−0.09	0.02	−0.07	−0.01	−0.12	−0.05	0.29	0.05	0.13	−0.11
19th century	0.20	0.24	−0.29	−0.05	0.28	−0.07	1.00	0.49	0.52	0.40	0.41	0.17	0.09	0.05	0.28	0.20	0.19	0.12	0.34	0.07	0.29	0.32
Modern Art	0.44	0.51	−0.56	−0.18	0.26	0.08	0.49	1.00	0.60	0.70	0.35	0.43	0.28	0.36	0.42	0.38	0.40	0.43	0.44	0.02	0.36	0.41
Post-war	0.37	0.44	−0.43	−0.10	0.33	−0.24	0.52	0.60	1.00	0.82	0.17	0.30	0.19	0.27	0.36	0.26	0.30	0.35	0.22	0.05	0.34	0.43
Contemporary	0.39	0.46	−0.47	−0.17	0.28	−0.16	0.40	0.70	0.82	1.00	0.29	0.29	0.21	0.26	0.33	0.18	0.36	0.37	0.40	0.07	0.37	0.38

Source: own calculations.

Table 7. Summary of the number of correlation coefficients in individual ranges

Number of cases	<−0.5	(−0.5; −0.1)	(−0.1; 0.1)	(0.1; 0.5)	>0.5	Max	Min	Total max of correlation coefficient	Total min of correlation coefficient	<0
First period (T1)										
Global Art Index	0	6	8	5	2	0.20	−0.22	0.25	−0.49	10
Old Masters	0	1	8	12	0	0.25	−0.08			1
19th Century	0	11	6	4	0	0.00	−0.39			14
Modern Art	0	4	8	7	2	0.21	−0.21			7
Post War	0	3	12	3	3	0.05	−0.24			12
Contemporary	0	4	12	4	1	0.08	−0.49			6
Second period (T2)										
Global Art Index	0	1	0	9	11	0.94	0.17	0.94	−0.23	1
Old Masters	1	1	4	3	12	0.76	−0.12			3
19th Century	0	1	0	8	12	0.77	0.28			1
Modern Art	1	0	1	4	15	0.81	0.41			1
Post War	0	1	1	11	8	0.85	0.04			1
Contemporary	0	3	6	5	7	0.93	−0.23			6
Third period (T3)										
Global Art Index	0	7	8	6	0	0.16	−0.15	0.44	−0.15	12
Old Masters	0	5	13	3	0	0.29	−0.12			7
19th Century	0	1	5	14	1	0.34	0.05			2
Modern Art	1	1	3	13	3	0.44	0.02			2
Post War	0	2	2	14	3	0.43	0.05			2
Contemporary	0	3	1	15	2	0.40	0.07			2
Fourth period (T4)										
Global Art Index	0	1	11	9	0	0.18	−0.03	0.43	−0.03	3
Old Masters	0	1	4	16	0	0.41	0.08			1
19th Century	0	1	2	17	1	0.34	0.09			1
Modern Art	0	1	1	16	3	0.43	0.19			1
Post War	0	1	2	16	2	0.32	0.06			1
Contemporary	0	1	6	12	2	0.30	0.05			1

Source: own calculations.

4.3. Risk-reward maps for specific periods

Maps showing the location of individual asset classes, taking into account the rates of return and risk (standard deviation) are presented in Chart 1–4.

For the first investment period, the following art market indexes are located most north of other assets with similar investment risk: Modern Art and Post War. The 19th Century Index location on the map may be considered as less favorable.
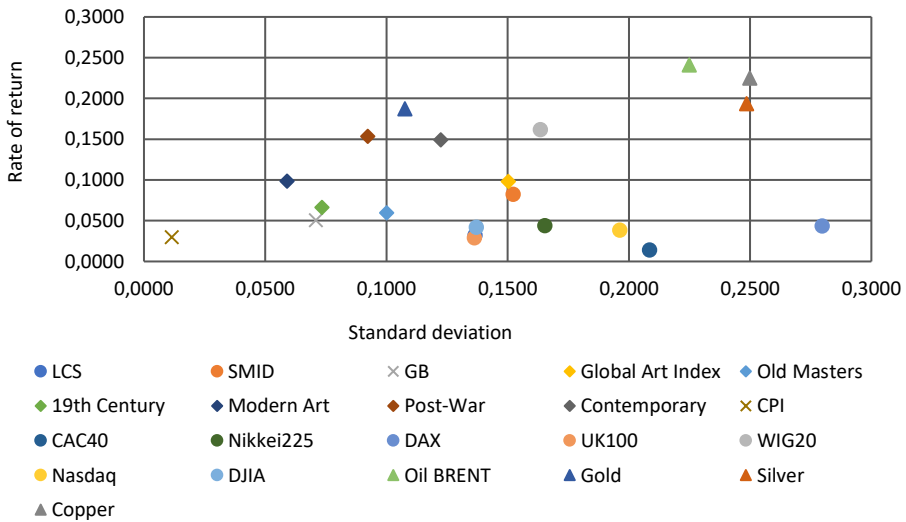

Chart 1. Risk-reward map for the first subperiod

Source: own calculations.

In the second period, dominated by negative rates of return, the location of such art market indices as Post War, Modern Art, Contemporary and 19th Century (characterised by low investment risk) had a slightly negative returns. This fact deserves attention. The investment risk for the Old Masters index was greater than for above mentioned four indices, but the rate of return was higher, although still negative. The investment risk of the Old Master index was similar to the risk of investment in the portfolio replicating the Global Art Index. In the case of the latter index, the investment risk in the analyzed period was the highest among all art market indexes. Similar investment risk to that of the four above--mentioned indices (Post War, Modern Art, Contemporary and 19th Century) was registered in the case of gold, but its return remains positive.

From the portfolio theory point of view, the locations of art market indexes on the map in the third period are not favorable. All indexes are characterised by negative rates of return with relatively low risk, except of the Global Art Index. Attention should be paid to the favorable location of stock market indices.
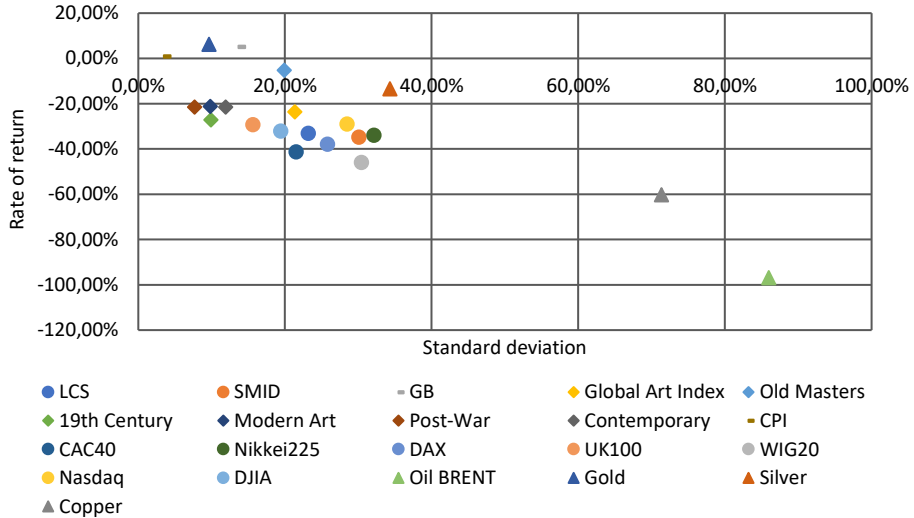

Chart 2. Risk-reward map for the second subperiod
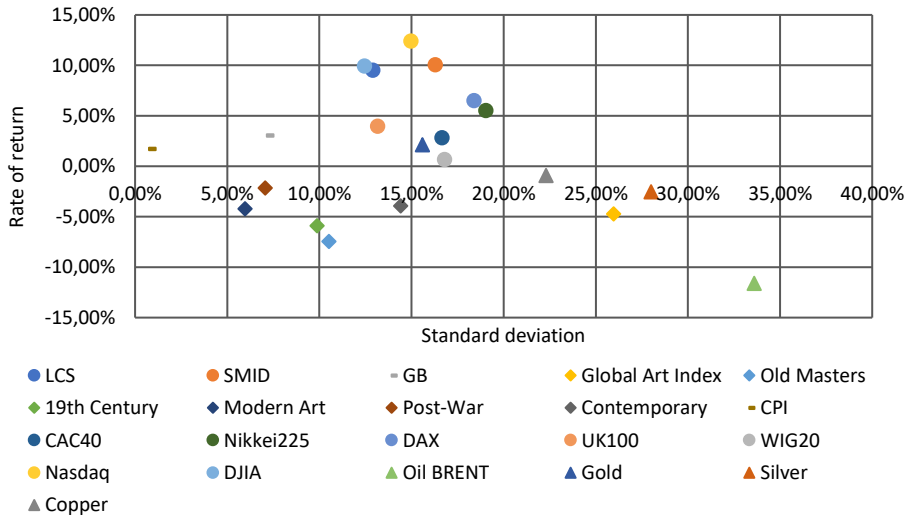
Source: own calculations.

Chart 3. Risk-reward map for the third subperiod

Source: own calculations.

In the entire analyzed investment period (the four period), the following art market indexes are located close to the effective portfolios curve: Post War and Modern Art. The returns of 19th Century and Old Masters indexes were negative, but the risks assigned to these two instruments were the same as the risks of the following financial instruments: Post War and gold, respectively. Investments in the portfolio replicating the Contemporary index were characterized by a positive rate of return with a slightly higher risk than the Old Masters index. The last position in this raking is occupied by Global Art Index, which with the highest risk for the art market indexes, offered a negative rate of return. The high profit/risk ratio was assigned to the gold market.
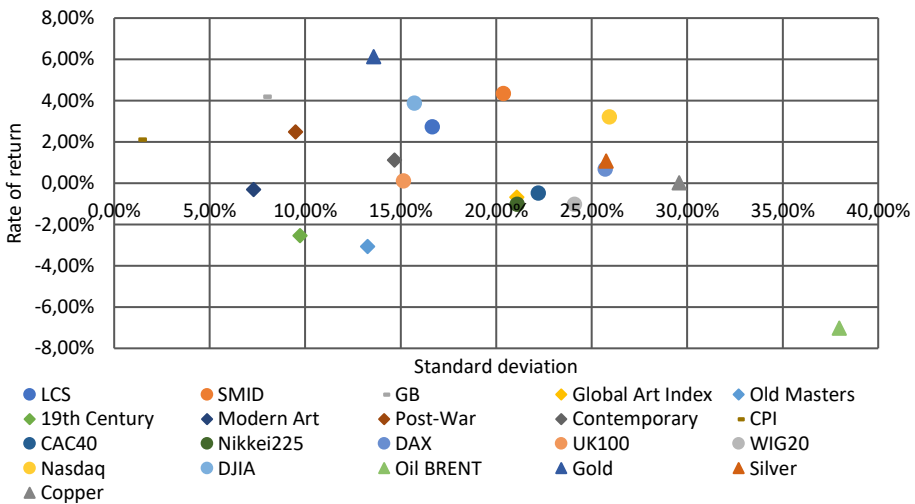

Chart 4. Risk-reward map for the fourth period (all available data)

Source: own calculations.

4.4. Analysis of the coefficient of variation

For each of the financial instruments, the coefficient of variation (risk measure divided by the rate of return) was calculated, and then a ranking was created according to the following criteria (see Table 8). The highest positions in the ranking are occupied by instruments with the lowest coefficient of variation, assuming that it is positive. Subsequently, instruments with the highest negative coefficient of variation were classified.

Table 8. Variation coefficient and the ranking of financial instruments

Position in ranking	1st subperiod		2nd subperiod		3rd subperiod		All analyzed period (4th period)	
	V. Coeff.	Instument	V. Coeff.	Instument	V. Coeff.	Instument	V. Coeff.	Instument
1	0.39	CPI	1.52	Gold	0.44	CPI	6.10	LCS
2	0.58	Gold	2.62	GB	0.84	CB	4.69	SMID
3	0.60	**Modern Art**	3.50	CPI	1.21	Nasdaq	1.88	GB
4	0.60	**Post War**	17.26	CB	1.25	DJIA	0.96	CB
5	0.72	CB	−0.36	**Post War**	1.36	LCS	−31.17	**Global Art Index**
6	0.82	**Contemporary**	−0.36	**19th Century**	1.62	SMID	−4.33	**Old Masters**
7	0.93	Oil BRENT	−0.46	**Modern Art**	2.35	GB	−3.83	**19th Century**
8	1.01	WIG20	−0.52	CAC40	2.83	DAX	−23.27	**Modern Art**
9	1.11	**19th Century**	−0.54	UK100	3.32	UK100	3.82	**Post-war**
10	1.11	Copper	−0.56	**Contemporary**	3.45	Nikkei225	13.09	**Contemporary**
11	1.29	Silver	−0.61	DJIA	5.90	CAC40	0.62	CPI
12	1.40	GB	−0.66	WIG20	7.38	Gold	−46.81	CAC40
13	1.53	**Global Art Index**	−0.68	DAX	25.88	WIG20	−20.63	Nikkei225
14	1.68	**Old Masters**	−0.70	LCS	−1.40	**Modern Art**	37.30	DAX
15	1.85	SMID	−0.86	SMID	−1.40	**Old Masters**	140.41	UK100
16	3.28	DJIA	−0.89	Oil BRENT	−1.67	**19th Century**	−23.50	WIG20
17	3.78	Nikkei225	−0.90	**Global Art Index**	−2.89	Oil BRENT	8.05	Nasdaq
18	4.24	LCS	−0.95	Nikkei225	−3.25	**Post-war**	4.05	DJIA
19	4.72	UK100	−0.99	Nasdaq	−3.66	**Contempo-rary**	−5.41	Oil BRENT
20	5.12	Nasdaq	−1.18	Copper	−5.48	**Global Art Index**	2.22	Gold
21	6.46	DAX	−2.57	Silver	−10.94	Silver	24.02	Silver
22	15.00	CAC40	−3.88	**Old Masters**	−23.61	Copper	1260.05	Copper

Source: own calculations.

In the first analyzed sub-period, four art market indexes were classified in the top ten (ranking in brackets): Modern Art (3), Post War (4), Contemporary (6) and 19th Century (9). In the second sub-period, the same indexes are included in the top ten ranking, only in different places: Post War (5), 19th Century (6), Modern Art (7) and Contemporary (10). In turn, in the third sub-period all art

market indexes were classified except for the top ten: Modern Art (14), Old Masters (15) and 19th Century (16). In the ranking created for the entire analyzed period, all art market indexes were placed in the top ten, in positions from 5 to 10. The following three indexes were classified in the first three places: Global Art Index (5), Old Masters (6) and 19th Century (7).

4.5. Analysis of the normality of the distribution of rates of return and calendar effects

Although in the last three decades the validity of this assumption has been widely rejected because of the strong leptokurtosis of financial variables, the normal distribution is still the assumption underlying most of the methods used in empirical finance. Most scientific papers are devoted to examining the normality of distribution on the stock, commodity or currency market. Therefore, it is interesting to verify the hypothesis about the normality of distribution of rates of return in one of the financial market segments, i.e. the art market.

The analysis of normal distribution of rates of return and the occurrence of calendar effects was proceeded for:

a) all art market indexes,

b) individual quarters (and for all four quarters in the case of normal distribution).

The results are presented in Table 9.

Table 9. p-value coefficients calculated in the process of analyzing the normality of distribution of returns and the occurrence of calendar effects (p-value less than 0.05 in italics).

Art. Market index	Calendar effects (z statistic)				Normal distribution of returns (Jarque-Bera test)				
	1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q	All data
Global Art Index	0.2600	0.1010	*0.0000*	*0.0005*	0.5939	0.7632	*0.0000*	0.4364	0.1505
Old Masters	0.1987	0.9157	0.2130	0.8204	0.4732	0.7953	0.4022	0.8553	0.7238
19th Century	0.7779	0.7581	0.7554	0.8277	0.5827	0.7166	0.5565	0.8410	0.6242
Modern Art	*0.0291*	*0.0449*	*0.0237*	0.2467	0.5299	0.5523	0.9575	*0.0145*	0.0777
Post War	*0.0115*	*0.0489*	*0.0011*	0.0535	0.8485	0.3765	0.8913	0.2946	0.6007
Contempo-rary	*0.0045*	0.8703	*0.0028*	0.8190	0.0758	0.4967	0.1022	0.4428	0.7076

Source: own calculations.

In the case of the analysis of the normality of the distribution of returns, the null hypothesis was rejected in two cases (the p value in brackets):

a) Returns in the 3rd quarter of the Global Art Index (0.0000),

b) Returns in the 4th quarter of the Modern Art index (0.0145).

In other cases, there were no reasons for rejecting the null hypothesis. Generally, it can be concluded that the distribution of quarterly rates of return was a normal distribution for all analyzed indices.

The Efficient Market Hypothesis is a cornerstone of modern investment theory that essentially advocates the futility of information in generation of abnormal returns in capital markets over a period of time. However, the existence of anomalies challenge the notion of efficiency in stock markets. Calendar effects, in particular, violate the weak form of efficiency, highlighting the role of past patterns and seasonality in estimating future prices. Calendar effects were observed for the following indexes (p value parameter in brackets):

a) Global Art Index: 3Q (0.0000) and 4Q (0.0005),

b) Modern Art: 1Q (0.0291), 2Q (0.0449) and 3Q (0.0237),

c) Post War: 1Q (0.0115), 2Q (0.0489) and 3Q (0.0011),

d) Contemporary: 1Q (0.0045) and 3Q (0.0028).

In the case of Old Masters and 19th Century, no calendar effects were found. Thus, calendar effects occurred in 10 out of 24 analyzed cases (41.67%).

CONCLUSIONS

Comparison of rates of return on the stock and art markets leads to the conclusion that their relationship depends on the period chosen. In some of these periods, the rates of return on the stock market were higher than calculated for other segments of financial market. However, in other periods this relationship was inverse. For example, in the longest analyzed period, rates of return on the art market were lower than on the stock market. In the overwhelming number of cases the rates of return on the commodity market were higher than on the art market. A similar relation occurred also for the money and art market – the returns on the money market were higher than on the art market (except for the first analyzed period).

In turn, comparing the volatility on the following markets: art, commodity and stocks allow to draw the conclusion that the volatility on the art market was lower than the volatility in the other two segments of the financial market. By confronting the volatility of the art and the money market, one can conclude that they are comparable. Furthermore, it can be ascertain that the distribution of quarterly returns on the art market was mostly a normal distribution. The analysis of the effectiveness of the art market led to the conclusion that calendar effects are

present on this market (differences in returns in individual quarters) except indexes: Old Masters and 19th Century.

The conclusions presented in this article for the first and second analyzed periods, confirms earlier works, maintaining that the rates of return on the art market are higher than on the stock market [Anderson 1974: 13–26; Hsieh et al. 2010, access 7.06.2020; Kraeussl and Logher 2010: 301–318].

The obtained results for the third and fourth analyzed period are in line with conclusions published by the authors, who claimed that the rates of return on the art market are lower than rates on the stock market [Baumol 1986: 10–14; Frey and Eichenberger 1995: 528–537; Burton and Jacobsen 1999: 193–212; Agnello 2006, access 12.02.2020; Renneboog and Van Houte 1999: 331–357; Worthington and Higgs 2003: 649–669; Ashenfelter and Graddy 2003: 763–786; Mandel 2009: 1653–1663; Higgs 2012: 189–209; David 2014].

In turn, the results presented in the article regarding the low correlation of rates of return on the stock and art market, are consistent with the observations published by other researchers [Mei and Moses 2002: 1656–1668; Ashenfelter and Graddy 2003: 763–786; Worthington and Higgs 2004: 257–272; Campbell 2008: 64–81; Taylor and Coleman 2011: 1519–1529; Renneboog and Spaenjers 2013: 36–53], while they deny the outcomes presented by Mandel [2009: 1635–1663].

The occurrence of calendar effects for the six analyzed art market indexes is in line with the conclusions of David's work on the effectiveness of the art market [David et al. 2013: 23–25].

Similar tests should also be proceeded in other time intervals, e.g. on an annual, two, three, four and five year basis, as well as for other art market indexes, including hedonic ones. This analysis can also be extended for other stock market indices, as well as for other commodities.

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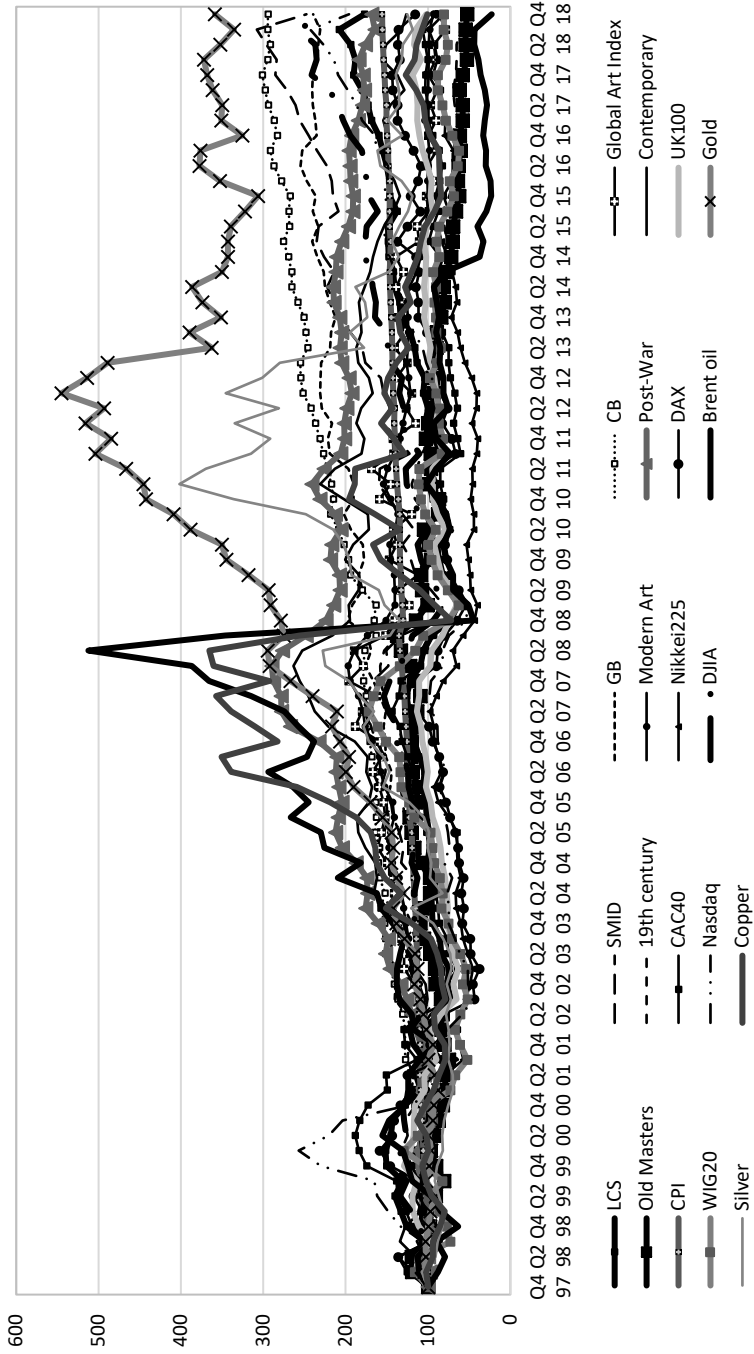
Appendix

Chart 5. Performance of individual financial instruments and indexes in the analyzed period (Q4 1997–Q4 2018)

Source: own calculations.