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Art – A purely emotional Asset?

Diversification potential of art in an equity setting.

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> *“When bankers get together, they talk about art. When artists get together, they talk about money.”*

— Oscar Wilde

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AbstExpr	Abstract Expressionism
AI	Artificial Intelligence
AXP	American Express Company
BA	Boeing Co
BAC	Bank of America
bn	Billion
BRPF	British Rail Pension Fund
CAPM	Capital Asset Pricing Model
CAGR	Compound Annual Growth Rate
CAR	Compound Annual Rate
CCR	Continuously Compounded Rate
Cf.	Compare
Ch.	Chapter
CuFuCo	Cubism, Futurism & Constructivism
DadaSurr	Dada & Surrealism
DIS	Walt Disney Co
ES	Expected Shortfall
ETF	Exchange-Traded Fund
ERC	Equal Risk Contribution
EW	Equally-weighted
FASB	Financial Accounting Standards Board
FauvExpr	Fauvism & Expressionism
FDX	FedEx
GE	General Electric
HNWI	High Net Worth Individuals
HPR	Holding Period Return
IAS	International Accounting Standard
IASB	International Accounting Standards Board
IFRS	International Financial Reporting Standards
ImprSymb	Impressionism & Symbolism
IRR	Internal Rate Of Return
JNJ	Johnson & Johnson
JPM	JPMorgan Chase & Co
k	Thousand
KO	The Coca-Cola Co
KS	Kolmogorov-Smirnov

LGD	Loss Given Default
LOOP	Law of One Price
LSE	London Stock Exchange
LTV	Loan-To-Value
m	Million
MEDREN	Medieval & Renaissance
MinCont	Minimalism & Contemporary
MMM	3M
MTF	Multilateral Trading Facility
MV	Minimum Variance
MVP	Minimum Variance Portfolio
NAV	Net Asset Value
OLS	Ordinary Least Squares
OTF	Organized Trading Facility
PCA	Principal Component Analysis
PD	Default Probability
PFE	Pfizer
PP	Principal Portfolio
ROI	Return On Investment
RSR	Repeated Sales Regression
SFAB	Statement of Financial Accounting Standards
SR	Sharpe Ratio
SVD	Singular Value Decomposition
tn	Trillion
UCLA	University of California Los Angeles
USD	United States Dollar
US-GAAP	United States Generally Accepted Accounting Principles
VaR	Value At Risk
VAT	Value-Added Tax
VOLT	Volatility-Timing
XOM	ExxonMobil
YTD	Year To Date

Introduction

Andy Warhol is credited with the sentence that “good business is the best art”. The fact that art not only requires a financial investment, but may also bring in a financial return and thus constitutes a “good business” is a sensitive issue and highly debated. The perception of art as an investment may raise the eyebrows of those who are passionate about its aesthetical value, which they see as incompatible with any financial interest. Though, art history teaches us that art collections have always been – in the Middle Ages, cultivated by nobility and clergy, in modern times by wealthy citizens and businesses – serving not only the prestige and the pleasure of beauty, but also forming a stately fortune (Czotscher, 2006). The ancient Romans in the High Antiquity, for instance, maintained a flourishing auction system with art treasures from home and abroad (Czotscher, 2006). In view of the rise of Rome, it was mainly about artifacts from the conquered provinces (Wilke, 1999). Ownership, greed and dishonest appropriation could already be observed at that time, according to Wilke (1999). Wilke (1999) also points to first cyclical price fluctuations, upswings and slumps, and even speculative bubbles in the art and antiques market. The fact that art market actors have purely emotional and no monetary interests has long been proven wrong, as will be shown by relevant literature. What is relatively new is that financial market players who have not been involved in art so far have become aware of this highly exciting market. Since the beginning of the 21st century, increasingly media are enjoying wordplay with Monet: "Show me the Monet" (Palmer, 2002) or “Monet Maker" (The Economist Newspaper Ltd., 2006). Not so long ago, there was a perception that the fine art market was reserved for the rich and the very rich. However, fine art markets also follow the laws of capitalism, mainly due to one major phenomenon: globalization. The *bonmot* of Karl Eusebius von Lichtenstein that “Geld kann jeder haben, Gemälde aber nicht” [everyone can have money, however not paintings] is no longer valid (Wagenführ, 1965). With the long-termed, worldwide trend of increasing wealth, alongside the growth in knowledge about collectible markets, a much larger community has started to be interested in collecting and/or investing in rare collectible assets. Reasons for the rethinking of the economics of art include the growing number of publications on the subject, some sensational increases in the value of works of art and collections, and better access to information for buyers (Kunze, 2002). Regarding art as an investment is no longer reprehensible. The metaphor of a "wall share" nicely outlines what it is all about: on the one hand, a monetary dividend, and on the other hand also an "aesthetic dividend". Based on the findings of art history, the aim of this work is to investigate whether art can be used systematically for wealth creation. It is not only a question of whether art is suitable as a capital investment, i.e. whether it fulfills the requirements of an investor, but also in which form an investor can become active. At this point, the option to reach exposure to the art market via art investment funds will be examined and evaluated from the perspective of an investor. Thereby the primary focus does not lie on motives such as passion for art, prestige or speculation, but on solid investment in the sense of systematic asset accumulation. However, of course it would be wrong to consider works of art as purely a financial investment. Samuel Keller, director of Art Basel and Art Basel Miami Beach, remarked aptly that anyone who sees art as an investment would miss out on the best (Zehle, 2006); any truly successful art investor not only understands the market but also recognizes the artistic idea of the artist (Wilke, 2000). Financial markets have had the worst year since the 2008 crisis. Trade

and tariffs remain one of the biggest risks to the general market outlook. In fact, according to the University of California Los Angeles [UCLA] Anderson Forecast, there's "a very real risk" the national economy will slide into a recession in late 2020 (Daniels, 2019). One of the indicators that raise concern is the fact that the US bond yield curve has inverted, for the first time since mid 2007. Therefore, in the short-term businesses will find it more expensive to expand their operations. At the same time, consumer borrowing will eventually fall, thus leading to lesser consumer spending in the economy. All of these is feared to lead to a subsequent contraction in the economy and a rise in unemployment (Srivastava, 2019). In light of current market conditions, the examination of alternative assets that would retain their value in the longer term especially in a period of economic uncertainty appears particularly relevant today. 2018 has brought both highs and lows to the art market. Auction records were broken, confidence levels wavered, paintings were shredded, and social media continued to change the artist's role in the industry. One of the most notable changes was the increase in vibrant conversation around blockchain, which is being introduced to broaden the market's transparency, track ownership and provenance, and provide an infrastructure for the tokenization of fractional artwork sales. Given that art is (at least for the time being) mostly (almost exclusively) traded and owned by the rich or ultra-rich only, it seems likely that the price development of art works is decoupled from the general economic situation – since in times of crisis, the rich and the ultra-rich are the ones least affected. As a result, one could naturally conclude that investment in the arts must offer diversification opportunities; this seems to be what many investors are willing to believe, as evidenced by the number of art fund and art market advisory firms that have evolved in recent years.

This thesis does not attempt to settle the question of the legitimacy of buying and selling art with the principal aim of obtaining a financial benefit. Instead, it goes forward with the mere fact that pieces of art are assets, i.e. they can carry a certain financial value, which is – driven by changes in supply and demand – subject to changes over time and therefore harbours an opportunity of a monetary return. It thus attempts to assess the benefits of diversification of art investments in addition to a portfolio of financial assets. Furthermore, this thesis builds on the finding of Pownall (2005) who has concluded that indeed, significant diversification benefits can be achieved by adding art to an investor's portfolio. Given these preconditions from prior research, the following analysis sheds light to the methods of measurement of financial returns on art and on the resulting conclusions for the performance of art funds as a means for the broader public to reap the benefits. The record-breaking auction prices in the past couple of years may have helped create the conventional wisdom that artworks in general are worthwhile investments, yielding returns that exceed those of other asset classes. It is noteworthy that this perception is just based on sales records, not even on return calculations. While such auction prices indicate that it is possible to earn superior returns by investing in art, they do not suffice for the conclusion that investing in art in general is financially attractive. Only a thorough analysis of the price development of a large amount of possible art investments can give way to more meaningful conclusions about the above-mentioned objective of this thesis. Compared to the analysis of returns for other assets such as stocks, bonds or commodities, an accurate computation of an art investment's financial performance poses several challenges. Only auction prices are publicly available, while gallery prices or artists' own estimations

are difficult or, in most cases, impossible to obtain in a consistent manner over a reasonable analysis period. The purpose of this paper is to test the hypothesis that art can provide investors with an opportunity to systematically improve their overall investment portfolios (in addition to equities). Also in line with Pownall (2005), who recommends to buy shares in art investment funds (for those who do not want to invest directly or simply cannot afford to do so), this thesis shall further provide answers to the question whether art investment funds constitute a favourable vehicle providing a broader investor base with exposure to the art market. This hypothesis is based on the idea that art as an asset class (once established as such) offers opportunities for portfolio diversification. The underlying assumption is that the bundling of investments in the form of a fund should circumvent (as to be found typically high) transaction costs associated with investments in art. Therefore, another assumption underlying this consideration is that the fees charged by art funds do not outweigh the cost savings from them; or more generally, that their benefits do outweigh their disadvantages.

On the research methodology of this thesis: The theoretical topic of the thesis suggests a combination of both, a qualitatively oriented observation as well as a quantitative complement. The procedure is based on the analysis of the relevant literature, as cited by Renneboog and Spaenjers (2009) or Worthington and Higgs (2004). This is quite rich in terms of art as an investment. It is clear that this body of research is not only relevant to individuals and institutions for whom art is just another asset class, next to stocks, bonds, real estate, and commodities. Art collectors (and art-collecting institutions) in general are concerned with the price formation in the art market and the return characteristics of art. Accordingly, there is a growing academic literature on art investments apart from the private and corporate research, such as within investment banks. However, the field of art funds is an "unaccomplished field" especially at the academic level, which makes it all the more important to illuminate this area on the basis of the findings of Bernhard (2005). In order to incorporate current developments, journals and reports were consulted. In addition, findings from discussions with art market participants are interwoven. Subsequent extensive quantitative analysis based on art data provided by Renneboog and Spaenjers (2009) should substantiate the qualitative conclusions.

This paper addresses the assessment of art as an investment in three main chapters. A first section addresses contextual aspects and is devoted to the controversial question of how art qualifies as an investment. It deals with various financial aspects vis-à-vis alternative asset classes, such as pricing, correlation, risks, return determinants and price elasticity. Also, the question arises, to what extent price indices and rankings in the field of art make sense. In these regards, this section will review existing literature on returns in the art market and correlations with other asset classes. Furthermore, an introduction to the functioning of the art market, its constituents, and its peculiarities is provided. It will be found that for its inefficiencies the art market has to be described as "imperfect". These a priori considerations will be essential in interpreting and qualifying the results of the analysis of performance observations. Chapter 2 follows with the introduction of art investment funds as a means to get exposure to the art market. In particular, the chapter provides a detailed account of the theoretical foundations of art fund construction and then gives an overview of real projects. Here, according to the research question, it will be primarily of interest what problems arise in practice with regard to

investments in art funds and their performance evaluation. Lastly, this chapter shall deal with an outlook on the art funds universe. Within the third section of the thesis, the evolved hypotheses shall be quantified and tested using real data: Based on Markowitz's portfolio theory, minimum variance frontiers are created starting with a pure equity portfolio, extended by art investments. The insights obtained after the first two chapters paired with the results from the financial analyses shall then be employed to evaluate the art market potential for systematic wealth management. The thesis concludes with a vivid snapshot of the art market as well as with a prediction in light of current advancements in technology. The work concludes with a final summary of the findings.

1. Art as a New Asset Class

"Making money is art.", Andy Warhol once wrote. If so, death has done little to diminish his productivity. His work has sold for a cumulative USD 3.38bn at auction in the past decade (Tozer, 2016). Plenty of other artists have famously generated astonishing numbers. The definition of art varies depending on who answers the question. For example, The European Fine Art Foundation (TEFAF) categorizes art as follows: 1. Classical Antiquities and Ancient Art, 2. Antiquities, 3. Old Masters, 19th Century and Impressionists Works, 4. Modern Art, 5. Post-War and Contemporary Art, 6. Prints, Precious Books and Maps, 7. La Haute Joaillerie and 8. Design Objects (TEFAF Art Market Report 2017). For the purposes of this discussion, art is meant to encompass as broad a categorization as possible and may include the following which is by no means a complete list or representation: paintings, sculpture, jewellery, cars, furniture, wine and collectibles, often – and thus as well here – referred to as "fine art". An asset class is a group of securities with distinct investment characteristics, including the level of risk and potential for delivering returns and performance in different market conditions. Each asset class is homogenous and largely independent of other asset classes (Sarah D. McDaniel, 2018). The three main asset classes are equities, fixed income and cash equivalents (BlackRock).

Art is characterized by a multitude of special attributes that differentiates it from other assets; namely, art objects are a product of the creativity of individuals. They are characterized by their heterogeneity: works of art are - except for prints and others multiple - unique, and thus differ from homogeneous goods such as shares or bonds (Throsby, 1994). Painters may paint the same subject several times, such as Edward Munch's "Der Schrei", which exists in four different versions. However, those paintings still represent imperfect substitutes (Baumol, 1986) and would not be traded in exchange for each other. Prints may be identical, but do not represent the original piece of art and are therefore traded at a significant discount. The same can be said about copies of artworks produced by another artist. Therefore, to put it in financial terms, art is not fungible. Compared to that, companies issue millions of fungible shares, which contribute to the liquidity of stock markets.

Since it brings an individual benefit, each and every single piece of artistic creation is subject to individual demand. Furthermore, the production of art goods ends by the death of the artist. Art can be reproduced but not perfectly copied. Art is hence subject to scarcity, meaning that it is limited in its availability of economic resources (Frey & Pommerehne, 1993). The fact that the quality of art is ultimately also reflected in the price cannot be prevented. Although the primary benefit of works of art thus far has undoubtedly predominantly lied in the consumption of its aesthetic qualities (Throsby, 1994), art generally constitutes a financial investment, too, for which price and future performance plays a role in the buying decision. Accordingly, art investors generally reconcile the costs-benefit relations (Wilke, 1999), that is, maximize their utility, both material and ideal, taking into account their respective economic conditions. Hence, art investors are themselves *homines oeconomici* in that, when investing in art, just like it is the case for investing in securities or real estate, they want to ensure that they do not over pay (i.e. maximize their expected utility); The trouble is that there is no reliable way of doing that in the art market.

As equity investors screen the stock market, art investors must mathematically and unemotionally figure out what a piece of work is worth. Art indices are certainly helpful to a point, but they only track art offered at auction, less than 50% of the overall market, and typically only successful sales at auction, which account for an even smaller slice (Powley, 2013). Moreover, buyers are subjective, faddish and emotional, which is likely to massively inflate prices: There could always be someone active in an auction willing and able to pay multiple times what they think they actually should because – for instance – it fills out their collection.

That being said, art is undoubtedly an asset in the broadest sense of the word: Besides the invaluable emotional value it may bring to its owner, its aesthetic, cultural, or historical value can be limitless. As art has its price it can very well be expected to serve as a financial asset as well (Throsby, 1994). Like the Warhol example above and many other popular auctions have shown, investments in art may indeed be financially valuable. However, merely based on such popular examples, where some people happen to own pieces that are more worth today than what they have originally paid for, one cannot and certainly must not draw conclusions on whether buying art in order to make money is somewhat easy to systematically pull off.

In the centre of any financial investment is the increase in value whereby the accurate valuation plays a major role. Accordingly, the investor must anticipate the future valuation of the market, which means that he has to validate the artwork better and quicker than the market. The "enlightenment" about the value of one artwork does not come when looking at a picture (Czotscher, 2006). Though, according to Czotscher, the investment analysis in the art market is comparable to that in the financial market: The fundamental analysis consists of visiting galleries, fairs and auctions, talks with insiders and intensive study of technical literature and relevant internet databases. As it is the case with stock investments, it is crucial to use a variety of complementing sources, to get the right information at the right time and to act accordingly. But unlike equities, price-sensitive information are not published immediately as the flow of information in the art market is much slower. Combined with no existing prohibitions regarding the use of inside information (as for financial instruments admitted to trading or traded on Multilateral Trading Facilities [MTF] or Organised Trading Facilities [OTF] and emission allowances[1]), good relationships with insiders can therefore be immensely beneficial.

1.1 Art vs. Alternative Asset Classes

Talk of art as an asset class is not quite new. One early art investor was the British Rail Pension Fund [BRPF], which decided to invest into fine art and collectibles between 1974 and 1980, in an attempt to diversify its portfolio and hedge against inflation. Due to careful buying and smart timing in its purchases and sales, the BRPF generated respectable returns of 13.1% *per annum* (Peers, 1996). But today's investors and potential casual art buyers may not fully appreciate the profound differences in how the art market functions compared with the market for stocks and bonds. In the following, a closer look shall be taken at how those differences affect the risks and returns of being an art investor. Historically, art has often been considered a personal interest rather than an asset, leading to investors often segmenting their wealth between financial assets

[1] as required by the Market Abuse Directive [MAD] and Market Abuse Regulation [MAR] (cf. https://www.esma.europa.eu/regulation/trading/market-abuse).

including stocks, bonds and real estate from other possessions such as art. Additionally, the historical opacity and inaccessibility of the art market may also have been contributing factors. Art is also often considered a high-risk investment, illiquid, opaque, unregulated, carrying high transactions costs, at the mercy of erratic public taste and subject to short-lived trends (Torcello, 2012). However, these factors have and are being alleviated. While a collector's rationale for collecting art may be varied, the significance of art on a collector's balance sheet is increasing. As well Laurence D. Fink, chairman and CEO of BlackRock, said "the two greatest stores of wealth internationally today include contemporary art [...] and apartments in Manhattan, Vancouver and London." (Burgos & Ismail, 2015). Interestingly, the evolution of real estate as a definable and measurable asset provides precedence for art in that real estate and art present similar challenges: each asset is unique; valuations can be challenging given few if any direct comparables exist; there are a myriad of indices with diverse underlying calculations and results; both are highly illiquid; buying, holding and selling costs are considerable. Nonetheless, for the last 20 years, real estate has commercialised as an investment. Many of the basic tools of portfolio management have been applied, though the underlying concepts (i.e. diversification, capital asset pricing models, international investing, structured finance, securitization, hedging, etc.) may be much older (Clayton, et al., 2009). Hence, why would art not be able to overcome its peculiarities and join this movement? The most important discrepancies between an art investment *vis-à-vis* an investment in equity stock can be summarised in a table (Appendix 1) based on a collection of attributes from Wagenführ (1965), complemented by Baumol (1986), which have not lost their validity since then. The most striking difference to other assets is, as Baumol notes, that pieces of art do not have one "true" (equilibrium) price; whereas, for instance, the fair value of an equity share of a company at any given time can be determined by discounting the future cash flows an investor expects from owning the share, such as from dividend payments. Art, however, can be seen as an asset that does not yield any financial revenues that can be discounted except for the income that can be obtained through lending and the price for which one expects it to be resold to a future buyer/ investor; furthermore, expenses incur in the form of storage, insurance and associated costs. Due to the nature of any artwork – by its own definition – who would dare to claim to know the true equilibrium price? Baumol at this point refers to the Oscar Wilde, distorting his famous quote for his purposes: "Even those critics who claim to know the value of everything may know the true price of nothing" (Baumol, 1986). In line with such reasoning, it seems implausible that art markets possess anything like long-run equilibrium prices, let alone that there exist reliable forces that drive market prices toward them. Logically, these differences in supply, demand, liquidity, volatility and availability of information – just to name a few – all can be expected to collectively impact the pricing and thereby ultimately the expected rates of return, as to be discussed in the next sections below.

1.1.1 Average and Optimal Holding Period

According to Bijan Khezri, former CEO of the Artist Pension Trust, art is an asset class, but it should not be tackled with the mentality of a classic investor (Steward, 2007): Those who wish to invest capital in the art market should follow a long-term strategy and "dynastic thinking"; namely, they should acquire art for future

generations, as once former chairman of Sotheby's, Peter Wilson, expressed precisely (Wagenführ, 1965). The average stock holding period in the international equity markets is found to have been decreasing for decades, supported by the growth of high-frequency trading; whereas the mean duration of holding period by US investors was around seven years in 1940, it had fallen to seven months by 2007 (Ritholtz, 2010). Compared to company stocks, for which an average holding period is easily estimated based on total shares outstanding and the traded volumes observed in the market, an equivalent analysis for works of art, as well as for real estate, is difficult to conduct due to incomplete coverage of the entire market, a lack of liquidity in the market, as well as high transaction costs. Mei and Moses (2002) find an average art holding period of 28 years, based on repeated sales observations from 1925-2004. This average holding period can have both an upward or downwards bias. For older paintings, an upward bias could stem from the fact that only auction sales are considered, whereas data for other (private) sales channels, such as gallery transaction, is missing. Holding periods based on auction data for Modern and Contemporary art most likely have a downward bias, since other sales channels are more important in early periods of the life cycle of a painting. Another possible downward bias stems from the fact that only resales in a certain period are being considered, whereas a longer analysis span hypothetically – often precluded due to the lack of historical data – would yield more resale pairs with a longer average holding period.

To determine the optimal holding period of art investments, Kraeussl (2013) used his repeated sales database of nearly 30,000 resales, covering the period between 1985-2012. Splitting the data into two sets – one looking at works with a second sale that took place between 1985-2001 and the other looking at those with a second resale from 2002-2012, he sought to find out if the market has shifted in recent years. Across all auction house categories examined except Postwar and Contemporary, a peak in returns is realized by holding artworks for a period of five to ten years. The analysis shows an impressive consistency of the optimal holding period across art categories:

CATEGORY	<2 YEARS	2 TO 5 YEARS	5 TO 10 YEARS	10 TO 20 YEARS	>20 YEARS
ALL	0.21%	1.32%	4.47%	3.98%	1.61%
Old Masters	-8.27%	-5.43%	3.74%	2.81%	2.50%
19th-century European	-3.93%	-2.29%	3.22%	2.97%	1.11%
American	-3.62%	-4.83%	2.88%	3.05%	1.53%
Impressionist and modern	-2.55%	0.15%	4.20%	3.73%	2.41%
Postwar and contemporary	7.49%	4.54%	5.90%	4.69%	3.35%

Table 1: Optimal Holding Period Per Auction Category (KRAEUSSL, 2013)

1.1.2 Pricing Anchors

Who and what determines the value, the price and the quality of an artwork? Do current market conditions constitute the all-important yardstick for it, or do other factors, such as changes in taste, matter as well? Eventually, whether a buyer acquires a piece of art for reasons such as prestige, the artist's reputation or the intrinsic value of the art object or if he or she is led by taste and intuition is of little relevance; ultimately, the prices of art objects are determined by supply and demand. Representing the supply side, artists can have an

important role regarding the prices of artwork. Artists who are still actively painting, can regulate the market for their artwork either by limiting or extending their output, by adjusting to current tastes and trends in the market and by buying back their own art pieces in order to back the prices of their artwork. Following such reasoning, artists are, together with the galleries who represent them, responsible to foster the demand for their artwork, which deviates from the notion of the artist that does not allow commercial interests to interfere with his artistic freedom. Andy Warhol, one of the best-known artists of the past century (Cumming, 2005), does not even attempt to negate this responsibility – quite the contrary: "I wanted to be an art businessman or a business artist. Being good in business is the most fascinating kind of art." Another, more recent example is given by the British artist Damien Hirst, who admits that he only bypasses the Gallery market and directly auctions his own work to maximize his own profit (Carrigan, 2017). The business mind-set exemplified above is not confined to Modern or Contemporary artists: Winslow Homer, one of the best-known US painters of the 19th century (Cumming, 2005) is quoted by Murphy (2002) as follows: "I will paint for money at any time, any subject, any size." Homer was known to work without the financial support of patrons, instead selling his paintings directly through different channels such as galleries, academies or expositions. More than that, he did not shy away from reworking paintings that proved difficult to sell. In order to untangle the variety of relevant pricing anchors, it is worthwhile to differentiate between quality-dependent and quality-independent factors.

a. Quality-dependent Pricing Anchors

In view of the strong limitation or singularity in its supply, the price of a work of art is generally determined by demand (Kunze, 2002, p. 42). It therefore follows that prints – for instance – must be rated at lower prices, as they appear in higher editions (albeit limited). In the pricing realm there are always hierarchies; Wagenführ (1965) also recognizes an order of art goods in value from top to bottom. The ranking is led by a group of the so-called "Unschätzbaren" [invaluable], for which there is, so to speak, no price scale. They constitute the narrowest circle of highest-ranked works from the "Akademie der Unsterblichen" [academy of the immortals], as a result of centuries-long sieving and selection process (for example 'Mona Lisa' by Leonardo da Vinci). The next groups to follow are the preferred works, the middle class (solid average) and finally the "Spekulationswerte" [speculative objects] (p. 125).

In general, art investments are worthwhile only at first quality (Wagenführ, 1965). In fact, Renneboog and Spaenjers (2009) find evidence of a positive so-classed "masterpiece effect". That is, high-quality art makes a better investment. High quality of an image, according to Czotscher (2006), is characterized by its art-historical importance, less by whether it is 'well painted'. A work is worthwhile if it is typical for one artist and still stands out from his other oeuvre, for example, by another formal language that has ushered in a new creative period of an artist. Contrary, typical works are often subject to discounts (p. 26). Czotscher (2006) finds a long list of relevant pricing factors (p. 27), including *inter alia* the origins of the artist, the scarcity of the artist's works, the provenance of the artwork, the market conditions and general economic conditions, as well as the motive of the work. Hence, of importance is not only the artistic quality but also external factors like genre, era or style. The provenance should be fully documented to exclude counterfeiting and theft (Czotscher, 2006).

For the latter this applies in light of possible return claims particularly for the years of war (Kunze, 2002)Another criterion that impacts demand positively is the time that elapses before a work of art returns to the market (the so-called “Marktfrische” [market freshness]. According to Czotscher (2006), this is given for a period of seven to ten years. “Wanderpokale” [challenge cups], on the other hand, are subject to price discounts.

Real estate or gold have an intrinsic value. In contrast, the costs of material used for artwork is usually negligible (Czotscher, 2006). The value of works of art would be relatively low if one were to sum up the costs of production, such as the prices for paint, canvas, frame and hourly wage of the artist; it quickly becomes clear that those inputs do not suffice to explain the prices paid on the art market (Kunze, 2002). However, the influence of the material used on pricing must not be dismissed, because one may very well expect an oil painting by a particular artist to be priced higher than a painting based on watercolor (Kunze, 2002). Neither the size of a piece of art constitutes an ultimately decisive factor for its price determination. Although larger formats tend to be more expensive (Kunze, 2002), unordinary formats, especially oversizes, are difficult to resell. In the art world goes the saying that one should only buy what one can also carry by hand (Czotscher, 2006). Of obvious relevance is the condition of a work of art as a price-determining factor. Relevant factors for the professional storage or preservation of a work of art are factors such as exposure to sunlight, humidity and ambient temperature to prevent cracks on canvas, paint peeling, brittle or wavy paper and the formation of molds (Kunze, 2002). In case of a restoration, the original state of a work should be restored as well as possible without changing or alienating it (Kunze, 2002).

A personal dating and titling of the work of art by the artist not only facilitate the identification and assignment to a creative period but also constitute a price-increasing factor. However, these do not serve as means to identify a fake because those are regularly subject to forgery In order to identify a forgery one must rely on the expertise of a specialist, common sense and a trained eye (Kunze, 2002). According to Czotscher (2006), one basic rule applies that pleasing subjects are most in demand (p. 27). Muellerschoen (1991) has important representational objects and their respective impact on pricing summarized (p. 179): Just to name a few, as price-increasing motives apply winter landscapes, children genre or oriental topcis. On the other hand, as price-decreasing motives apply religious representations, nocturnal depictions or portraits of men.

Art is an atypical material asset because in the art world, the spiritual, artistic content that counts is based on the intellectual capacity of the artist (Czotscher, 2006). A work of art is then valuable if it is unique, non-reproducible and characterized by originality (Kunze, 2002). The value of an image is thus determined primarily by the name of the artist. This can be corroborated by the fact that anonymous art only in the rarest of cases obtains a high price (Czotscher, 2006). A price-increasing influence has the inclusion of a work in a major exhibition, since in a museum usually only works of first-class quality ("museum quality") are exhibited (Kunze, 2002). All the more understandable is for Kunze (2002), the attempt of private collectors to present their collections *en bloc* in a museum. An exhibition where the original work of art can be viewed and examined by various experts, also serves its verification and authentication.

b. *Quality-independent Pricing Anchors*

The value of a work of art is not determined solely by the fundamentals just defined, but is subject to fashionable trends as well (Frey-Broich, 2006). It would be naive to believe only the quality of the work is important in determining its rating. As Hodgson and Vorkink (2004) note, art also carries a consumption value. Both elements are subject to a high degree of uncertainty and are thus difficult to quantify: The consumption value may change along with one's own taste, while the value for which the art work may be resold to another investor at a future point in time may vary with the *Zeitgeist*. Hereby, intuitively an important distinction would be made at this point between established, well-known artists and other, newer and not (yet) established artists. Whereas the expected selling price for well-known artists may generally be high and less fluctuating, the opposite should be expected from new, rather unknown artists (Hodgson & Vorkink, 2004). Yet, this distinction into two elements still does not help much to calculate the present value of an art work, since both are rather intangible and thus difficult to quantify. Anderson (1974) further refines the consumption value by distinguishing between decorative and aesthetic-prestige services. According to him, decorative services refer to the way a painting or another work of art is able to improve the perception of a room or an environment in general. Aesthetic-prestige services, in turn, are derived from the attribution, the artistic merit and the ownership history of art. A different approach can be found in the work of Hutter et al. (2007), who derive the value of art from its communication potential, "the ability to offer opportunities for conversations with others who share knowledge about the same class of commodities". The establishment of a network with a consensus for the work of a certain artist then constitutes a "circuit", which is a major determination factor for the price of a work of art. According to (Czotscher, 2006), marketing is enjoying an increasingly high status in the art market. This is done either through galleries or else directly by the artist. Similar to film or music stars, artists create impressive lifestyle changes or sensational art actions in order to get attention. Internationally the strongest representatives of such marketing geniuses are Andy Warhol, Jeff Koons or Damien Hirst. An empirical analysis has shown that the most critical factor for success of gallery owners is to have good communication skills in order to maximize reputation (Bernhard, 2005). The art world is in the words of Herchenroeder (1990) in a paradoxical field of anonymity (sale) and over-publicity (marketing). It becomes critical – or interesting, depending on the point of view –when such marketing strategies turn out more successful than the quality of the work. According to Perregaux (2007), artists who are not professionally managed during their lifetime have no chance. He continues that for a contemporary artist to have a chance of future success and thus an increase in the value of his works, the artist would need first-class management through a gallery and the presence of the artist's work in galleries, at fairs and in museums during the lifetime of the artist. Otherwise, he or she will hardly be able to catch up on the lost market potential in the future, because new generations of artists are constantly coming.

According to Dr. Roman Kraeussl (2016), Professor at the Luxembourg School of Finance, the most important pricing factors of any artwork are its provenance and the timing of the sale, which make it difficult to establish an expected measure of return on investment [ROI]. A prominent provenance in the form of a famous collection or a famous collector indeed constitutes another quality-independent feature of artworks with a

price-increasing effect (Czotscher, 2006). According to Schneider (2005), this bonus effect may even lead to a multiplication of the price. This cannot be observed for homogeneous goods, such as stocks. Whereas historically, alongside big collectors, in particular those of royalty were considered famous collectors, nowadays also stars of the entertainment industry or politicians join the rank (Schneider, 2005). According to Schneider (2005), this psychological factor about significant pre-ownership of any artwork is often exploited by art dealers when telling small anecdotes about their traded objects.

When looking at the pricing anchors of artworks, it seems intuitive to suggest further distinguishing between works of art of living (still producing) artists and no longer living artists. In the case of no longer living artists, the art works produces constitute a scarce resource; hence, the pricing of their artwork can no longer be influenced by changing their supply; or as Baumol puts it: "[…] the elasticity of supply is absolutely zero" (Baumol, 1986). Thus, the only price anchor remains with the demand, whereas in the case of living artists who may still be producing (although not perfect substitutes) the pricing of their work is impacted both by the demand as well as by the supply mechanism. The markets for the products of what are considered minor schools work very differently. At this point, Baumol refers to Montias who had pointed out that a sudden rise in the popularity of a group of not noted artists can elicit a flow of their works from attics and basements, thereby rapidly expanding their available supply and thus impacting their pricing (Baumol, 1986). Whereas "[…] in the market for the visual arts, particularly the works of noted creators who are no longer living, there may exist no equilibrium level, so that the prices of such art objects may be strictly unnatural in the classical sense.", as Baumol (1986) states.

Another conventional wisdom dictates a near-immediate upswing in prices whenever a famous artist dies as collectors try to get hold of remaining available works. This was tested by Roman Kraeussl (2013). In addition to the certainty that no new work will be created and thus any existing work of the artist is scarce, there is a presumption that an evaluation or re-evaluation of the existing body of work is imminent. Kraeussl examined what effect the death of an artist has on the price of paintings subsequently sold at auction, examining more than 250,000 auction records from Blouin Art Sales Index auction data from 1980-2012. His analysis shows however that the death of a famous artist not necessarily means a jump in prices. In fact, the sample of 500 top-selling artists at auction indicates that the volume of sales or trading in a particular artist's work following his or her death initially grows faster than price. As time goes on, this trend is reversed: Supply shrinks as prices rise. Prices escalate more quickly if the artist is younger at the time of death. Older artists with more established, mature markets tend to have less movement in price both before and after their death. But numerous other factors are shown to affect how prices perform posthumously, including overall market conditions or how prolific the artist was. Exactly how the variables will interact to determine value is impossible to predict. As Kraeussel puts it: "[…] scarcity might spark higher prices, or make for a market that sees so little activity the artwork becomes virtually illiquid" (Kraeussl, 2013).

Under no circumstances may the production costs of a work of art be equated with its value. The value of a work of art differs with market participants so that the rating is highly subjective. Interestingly, according to Kunze (2002), however, dealers and savvy collectors generally agree upon on the assessment of quality.

Arguably, well-known and successful collectors can even set price trends, as Francois Pinault, founder of the French retail company PPR, rather self-confidently states: “As soon somebody observes me scrutinizing a work of art, the market value of the artist is soaring” (Grimm-Weissert, 2007).

Therefore, identifying the intrinsic value of an artwork and ultimately the fair price to pay for it requires a lot of knowledge and/ or expert help. It also assumes you can get hold of coveted works at a time when plenty of other people are after them and when some buyers are prepared to spend unlimited resources. To get hold of undervalued art pieces, an investor preferably has both, limitless time and oodles of financial resources. However, despite the most thorough analyses, the pricing of artworks ultimately remains a puzzle; the value of a work of art can never fully be estimated objectively, even if all these price criteria apply and price trends on the auction market are to be considered. Among passionate collectors there may always arise bidding duels leading to outlier prices. One example that is often referred to in literature is given by the auction of the "Portrait of Dr. Ing. Gachet "by van Gogh in May 1990: Christie's achieved a price of USD 82.5m (The Economist Newspaper Ltd., 2003) though most bidders had dropped out at about USD 40m (Kunze, 2002); two bidders, however, again doubled the price until the contract was awarded to Ryoei Saito, the Japanese "paper baron". Once at Sotheby's in New York a Warhol copy auctioned for USD 60,000, while the real Warhol only sold for USD 26,000. Similarly, Banksy’s ‘Girl with Balloon’, appreciated significantly just shortly after the work was auctioned at Sotheby’s for USD 1.4m, although – or because – at hammer blow it ran through a shredder, which was hidden in the lower part of the frame (Rodney, 2018). Eventually, an investment in art is like a lottery game, because it is not only a bet on the quality of the artist and his work but also on fashions, flavors and marketing (Prickett, Andrews, & Kumar, 2004). The only rule that truly holds, is that any piece of art is worth exactly as much as the next owner is willing to pay for it. Analogous to company valuations in the mergers and acquisitions [M&A] market, comparable analyses can be made using auction prices of similar works serving as a guide in the evaluation (Czotscher, 2006). As will be discussed in ch. 3.7.1 below, the advancements of technology, for instance in the form of Machine Learning [ML] techniques, are currently being proposed to support the valuation of art.

1.1.3 Price Elasticity

Generally, in order to specify the supply and demand behavior of the art market, it is worth analyzing the price elasticity, that is, to investigate how market participants respond to a price change. The price elasticity is defined as the percentage change in quantity (of supply or demand) relative to the percentage price change. With inelastic behavior ($|\varepsilon| < 1$), a price change has a disproportionately lower effect on the supply or demand behavior of market participants. According to Kunze (2002), due to the heterogeneity of the art market, it is not possible to conduct a uniform, comprehensive analysis of its elasticity. Tools for such analyses applied in other markets are not applicable in the art market, or only very distinctively (p. 19). Kunze (2002), however, assumes that demand behavior of patrons as art investors is relatively price inelastic as their decision whether to buy a work of art will most likely depend very little on the price. Art dealers on the other hand would behave exactly the opposite way, since their demand depends primarily on the price and thus is relatively price elastic.

Similarly diverging elasticities would also be identifiable for other groups of consumers – depending on their purchase motivation or order to buy and collect art. Another phenomenon of the art market, according to Kunze (2002), lies in the occurrence of the so-called "*snob-appeal*" effect; this can be observed in moments when – against expectations – rising prices do not lead to a decrease but to an increase in demand.

1.1.4 Benchmarking

In the stock market, investors around the world rely on various indices like the S&P 500, Dow Jones Industrial Average, or the NASDAQ Composite (which mainly differ in their weighting methodology) to evaluate potential investments and/ or to understand its historical risk and return profile. These indices, representing large, liquid and active markets, are typically recalculated continuously throughout trading periods to reflect up-to-the-moment pricing data and to indicate the direction and magnitude of the market's price sentiments; That being said, index values can be compared in order to calculate relative performance and to show how the markets have changed over time.

The S&P 500, a free-float capitalisation-weighted index that tracks 500 large US companies, is a powerful tool, amongst other reasons because it is investible: Investors have the opportunity to invest into mutual funds or exchange-traded funds [ETF] that mimic the index; that being said, investors can in fact be confident that they will get returns in line with the return on the index. Alternatively, investors can invest into a more expensive – i.e. due to higher fees – actively managed mutual fund or hedge fund, and use the S&P 500 index as benchmark to evaluate the fund's (or, more precisely, the manager's) performance (Spaenjers, 2010).

The real estate market has adopted this idea: The Case-Shiller Home Price Indices (now named S&P Case-Shiller) are calculated from data on repeated sales of single family homes. Given that repeated sales are the only basis for true return comparisons over time, Jianping Mei and Michael Moses utilized a similar process to create the Mei Moses Fine Art Indices (now named Sotheby's Mei Moses) (Sarah D. McDaniel, 2018).

Generally, a price is standardization of works of art should not be possible due to their heterogeneity and incomparability. However, a historical time series may be relevant to show basic trends for the entire art market as well as for individual art sectors and/or categories. Furthermore, such database may help to gain information in terms of correlation and volatility of the returns of works of art and allow for them to be integrated into a portfolio context in order to optimize the overall portfolio (Arends, 2002, p. B5). Whereas auction results were previously listed in extensive art books, these transactions are nowadays – in today's age of information – recorded by various databases to bring more transparency to the flood of information (Wilke, 1999). Just to mention a few, websites such as Artnet.com, Artprice.com, Artfact.com, Artasanasset.com or Artinfo.com come with extensive analysis tools (Brewster, 2007). Extensive records of art auctions have only been published since the seventies, so that a problem of (in)availability of suitable statistical material arises. In particular, transactions dating back to previous centuries can only be retrieved in isolation and not continuous in time from art literature or from old auction catalogues (Wilke, 1999). Hence, the data may very well show larger time gaps, meaning that the indexation of the entire art market is doomed to failure in advance. On the one hand, shorter data periods and more recent data may be easier to analyze; on the other

hand, the meaningfulness of conclusions drawn from such observations (Wilke, 1999) is limited. So, instead of generating a price index against the heterogenic nature of art, rather a curve of average prices may be constructed (Brewster, 2006). Consider a collector selling an unusually large number of relatively insignificant works of one great artist; or the opposite, where one particularly sought after piece of art is being sold. In both such cases, the impact on an index would give a false impression of the actual situation (Brewster, 2006). Several attempts by index providers to smoothen this problem by either subjectively taking out of the indexation certain works of art or to lump sum the top as well as the bottom 5% of data to not have any impact on the index (Brewster, 2006) are not convincing. More problems arise from the fact that there will always be many artists whose works only very rarely change hands, and thus do not show sufficient claims to be indexed (Radell, 2005). Moreover, neither privately negotiated sales can be taken into account, nor works of art for which buyer and seller could not obtain an agreed-upon pricing a at auction. Additionally, prices both with and without commissions are used for the indexation. Here, only the inconsistency is pressing, not the omission of auction costs in general; neither do stock indices take into account transaction costs, nor do real estate indices (Arends, 2002). As Spaenjers (2010) has pointed out, there are at least three reasons why it is impossible to create an investable art index, analogous to the stock market's S&P500. First, roughly half the art market's annual sales are automatically off limits for the purposes of creating an index, because they occur in the gallery market where public price disclosure is not required. Second, the indices researchers have built thus far using repeated sales of artworks at auction, such as the probably most well-known Mei Moses Art Index (recently purchased by Sotheby's and now better known as Sotheby's Mei Moses), paint an incomplete picture of the market and the movement of prices over time (for reasons that will be discussed in ch. 1.5). Third, even if those indices accurately captured the performance of the auction market as a whole, there is nothing in the real world one can buy to replicate that performance.

As we have seen in previous sections, many financial analyses tools – possibly in a modified form – not only serve the equity investor but also the art investor in order to identify potential growth candidates and thus to find adequate investment opportunities. Accordingly, following the financial markets, rankings were brought to life in the art market as well. In line with the insights derived from the analysis of the pricing anchors of art, the level of fame and attention an artist receives – as a key factor when pricing works of art – forms the basis of existing rankings. A comparison of existing rankings with respect to the price indices becomes evident as it appears interesting whether rankings actually precede price indices.

The perhaps best-known rankings are the annually published "Kunstkompass" of the journal Capital and the "Artist Ranking" by Artfacts.net. Since art is neither measurable nor comparable, Capital's Kunstkompass measures the public reputation and resonance of an artist (Frey-Broich, 2004). It is based on a scoring system, from which a ranking of international artists is derived. An increase in the total score from one year to the next may be interpreted as an increased level of interest in the artist (Czotscher, 2006). Evaluated and with scoring points rewarded are factors such as the significance of exhibitions and reviews in the literature. The Kunstkompass is therefore often accused of superficiality (Czotscher, 2006). Interestingly, however, it seems to predict price trends correctly, because investing in the top artists of the ranking between 1970 to 1995 would

have been financially successful, according to Capital (Czotscher, 2006). Artfacts.net's ranking is also based on a scoring system in which points are distributed by experts such as gallery owners and curators in terms of significance, prestige and relevance of the artist. Information from affiliated museums, art galleries, and fairs are evaluated continuously in an automated scoring process (Czotscher, 2006). The theoretical basis for their ranking is provided by Georg Franck's book "Economics of Attention". It postulates that attention, fame and retention are economic factors that follow the market mechanisms (Czotscher, 2006). It follows that curators and gallery owners will invest in those artists from which they hope for an economically beneficial capital increase in the form of greater attention or awareness (Artfacts.net, 2005, p. 2).

An important figure often employed to measure and benchmark the risk-reward relationships for equities is the so-called *Sharpe*-Ratio [SR] showing the stock's (portfolio's) excess return over investment in a risk-free asset, such as government bonds, over the volatility (risk) of the stock (portfolio). This relates the risk to the return; that is, it quantifies how much return (i.e. excess return) the investor receives for the assumed risk (standard deviation) (Taylor, 2003, p.). Renneboog and Van Houtte (2002) conclude in their study that art investments have an underperformance with respect to the Sharpe ratio[2] to equity investments. Yields on art installations would not make up for their high risk – for example, transaction costs and insurance premiums (p. 331). Rennebog and Van Houtte examined 10,500 auction prices of Belgian paintings for the 1970-1997 period. Pownall also analyzed the Sharpe ratios of art investment in other asset classes. In her opinion, however, equality prevails. Pownall obtained a coefficient of 0.642 in her Sharpe Ratio calculations for American art (period 1974 to 2004), compared to 0.648 for US stocks (Czotscher, 2006).

1.1.5 Co-Movements: Benefits of Diversification and Hedging Inflation

Globalisation has led to an increasing correlation of markets. That is, to the disadvantage of investors, stock price decreases in one country (continent) can no longer be easily offset by stock price increases in other countries (continents). The more investors diversify their investments, the more the correlations across countries (continents) increase; as crises hit markets, investors in that market that are affected by such crises will withdraw their funds from other investments (in other markets) as well, thereby affecting these (other) markets as well (Czotscher, 2006). The creative search for new asset classes with low correlation combined with strong returns goes on and has now reached art as a potential candidate (Curry, 1998). Scientists and market insiders try – thus far rather unsuccessfully – to find regularities in the art market that can be leveraged. Besides by art investment pioneers like corporates and financial institutions, both of which have long been combining art acquisitions and patronage, art works have hardly been employed systematically for portfolio diversification (Czotscher, 2006). In the eyes of many private investors or investment advisors art is afflicted with the reputation of a slippery investment vehicle. However, this assessment is undifferentiated in this form. Because art should not be seen primarily as a "return-producing strategy", but rather as a "risk-reducing

[2] The Sharpe ratio examines the performance of an investment by adjusting the risk. It is a ratio measuring the excess return per unit of risk taken (Sharpe, 1963).

strategy" (Pasha, 2006). Art is considered "*Depot Würze*" [depot seasoning] (Faber-Castell, 2007). According to art investment experts like Wilke (1999), an investment share of 5-10% of the total assets in art is appropriate. The proportion could vary and be significantly higher along with solid technical support or high level of knowledge on the subject. However, there are academic studies that obtain even higher proportions: Tucker and Hlawischka (1995), for example, arrived in their analysis of historical data for portfolios of works of art and other financial assets over the period from 1981-1990, at an optimal art share of more than 36%. The percentage is so high because of the very low correlation between the returns on art and the returns on financial assets. Different empirical studies and their correlation calculations have led to varying results. Some of these differences may be due to the use of different intervals of observation and estimation, or to drawbacks of the repeated-sales regression, the method commonly used to build art indices (cf. ch. 1.5). The low correlations may also be caused by a focus on U.S. stocks; the art market has become a global trading place over the last few decades. Basically one could assume that economic prosperity and the art price level are moving in the same direction, given that in good economic conditions with a strong stock market phase, households tend to have more resources to invest in art. Accordingly, an old art market wisdom says that art lives off superfluous money (Herchenröder, 1990). Renneboog and Spaenjers (2013) have examined the correlation or causalities between global wealth and the demand for art, for which there seems to be strong evidence for a positive relation: When individuals' buying power rises, this can be expected to lead to higher art consumption, and thus to a higher price level in the art market. Within their investigated time period (1830-2007), they find that indeed top incomes are fundamental in setting the price level in the art market. In fact, they find significant price drops in their art price index during World War I, over the Great Depression in the 1930s, and after the oil crisis in 1973. Moreover, they find strong price appreciations throughout the 1960s, during the art market boom at the end of the 1980s, and in the first years of the 2000s. Furthermore, one might want to differentiate between masterpieces and less known art. Whereas the value of pieces from unknown artists may fluctuate more with the economy according to the reasoning above, old masterpieces tend to be owned by the very rich – high net worth individuals [HNWI] – only whose wealth generally is not affected by fluctuations in the economy. Studies by Goetzmann (1993) or Stein (1977) have shown a generally positive relationship between art and stock markets. However, there are also voices that oppose the view of the stock market as the one and only factor influencing the long-term development of prices in the art market because art prices can also rise if stock markets are weak. Ginsburgh and Jeanfils (1995) have shown in their study that the financial markets affect the art markets only in the short term. According to their output, long-term relationships do not exist. This, in turn, would suggest art could make a good diversifier for equity investments. One quite famous study on the correlation of art prices with other asset classes was undertaken by Mei and Moses, based on its own art market index. In their investigation, Mei and Moses (2002) yield proof that artworks show a coefficient of correlation of only 0.3 equities and therefore have a positive diversification effect on asset portfolios.

Furthermore, Pownall (2005) dealt with the behavior of art markets in times of turbulence. She pointed out that correlations among art, stock and commodity markets do not change notably, when prices on stock

exchanges or commodity markets undergo extreme changes. Generally, one could assume that in stock market crashes correlations among all asset classes are increasing, as a simultaneous flight of capital from the different markets takes place. However, Pownall shows that the crashes in October 1987, September 1990 and August 1998 have not diminished the yields on the art market; on the contrary, yields on art investments showed even slight increases (2005). Although yields in the art market are more volatile than stock returns, they show less extreme market movements (Pownall, 2005). There are fewer outliers and thus the downside risk is lower (Pownall, 2005). Art is therefore apt to protect the investor in extreme downward movements in the stock market. The well-accepted believe of a co-movement of art and stocks thus could not be confirmed. As comparison, classic bond investments show correlations to equities of 0.4, major stock market indices amongst one another show coefficients of around 0.8 (Arends, 2002). (Pownall, 2005) therefore advises all investors to make use of the strong diversification effect of art investments. For those who do not want to buy them directly – or simply cannot afford to – she recommends to buy shares in art investment funds.

For its particular co-movements, there are further, less obvious factors that could make investments in art relatively more or less attractive compared to alternative asset classes: The assumption is evident that high inflation rates are conducive to the art market. According to Wagenführ (1965), Liselotte von der Pfalz already noted in the eighteenth century that an investment in paintings in turbulent times was a commandment of reason. Studies by Mei and Moses have shown that in indefinite armed conflicts over the last century, art indices repeatedly haven beaten major stock indices (Barker, 2001). However, the idea that money is safe in art because it represents a *valeur refuge* (Wagenführ, 1965) does not only hold for times of war. Schneider (2005) argues that the art market – fuelled by the rising appetite of the American baby boomer generation for luxury goods – was only really revived in 1974 by the inflation panic caused by the oil crisis. Based on historical data, Czotscher (2006) shows that in the early 1970s, when industrial inflation reached its cyclical peak, art prices had fallen in real terms. Since then, art has become more expensive in real terms, while consumer prices around the world have fallen behind. The price boom on the art market during the intermediate inflation high in the late 1980s was not a reaction to inflation, but due to short-term speculation with funds from the Japanese financial market. That art performs better in periods of high inflation or rising inflation than other financial assets has also been confirmed by an analysis made between 1973 and 2012, where art has obtained an average return of 18% whereas equities, bonds and commodities yielded only 2.5% and 13%, respectively (Saatchi Art, 2016). The extent to which the psychological factor of inflation protection plays a role in present-day Russia, where large portions of the wealth of new-rich Russians flow into art (Schneider, 2005), can only be speculated on.

1.1.6 Legal Aspects

A curiosity of the asset "art" exists in copyright. It grants the artist a right to make changes to the transfer of ownership to buyers and third parties - for 70 years after the death of the artist (Studer, 2008a). In the foreground is Art. 11 para. 1 lit. a of the Copyright Act: This very personal right gives the artist the exclusive right to determine whether, when and how the work may be altered. After death, heirs and other legal

successors (foundations, etc.) exercise this right (Studer, 2008a). It follows that the duplication and editing of a work of art without permission of the artist or his heirs is not permitted (Czotscher, 2006). The protection of the artist basically extends to any change, big or small, "good" or "bad" (Studer, 2008a). Copyright cannot be acquired, for example by purchase (Czotscher, 2006). However, the determination of what constitutes a work worthy of protection in copyright law is still a matter of discussion. According to the law, the work must be a spiritual creation and have an individual character (Article 2 (1) Copyright Act). Especially the latter condition leaves much room for interpretation (Studer, 2008a). In the best case, the artist may even receive a share of the proceeds from resales. Europe goes far in this concern: A resale right standardized throughout Europe since 2006 states that if the work of art is sold in professional trade or at an auction, the artist or the heirs also participate in a later appreciation of a work of art with a small percentage (Czotscher, 2006). Starting point for this claim is the idea of having the artist co-earn if the work becomes more and more expensive in later sales (Sykora, 2008). The resale right shall only be applied if a representative of the art trade acts on the side of the seller or the acquirer; private sales are thus exempted from resale rights (Sykora, 2008). The problem of such regulations with regard to the art trade is the high administrative burden. It also uses the cliché of the poor artist (Sykora, 2008). This goes against logic as the resale right only favors the established artists, who already earn well in any case. Czotscher (2006) concludes that this technocratic rule is likely to be damaging Europe, as the art auction market would be expected to shift even further to the US because of this additional cost factor (p. 13). However, uncertainties among collectors have also been caused by other legal developments, which are primarily attributable to the numerous cases of illegal trade in art and cultural goods. In general, these can be divided into three categories: trade in stolen cultural assets, the problem of illegal excavations and the illegal export of cultural property (Schönenberger, 2008). Going forward, collectors will have to pay even more attention to the origin of the works of art and even have to contractually secure them, since the laws regarding the return of stolen, illegally exported artworks or art declared by a state as unsellable are currently being tightened internationally. The rules for the art trade shall meet the danger that cultural goods of dubious origin are being offered in the market. At his point, on the one hand, attention should be brought towards the Unesco Convention on the Protection of Cultural Heritage and, on the other hand, to the 1995 Unidroit Convention on Stolen and Illegally Performed Cultural Property. The latter is rather restrictive – too restrictive for many representatives of the art scene. The Unesco Convention, the first global convention on the protection of cultural property, contains minimum rules on legislative and administrative measures to safeguard the cultural heritage and prevent the illegal transfer of cultural assets (import and export, return of cultural property, information sharing and involvement of commerce and museums) (Mercker & Mues, 2005). On the Unidroit Convention, we learn from Mercker and Mues (2005) that it was intended to complement the Unesco Convention, which – as a purely intergovernmental regime – provided no instruments for the recovery of stolen or unlawfully exported cultural assets by private individuals. For the return of stolen or illegally excavated cultural objects it requires a return within a period of 50 years, in individual cases of 75 years. A *bona fide* acquirer is entitled to compensation for the return of the artwork. In addition, unlawfully exported cultural goods, the export of which means an impairment of essential cultural or scientific interests, must be

returned within 50 years. Even in these cases, the *bona fide* buyer can assert a claim for compensation. The practical significance of this convention or its contribution to the standardization of the law has remained small to date, as it has either never been signed by major import nations of cultural goods (e.g. USA, United Kingdom, Germany) or not ratified (e.g. Switzerland, France, Russia) (Schönenberger, 2008). As a result, it still remains with very different solutions respective the different countries. However, the art trade is a very international business; this also applies to its illegal form, where stolen works of art are sometimes brought across one or more national borders to impede traceability (Schönenberger, 2008). In view of this, the classical problem of international private law, of which law is to be applied, is of particular practical importance.

1.2 Art Market (In)Efficiency

Many compare the art market with the luxury industry as the market is driven by passionate collectors and those who want to emphasize their status. On the other hand, the art markets are more closely resembling the real estate or private equity business than the luxury goods market, since they are underdeveloped, the information level is extremely uneven, the valuations are difficult and there are innumerable players.

1.2.1 Allocational and Informational Efficiency

One peculiarity of the art market is that it is built like a pyramid: Whereas “at the top” (price segment) there are very few buyers, “at the bottom” there are several thousand potential buyers (Czotscher, 2006). In this top price segment, there is a so-called bilateral oligopoly to be found, where few suppliers are also facing few buyers. However, the art market cannot be considered detached from the economy, because works of art are in fact exchanged, which automatically results in a “market”. Like all other markets, this market is part of the global economic system embedded in macroeconomic trends and developments (Herchenröder, 1990). So, also the art market basically follows the laws of supply and demand, especially at auctions, but has several peculiarities compared to stock markets. Outside auctions, the prices are not organic, but artificially made, because the gallery owners set prices from the start; for contemporary artists who cannot yet have a track record these price settings appear especially ambiguous. However, the supply and demand behavior is also important here, since only prices are realistic, which result in an actual demand. Nonetheless, clearly the art market is less efficient compared to financial markets. This is primarily due to the limited market transparency. For example, unlike in stock exchanges, there is no one single go-to-shop for persons with buying intentions (Czotscher, 2006). It is not certain that an artist's work will find a buyer or a seller at any time. It follows that costs for research are significantly higher; if an investor is looking for a specific work of art, he may have to undertake extensive research work. Moreover, varying with the level of connoisseurship, art market actors are often in disagreement about quality, authenticity or price levels (Wilke, 1999). Examining the law of one price [LOOP] is a common tool for analysis to evaluate market efficiency. It can be applied in the art market as well; though, due to limited data availability, with some caveats. Hence, the degree of art market efficiency is difficult to infer. In general, the LOOP states that in geographically distinct markets with the same transaction prices, price differences cannot persist because they would be exploited by arbitrageurs. Significant price

differences in different markets for the same piece of art would thus hint at inefficiencies in the art market. However, due to the heterogeneity of art pieces, it is difficult to establish a meaningful base for a comparison; the art market's illiquidity adds to this challenge. With regard to prints, this challenge is slightly alleviated because various, identical copies of one original painting exist at the same time, adding to the market's liquidity. Pesando (1993) examined systematic differences in auction prices for prints of Modern artists in a time window of 30 days during the year, in the 15 years period from 1977-1992 for London, Continental Europe and New York. This extended time window is necessary because the major auction houses, Sotheby's and Christie's, do not hold auctions at the same time to facilitate access for all participants. Pesando (1993) compares net prices, i.e. the price the buyer is paying, including the buyer's premium to the auction house. The results reveal an enormous difference for the same print, measured by a ratio between the mean absolute price difference and the mean price of 18-59%. While parts of this difference can be attributed to variances in quality and condition of the prints, Pesando also reasons that this difference is partly due to the "noise" experienced in auction outcomes, noticing significant differences even for prints with nearly identical properties. Two details of price differentials are worth noting: While prices in New York are significantly higher than in London for the period analyzed, a constant and significant difference of 14% can be found for matched sales in the New York salesrooms of Sotheby's and Christie's. While an immediate arbitrage would not be possible because of seller's and buyer's commissions (6 and 10%, respectively), it remains a puzzle why such a price difference can persist over time for two salesrooms without any geographical barriers.

Mei and Moses (2002) examine the hypothesis of the LOOP in a repeated sales regression, covering the period from 1955 to1999 obtaining "mixed evidence": With sales at Christie's serving as a benchmark, for Old Masters, paintings sold at Sotheby's realize higher average prices with statistical significance. However, the absolute return differences still remain small. Furthermore, Mei and Moses show that the return for a painting is highest when purchased at a minor auction house and sold at Sotheby's or Christie's. It is doubtful, however, if the reputation of the auction house or the changed public opinion for the painting, which consequently led to an auction in one of the "blue-chip" houses, or a combination thereof, has led to the higher price. The same conclusion can be drawn from Renneboog and Van Houtte's (2002) examination of the performance of Belgian paintings from 1970 to 1997, with Christie's New York reaching the highest prices, followed by the New York branch of Sotheby's. Analysing German paintings in a hedonic regression, Kraeussl and Schellart (2007) find that paintings sold in Berlin/ Cologne realize higher prices, even compared to London and New York. Assuming that the provenience of the audience of an auction reflects the location where it is held, a home bias could be inferred from this finding. Regarding auction houses, however, Kräussl and Schellart's findings are in line with earlier research, indicating a premium for paintings sold at Christie's and Sotheby's.

Furthermore, contrary to securities laws prohibiting trading on material, non-public ("insider") information, leaving the few publicly traded actors in the market (e.g. Sotheby's) aside, such regulation does not apply to a great portion of the much less evolved and lightly regulated art market comprised of private art galleries, individual collectors, and artists. The constituency of the art market reveals some patterns that severely hinder information to reach all market participants. In fact, the predominant information asymmetry in the art industry

allows knowledgeable insiders to monetize their information to others. Moreover, most opinions regarding art – e.g. regarding its quality – are highly subjective and can thus not be proven as to be misleading or untruthful in possible legal proceedings. Having access to insider information involving important tips and rumours presumably constitutes an important determinant of returns and those without this privileged access can be expected to be at a significant disadvantage. A logical consequence is the formation of art advisory services and art investment funds. Nonetheless, the evidence of the history of art connoisseurship provides strong warnings. Baumol (1986) lists a few examples that should teach the art investor a lesson regarding the wanderings of general tastes and trends: For once, Vermeer virtually disappeared from sight for several centuries, only to be resurrected as a producer of works of the most priceless variety. Not to again mention Turner, who for a while was a leader of the British art world, is said later to have become an embarrassment to the Tate gallery because of the large collection of his works stored in their cellars; though they are now among the most valued items in the museum's collection. Who possesses the knowledge to say if and when such changes in trends will happen to one or another? Moreover, Baumol (1986) finds that the art market does indeed approximate random behavior, analogous to the stock market: In order to determine what range of rates of return the investor could have hoped for between 1652 and 1961, sales recorded in Reitlinger's book were filtered for cases in which a given work of art was resold at least two times during this 300-year period. A complete list of such multiple sales and their prices was compiled. Specifically, all cases were eliminated in which an interval of less than 20 years intervened between the sales or where there were no firm price figures but only word of mouth financial information, yielding a total of 640 transactions. The reported prices were then deflated by a price index to transform them into pounds of constant purchasing power. Finally, from these deflated figures, rate of return figures were calculated from the standard continuous compounding formula

$$y_t = y_0 e^{r(t-t_0)}$$

Equation 1: Standard Continuous Compounding Formula

for each painting for the period between adjacent transactions. Measures of central tendency were determined, including amongst others the mean, median, and standard deviation, and a histogram of the observations was prepared. The histogram was found to show a remarkable resemblance to a normal probability distribution. The hypothesis was tested that the two distributions are in fact the same. Based on a Kolmogorov-Smirnov [KS] test of the divergence of the observed distribution from a normal distribution, the hypothesis could not be rejected at a confidence level of 0.05%. Prevalence of any such aforementioned biases *per se* is not a sufficient indication of market inefficiency, as long as one cannot exploit them systematically. In turn, if prices in the art market just like stock prices do indeed approximate random walks, as the evidence strongly indicates, then there is little that information can do to improve estimates of future prices.

1.2.2 Capital Controls and Institutional Efficiency

While it becomes harder to move money around countries globally with increasing legislation, individuals, corporations and companies can still purchase art at the multi-million-dollar level, and then move the art to their country for safekeeping, with relative ease. Ex-deputy managing director of Christie’s and founder and

chief executive of the art investment fund “The Fine Art Group” (cf. ch. 2.9 below), Philip Hoffman, was correct to believe that this would be an important theme in 2018, with works being sold around the world creating a universal currency (White, 2018). Still, regulations on capital controls are constantly evolving. With the US, UK and China making up 84% of the overall art market, mainland capital controls may very well hamper art sales as well; however, even outside Hong Kong: Due to the absence of tax and an independent currency which is pegged to the USD, Hong Kong is a key centre for art transactions, making up 19% of the global art sales by value in 2018 (UBS & Art Basel, 2019). Since mid 2016, Chinese buyers are facing increasingly large constraints to get money out of the mainland, as the Chinese government increases scrutiny on capital outflows and steps up measures to strengthen its currency. Thus far, Chinese collectors were able to circumvent restrictions by using methods including underground banking. However, according to galleries attending Art Basel and Hong Kong’s Art Central exhibitions, getting money out of the country had become much harder (Farah Master, 2017). How Chinese capital controls can directly affect the largest art market worldwide, the US art market (with 44% share), became obvious in 2018, when the US government as a response announced a range of tariffs to be imposed on Chinese imports, which originally included works of art and antiques created in or imported from China. A tariff of 10% was proposed on these items for 2018, rising to 25% in 2019, which applied to works imported from China as well as those created in China and exported from any national port in the world (Sussman, 2018). After vigorous protesting from members of the US art trade, the US government ultimately revised the list of goods, removing works of art and antiques. Another reason to worry regarding the flow of capital in the art market give the current Brexit negotiations. Thus far, no impacts seem to have been recorded. It remains to be seen how the Brexit will manifest on capital controls in the UK and thus on international transactions in the art market, with UK being the second largest art market worldwide with 21% market share (UBS & Art Basel, 2019).

1.2.3 Liquidity Aspects

In addition to return and risk, also liquidity belongs to the "Geldanlage Dreieck” [investment triangle] (Czotscher, 2006). Liquidity is a measure of how quickly an asset can be converted into cash without the sale affecting the price and thus provides another source of risk which requires compensation. Cash is, by definition, the most liquid, with real estate, fine art, and collectibles among the most illiquid (UBS & Art Basel, 2019). According to the Art Market Report 2019 by UBS and Art Basel, only 1% of artworks accounted for the majority of sales value (64%). The art market seems to be characterized by a winner-takes-all dynamic, in which the top names capture most of the rewards, with the rest selling for far less.

In line with Schneider (2005), the lack of liquidity can be listed as one of the major drawbacks of art as an asset class. Many potential investors could fear the risk of being stuck with the property. To minimize this risk, it is advisable to buy high-quality works. Seeing a lack of liquidity, like Taylor (2004), to have a positive side effect by automatically promoting a healthy “buy-and-hold” mentality that reduces the risk of precipitous action that can occasionally be observed in liquid markets such as stock markets, appears daring; in the center of considerations lies a rational investor with a sound investment policy for whom such illiquidity is likely to

be unfavourable. Taking the stock market as are reference point, some inferences can be made about the efficiency of the art market looking at its liquidity. First, every piece of art can be considered unique, while there are up to millions of stocks for each company. This implies that markets for securities are far more liquid, which is crucial for market participants to react timely to additional information, which in turn is reflected in the price. More than that, as seen above, transaction prices of art are significantly higher than for securities, which is likely to restrain the willingness of both buyers and sellers to act in the market when new information is available, since the impact on the valuation stemming from the new set of information would have to be quite high. Extending this point of view from piece of art to a certain artist, the supply is limited, if the artist has deceased. On could also say that the owner holds a monopoly on a piece of art (Baumol, 1986). Thus, the price of a piece of art is determined solely by the demand for it, or put simply, how many people want to own the artwork at the same point of time. In capital markets, in turn, supply is more flexible and contingent upon opportunity costs of a certain investment. Some additional important features can be added to Baumol's comparison. Single art works have yet to be securitized. Apart from enabling continuous pricing and the possibility to split ownership among different market players, this would make short-selling possible, which can be regarded as an efficiency-enhancing property of a market. Contributing to the illiquidity of the market is the time lag between a selling decision and the actual execution, especially when carried out in an auction. According to Frey and Eichenberger (1995), it can take three to six months until an object can be auctioned. After the admission to an auction by an auction house, the art work has to be documented, catalogues have to be printed and the auction date has to be communicated. In addition, large auctions are only held during spring and autumn (Renneboog & Van Houtte, 2002).

1.3 Art Market Actors

As for any other market, the participants of the art market consist of sellers on the one hand and buyers on the other, with intermediaries in between. The following part will discuss the distinct features and characteristics of the specific art market players that surround the artists and their artworks. Similar to capital markets, the art market can also be divided into a primary and a secondary market. The primary market is formed by first sales of images through galleries, art fairs or directly by artists. Re-selling the image will then draw on the secondary market formed by auction houses and art dealers (Gérard-Varet, 1995).

1.3.1 Art Dealers

With a market share of 54%, including dealer, gallery, and online-only retail sales, the dealer sector obtains an important marketing and communication function in the art market (UBS & Art Basel, 2019).

Hutter et al. (2007) characterize art dealers as service providers, because they select, interpret, educate and signal with the aim of generating the belief that the appreciation of a particular set of new artworks is constantly rising. That they usually focus on contemporary art is constituted by the fact that they promote, build and accompany young artists in advance through their exhibitions, thus making a significant contribution to art innovation for Czotscher (2006). Galleries play a special role on the art market, as they work actively with the

artist (Schneider, 2005). They act as trendsetters, creating awareness for the new and are considered a kind of gatekeeper by making a pre-selection for the market (Müller, 2006). Gallery owners often get credit for having discovered an artist and are able to cash in on this achievement during the career of the artist. In fact, Kunze (2002) believes that artists, without the support and recognition of gallery owners, have little chance of success. The gallery owner regularly takes the risk of total economic loss if he or she invests in an unknown artist. Usually, the artist receives 50% of the income generated with the sale of his paintings. This percentage is especially common for young artists, whereas more established artists can afford to ask for an even larger portion of the total revenues since they could also sell their art through other channels. It comes as no surprise that some Contemporary artists, most notably the British Artist Damien Hirst, completely bypass galleries and sell their artwork directly. When the artist succeeds in the market, the secondary market begins to play a role, with prices no longer being set by the gallery owner, but by market activity. Dealers also have an additional market function, the so-called backroom selling of art that is not accepted by auction houses to appear in an auction or could not be sold in an auction. This second business model of galleries – the marketing of art – has become increasingly important in recent years. The expansion in the early 2000s, which manifests itself in the opening of branches across the world, spoke in favor of this (Czotscher, 2006).

In recent years, while gallery closures have varied, the general trend for gallery openings has been a steady decline. Based on the Artfacts.net database tracking close to 6,000 galleries, and including only galleries that have exhibited at, at least, one major art fair, the number of new galleries established in 2018 was 86% less than in 2008. One of the biggest issues confronting dealers continues to be a lack of financing and credit in the face of volatile sales and rising costs. While some galleries have found investors for their businesses, or occasional public subsidies, most say that they find it difficult or impossible to access bank credit and, as such, are self-financed, relying on selling on consignment rather than through the more traditional model of owned inventories (UBS & Art Basel, 2019).

However, dealer sales in 2018 reached an estimated USD 35.9bn, up 7% year-on-year. UBS and Art Basel have segmented the dealer sector according to turnover value in order to identify the best-performing segment for sales year-on-year. Dealers with turnover between USD 10m and USD 50m have increased by 17%, while the poorest performance was in the lower end of the market, below USD 250,000, down by 18%. The sales outlook for 2019 is mixed though a little less optimistic than the outlook was in 2017 for the year ahead. The biggest challenge to dealers in 2018 as cited remains finding new buyers; especially for those dealers with turnover below USD 1m, where new buyers accounted for 32% of their total sales (UBS & Art Basel, 2019).

1.3.2 Auction Houses

In 2018, the auction sector (including both public and private sales) made up 46% of the market, down 1% year-on-year (UBS & Art Basel, 2019). Auctions may be considered the best way to establish a fair price, as a balance is achieved between supply and demand. The auction market is practically in the form of oligopoly (if not even a duopoly); This means that a large number of buyers face just a few but large suppliers, dominated

by two, Sotheby's and Christie's, who together generated 62% of total sales value in 2018 while Phillips, China Guardian, and Poly Auction together made up a further 10% (UBS & Art Basel, 2019).

According to Czotscher (2006), until the 1970s, auction houses were mainly aiming at the traditional art trade, but increasingly the end users were approached directly. This has brought many benefits for the art buyer, especially those of greater transparency, caused by the publication of estimates and auction prices in detailed catalogs and the further processing of this information in the press or the Internet, which finally lead to derived market analyzes (Czotscher, 2006). Auction houses also offer advice, guarantees of authenticity and financing, which is hardly surprising that generally the best market experts are also employed (Czotscher, 2006). The auctioneers are interested in the highest possible prices due to their proportionate compensation. Not only the sellers pay commissions, but also the buyer has to pay a premium. Both fees depend on the auction price and the auction house and are usually between 2% and 25% for the seller, as well as 11% and 22% for the buyer (Kunze, 2002). The costs of changing ownership in the auction room can amount to up to 40% of the auction price, if one adds the premium for the insurance policies and the taxes due (Boldt, Böll, & Palan, 2007). In 2001, Christie's and Sotheby's were each sentenced to USD 256m in damages, as the two auction houses had entered into market agreements in the areas of fees and commissions, damaging a total of 130,000 customers (Kunze, 2002). Both the seller and the auction house have a positive interest in the smallest possible difference between estimated and hammer prices, which in reality is usually small: If the estimated price is too high, potential buyers are deterred, and if it is too low, there is a risk of over-selling (Czotscher, 2006). If the minimum bid is not met, the artwork will be returned to the seller. If a work remains unsold several times, it is considered "burned" and hardly finds another customer. Here, according to Wilke (1999), there is often the danger that the market value of the entire artistic work of an artist or even the entire art movement suffers. As a rule, the estimated price of auctioneers will therefore be at most 10% above the minimum price or even identical to it (Czotscher, 2006). Increasingly, sellers are guaranteed a minimum price that will apply even if the works of art are not sold at all. These can cause very high costs for the auction houses in the event of a change in market sentiment and a correspondingly slow auction process.

In general, the main advantage of an auction over a sale at a gallery is its ability to concentrate the demand for a certain piece of art to a competitive and temporally fixed bidding event. However, this also constitutes the main risk; a failed auction sale is highly visible thanks to the transparency of the auction event. Contrary to that, a failed gallery sale at a certain expected price will not be further noticed. Thanks to their public availability, auction prices have an important anchoring function for artwork, artist, a certain genre and the entire art market, which constitutes another advantage of an auction sale over a gallery sale. Also, being of interest as a society event, auction sales are frequently covered by media, which can influence the profile of an artist. However, the advantages of auction sales also come at certain risks; resulting price volatilities, for instance, can distort the image of an artist (Hutter, Knebel, Pietzner, & Schäfer, 2007), and the new owner cannot be selected. Sales at public auction of fine and decorative art and antiques (excluding auction house private sales) reached USD 29.1bn in 2018, an increase of 3% year-on- year. The US, China, and the UK – the three largest auction markets – had a combined share of 88%, which constitutes a rise of 4% since 2017.

The US was the largest auction market, with a share of 40%, followed by China with 29%. While the number of lots sold in the fine art auction market grew by 9% year-on-year, the value increased by 13%; 61% of total sales value in the segment accounted for works of art selling at prices in excess of USD 1m but just for 1% of lots sold. By sales value, artworks from the Post-War together with works from the Contemporary sales were the best-sellers, accounting for half of the fine art auction market's value with USD 7.2bn, a rise of 16% year-on-year (UBS & Art Basel, 2019).

1.3.3 Art Fairs, Museums and Exhibitions

Events such as Frieze Art Fair in London, Art Basel, or its sister event Art Basel Miami, are at the same time exhibition, networking and selling platform for galleries and the artists they represent. By bringing together galleries, artists and people interested in art in terms of location and time, they are able to mitigate inefficiencies stemming from the geographical dispersion of the art market. Art fair sales were estimated to have reached USD 16.5bn in 2018, a rise of 6% year-on-year (UBS & Art Basel, 2019).

Large fairs promise about 100 to 300 exhibitors between 50,000 and 100,000 visitors. Organizers at very large fairs report that often only about 5% of the visitors attending are "serious buyers", while this share is often much greater at smaller niche fairs with lower visitor numbers (UBS & Art Basel, 2019).

In turn, such events serve, above all, as a snapshot of the international art market in terms of the leading artists, styles or providers, as well as on price trends, according to Czotscher (2006). However, price information is only given to interested parties willing to buy, which means that the factories are rarely provided with price tags. Nonetheless, the variance in the number of galleries exhibiting in such fairs, as well as the number of visitors frequenting those events can be taken as indications for the current condition of demand and supply side of the market. Experienced participants could infer even more information from such events by testing the behavior of art dealers during price negotiations, taking recent auction prices as a reference.

The presentation of art in museums and other exhibition spaces can represent – depending on the importance of the institution – a boost for an artist's reputation. For young artists, an exhibition can be decisive in terms of branding and thus for forthcoming gallery and auction sales. How such an effect can be exploited became visible when the so-called "Estella"-Collection of Contemporary Chinese Art was successfully put on auction shortly after a series of exhibitions (Barboza, 2008). Hence, some art investment funds, for instance the Artist Pension Trust, launched in 2004, includes plans to show extracts of its collection in well-known museums, such as Tate Modern or MoMA, as well as in major art venues, including the Art Basel or Documenta, in the fund's business model (MutualArt).

1.3.4 Investors and Speculators

Renneboog and Spaenjers (2009) argue that with the increased number of HNWIs, the interest in art has also risen. In addition to that, the changed attitude towards art is seen as a contributor to the current boom: Art, earlier seen as a subject that should only be approached by experts and connoisseurs, is now increasingly seen as a financial investment to diversify an existing portfolio, disregarding the aesthetical pleasures that can be

obtained by purchasing art. In fact, while investments in art for social aspects, identity and status show a downward trend, a majority of participants of the (online) art market show increasing interest in art for its value potential – and the investor base is yet increasing (62% of respondents versus 56% of respondents in 2018 and 2017, respectively) (Hiscox, 2018). At which point an art collector is considered an investor cannot be said exactly. Schneider (2005) may be mistaken in stating that investors, unlike collectors, are not art connoisseurs. Even the prestige collectors may have rarely studied art history. And in contrast to these, an investor will have to be informed accurately and with patience about the art market and make his investment decisions based on in-depth analyses. This is difficult to imagine without an understanding of art, especially in the case of long-term engagements. However, to an art investor art is just one of many investment fields. Also, the demarcation of investors to speculators is spongy. And here, too, Schneider (2005) may be wrong in his statement that speculators do not understand art and are notable for their aggressive and often also ill-considered purchasing policy. This would be a bad speculator. Rather, the difference between investors and speculators should exist in the investment horizon. According to Wagenführ (1965), it constitutes speculation when art goods are only bought with the intention of selling them again with profit at the next available opportunity. Speculators who hope for quick gains usually only occur during boom phases (Schneider, 2005). The positive effects of both, art investors as well as speculators – mainly the reduction of illiquidity – are often ignored. However, there is reason to believe that art funds can increase the art market's luqidity. After all, Schneider is right in his assessment that speculators and investors are discredited within the art market. The negative attitude towards investors, however, is unfounded, because the artwork does not suffer when it is bought by an art investor. Rationally, for which motives it is bought is only relevant to the buyer. And it should not bother anyone that a speculator usually holds a piece of art for a short time before he resells it. Even this does not harm a work of art. In addition, it is forgotten that the speculator does not primarily trigger the exorbitant development of auction proceeds, but only wants to exploit the speculative price trends by jumping onto the (already) moving train. However, critics do have a point when considering the aforementioned impact of an artwork's provenance on pricing.

1.3.5 Financial Services

An important phenomenon to point out is the increasing interest from the financial industry. With art increasingly perceived as an asset class, there is a development of art services among financial institutions and small financial boutiques. The offering mainly consists of three categories of art services, each being at a different stage of maturity: art advisory services, art lending (securitisation) and art investment services. Art advisory services tend to complement the traditional range of private banking services in order to offer a holistic approach to wealth management. Generally, art advisory services include art research (e.g. authenticity), art transactions (e.g. purchase and sale), art management (e.g. valuation, insurance, storage, transportation), or structured solutions (e.g. inheritance planning, tax advisory services). Art lending, as discussed in ch. 1.4.6 below in more detail, aim at turning art into a working asset. Lastly, art investment services are still in its infancy. It finds its source in the growing recognition of art as a new alternative asset

class and supports the development of art investment products, the role of art to positively diversify investment portfolios and the integration of art into wealth portfolio analysis. Their services involve art investment research, portfolio management, or the structuring of art investment funds (Torcello, 2012) – for more to be discussed within the second chapter of this thesis.

Financial institutions, such as UBS, Deutsche Bank and Dresdner Bank not only offer their wealthy clients art investment advice but also constitute the largest corporate collectors. Internationally important private banks that have established such art advisory allocations are, for example, Citibank, JP Morgan or UBS. These departments are designed to help clients navigate the art market. On the one hand, this means communicating with experts such as restorers, insurance companies, auction houses or art dealers (Kunze, 2002), but on the other hand also concrete support in the conception, construction, maintenance, evaluation, inheritance or sale of collections (Czotscher, 2006). Art banking is especially a point of contact when it comes to structuring art assets in foundations, trusts or societies. In individual cases, the bank may also appear as a buyer or seller of works of art in order to safeguard the discretion of private customers (Kunze, 2002). Art also serves both banks and non-banks as a marketing tool for employees, customers and the public (Czotscher, 2006). A well-known example is Deutsche Bank, which has one of the largest corporate collections, with a total of almost 50,000 works by mostly contemporary artists, according to Kunze (2002). Their concept of "art at work" offers the opportunity, both internally and externally, to experience modern art outside the usual paths of museums or galleries in branches of the bank.

1.3.6 Clicks and Mortar: The Online Art Market

Although there was a significant spread of growth rates among the different online art sales platforms in 2018, the estimated aggregate online sales figure in the online art and antiques market of USD 6bn shows an increase of 11% year-on-year. Aggregated online sales accounted for 9% of the value of global sales, slightly lower than the global online retail sector, where e-commerce represented 12% of total retail sales in 2018 (UBS & Art Basel, 2019). Despite the online art market growing around 20-25% between 2013 and 2015 (comparable with growth rates observed in the online luxury goods industry), the last 24 months shows signs of a slowdown, perhaps as the industry struggles to broaden and grow its online client base. The transition between offline and online is proving a challenge and while parts of the industry (auction houses in particular – with Christie's now publishing results for their online-only auctions) have been rapidly adapting to a new digital era, other areas of the industry such as galleries and dealers are still struggling with the digital market (Hiscox, 2018).

Online market is slowing, gaining momentum, with the imminent lack of transparency, especially concerning pricing, seemingly constituting the main stumbling block holding the online art market back. In addition to the lack of transparency, also cyber-crime instills fear in online buyers. According to the Online Art Trade Report by Hiscox (2018), four in ten online art buyers are in fact "concerned" or "very concerned" about cyber-crime when buying art online, and 82% said they would most likely buy from platforms they had prior knowledge of due to fear of cyber-crime. As the art market is dominated by small- and medium-sized businesses who have historically been at the less tech savvy, more complacent end of the scale, these

businesses are vulnerable and likely to be perceived as a soft target for cyber-criminals. Indeed, more than half of online platforms were targeted by cyber criminals; a worrying 54% of platforms surveyed have been the target of an attempted cyber-attack in the past year and around 15% said the attack had been successful. Into force since May 2018, the new General Data Protection Regulation [GDPR] seeks to unify data standards and provide greater data protection for EU citizens (Hiscox, 2018). Moreover, over the last years blockchain has been evolving with many claiming it can cure some of these market's ills. In ch. 3.7 below, the current impact that blockchain and cryptocurrencies, such as Bitcoin, are having on the online art market, as well as their future potential will be explored in greater detail.

1.4 Peripheral Fees & Other Rate of Return Determinants

When acquiring art, similar to acquiring real estate, there are numerous additional costs besides to those associated with finding, negotiating and paying the purchase price. Within existing research on the returns on art investments, many researchers do not elaborate on the (transaction) costs that should in fact be deducted from an art work's resale price to account for costs that arise from the acquisition as well as from holding the asset. Baumol (1986) notes, that "whatever the apparent rate of return the ownership of a painting yields, a substantial [risk] premium must be deducted from the figure to get the true underlying rate of return.". Still, quite a few researchers have neglected the impact of such costs when computing their rate of return estimates. Like Baumol (1986), most of them mention transaction costs to have a potentially severe impact or have even further specified those to come in form of storage, insurance or commission fees. In fact, Frey & Pommerehne (1993) were the first scholars to take into account transaction costs in their return computation at 0.4% *per annum*. Pownall (2007) has even calculated with a more conservative 1.5% *per annum* estimate. However, the majority has not quantified the impact but merely referred to associated costs as to be considered.

1.4.1 Risks

For stock investments, investors differentiate between diversifiable (firm-specific) and undiversifiable (systematic) risk. Just like stocks, art is exposed to diversifiable risk (e.g. value depreciation due to decreasing popularity of the artist or natural deterioration such as fading or oxidation). Whereas stocks commonly strongly fluctuate with economic conditions (systematic risk), there is enough reason to believe that such risk is much lower for artworks – whose pricings are much less dependent on the general economy. However, because of its physical nature, as opposed to stocks, art can become a target to calamity or a victim of artificially induced catastrophes (e.g. arson, etc.). In those cases, the value of art pieces quickly vanishes to zero which is why investors generally purchase insurance to protect themselves from those sources of risk. Buyers must take precautions necessary to alleviate fraud including verifying authenticity, title and documentation in order to prevent the risk of a reattribution to a different artist. Moreover, as discussed in ch. 1.2.3 above, art investors face liquidity risk: Contrary to stock investors who can sell company shares with relative ease, art cannot simply be divested (Schneider, 2005). Accordingly, many potential investors could fear the risk of being stuck with the property. Consequently, as art is subject to a wide range or risks, the required rate of return on an art

investment should be high – and possibly higher than on alternative investments – to compensate investors for the exposure to the extra risk that investors must tolerate as opposed to risk-free (or less risky) investments.

1.4.2 Commissions and Shipping Costs

Analogous to equity investments, also investments in art come with transaction costs that depend heavily on the sales channel through which the work of art is being traded, such as in the form of a commission. In existing literature, Mok et al. (1993) consider 10% sales commission to be deducted from the hammer price. Renneboog and Van Houtte (2002) consider a more conservative seller's commission of 10-12% and an additional buyer's premium of 15%. In fact, such numbers still underestimate fees charged by the biggest players, such as Sotheby's who publishes a buyer premium chart as of February 2019[3], exhibiting premiums of up to 25%, excluding taxes.

Furthermore, art may be most vulnerable when it is moved. On top of the – relatively low – travel expenses for the owner, specialist art movers who are experts at shipping and handling as well as documenting an audit trail for the chain of custody from point to point must be paid to transfer the artwork from the place of acquisition to the desired destination. Leading to the next section, careful measures should be taken to ensure art is well protected and properly insured for the time of travel, resulting in further expenses for the art investor.

1.4.3 Insurance & Maintenance Costs

Threats to the physical security of art are not only posed by improper transportation but also by improper storage, installation and environmental controls. Costs for storage and maintenance, e.g. cleaning, can vary depending on medium and location and are therefore difficult to estimate. However, it can be assumed that such costs will not lead to a significant impairment of the return of an art investment. In existing research, such costs have been mentioned in some instances but have not been quantified. With the general rise in art prices in the past decades, theft rates have grown, leading to increased insurance costs. However, contrary to conventional wisdom, the biggest risk stemming from the possession of art is not theft. According to underwriters of fine art, damage from water and fire poses a significantly bigger threat (McDonald, 2004). Besides the risk of theft and damage, insurances also offer protection against the possibility of reattribution. Most contributions on art as a financial investment do not take insurance costs into consideration when computing returns, but mention them as possible upwards bias of their findings (Mok, Ko, Woo, & S., 1993). Stein (1977) estimates insurance costs to range between 0.2-1.0% of the appraisal value, while more recent research by Renneboog & Van Houtte (2002) estimates insurance costs at 0.5% of the appraised value. Moreover, art should be stored in facilities that provide the expertise for proper handling. Specialist art storage facilities provide a detailed facility report that includes information about fire detection and suppression, humidity and temperature control. The physical and environmental conditions in which the art is housed are critical. Hence, for art investors additional costs result from services provided by conservators who specialize in the type of art owned who should be consulted on a regular basis.

[3] cf. http://www.sothebys.com/content/dam/sothebys/PDFs/buyerspremium/February-2019-Buyers-Premium.pdf?locale=en.

1.4.4 Taxation

Being in possession of an art piece can have multiple reasons – for the store of wealth, to have a masterpiece to cherish, as a result from a family heirloom, to serve as a part of a trust or estate, or even as a gift to a cultural institution. Whatever the reason is to a private individual, business or public entity, tax concerns are always relevant. Besides the previously mentioned argument that art owners may draw aesthetical pleasures from art ownership, indeed Frey and Pommerehne (1989) note that tax aspects may provide a rationale for an art acquisition – as art may not be subject to property taxes or death duties.

Recent years have seen a number of new free zones (also known as freeports), for instance Luxembourg, springing up around the world. Art dealers, auction houses, and collectors have been among the first to jump on the tax-free bandwagon. Free zones are physically limited regions with favorable conditions for trade, allowing goods to be bought and sold without having to pay value-added tax [VAT] or customs duties. Though the zones vary in the specific exemptions they provide, a typical freeport includes a warehouse where goods are stored during sales and transactions. The arrival of several new freeports in China and Southeast Asia has provided a boost to the countries' art markets, saving buyers from otherwise high taxes (Hill, Iturbide, & Naquin, 2015).

In the United States, for instance – outside such freeports – while a higher sales price is advantageous to the seller, the capital gain tax, the tax paid on income generated by the sale of assets whose value has risen since purchase, may be up to 28% on art in contrast to only 20% for financial securities. Also, the buyer must pay sales tax on the sum of the purchase price and premium or commission, making art investment less attractive (Sarah D. McDaniel, 2018). In order to shed light into the sheer complexity of tax implications, Deloitte Tax and Consulting (2016, S. 4-16) provide an art tax matrix, as summarized in Appendix 2. Also, Virtosuart, a US contemporary art gallery, supports transparency and lists "facts about the complex world of art taxation" on its website (Lewis, 2018).

Sticking to the United States as an example, use tax (the term used to refer to VAT in the context of imports) and sales tax, just like most other forms of tax payments, vary from state to state. Residents of certain states are not required to pay any sales tax whatsoever, while art investors from New York City must pay the highest figure (at 8.875%) in the country. Capital gains tax is applicable to artworks across the U.S. provided that more than a year has passed between the purchase and resale of an artwork. When resale occurs within a year of the original purchase, any income gained is subject to normal income tax, which can reach 39.6% depending on annual income. If a work is sold more than a year after its purchase, however, sellers can choose either to pay capital gains tax on the income from that sale or to class it along with their other income and pay the appropriate percentage depending on their tax bracket. For almost any high-income individual (depending on their marital status and living situation) the more sensible financial choice is to opt for the capital gains rate of up to 28%. However, as of now, according to section 1031 of the Internal Revenue Code, art investors – as opposed to art collectors – may defer paying capital gains taxes on the sale of art: When an investor sells property that has increased in value, such as an apartment building, capital gains taxes are due in the year of the sale. Section 1031 permits investors to defer paying the tax if they reinvest the proceeds in similar, like-

kind artwork. Unfortunately for art buyers, the tax strategy resulting from section 1031 of the Internal Revenue Code recently attracted the attention of the U.S. House of Representatives, which in early November proposed its elimination in the Tax Cuts and Jobs Act. The availability of 1031 exchanges for art has been a very important factor fuelling art market turnover. While the House of Representatives tax bill eliminates the use of 1031 exchanges for art (but preserves it for real estate investors), it faces, like most legislation, a long and winding road to passage. But if art is no longer eligible for 1031 exchanges, then many art market participants subject to U.S. law will likely elect to hold their art for longer time periods, causing a noticeable decline in art market turnover (Fuller, 2018).

Furthermore, there are a number of laws in place in the US that encourage patronage of the arts, with tax deductions for individuals and organizations that donate artworks and cultural goods to foundations and non-profit institutions. Generally, tax deductions for donations to charitable organizations vary between 20% and 50% of their value, with donations to cultural institutions resulting in a deduction of 30% (Deloitte Tax & Consulting, 2016). In addition, while in the United States and Europe imported goods are not subject to any customs duties, China imposes high import duties, which vary according to the country of origin. Ranging from 0% in the country's free ports up to a staggering 50%, the high rates of taxation have no doubt hindered the development of the Chinese art market in addition to recent developments regarding their capital controls (Lewis, 2018).

1.4.5 Aesthetic Return

Mandel (2009) demonstrates how a utility dividend derived from "conspicuous art consumption" may explain the relatively (compared to other risky assets) low risk-premium of a portfolio of artworks with a consumption-based asset pricing model. In a consumption-based pricing model (Robert E. Lucas, 1987), an asset's risk premium is a function of the covariance of its returns with agents' marginal utility of consumption; agents need to be compensated if the asset pays off in a period of already high utility. "Luxury is a form of waste designed to confer status on an essentially useless class of people.", Veblen once wrote (Veblen, 1899 cited from The Economist 2014). Since art is a luxury good, by definition, its relative demand is an increasing function of wealth. Accordingly, positive shocks to income increase the demand, price, and returns to art in periods of high consumption utility, implying a high risk-premium. This intuition goes against empirical studies that often find that art underperforms equities and bonds in terms of the risk-reward relationship (cf. ch. 1.6 below). Furthermore, unlike dividends for stocks, art offers no claim on an underlying stream of payments.

Indeed, Mandel's model predicts a low and possibly even negative risk premium for art. However, he points out that financial returns only tell one part of the story. Mandel (2009) call art a "hybrid of consumption and investment" since utility is derived from both, the value of contemporaneous art possession and the expected capital appreciation of art holdings. Mandel (2009) concludes that the dynamic demand for art is the only meaningful driver of equilibrium prices and thus investment returns, which – according to him – comprise the demand for savings as well as a "utility dividend" that is increasing in the value of art. What he calls the utility

dividend is a special feature of demand for luxury goods, which formalizes the satisfaction derived from the "conspicuous consumption" (Veblen, 1899) of high-priced luxuries, which is independent from its intrinsic value. Namely, art yields incremental utility when its price is high; effectively, an increase in the price of art is an upward shift in an agent's contemporaneous marginal utility of consumption (Mandel, 2009).

1.4.6 Securitization

Philip Hoffman, claims that since his fund was launched back in 2001, the perception of art as an asset had changed fundamentally. Massimiliano Subba, managing partner of Anthea Art Investments AG, an art investment and advisory boutique, agrees that art is now firmly established as an asset class, leading to a corresponding evolution in the services available for investors. According to them, services originally developed for traditional asset classes are or will shortly be (if they are not just yet) also available for art, for instance risk management or insurance services, combined with asset management operations, encompassing products relating to valuation, cataloguing, and logistical optimisation – all services which fall underneath the management umbrella of an asset class (Spindler, 2018). Such art lending services provided by financial institutions may include term loans (e.g. to borrow against art, acquisition financing, or revolving credit facilities), dealer inventory financing, bridge loans, advances and auction guarantees, or arranging loans to museums and exhibitions (Torcello, 2012). Accordingly, Hoffman's art fund is now also lending against art as collateral (so-called "art-backed lending"). That is, art with investment quality worth between USD 0.5m and USD 5m can be hypothecated at The Fine Art Group. In its execution he explains: For a painting that is perhaps worth USD 2m, the fund lends around 50% of the value against a moderate interest rate of 6-7%, depending on the amount and urgency. That is, the fund finances the purchase of artworks (given a certain investment quality), comparable to a mortgage loan on real estate, which is more common in the US, but relatively unknown in Europe. Doing so, Hoffman claims to offer faster and less complicated services than established institutions in that business, i.e. banks, thereby offering an attractive financing alternative to art investors (Karcher, 2018). Also the Citigroup Private Bank consistently offers art services that include lending, through its "Art Advisory Service". This service makes loans of up to 50% of the value of a collection or artwork. They conduct valuation in-house, basing value on their best estimate of market value, which they report as around the mid-point of the presale high and low. Alike, some of the larger auction houses occasionally offer loans using artworks as collateral. So did Sotheby's in the late 1980s, when it lent an Australian entrepreneur 50% of the purchase price for Van Gogh's Irises, using the painting itself and others in the entrepreneur's collection as collateral. The Australian has famously defaulted on the loan. Consequently, Irises and other paintings had gone into repossession of Sotheby's and had been sold some time later to the Getty Museum (for an undisclosed amount) (Lacey, 1998).

Sotheby's and other auction houses, like Christie's, still formally extend financial services to their consigners. That being said, securitization is a means to not only decrease the risk of the lender but at the same time to decrease an investor's cost of debt, i.e. the costs of borrowing. Thus, art used for securitization may allow investors to further increase the rate of return on their investment. The collateral value of fine art has been

investigated by McAndrew and Thompson (2007). They have examined fine art concerning whether this asset class meets the criteria required of lending institutions for loan collateral, which requires that it is possible (for banks and financiers) to quantify two essential elements of standalone credit risk: the default probability [PD], i.e. the probability that borrowers will fail to service their loan obligations; and the loss given default [LGD], i.e. the extent of the loss incurred in the event of default. These two credit issues underlie most of the models for estimating credit risk that have been developed over the past three decades (McAndrew & Thompson, 2007). In their research, they have considered the situation where a borrower uses a portfolio of fine art as collateral on a loan without the art providing any cash flow. In this context, they assume that a default occurs in a two-stage process: first the borrower chooses (or is forced) to sell the underlying assets to repay the loan, and then once brought to market, the sale of the assets does not raise sufficient funds to cover the loan obligation ("collateral shortfall"). Relative to these loan-to-value [LTV] ratios, McAndrew and Thompson find a rather high shortfall probability (about 15% for a portfolio of five correlated works). Contrary, delinquency rates on real estate loans in the first quarters of 2019, as reported in the Federal Reserve Statistical Release[4], were 1.74% while those on all loans and leases were about 1.53%, as a benchmark of comparison. For 2018, Standard and Poors reports a global average annual default rate of about 0% per year for BB rated corporate bonds (down from 0.08% in 2017)[5]. A rating of BB corresponds to credit quality one rating below investment grade. They conclude that art as an asset class, reflects a riskier venture for lending institutions than the traditional assets, which they interpret as one reason why still only few financial services encourage art lending. Again, further research and potentially the implementation of technology for the risk assessment should shed some lights into the art business and help clarify the risks, thus reducing the total level of perceived uncertainty, thereby attracting more capital to the art market.

1.5 Art Price Indices Computation

It goes without saying that the informative value of price indices particularly for inhomogeneous goods such as works of art is extremely limited. Though retrospective comparisons may be possible, in contrast, future price developments cannot be predicted (Arends, 2002). At most, art price indices may provide an orientation about what average returns among the different genres can be expected. Of course, no direct conclusions can be derived for individual artworks. Neither for the entire art market it is possible to maintain an exact index for very long periods of time, but only to derive a basic trend (Wilke, 1999). According to Wilke (1999), for both, the overall market and the subsectors, such trend would be significantly upwards in the long term. However, detailed forecast calculations for art prices thus remain an illusion, or – as the economist William Baumol (1986) expressed precisely already more than twenty years ago – a "floating crap game". Especially individual works can show large price fluctuations. However, also the art market as a whole is taken as highly volatile. Journalist Christian von Faber-Castell, specialized in the art market, puts it in a nutshell when he says

[4] cf. https://www.federalreserve.gov/releases/chargeoff/delallsa.htm.
[5] cf. https://www.spratings.com/documents/20184/774196/2018AnnualGlobalCorporateDefaultAndRatingTransitionStudy.pdf.

that the entertainment value of such price indices is greater than their informative value (Perregaux, 2007). As elaborated before, the question of how any collector or investor can recognize, which artists or individual artworks could experience future increases, cannot be answered easily. Serious predictions are not possible, or highly speculative.

1.5.1 Naïve Indices and Geometric Mean

So-called naïve indices are the easiest approach to track the development of prices. Applied to art, such an index can be computed by calculating the mean or median price of all auctions of a certain subgroup during a selected period. For example, a Picasso index will aggregate all Picasso sales in a given period and divide by the number of lots sold, producing an average price for Picasso art that oscillates through time. Online art information providers such as Art Market Research (Global Art 100 compiling auction results of the world's 100 most traded artists) (Czotscher, 2006) use average prices of transactions in the public auction market. The underlying assumption of this calculation is that quality and characteristics remain constant over time. However, given the myriad of different sets of characteristics of paintings and the comparatively low turnover, this assumption hardly holds true. If such a simplistic index is the computation method of choice, then a calculation with median prices seems more accurate than one with mean, because outliers and different trading volumes have less influence (Renneboog & Van Houtte, 2002). Another approach to track art prices with a naïve index is the tracking of the prices of artworks in a fixed basket (Higgs & Worthington, 2005), which is comparable to the computation of a Consumer Price Index (Renneboog & Van Houtte, 2002). While such indices may control for quality and characteristics of paintings, a possible bias can result from the initial selection of paintings and the appraisal by experts that is necessary because the index computation interval is significantly shorter than the average holding period of a painting. A revaluation can be avoided by selecting substitute paintings (e.g. similar paintings by the same artist) that were auctioned in a period where there is no sales price for the original painting. Renneboog and Van Houtte (2002) correctly argue that such an index would possibly create another selection bias (of the substitute), and suggest an *ex ante* selection to alleviate the problem. However, one may argue that it is difficult to forecast the selling date of a substitute, and another selection problem would arise once more when a substitute artwork is sold in the same period. As outlined above, this method typically excludes outliers (the extraordinarily high- and low-priced transactions), and practitioners often use moving averages techniques to smooth the inherent dramatic volatility in auction market price movements. Given the issues described above that arise with the calculation of the returns on art based on naïve art indices, more elaborate methods seem to yield better results. Notwithstanding, some inferences can be made based on such computations. Renneboog and Van Houtte's (2002) comparison of mean and median price of average auction price, for instance, reveals some skewness in return distribution.

The geometric mean method can be regarded as another very basic and thus easy to calculate method to estimate returns over the course of time. However, it also brings along several deficiencies that can only be alleviated with other, more complex computation methods. Assuming that an observation (an auction price) represents a random and independent sample from a "fixed stock of auctionable paintings", Stein (1977)

constructs an index by sampling observations from an overall population. By only taking into account artists who deceased prior to the first year of the index, he presumes that the underlying supply is fixed. Stein sheds light on two possible biases inherent in his analysis. To the claim that the overall supply is not fixed because museums take paintings off the market, he argues that museums possibly purchase works of all segments and thus do not influence the average overall quality. Moreover, he assumes that the overall holding period exceeds the analysis period (1946-1968), thus museum purchases would have the same effect as private purchases. In addition, he hypothesizes that the most highly regarded works are not sold through auctions anyway, which would mitigate a possible bias because these paintings are not included in the overall sample of auctionable paintings. The second bias refers to the possibility that observed auction prices do not represent a random sample of auctionable works, but that some paintings, i.e. those currently in fashion, are sold more frequently. Stein assumes that this bias is persistent over time, with constant mean and random distribution, and therefore does not have an influence on overall returns. As can be shown with more advanced methods, the assumption that these biases do not have a significant impact on the periodic returns has to be revised. The bias might be lower for artists that have already deceased, but given the large variety in characteristics like medium, size or artistic quality relative to the number of samples, Stein's assumption is unlikely to hold true. A failed Chow test, examining if the distribution of auction prices around their mean is constant over time, can be taken as an indication.

1.5.2 Hedonic and Repeated Sales Regression

The challenges in evaluating prices of heterogeneous investments, which are only comparable to a limited extent, are not confined to works of art. One often applied method for such data sets is the so-called "Hedonic Regression", which was first applied to cars. Its invention can be attributed to Court's research from 1939 (quoted in Goodman (1998)). The term "hedonic" was defined as weighting the relative importance of characteristics (that is, the independent variables), ranging from the easily measurable (e.g. size, medium and date) to the more complex (e.g. condition, provenance, scarcity or rarity). Individual pieces scoring extraordinarily high or low on an average scale for any of these attributes would be weighted accordingly in the construction of a price performance index. A welcomed side-effect of the construction of price indices based on hedonic regressions rather than, for instance, based on a repeated sale regression (to be discussed below) are the inferences that can be made based on the coefficients for independent variables other than time. For instance, contrary to conventional wisdom that the price of paintings increases once the painter has deceased, the so-called "death effect", Buelens and Ginsburgh (1993) find that for English painters, there is a premium of up to 130% (depending on the sub-period chosen) for works of living painters. They interpret the change in those coefficients over time as a change in taste for different styles or artists. However, those conclusions can be challenged because of omitted variables. Also, Renneboog & Van Houtte (2002) find that the presence of a signature has a significant positive correlation with the price of a painting. They hypothesize that this might contribute to the credibility of the attribution. However, a cautionary approach is required regarding such interpretations as not only demand, but also supply characteristics influence these values – or,

as Rosen (1974, p. 35) puts it: "[…] these data [the estimators] generally contain less information than is commonly supposed".

The method that is known by the term "Repeated Sales Methodology" includes only works that have been publicly auctioned more than once (i.e. at least twice) (Arends, 2002). Constituting the main difference to the hedonic regression, the preliminary task of identifying repeated sales from an initial sample deserves special attention. This task can be very time consuming; especially for long periods, it can occur that a sale through another channel lies in between two auction sales, which would alter real period returns. Besides the deficiencies of auction data in general, which affect any analysis based upon, the relation between observed sales pairs and the overall sample has to be examined. This issue becomes more eminent with a decreasing ratio of repeated sales to the total number of sales. Depending on the time range of auction observations and the focus on a certain style, the number of repeated sales in the overall population can be quite low. Much of the available data therefore cannot be processed and is, as Ashenfelter and Graddy (2002) put it, "wasted". The most well-known art index is likely to be the Mei Moses Index, which analyzes repeated sales of works of art since 1875. Founded by the two NYU Stern professors and released in 2001, the index was based on a data set of 4,500 hand-picked pairs of sales representing one work's acquisition and resale at a later date. Initially the index had an annual basis, but with more data, they are able to calculate a monthly index. When Sotheby's acquired the index in 2016, that number had grown to 45,000, and the makers of the tool claim that the number of repeated sales added each year is around 4,000 (Boucher, 2016). The primary problem with applying repeated sales regression to art data is (again as for any other computation method) the paucity of available information, as they do not include private sales (at auction or through galleries), thereby only reporting on the public market. Moreover, most indices – just like the Mei Moses Index – also use exclusively data for artworks that have sold more than once, and do not include artwork offered for public sale that fails to sell. The advantage is immediately evident: they are comparing only like commodities. More than like – identical. But with their methodology, Mei and Moses have eliminated subjectivity. In real estate, 90% of sales represent properties being resold, but the Mei Moses Index, for instance, covers less than 2% of sales in the fine art market (Boucher, 2016); in the widely used compendium by Reitlinger (e.g. Baumol (1986)), only 20% out of 5,900 records are resales. The reduction in eligible data is even more significant when, for instance, only Modern or Contemporary paintings are taken into account and when the analysis period is shortened. Moreover, in addition to the introduced "selection bias" it is questionable whether a couple of thousand pairs would provide any practical guidance for the art fund manager confronted with a myriad of unlike object buying options. As comparison, the artnet Price Database has nearly ten million auction records compiled since 1985 from which 800,000 are repeated sales (Boucher, 2016), one indication of the vast amount of useful market information that repeated sales regression ignores. In turn, high transaction fees may discourage owners to sell paintings only after a short holding period (Renneboog & Van Houtte, 2002). Additionally, most auction houses will not accept the same painting for resale for at least four sales periods, or two years (Mok, Ko, Woo, & S., 1993). Both effects are eminent in the analysis of Modern Chinese Paintings (defined as paintings created after 1911) of Mok et al. (1993). They only find 20 paintings that were sold at least twice out of 4,000 sales

records between 1980 and 1990. The scarcity of eligible data points makes a regression and the computation of an index impossible. Thus, the data sample of Mok et al. only allows the calculation of the average yearly rate of return. The research of Renneboog & Van Houtte (2002) even dismisses the possibility of a repeated sales regression at all, because of an insufficient number of data sets. As will be discussed (cf. ch. 1.7.2 below), regarding auction data in general, a survivorship bias is even more evident for repeated sales. With the price of the last sale publicly available, it can be expected that an owner will only auction a piece of art when he expects his investment to yield a positive return. In addition to that, auction houses are seeking publicity from record prices and try to avoid reports of a large percentage of paintings that could not be sold (Frey & Pommerehne, 1993). However, there are also some sources of a downward bias, which possibly mitigate or offset the above mentioned upward bias. First, as only auction records are included, the first auction sale already occurred when the artist's reputation was established to some extent, i.e. when prices for his works have already risen from a lower gallery price (Mei & Moses, 2002). However, these lower prices, which would yield the highest returns when matched with later auction sales, are not included in the initial sample since only auction sales can be observed. Assuming that the best works of art are endowed or privately sold to museums, some of the paintings which supposedly would fetch the highest prices in auctions disappear from the market, which also has a mitigating fact on mean returns on repeated sales.

The main advantage of the repeated sales regression is its ability to resolve the difficulty that prices of artworks cannot be compared because of the different characteristics that have an influence on the price. By solely processing repeated sales, the characteristics are held constant, assuming the painting does not suffer any damage. Possible quality changes can be an issue in repeated sales regressions for real estate, where depreciation is a common determinant of price changes (Palmquist, 1980). A hedonic regression would be necessary to approximate the impact of depreciation, estimated with the coefficient for a variable depicting the age of a building, for example. This restriction, however, has two main consequences. First, not only driven by the heterogeneous data structure among different sources, the identification of resales can be a tedious process. Second, holding periods of art investments can be very long. This, in turn, results in only a small fraction of all sales to be considered in the analysis. One cautionary note about data characteristics only applies for repeated sales regressions: it cannot be excluded that a work of art was purchased and sold through another channel (e.g. gallery or private sale) which does not appear in the publicly available records, resulting in a bias in the calculation of returns. In a hedonic regression, in turn, nearly all information can be included in the regression. While this can lead to a much broader base of observation to monitor actual returns for an artist, the critical issue with this method lies in the specification of the functional form of the regression. Mei and Moses (2002) state that the major advantage of the repeated sales method is that it does not suffer from the "arbitrary" specification of a hedonic regression. Hedonic regressions may be carefully designed to maximize its predictive power, which would outweigh any sense it might be less objective. All in all, both models produce errors in their estimates, therefore it is up to the modeller to minimize this error and choose which is more useful to them, or a hybrid of the two, as suggested by Quigley (1995). There is no generally valid definition for such a functional form, since demand and supply functions of the market participants are not

known. Compared to the repeated sales regression, much more information is required to identify all the characteristics of a painting that have a significant impact on its price (as discussed in ch. 1.1.2 above). To assess the change in shadow price over time, the number of observations can be doubted to be sufficient to yield statistically meaningful results. Thus, hedonic regressions can be seen as more suitable for established, well-known artists, where a change in taste is unlikely, or short analysis periods, where taste can be regarded as constant. Omitted variables, for which no or not sufficient information is available, can create a bias in the return approximation.

However, the repeated sales regression method does bring fine art to the attention of serious quantitative analysts and gatekeepers of institutional capital, providing strong evidence that art has positive expected returns. Once refined and possibly bundled with other specific art knowledge and financial techniques, it may enable further development of portfolio management tools that measure such things as volatility and correlations with other asset categories. Always eager for investment diversifications to enhance returns, institutions only require industry expertise, supported by reasonably correct analysis in their language of statistics.

1.6 Returns Found in Existing Literature

Existing scholarly work on the attractiveness of art as an investment shows no clear picture. While art as an asset class has been proving its mettle in recent years, not all categories of paintings – old Masters, 19th-century European, Impressionist and Modern, American, Latin American, Asian Contemporary, and Post-war and Contemporary, etc.– have performed alike. Returns and standard deviations found in existing studies vary significantly, even if based on the same observations. As many researchers draw from earlier work, this overview will roughly follow a chronological structure.

In one of the first works on art as an investment, Anderson (1974) examines prices of paintings from 1780 to 1970. For this period, he finds an average return of 3.3%, with significantly different returns for various schools (e.g. Old Masters, Impressionists) and periods. Anderson finds that these returns are about half of the long-term average returns for common stocks. Rather than dismissing art as a worthwhile investment, he hypothesizes that the difference is compensated by the "consumption value" of art (cf. ch. 1.4.5 above).

Stein's (1977) conclusion is in line with Anderson's findings. He limits his analysis to the years 1946-1968 and to paintings by artists who deceased before 1946, assuming the auction prices to be sample observations from a fixed stock of paintings. Although average returns of 9.9%, based on a geometric mean analysis, are significantly higher than the returns estimated by Anderson, Stein finds that they are still inferior to equities with comparable risk properties. To be an efficient investment, viewing pleasures (i.e. the consumption value) have to account for at least 1.6% *per annum*, Stein concludes.

Baumol (1986) calculates the average yearly return of repeated sales in the period 1652-1961 with a holding span of more than 20 years. He finds unfavorable returns for art; the average real return at 0.55% is by far outperformed by less riskier fixed income assets (2.5% return over the same period), with 40% of the returns yielding negative returns. Confirmed by the results of Frey and Pommerehne (1989), as well as Mei and Moses

(2006), Baumol finds that the volatility of the returns decreases with the length of the holding period, while mean returns remain almost constant. Like Stein and Anderson, he also notes that art may be a worthwhile investment for those who "derive a high rate of return in the form of aesthetical pleasure" (Baumol, 1986). However – on the base of *a priori* considerations on the art market and the fact that the distribution of the returns resembles a normal distribution (based on a 95% confidence level), his assessment of art as a financial investment is much blunter – he calls it a "floating crap game" – with art prices moving in unpredictable oscillations (Baumol, 1986).

Buelens and Ginsburgh (1993) revise Baumol's analysis. By establishing an index and separately analyzing different periods, they find that art outperformed other asset classes in some instances. Notably, they find an average return of 0.87%, using exactly the same sample and method as Baumol. Buelens and Ginsburgh (1993) regard costs associated with purchase and ownership of art as possible reasons for art prices outperforming other asset classes for some periods. However, they do not tackle Baumol's a priori considerations on the predictability of the art market, with the ultimate objective of assessing whether art should be included in an investment portfolio. Moreover, one should point out that in their analysis, Buelens and Ginsburgh do not differentiate the fixed income rate of return against which they compare rates of return of art; this may lead to wrong conclusions as this rate also fluctuates over time.

Compared to Baumol (1986) and Buelens and Ginsburgh (1993), Frey and Pommerehne (1989) draw observations from an extended database, covering auction prices for paintings over 350 years (1635-1987) and widening the geographical scope to auction houses across Europe and North America. In addition to that, Frey and Pommerehne are the first scholars to take into account transaction costs in their return computation, which amount to about an average *per annum* rate of 0.4%. The average real return yields 1.5% for repeated sales over the entire period, whereas the corresponding return for government securities would have yielded 3.0%. Moreover, the standard deviation of 5.0% is much higher than for the latter, with volatility being lower for paintings with longer holding periods. Isolating the performance of paintings after World War II (1950-1987), Frey and Pommerehne find that paintings still did not perform as well as other asset classes (1.6% vs. 2.4%). Besides the previously mentioned argument that art owners may draw aesthetical pleasures from art ownership, Frey and Pommerehne note that tax aspects (i.e. art may not be subject to property taxes or death duties) may provide a rationale for an art acquisition. However, it is worth mentioning that when excluding holding periods shorter than 20 years, such findings like those of Baumol (1986) et al. discard the entire data of the top-performing “La Peau de L’Ours”.

Drawing from similar data sources, covering the period 1716-1986 and applying a repeated sales regression, Goetzmann (1993) identifies three bull market (1780-1820; 1840-1870; 1940-1986) and three bear market periods (1830-1840; 1880-1900; 1930-1940). In line with previous studies, Goetzmann finds that over very long periods, art is dominated by less volatile asset classes. Excluding earlier periods however, he finds that paintings grew at a yearly nominal rate of 6.2% vs. 2.6% growth in the London Stock Exchange (excluding dividend yields) from 1850-1986. When assuming dividend yields to amount to 3-5% *per annum*, Goetzmann (1993) finds that stocks yield the same returns as art, however with a much lower volatility. More than that,

he finds that contrary to conventional wisdom, art is closely correlated to the stock market, making it a poor vehicle for diversification. Noteworthy regarding Goetzmann's work is his emphasis on a potential upwards bias stemming from the data population under analysis.

Mok et al. (1993) provide insight into returns of Modern Chinese paintings sold in auctions at Sotheby's and Christies between 1980-1990. However, their findings need to be analyzed cautiously since their focus on repeated sales leads to a significant reduction in the amount of observations processed. Mok et al. find an annualized return 53%, which outperforms regional stock market indices in the same period (Hong Kong's Hang Seng Stock Market Index, Singapore's Strait Times Market Index, and Taiwan's Weighted Index). However – not surprisingly due to the small sample – the standard deviation of 0.72 indicates risk-return properties that are by far dominated by other asset classes. They further note that in line with earlier research, the inherent selection bias as well as costs associated with the investment may further reduce the performance. However, contrary to the majority of the here-mentioned researchers, their calculations actually include a proxy for sales commission (10%) to be deducted from the hammer price.

Rather than geographically, Pesando (1993) broadens the scope of art investments to prints, which allows him to identify repeated sales from a larger set of data. At the same time, he is among the first researchers to track the exceptional growth in art prices in the late 1980s as well as the subsequent collapse in the 1990s, which is in line with reports of record auction prices for Impressionist paintings from 1987-1990. To test whether the recommendation of art dealers to only buy renowned artist holds true, Pesando isolates Picasso prints. For the period 1977-1992, he finds an aggregate mean real return of 1.51% for all prints and 2.10% for Picasso prints, which are well below returns for other asset classes with similar risk properties, at a higher standard deviation for Picasso prints (19.94% vs. 23.38%). More than that, Pesando notes, transaction and insurance costs, that are significantly higher for art compared to other asset classes, are not included in his computation. In an extension of Pesando's prior study of the period 1977-1996, Pesando and Shum (1999) find that the average real return for Picasso prints decreases from 2.10% to 1.48%, which is well below asset classes with similar standard deviations, like stocks (9.13%) or long-term bonds (3.45%). However, even less risky treasury bills performed better in the analyzed period (2.29%).

Mei and Moses (2002), based on a significantly extended set of data compared to Baumol (1986) et al., are computing general and specialized annual price indices for American, Old Master, Impressionist and Modern paintings based on a repeated sales regression for the period from 1875-2000. The research of Mei and Moses further strengthens the relation between economic environment and the art market, as prior discussed by Goetzmann (1993), by identifying price drops during the Oil Crisis (1974-1975) and the Great Depression (1929-1934). With regards to the properties of art as a financial investment – real returns, volatility and correlation with other assets – the findings of Mei and Moses are among the most favorable so far. Over the period 1950-1999, they find an annual real return of 8.2%, just below the respective returns on stock markets (8.9% vs. 9.1% for the S&P 500 and Dow Jones Industrial, respectively) at a slightly higher standard deviation of 21.3%. Although their findings yield the most positive indication with regards to art as an investment, Mei

and Moses remain cautious and conclude that art "may be appropriate for long-term investment only", especially due to the high transaction costs (which they have neglected in their computation).

Focusing on Belgian painters, from social realism to surrealism for a time span of 1970-1997, Renneboog & Van Houtte (2002) are joining Frey and Pommerehne (1989) and Mok et al. (1993) with regards to the incorporation of associated costs. In fact, in addition to a seller's commission (10-12%) and insurance costs (0.5%), they consider a buyer's premium (15%), duties for Belgian and French art (4% and 3%, respectively), as well as value-added tax on auction commission (14-21%). With an annual return of 5.6%, they conclude that art underperforms equity markets due to risks and associated costs.

The second study by Mei and Moses (2006) captures repeated sales in the 50 years from 1954-2004 with an average holding period of 28 years. Not surprisingly, the findings are very similar to the first study discussed above, with absolute returns for the art market at 10.0% and 10.4% for the S&P 500, respectively. The volatility is slightly lower at 18.6% and 15.7% for the S&P 500. In line with findings by Frey and Pommerehne (1989), Mei and Moses find that volatility decreases with the length of the holding period. With regards to transaction costs, Mei and Moses argue that for the purpose of comparison to equities those can be neglected as these fees would be comparable to (equity) investment fund fees. They conclude that art compares favorably to bonds, but is outperformed by stocks; however, they note that art can indeed be an addition to a long-term investment portfolio due to very low correlation coefficients.

The work from Worthington and Higgs (2004) covers auction records of paintings from Old Masters to Contemporary artists in the period 1976-2001. Notably, the conclusions of this study are drawn from a simple index, which is computed by comparing the average prices per year, skimmed by 10% to account for outliers, with the base year (1974). As mentioned earlier, this method fails to account for potential variances in the quality of the paintings sold during different periods. Worthington and Higgs reach the same conclusions as most earlier studies that apply more elaborate methods, finding that even considering the low correlation of art to other asset classes, the unfavorable risk-return properties exclude art from an efficient portfolio comprising a variety of other asset classes such as stock or bonds. However, they find that there is no added value through diversification in an equity setting; though, they do point towards diversification among different styles of art which would be favorable especially for collectors or museums.

According to a more recent academic study (Renneboog & Spaenjers, 2009) – based on a dataset of oil paintings, prints and works on paper (i.e. watercolors and drawings) which account for approximately 90% of the total turnover in the art market with an overall number of 10,211 artists in more than 1.1m transactions – real returns in USD terms were 4.03% *per annum* from 1951-2007. They have found that the annual return is lower than the return of the S&P 500 over the same time period; in addition, art investments have a higher volatility than the stock market return. However, real returns from 2002-2007 have been 11.6%, which is higher over the longer term than bonds (at higher risk though), but lower than stocks which also demonstrate that art is a storage of value and a hedge against inflation which could meet investors' needs provided that an art tradable index would be available. They point out that these indices and ultimately the results on return rates should be understood as only an indication of the painting category movement as they do not capture all

the auction house information and any of the dealers or private treaty sales prices. Also, there are not tradable and do not include the costs of buying and selling art that can be large. Moreover, it must be noted is that the painting category is composed of several sectors that do not react in the same way. For instance, the old masters sector does not have the same risk-return profile as the contemporary sector. That their returns are much lower than the outcomes presented by other researchers, such as Goetzmann (1993) or Mei and Moses (2002), although their time frame includes an extra boom period, they explain with the fact that their dataset comprises a broader coverage; that is, it does not only capture the sales and resales by top artists at the biggest auction houses. They do, too, come to the conclusion that buyers of art should expect to reap "non-pecuniary benefits rather than high financial returns, especially because the modest art returns are further diminished by substantial transaction costs" (Renneboog & Spaenjers, 2009).

In order to compare the ROI in hypothetical portfolios representing each of the auction house categories, Roman Kraeussl (2014) has analyzed a data set drawn from more than 800,000 auction records from 2003-2013, which reveal disparate market performance by painting category. Krauessl and his team examined works by old Masters, 19th-century European artists, and Impressionist and Modern painters for the given decade. He demonstrates that for this period old Masters have behaved much like a "blue-chip" stock, with slow, steady growth and minimal volatility, aside from a dip in 2009 during the financial crisis. Over the course of the decade, an investment in an old Master paintings portfolio would have yielded a nominal 9.93% ROI *per annum*, whereas that same investment in 19th-century European paintings would have accrued to just a bit more than half of that with 5.98% ROI. He also shows that the number of sales in this art category have dropped by 30% in the past five years. From an investment standpoint, Impressionist and Modern paintings performed the best of the three, producing an average annual return of 11.87%. However, it must be noted that his indices do not account for peripheral fees (Kraeussl, 2014).

1.7 Assessment of Available Data

Regardless of the method chosen to assess or approximate the performance of art, not only the output but also the availability, quality and structure of the data deserves attention. These properties are very important for the analysis of returns found and could lead to misleading conclusions if overlooked. Firstly, possible data sources are identified, while the second chapter discusses possible biases that can be caused by the data selection.

1.7.1 Possible Information Sources

The range of possible data to conduct an analysis on the returns on art can be derived from a classification regarding real estate indices used by Eichholtz (1997). Similar to real estate, the construction of a transaction-based index is both easiest in terms of data availability and consistency, as well as expandability to the past. It is applied in the vast majority of research papers analyzing returns on art, thereby using auction data. Renneboog and Spaenjers (2009) point out that indeed it seems reasonable to assume that the price trends observed in public sales are similar to those in the art market in general. However, one may criticize existing

research on art as incomplete (Ginsburgh, Mei, & Moses, 2005). The main reason for this limitation is availability and reliability of data (Mei & Moses, 2002). While auction records are widely available, other sales channels such as art galleries have no interest in disclosing price histories, as they are trading privately. Thus, the restriction on auction prices may be legitimate from a feasibility point of view, though it makes it harder for indices to paint the real picture of returns because as much as 60% of art is estimated to be traded privately (Powley, 2013). The resulting unbalanced panel data puts some restrictions on the depth of analysis that can be conducted; advanced time-series methodologies, for instance, cannot be applied. Drawing an analogy to the S&P 500, (Pownall, The „art“ of portfolio diversification, 2005) argues that auction prices are still "highly significant" with regards to the portion of the overall market represented. However, such a comparison does not consider that auction prices may represent a specific fraction of the market that exhibits distinct price behavior.

1.7.2 Potential Biases in Auction Records

An important preliminary consideration regarding biases is the fact that an art auction represents only one sales channel among many other alternatives, meaning that any piece of art could also be sold through a gallery or within a private deal. This constitutes a major difference to other asset classes such as stocks or bonds, where a dominant sales channel exists, i.e. a stock market exchange, for instance the NASDAQ.

Also, the character of an art auction differs from auctions of other asset classes. While auctions in the case of real estate, for instance, are often induced in case of financial distress, for art they represent a common sales channel (Mei & Moses, 1996). Though, as Goetzmann (1993) argues, the price expectations of an owner may have an influence on the sales channel or the selling decision after all. He assumes owners to sell through auctions only when they expect a higher price than their acquisition price, that is, when there are enough agents interested in participating in competitive bidding. If not, he hypothesizes, the seller would opt for either a private sale through a gallery, or decide to keep the art work. Accordingly, art objects that “fall from fashion” (Renneboog & Spaenjers, 2009) are often not sold through auctions. However, this bias is probably small in very large datasets which also cover lesser-known auction houses. Still, auction prices are likely to be subject to a survivorship bias because they understate stylistic risk, i.e. the risk that a painting gets out of taste, that is inherent in any investment in art. Even if a painting is entering an auction event, such a bias can arise because paintings that fail to sell below a predefined reserve price are bought-in (Anderson, 1974). In this case, no sales price will appear in the records, constituting an additional source of survivorship bias. However, the bias stemming from the preliminary selection, i.e. the painting not entering the auction at all, is likely to be higher. Neither seller nor auction house benefit from a publicly transparent bought-in record and thus try to avoid such failure to happen, whenever possible. Possibly mitigating such upward biases, as Mei & Moses (2002) argue, is the willingness of auction houses to sell inexpensive pieces of established artists to attract first-time collectors. More than that, Mei & Moses argue that just because only the paintings that were actually sold during an auction are included in the analysis does not constitute an upward bias. They reason that the

preference of the art owner not to sell art below a certain price does not deviate from the general aversion of individuals to sell any asset at a loss, which can also be seen in other sales channels, and for other markets.
An indication of a potential bias inherent in auction prices can be found in Hutter et al. (2007). They assess gallery prices by comparing dealer price quotes with auction prices of the same artists in order to test the often-stated implicit assumption by other researchers that the price vectors in the two markets are linear and scalar transformations of one another. Contrary to anecdotal evidence, Hutter et al. hypothesize that prices of art sold in galleries are on average higher than those of art of the same artist sold in auctions. They reason that art sold in galleries also provides "club services", whereas auctioned art just consists of the "bare object". Club services are defined as "the membership in the community which adheres to the dealer's aesthetic style". The fact that galleries also sell art purchased through auctions – with a markup – could be a second explanation for higher gallery prices (Anderson, 1974). Another problem that arises using auction data is that valuable works that are donated to museums do not appear in auction sales databases either. However, at the least, auction prices serve as reference points for the rest of the market (Ashenfelter & Graddy, 2002).

Generally, this stream of literature legitimizes art as an investable commodity. The majority of researchers, amongst them Frey and Pommerehne (1989), Mok et al. (1993), or Mei and Moses (2002), come to the conclusion that art is dominated by other asset classes, especially when considering associated transaction costs. They further agree, that art investing is not for short term profit, but its attractiveness increases with the holding period. Hence, some hypothesize that art is only an attractive investment if the consumption value (or as Renneboog and Spaenjers (2009) put it: "non-pecuniary benefit") is included in the return calculation (compare Anderson (1974), Stein (1977), or Baumol (1986)). Stein (1977) even quantifies such notion and postulates that if the aesthetic return of art exceeds 1.6%, art would possibly constitute a worthwhile investment. However, the majority points towards the fact that art investing has low correlation with the broad markets and does indeed provide a positive, though lower, average risk-adjusted financial return.
Based on the findings of Renneboog and Van Houtte (2002), who conclude that (only) well-informed collectors could possibly outperform stock markets; and on those of Pownall (2007), who emphasises the low correlation of art with other asset classes; as well as in line with Pesando and Shum (1999), according to whom the high non-systematic risk of art would require diversification efforts; the idea of art funds is born. The next chapter is dedicated to the analysis of their investment services. With reference to the aim and initial hypothesis of this thesis, after having established art as an asset class with certain benefits (e.g. low correlation with other asset classes, tax benefits, inflation hedging) as well as particular drawbacks (e.g. transaction costs, risk profile), in the following, art funds with their benefits and limitations will be introduced as an opportunity that provides exposure to art.

2. Investment Opportunities: Art Investment Funds

Existing literature seems to lead to the conclusion that (minor) exposure to art may very well bring diversification benefits for its low correlation with other asset classes despite the significant downsides that might hamper capital flows. However, a broad base of potential investors is kept from participation in the art market: if not because of exorbitant prices of individual art pieces that the average investor simply could not afford – or if so – because of the very limited availability of sought-after, affordable works; then probably due to tremendous transaction costs and risks. As if these were not enough reasons to be discouraged from art investments, to successfully identify a valuable piece to invest in is an art itself. Analogously to the stock market, art investments in individual assets would be advisable only to the expert who knows the art market and who possesses the necessary knowledge and abilities to estimate art market trends. It is self-evident that investing in multiple pieces of different genres to diversify the exposure is all the more far from feasible. The logical consequence was the systematic formation of art investment funds. The logic behind art funds can be summed up in three simple facts: first, good quality art (usually) goes up in value; second, the art market is inefficient, so experts should be able to find opportunities to exploit; third, because the art market is separate to other markets, it offers investors benefits for diversification. Everything that makes art a difficult asset class to invest in – lack of data, forgeries, insider information, volatility, etc. – means that true experts have an edge and should be able to generate a return. Therefore, it is not surprising to notice that the few art investment funds set up so far are generally set up by individuals who spent a significant amount of time in the art markets, such as The Fine Art Group with Philip Hoffman (cf. ch. 2.9 below) or Tiroche DeLeon with Serge Tiroche, who grew up with art (cf. ch. 2.10 below). The idea is that in addition to benefits of diversification (in two ways – that of an alternative investment portfolio as well as the art portfolio itself), the bundling of investment capital in the form of an investment fund has yet another advantage for the investor, which is that investments in art objects – that would otherwise exceed the available resources of the individual (Bernhard, 2005) – now become affordable. This is ensured by a relatively small denomination of the fund's shares. Furthermore, transaction costs can further be reduced significantly by a centralized administration of information and asset selection in form of a fund's management (Bernhard, 2005). On the grounds of the findings presented in the first chapter of the thesis, the following part will carry on with the introduction and qualitative evaluation of art investment funds as an opportunity to get exposure to art. After an introduction of art funds, including their conception, genesis, structural forms or strategies pursued, a performance evaluation follows complemented by a view on their (current) challenges with respect to the risk-reward relationship and diversification benefits of investments in art funds.

2.1 Conception

As detailed above, the art market does not shine with efficiency. But where inefficiencies are to be found, there are typically profits to be made. In particular, art dealers and galleries have learned to exploit these inefficiencies in their favor (Brewster, Art funds and indices: Inefficiency gains, 2007). Similarly, various art investors are now trying to achieve this by the initiation of art investment funds. Art funds are actually

considered a hybrid between private return-oriented investments and institutional collecting. In principle, these are normal investment funds and a majority understands them as such. The concept appears simple: Art acquired with investors' money is awarded to interested parties and shown in prestigious institutions, whereby its value is additionally increased. After a few years the portfolio will be sold. The return flows to the investors. The underlying characteristics of art investment funds are diverse and vary from fund to fund. While all art funds utilize some form and degree of a traditional buy-and-hold-strategy, art funds may differ in size, duration, investment focus and strategy or in portfolio restrictions. Some funds create further advantages for their investors with an interdisciplinary inclusion of museums. According to Bernhard (2005), not only investors but also museums can benefit from such cooperation; on the one hand, for the investor side these advantages come not only in the form of just monetary returns, but also the aesthetic returns are being preserved, namely by lending acquired artworks out to museums instead of storing them in a vault; as shielding the artworks from the public would not exactly be conducive to their prominence. Thus, such cooperation provides marketing-related opportunities for investors, for example in the form of an increased reputation. The core competences of museums such as expertise, insider knowledge, professional infrastructure and access to experts can be exploited for proper storage, maintenance and restoration of the artworks as well as to provide professional advice to the art investors, such as investment recommendations for acquiring new works of art (Bernhard, 2005). On the other hand, for the museums side, the cooperation offers – in addition to the extra source of income through storage and consulting – mainly the chance to exhibit works whose funding has become increasingly difficult, given sinking budgets and rising prices of artworks. Generally, the museum will receive a performance-related fee from the fund (Bernhard, 2005). Lastly, also the broader public benefits from such interdisciplinary inclusion, as works of art can be enjoyed in exhibitions that under normal circumstances would not be shown (Bernhard, 2005). However, the aesthetic return can not only be monetized with museums; there are alternative types of exhibition options that can be considered, such as rental or leasing directly to companies or investors, which would also generate income (Bernhard, 2005). According to Bernhard (2005), sponsorships must also be considered. Certain prerogatives would be granted to sponsors for its financial contribution, for example in the form of advertisements or events.

2.2 Strategies

Contrary to mutual funds, hedge funds and other regulated investment vehicles, art funds are not restricted by law in their choice of investment strategies, and therefore they can employ a varied basket of investment strategies. Consequently, understanding the differences between the various strategies is of vital importance as each strategy or combination thereof have varying degrees of risks and rewards. Two major strategies typically utilized by art investment funds include the traditional – and from the stock market well-known – “buy-and-hold”-strategy, “geographic arbitrage” or “intrinsic value” strategy. Whereas geographical arbitrage builds upon market inefficiencies, aiming to exploit differences in price realization for certain artists’ works in different geographic locations, the intrinsic value strategy follows Benjamin Graham’s value investing scheme, i.e. it involves investing in works by artists perceived by the fund manager to be selling at deep

discounts to their actual or potential value. Already known as often employed by hedge funds, "leveraging" strategies involve borrowing on the art held by the art fund and using such funds to acquire additional art expected to produce returns greater than the borrowing costs during the term of the loan. Also, there are funds focusing on only one geographic region (e.g. Chinese Art) or a specific style (e.g. Contemporary) or period (e.g. Post-War), just to name a few more. However, most art fund managers employ a diversified investment approach using more than one strategy simultaneously to realize gains for the fund's investors. In doing so, the art fund manager is able to capitalize on available opportunities within the art market. It must be pointed out that many of the foregoing strategies are impacted by the number of available artworks sufficing the investment criteria of the art fund as well as the amount of capital available to the fund to employ (The Art Fund Association).

2.3 Genesis

The idea of a collective investments in art is not new per se. Already in 1904, the French financier André Level together with a dozen art lovers launched an art investment fund, La Peau de l'Ours (Surowiecki, 2005). Each participant committed to an annual deposit of FRF 250, which was subsequently invested in modern art (Bolger, 2006). The fund bought more than a hundred paintings and drawings during a time span of ten years, including important works by Picasso or Matisse (Surowiecki, 2005). For that duration, each and every partner was allowed to rent works of the collection for private enjoyment (Bolger, 2006). In 1914, the fund liquidated its entire collection in a gigantic auction at a Parisian hotel with certain pieces having achieved auction prices up to ten times their original price (Surowiecki, 2005). Though, to this success it must be noted that the fund initially invested only a relatively little capital. Thus, the fund's management did not have a choice but to invest in yet unknown (and affordable) artists – as opposed to old masters whose prices would have exceeded their budget by far. Contrary, much larger funds, had to purchase established (and more expensive) artists to invest all investment capital provided, which in turn had a negative effect on the growth potential of the funds. Heller considers the carefully selected focus on one style of art as a major driver for the success. The often cited BRPF is considered the cornerstone for an institutionalized art fund. It may in fact be considered the business model for new funds projects. Within 15 years from 1974 onwards, the fund has invested GBP 40m in more than 2,400 works of art. Between 1985 and 1990, the works were gradually sold. The fund achieved a return of 13.1% *per annum* (Saigol, 2004). Even so, some financial analysts actually believe that the return could have been even higher, because the British fund managers have collected in too many areas (13 different areas and epochs) and sold too late. However, the fact that only 60 of the 2,400 works accounted for a full third of the profits contradicts this view. After all, the BRPF was the only fund that really existed, from which it is possible to read off a performance. Other than that, the market lacks appropriate examples. According to Krepler, markets in general fared well during that time (Krepler, 2007). Nonetheless, with regards to price trends of the past five years – where prices of works of individual artists of doubled within a year – to Krepler annual returns of 10-15% do not appear exaggerated (Krepler, 2007). After BRPF's foray into the art funds arena, there were a dozen proposals to create art investment vehicles, some offered even by certain of Wall

Street's most prominent financial institutions (e.g. plans by Christie's and Goldman Sachs were eventually revoked in 2009). Such proposals never truly got off the ground and other attempts that followed met with disastrous results due to, among other things, overpaying for their art works and failing to properly manage their operational expenses (e.g. Fernwood). Today there are a number of funds that have successful launched.

2.4 Open-End vs. Closed-End Art Funds

Art investment funds may come in an open-end, a closed-end or a hybrid form. Open-end funds address the broad mass of investors. They are characterized by the fact that their unit certificates are securitised on the fund's assets and traded on capital markets. Also, the share can be purchased and resold at any given point in time. From the perspective of an investor, this constitutes an advantage as the consideration of time and trading volume to buy or sell is flexible. Contrary, this feature requires the fund's management to constantly provide sufficient liquidity (Bernhard, 2005). Obviously, open-end structures are problematic in the art market; as noted, in the short-term artworks often cannot be liquidated at all or only at a discount. An open-end structure however, would require the holdings of large liquidity reserves (in form of assets in money market funds), which does not serve the investment purpose and thus cannot be in favor of investors (Bernhard, 2005). Furthermore, there is a problem in terms of the ongoing portfolio valuation. Closed-end funds generally have a limited maturity and are extremely limited in tradability. They are therefore primarily suitable for institutional or private investors who have a larger investment volume. For Bernhard (2005), they are unattractive to retail investors because of their inflexibility. The lack of fungibility prevents the sale at any time. After reaching the planned fund volume, no further shares will be issued and the funds will be "closed". According to Bernhard (2005), however, for its closed nature there are also disadvantages for the fund's management, as the fixed maturity reduces flexibility in terms of when to buy or sell, which is why attractive market opportunities may be foregone. In particular, it is not advisable to invest immediately all assets at once. This is promoted by the fact that the fund's volume is fixed after the launch of the fund. Although the planning reliability of the available liquidity is advantageous here, there is no possibility of at best increasing the funds volume at a later point in time with changing market conditions. Closed-end funds are suitable for small, manageable circles of investors, for example for "investment clubs". For art funds, which should be accessible to a broad group of investors, a semi-open status is an appropriate option. In this case, the maturity is usually unlimited. The increase in the fund's assets through the issue of new shares is envisaged, the repurchase of units by the fund though is not (Bernhard, 2005).

2.5 Funds Management and Regulation

The main body comprises the committee of the funds management, which is responsible for all decisions of major importance, such as its financial administration (e.g. business plans, annual reports, etc.), the asset management (e.g. strategy, policy, liquidity planning, etc.), and investor relations (Bernhard, 2005). It is obvious that the staffing of the committee should not be restricted to financial specialists. Excellent know-how regarding the art market and a network within the art scene is indispensable. Also technical (e.g. in terms

of catalogues, etc.) as well as organizational aspects (e.g. concerning vernissages, etc.) must not be neglected (Bernhard, 2005). From a marketing point of view, it can be advantageous if so-called "opinion leaders" are being recruited, who – in addition to their knowledge and their relationships – provide the fund with extra credibility and a professional image. Another alternative to mixed committees would be to establish a panel of experts, which would be consulted when needed (Bernhard, 2005).

While art funds are private investment vehicles that operate out of the public eye, art funds are still subject to regulation in a number of ways. For instance, the Investment Advisers Act of 1940 requires that persons who give investment advice relating to securities for compensation to US clients must register as an investment adviser with the US Securities and Exchange Commission (unless it meets certain exemptions). However, the act generally does not apply to art funds unless they engage in significant leveraging and securities trading strategies. Also, existing art funds rarely exceed the newly adopted AUM threshold of over USD 150m after which registration with the SEC is required for private fund managers. However, to the extent that a particular art fund management enterprise produces significant and consistent returns, it is not inconceivable that such entity could attract significant investment in excess of the available thresholds for exemption so as to require registration. Though the registration of an art fund manager as an investment adviser brings certain advantages from a marketing standpoint as investors typically take comfort from the fact that the art fund manager is regulated by the SEC but it also bring disadvantages in the form of regulatory compliance and restrictions on charging performance based fees to certain “qualified clients”. Moreover, it is noteworthy that registered art fund managers are subject to stringent record-keeping rules promulgated by the SEC as well as periodic SEC examinations looking into, among other things, charged performance fees and conflicts of interest disclosures. Art funds and their managers are also subject to the anti-fraud provisions of the Securities Act of 1933, the Securities Exchange Act of 1934 and the Advisers Act which prohibit fraud in connection with the offer and sale of the art fund’s equity interests and in connection with the advisory relationship. In addition, as a purchaser and seller of artwork within the United States, the art fund may be subject to various state laws specifically prohibiting the commission of fraud in connection with the sale of art by the art fund. Also worth mentioning is the required compliance of art funds with the Employee Retirement Income Security Act of 1974 which regulates the investment by pension funds in art investment funds. Essentially, an art fund accepting 25% or more of its investments from benefit plan investors are subject to various Department of Labor rules, including limits on investor lock-ups, valuation procedures for the fund’s assets and indemnification requirements.

As art funds generally would not wish to be subject to these rules, it comes as no surprise that, in most instances they are attempting to be eligible for these pre-defined exemptions. Accordingly, in order to avoid registration under US securities law, equity interests in art funds in the US are generally not offered for sale to the general public. Hence, their offerings are limited to “accredited investors”, namely certain institutional investors and individuals with either a net worth of USD 1m (excluding the value of their personal residence) or with income during the past two years of USD 200,000 (or USD 300,000 with spouse), with whom the art fund has a pre-existing relationship arising out of other than the art fund offering. Art funds may permit up to 35 investors to

be non-accredited; however, to do so requires more significant financial disclosures and presents additional challenges with respect to compliance. Art funds in the United States also seek to fall within one of two exceptions from the Investment Company Act of 1940 in order to avoid the need to register as an "investment company" (mutual fund) under such act, which impacts the number and character of the investors in such funds. Furthermore, art funds can avoid registering if its equity interests are sold privately to no more than 100 investors. Also, an art fund is not subject to regulation under the Investment Company Act if the total investors in such fund are less than 500 and all such investors are "qualified purchasers", defined generally as natural persons with at least USD 5m in investments, institutional investors with USD 25m or more in investments (or that are owned entirely by qualified purchasers) and certain knowledgeable employees of the art fund or its advisor (The Art Fund Association).

2.6 Fee Structure

The fee structure of art funds is related to that employed by hedge funds. This should not come as a big surprise as those funds are related; in a broader sense, art funds can be regarded as a form of hedge funds. The fees charged by art funds managers are primarily tied to performance, which serves to align the interests of such managers with those of investors. As o-called management fee – the fee for the professional asset management service provided to investors – of between 1% and 3% is charged, typically annually, of either the net asset value [NAV[6]] of the fund's art portfolio or the total capital commitments made by the fund's investors (Bernhard, 2005). In addition, a so-called performance fee of about 10 – 20% is common in these constructs, which – as the name suggests – depends on the performance of the fund, i.e. any profits made from the disposition of the fund's art portfolio. The accumulation of fees required for such investment is due to its unusual nature, whose active management requires specialists. Additional operating expenses, which also exceed the cost structure of "ordinary" hedge funds, arise from the transport, storage, insurance and restoration of the artworks. These special services are usually paid at standard market fees. The contribution to the funds can be made in a number of ways: through an initial charge on the issue of shares, a charge on the redemption of shares, a hybrid of these two options, or through a direct charge to the funds' assets, which indirectly reduces the share price (Bernhard, 2005).

2.7 Investor Relations

With regard to investor relations, an art fund does not differ much from other funds. For example, art funds will publish annual reports as well as half-year or quarterly reports that provide information on the financial situation and results of operations of the fund. This includes a documentation of the identification number, type and condition of the acquired works of art. Typically, an annual report should first give an overview of the development of the art market during the course of the financial year. Subsequently, a description of the

[6] Net Asset Value = The net asset value is the sum of all assets less all liabilities.

long-term fund strategy and the resulting buying and selling policy should be made during the financial year. It also makes sense to have an overview of the business activity in the financial year. Likewise, an annual report includes a statement and valuation of the fund assets at the balance sheet date as well as a statement of expenses and income from the administration in the financial year. Finally, for shareholders, the historical performance of the fund's assets or the unit value in comparison to a representative benchmark index is just as interesting as an outlook for the following financial year (compare Bernhard (2005)). In the context of regularly recurring reporting, information and ratios including the fund's (annualized) performance (since the last tick date/ beginning of the year/ beginning of trading), the number of negative months, the fund's current NAV, its volatility, Sharpe ratio, portfolio allocation, etc. are of interest to the investor. As initial information for interested investors, the fund publishes a prospectus that provides information on the objectives and functioning of the fund (Bernhard, 2005), including information on the management and performance fee, issuing commission, the type and management of the fund, its domicile and auditor, amongst others. Regarding the contents of fund reports and prospectuses, legal requirements generally exist. Active public relations is usually only permitted for a funds if it is officially approved (Bernhard, 2005). In all other cases, according to Bernhard (2005), corresponding information material may only be made available on request. As a result, instead of direct advertising, general public relations work will seek to stimulate interest in the fund and active demand (Bernhard, 2005).

2.8 Performance Evaluation – In Theory

When it comes to the ongoing evaluation of assets in the context of regulatory required recurring reporting, special problems for art funds arise. How should the change in value of singular investments be taken into account in the ongoing valuation of the fund without comparable reference prices? Generally, the value of an artwork can only be determined when being sold, namely by its selling price. However, this would imply that the return on a fund's investment could only be calculated at maturity, which would further mean that shares could not be traded during that lifetime of the fund as the intrinsic value cannot be determined. Investors will unlikely be willing to invest parts of their wealth only to find out about their profit or loss positions after decades. Whenever a transaction nonetheless occurs, the share price of the fund will generally deviate from its intrinsic value, meaning that there is a transfer payment among the shareholders, which is not desirable (Bernhard, 2005). For instance, if the price of the share is inflated, the seller will see an increase in value at the expense of the buyer, as it implicitly sends a transfer payment to the seller of the share, in excess to the intrinsic value of the transaction. Accounting standards do not exactly support the determination of the intrinsic value either. On the contrary, in most countries, the principle of prudence still applies when evaluating assets, which comprises the realization principle as well as the principle of imparity: The principle of realization requires that assets must be recognized at purchase price, i.e. profits may only be reflected in the valuation when they are realized, namely when sold. The imparity principle, on the other hand, forces immediate revaluation in the case of impairment (Bernhard, 2005). Assets may therefore only be recognized at market prices if they fall below their respective acquisition costs. Due to the fact that capital appreciation of works of

art could only be reflected in the share price in the case of a sale, the realization principle would have only benefited those shareholders who at the time of sale were in possession of fund shares (Bernhard, 2005). This is striking as it disregards hidden reserves – interim increases in the value of the fund – which is associated with an undesirable valuation discount for the early selling shareholder. Consequently, according to Bernhard (2005), incentives are set wrong: On the one hand, shareholders would only want to acquire shares in the fund if they can assume that the discovery of hidden reserves through sale was foreseeable; on the other hand, the fund management would be interested in choosing the holding period of works of art as short as possible and selling works of art as often as possible. This cannot be in the interest of investors. It is to be welcomed that international accounting standards such as International Financial Reporting Standards [IFRS] or United States Generally Accepted Accounting Principles [US-GAAP] have long been arguing for so-called fair value accounting, which is geared to the market value. The definition of the Financial Accounting Standards Board [FASB] for the "fair value" can be found in the Statement of Financial Accounting Standards [SFAS] no. 157 “Fair Value Measurements", paragraph 5: „Fair value is […] the price that would be received to sell an asset or paid to transfer a liability in an orderly transaction between market participants at the measurement date” (Financial Accounting Standards Board, 2006). And in SFAS 157.7: "[...] Therefore, the objective of a fair value measurement is to determine the price that would be received to sell the asset or paid to transfer the liability at the measurement date (an exit price).” (Financial Accounting Standards Board, 2006). Thus, in principle, it is a hypothetical market price under idealized conditions. Further, SFAS 157.8 states: “A fair value measurement assumes that the transaction to sell the asset or transfer the liability occurs in the principal market for the asset or liability or, in the absence of a principal market, the most advantageous market for the asset or liability.” (Financial Accounting Standards Board, 2006). This approach comes much closer to the intrinsic value of an art fund. The valuation is based on the observable market price of identical assets at or near the reporting date ("mark-to-market"). If this is missing, the observable market price of comparable assets should be used. In the absence of observable market prices – which is likely to be the case for artworks – model-based valuation techniques are used instead of a market price-oriented calculation, which simulate a market price ("mark-to-model"). This three-level fair value hierarchy is derived from SFAS 157.22: " „To increase consistency and comparability in fair value measurements and related disclosures, the fair value hierarchy prioritizes the inputs to valuation techniques used to measure fair value into three broad levels. The fair value hierarchy gives the highest priority to quoted prices (unadjusted) in active markets for identical assets or liabilities (Level 1) and the lowest priority to unobservable inputs (Level 3)“ (Financial Accounting Standards Board, 2006).

The imparity principle – the complementing half of the principle of prudence – can also have negative effects regarding the valuation (Bernhard, 2005). According to the imparity principle, a revaluation of expected value reduction of works of art takes place in addition to the time of sale. However, an only sporadically performed valuation of the funds’ contents in case of unfavorable market development can lead to an overvaluation of the fund shares, as the necessity of a revaluation under commercial law is not or only belatedly recognized by the funds management. In extreme cases, on the other hand, excess book values are continued until there is no

current valuation, until a realized loss of value, for example in the context of an art auction, brings about a drastic and sobering reduction in assets (Bernhard, 2005). Just as difficult to justify are regular depreciation, as art – generally – does not lose its value through usage. Again, international accounting standards have found a better solution. After all, the subsequent valuation is also carried out at fair value. The International Accounting Standard [IAS] 16, paragraph 29 of the International Accounting Standards Board [IASB], for example, offers a choice between the so-called "Cost Model" (16.30) and the "Revaluation Model" (16.31). The "Cost Model" serves as a benchmark. Its value consists of nothing but the acquisition or production costs or the amortized acquisition or production costs, i.e. less scheduled and unscheduled depreciation. IAS 16.30: "After recognition as an asset, an item of property, plant and equipment shall be carried at its cost less any accumulated depreciation and any accumulated impairment losses" (International Accounting Standards Board). According to the "Revaluation Model", the valuation is carried out at fair value. IAS 16.31: "After recognition as an asset, an item of property, plant and equipment whose fair value can be measured reliably shall be carried at a revalued amount, being its fair value at the date of the revaluation less any subsequent accumulated depreciation and subsequent accumulated impairment losses. Revaluations shall be made with sufficient regularity to ensure that the carrying amount does not differ materially from that which would be determined using fair value at the balance sheet date" (International Accounting Standards Board, kein Datum). Fair value increases are recognized directly in equity as revaluation surplus, whereas fair value decreases are recognized in profit or loss. Questions regarding the evaluations play a role also in connection with insurance issues. As Bernhard (2005) points out, in practice, the insurance values that have once been set are often updated annually with the average growth rate of the corresponding art market segment in order to still obtain as realistic a sum insured as possible – in the absence of a current valuation. An over insurance cannot be ruled out, especially since the masterpieces of art quite a cautious - that is rather higher - sum is used to be fully insured in the event of insurance. If the valuation of fund contents is based on insurance values, this may lead to overestimated valuations of fund units. Such an exaggeration of the valuation cannot be justified in the long run and can lead to artistic wear, that is to say the creation of a superordinate paper value, which in practice can scarcely be realized in a sale. This in turn would result in undesirable effects of implicit transfer payments. Accordingly, the use of insurance values cannot provide an acceptable solution to the valuation question. One would be best served to have the appraisal done by independent, experienced and honest experts. This service is offered for example by auction houses, museums, art college staff, art dealers or art experts. Under no circumstances may the result be accepted uncritically. The prerequisites and assumptions must therefore be critically reviewed. Ideally, one will rely on several expert assessments. The results of the art experts may very well be supplemented with historical price and rating analyzes, such as historical auction databases. These data are relatively short-term, specific and often even prepared in the form of an index directly accessible online (Bernhard, 2005).

2.9 The Good, The Bad and The Ugly – Performance in Practice

According to Enrique Liberman, president and member of the Board of Directors of the Art Fund Association, the trade association for the art fund industry, art funds can roughly be grouped into three categories: "the good, the bad and the ugly" (Private Art Investor, 2015). Some of the earliest art funds went famously up in smoke. According to Liberman's categorization, funds just like Fernwood Art Investments, which closed its doors after only four years, prompting litigation by a minority group of the company's equity investors, fall into the "bad" category as their failure is self-inflicted. Following his logic, funds that fail for reasons beyond their control fall into the "ugly" category. Often it is the case that, although these funds may have managers with great experience and access to excellent art investment opportunities, they struggle to raise capital. In this challenging landscape, only the funds falling into Liberman's "good" category are likely to survive and offer decent returns (Private Art Investor, 2015). Besides the here often cited BRPF or Level's La Peau de l'Ours, there are also some more up-to-date examples for the category "good", such as Philip Hoffman's The Fine Art Group, which was launched in 2001 as The Fine Art Fund. Hoffman started his career as an accountant at KPMG before joining Christie's as finance director at the age of only 27 (Karcher, 2018). He supported the restructuring of the auction house to make it profitable again. He rose to become deputy managing director before leaving to launch The Fine Art Fund. The Fine Art Fund Group is broken into three parts: an art advisory service, financial services and investment services (The Fine Art Group). Calling itself the "largest global art investment house of its kind" the Fine Art Fund was one of the first dedicated art funds. Thus far, The Fine Art Fund has launched five funds: The Fine Art Fund, The Fine Art Fund II, The Fine Art Fund III, The Chinese Fine Art Fund and The Middle Eastern Fine Art Fund. It had more than USD 500m of assets under management [AUM] in August 2018 from investors across 20 different countries. Today, the fund requires a minimum investment of USD 1m. A sales figure reveals in what dimensions the group is active: With reportedly nearly USD 300m implemented at Christie's and Sotheby's in 2016 only, The Fine Art Group is one of their top ten customers (Spindler, 2018). While the results of The Fine Art Fund are not publicly disclosed, it is rumored to be doing well. Those rumors are being supported by the launching of further funds. Philip Hoffman may very well be assumed to constitute one of the distinctive success factors of the fund, with his experience of both finance and art. In an information paper, the company speaks of 13% effective interest *per annum* in terms of the sum of all investments; Supposedly, 90% of all businesses were successful (Spindler, 2018). Destined to become the main competitor to The Fine Art Group, Fernwood was launched in New York in 2004 with the objective of raising USD 100m to USD 150m of equity to reduce inefficiencies in the art market. The intent was to split the funds into a short-term, speculative and a long-term strategic fraction. Because of conflicts among executives regarding the fund's investment policy, the fund was dissolved in 2006 without further announcement. Shortly thereafter, some investors sued for embezzlement of funds. Fernwood's collapse is seen as the main reason why current art fund activities are focused on Europe (Bizouati, 2007).

2.10 Case Study: Tiroche DeLeon

The art fund Tiroche DeLeon is a pioneer in actively focusing on increasing the art market's transparency by making its performance figures available to the public. The collection was established in January 2011 by Serge Tiroche and his partner Russ DeLeon. Shortly after, Tiroche and DeLeon founded the first art fund based on a private collection, the Art Vantage PCC Limited, in order to further grow the collection opening up to external (experienced) investors for contribution. Doing so, the founders have combined their experience in private banking, venture capital and art investments to create an art fund focusing on Contemporary Art from emerging markets (Tiroche DeLeon).

Tiroche DeLeon Collection (Art Vantage PCC Limited)

Launch Year	• *2012*
Term	• *10 years (5 years period of investment, 3 years holding and consolidation period and 2 years run off period)*
Currency	• *USD*
Minimum Subscription	• *USD 500,000*
Management Fee	• *2 %*
Performance Fee	• *20 %; subject to high watermark*
Operating Costs	• *1.5 % of NAV*
Redemptions	• *During the holding and consolidation period (years 6 to 8) on a semiannual basis with redemption gates of 5 % of NAV and a 90 day notice period. All other redemptions will occur during the run-off period (years 9 and 10)*
Redemptions in Specie	• *Upon mutual agreement Art Vantage may elect to meet redemption requests with artworks, based on the latest valuation*
AUM	• *USD 20.73m (Q3 2018)*
Return Since Inception	• *25.62 % (Q3 2018)*
Domicile of Fund	• *Gibraltar*

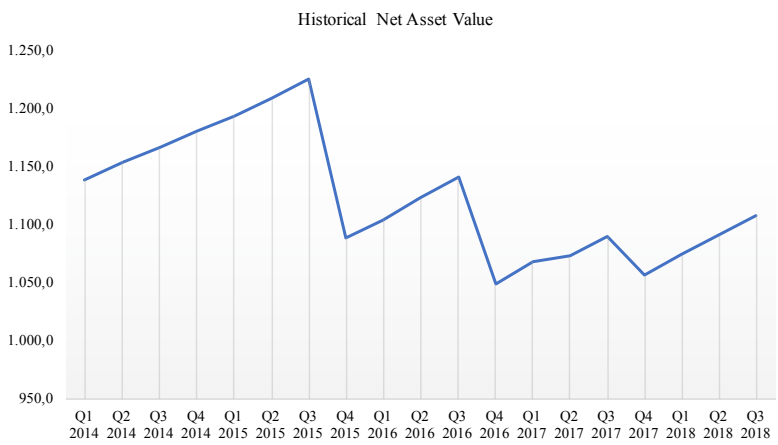

Figure 1: Case Study: Art Investment Fund's Structure and Performance (Tiroche DeLeon)

As disclosed by the fund, Q4 2015 and Q4 2016 constitute reductions in mark-to-market valuations provided by external parties on 31 December of each year. The biggest single contributor to these drops has been Ai Weiwei who was also a major contributor to the rises in value in the early years of the fund (ArtTactic, 2018). Moreover, in the interim management report for Q1 2019, the year-end collection valuation received in March 2018 is said to have turned out very conservative, resulting in a full year decline of 16%. However, the fund points out that this is a theoretical mark-to-market NAV only; Regarding the fund's NAV computation it communicates: "It [the valuation] is based on current auction estimates when the department experts feel there are sufficient comparable works in previous auctions, and when such don't exist (almost half the works in the current valuation) the value provided is our acquisition price (from several years ago)". Combined with a drop in the MSCI Emerging Market index, the fund admits that on paper the situation appears unsatisfactory. However, for its actual year to date [YTD] results in 2019, the fund reports that it has sold 15 works for USD 774,000 at a realized premium to the 2018 valuation of 21%, giving a reported gross internal rate of return [IRR] of 7.5% for this group. Generally, investors should beware of the communication policies of art funds, in either direction. Because real returns can only be calculated once pieces of art are sold, intermediate return numbers are based on subjective estimations. Thus, the fund investor is forced to wait until the fund is being dissolved to get an accurate return figure. As for its 2019 strategy, the fund states to continue to focus efforts on sales activity to reduce auction reserves, promoting works from the collection via active institutional loans, with the financial and the art market remaining receptive. Accordingly, Tiroche DeLeon is already in the

process of consigning works for private sales through galleries, auction houses and art fairs and in public auctions through individual as well as group placements. Doing so, the fund has achieved new world auction records for three female artists in 2018 – Firelei Baez, Haegue Yang, and Cui Jie (Tiroche, Manager Update - Q1 2019). Though the "on paper" performance of the fund may raise concern, re-assurance should be supported by the fact that the fund is in progress with preparations for the launch of a second fund in 2019, the Tiroche Contemporary Fund II (Tiroche, Manager Update - Q3 2018).

2.11 Advantages and Limitations

The unifying factor of all art investment vehicles is their focus on the art market, which is characterized by a lack of regulatory authority, deficient price discovery mechanisms, the lack of transparency in the market and the subjective value and illiquid nature of artworks. On the one hand, these very characteristics generate significant arbitrage opportunities within the market that seasoned art professionals can exploit for the benefit of the fund's investors. On the other hand, such characteristics denote art as the riskiest asset class, thereby creating the potential for substantial investment losses among the fund's investors. That being said, art investment funds do indeed hold strong limitations in the eyes of their investors which, in a nutshell, can to a great extent be traced back to principal-agent problems between the fund's management and its investors that shall be examined in detail below. Many of the advantages and disadvantages of an art fund correspond to the usual advantages and disadvantages of funds of all kinds. However, there are a number of peculiarities unique to art investment funds.

2.11.1 Diversification and Economies of Scale

By definition, pooling assets together and investing across multiple assets, funds provide diversification and economies of scale. What holds true for every kind of investment is that diversification across geographies and mediums are essential to avoid concentration risks. The diversification effect for art investment funds is a double-edged sword compared to the effect for traditional mutual funds. On the one hand, art may diversify a fortune. On the other hand, within art investment fund it is difficult to achieve the same level of diversification of individual positions by including different artists, countries or categories compared to, for example, an equity fund that can hold hundreds of stocks (Palmeri, 2007). In addition, according to Pownall and Pullan (2006), the advantages of an art fund over investments in individual works of art are economies of scale, which, for example, may stem from lower transaction costs. For instance, economies of scale allow for assembly of research and operational expertise, management skills, as well as buying and selling power. An art fund also allows one to participate in the value growth of expensive works with a relatively small capital investment (Faber-Castell, 2007). However, this is counteracted by the fact that art funds generally only qualify for HNWIs due to the generally high minimum deposit. These potential investors in art funds, however, may prefer to directly buy individual works of art with the amount of money they can afford, as they can hang and watch them at home. If they participated in an art fund, this "*Genussdividende*" [pleasure dividend] (Faber-Castell, 2007) would basically disappear. However, the capability to decrease transaction costs with

investments via funds as opposed to investments taken on individual accounts is much more convincing in case of art investments than for stock investments; This is partly due to the fact that capital markets law has been striving for maximum efficiency for decades, including institutional efficiency (cf. ch. 1.2.2 above). Moreover, high competition and regulatory measures in the market has greatly reduced the costs of access for stock investors, making capital markets basically accessible to any investor. In addition, investors have the opportunity to invest into mutual funds or ETFs that mimic the index; that is, investors can in fact be confident that they will get returns in line with the return on the index, at relatively low costs. Lastly, costs such as for transportation, storage, or maintenance (cf. ch. 1.4 above), are generally not associated with equity investments in the first place, as opposed to art investments.

2.11.2 Expertise and Infrastructure

More than that, professionally set up art investment funds provide a robust infrastructure that is essential in order to support the acquisition of large scale works and a global lending program. In turn, museum exposure for artworks in the collection enhances the value of these works, creates visibility for the collection, which in itself enhances the value of every work in a fund's collection. Also, a corporate governance and a regulated structure protect investors from potential conflicts of interest, as well as provide tax efficiency and regular accounting and reporting. Furthermore, such institutions typically show a clearly defined investment strategy, with proper risk management and exit strategy as well as independence and objectivity of the asset managers of the fund, and related segregation of duties. In addition, the investor can profit from a professional management, which is not only characterized by an information advantage (Bernhard, 2005).

2.11.3 Moral Hazard

Despite corporate governance, to a certain extent, areas of tension between investors and fund management are nonetheless inevitable. These conflicts of interest are quite classical in the sense of the principal-agent theory. According to this, the principal (in casu: investor) assigns an agent (in casu: fund management) to perform services in his or her interest, since the management knows the details of the business better (Wolf, Hill, & Pfaue, 2003). Conversely, however, the principal can control the agent badly, as only the results of the agent's actions can be observed, not the actions that led to it (Wolf, Hill, & Pfaue, 2003). There is the situation of an asymmetric distribution of information, also called "hidden action" (Wolf, Hill, & Pfaue, 2003). As a result, the agent has room for maneuver that he can abuse to maximize his own benefit, also known as the "moral hazard" phenomenon (Wolf, Hill, & Pfaue, 2003). The so-called agency problems describe processes in which the interests of the agent are not in harmony with those of the principal. The aim is to prevent this through institutional arrangements. The simplest solution for balancing the interests of the agent with those of the principal is to have the fund management profit-sharing in the form of own shares in the art fund - at a reduced price, but with a fixed minimum holding period - as a variable component of the remuneration. Thus, both the principal and the agent would have an interest in maximizing the market value of equity, since the market value of its participation depends on this performance, or its remuneration for the agent. Furthermore,

as a general rule, art fund managers typically have a substantial amount of their own capital invested in the art funds that they manage, thereby aligning their interests with those of their investors. The performance fee mentioned above (cf. ch. 2.6) also acts as an incentive in this direction.

2.11.4 Information Asymmetry and Lack of Regulation

The importance of information from experts is on the rise. Exaggeratedly, those with the expertise are the true value-forming factor of artworks. Experts, however, can misuse their power, for example, through a dubious attribution or misjudgments in the determination of value (Glaus, 2008). The industry also suffers from a quality problem, as the job description of the expert is not regulated – with an oversupply of "self-proclaimed" experts as a result (Glaus, 2008), and with their estimations strongly varying with connoisseurship (Czotscher, 2006). In no European country is the appraiser responsible for the accuracy of its fair value estimate. There is no warranty liability, and the appraiser is liable only if he has violated the contractual or customary care required (Schack, 2004). However, according to Glaus (2008), experts state that the scope of protection for disappointed buyers or sellers is constantly being extended, so that the liability risk of the experts tends to increase.

The lack of regulation of art investment funds is a double-edged sword: On the one hand, it provides unique opportunities for arbitrage that can be exploited for the benefit of art (fund) investors, especially in terms of insider trading. On the other hand, the absence of consistent regulation undermines the confidence of investors. Consequently, capital in the art market flows slowly which hinders the evolution of the art fund universe. That being said, the Dutch bank ABN-AMRO has discontinued its art investment practice, failing to establish a fund of art funds because “available art funds were not sufficient to put together a fund of funds” (Adam & Mason, 2005).

2.11.5 Conflicts of Interests

However, areas of tensions may as well be of internal nature: As the fund management is staffed by financial experts as well as art experts, such tensions are preprogrammed (Bernhard, 2005). Bernhard (2005) diagnoses a particular susceptibility to dissent situations for art funds because of persons with contrary fields of work such as art and commerce and equally different characters and opinions. However, different opinions can also be considered fruitful, with mutual understanding, recognition of the respective competences and renunciation of mutual interference in everyone's interest. A clear definition of the distribution of tasks (i.e. segregation of duties) is indispensable. The fund’s strategy must also be unambiguous, as conflicts of interest between the various fund management advisers are of course not excluded. For example, a work of art can be historically interesting, but strategically not. Of course, compliance with the fund strategy in place will take precedence.

2.11.6 Illiquidity

Though art funds may be able to bundle investments and thereby decrease transaction costs incurred, they are not able to tackle the problem of illiquidity, which is likely to be one of its most significant disadvantages

(Faber-Castell, 2007). Compared to equity funds, art funds are facing the difficulty to estimate of the current portfolio value as well as high art trading margins (Faber-Castell, 2007). In fact, it must even be warned of the communication policies of art funds: Because real returns can only be calculated once pieces of art are sold, intermediate return numbers are based on subjective estimations. Thus, the fund investor is forced to wait until the fund is being dissolved to get an accurate return figure, which can be at the earliest after five to ten years. Indeed, according to Deloitte and ArtTactic, an increasing majority of wealth managers refer to the lack of mark-to-market valuation as a major challenge preventing the incorporation of art into the wealth management services (ArtTactic, 2018). Hence, art investments certainly do not fit the shorter-term oriented investor.

2.12 Current Condition of the Art Fund Industry

Deloitte Luxembourg and ArtTactic have presented the global art investment fund market from 2011 up to the first half year 2017: After five years of decline, the overall art fund market was estimated to be worth USD 834m (ArtTactic, 2018). Up until 2012, the art fund industry has grown significantly over a decade with an increasing number of art funds, managers and service providers participating in the industry. However, the reality is that art funds and the transactions that they conduct represent only a small part of the global art market and investment industry. Even when considering that much of the art investment fund activity might be (increasingly) taking place under the radar, it is estimated that there are currently less than 200 art investment funds in the world with less than USD 3bn in aggregate art investments made over the course of staggered investment periods of between three and five years. By way of comparison, there are over 9,000 hedge funds in existence worldwide with AUM of over USD 1.7tn (The Art Fund Association).

Though the decrease in the overall AUM in the art fund market over the past few years is found to largely stem from the Chinese art fund and trust business winding down since 2013 presumably due to increased regulations, given its limitations (i.e. illiquidity, limited transparency) and with the art fund industry still in its early stages, it does not come as a surprise that it has been a challenge for art funds to raise sufficient capital and gather momentum. Being able to demonstrate to investors a track record of delivering (superior) returns – that are being audited and can be evaluated – goes a long way toward attracting new capital, as it means that these funds have had a certain amount of money go through their funds already. Track records are far more important and convincing than ingenious investment philosophies and strategies which, until proven, remain hypothetical. This can mean many potentially successful art fund managers are automatically

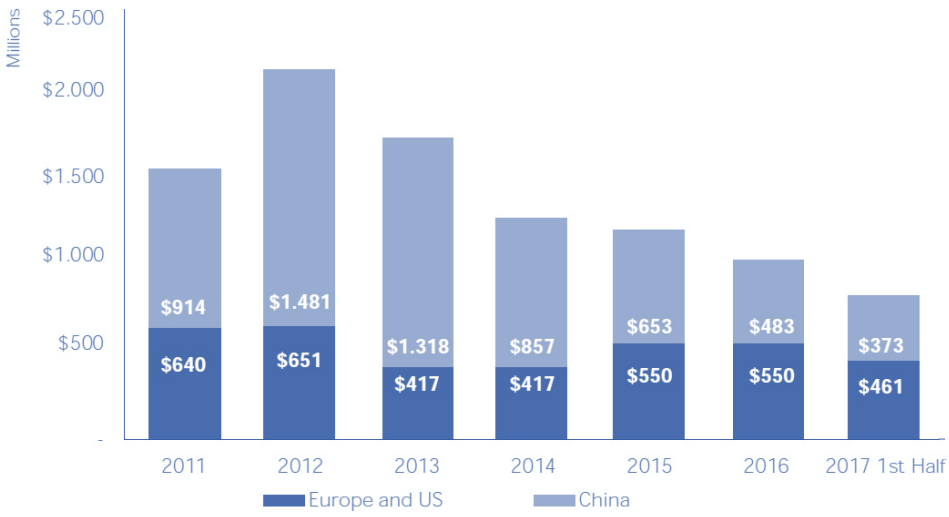

Figure 2: Art Investment Funds – Estimated AUM in USD

eliminated from consideration by many capital sources. Furthermore, that art can be an attractive investment, still proofs to be difficult. There are only a few cases from the past that reveal positive returns. The here-cited two funds, La Peau de L'Ours and BRPF, have certainly benefitted from extraordinary price hikes - driven by the discovery of Picasso and Matisse and the bubble in the late 1980s, mostly in Impressionists. However, even these days, most articles still cite the impressive annually compounded rate of return generated by the BRPF from 1974 to 1999. Aside from the fact that only 1% of the fund's 2,500 art objects ultimately accounted for the positive return, are there any other more recent impressive and popular examples to mention since last century? Added to this list of limitations should be the lack of indices for benchmarking the performance of funds as well as the methodological weaknesses in the measurement tools. These generally acknowledged problems make translating high levels of investor interest in art into meaningful shifts in investment capital all the more difficult.

Although art funds have struggled to gain momentum among investors, there are new art investment products constantly being developed addressing the pitfalls associated with art investment funds, with the issues of liquidity and price transparency leading the list. Since Liberman and his colleagues set up the Art Fund Association in 2009 as a direct response to the growing trend for art funds, and the need to share knowledge and experience within the art fund world and alternative investments industry, Liberman has seen several trends develop: First, there is a shift away from the traditional private equity fund structure whereby everyone stays in the fund until its maturity date – usually five to seven years. With the traditional private equity fund structure, there are no early withdrawals. Liberman sees this as preferable because it ensures there are no forced sales carried out to let people in and out of the fund and management and performance fees are not based upon a NAV that may not accurately reflect the true value of the fund's investments. However, since the market crash of 2008, investors have been wary of tying up their money for several years with no get out clause. Since art funds by their very nature are illiquid, after 2008 fund raising was becoming all the more difficult. More and more hybrid forms are evolving that resemble a private equity fund in that investors are not really supposed to be able to come in or out and fees are charged on actual capital raised and profits realised – but at the same time they do give some limited liquidity as about 5-10% of the fund investors are allowed to withdraw in any given year, supporting the marketing of art funds to investors. Second, there has been a rise of privately managed accounts as a result of fund managers pitching to family offices and HNWIs who want to be in the art market. These investors are often reluctant to comingle their moneys with others and do not want to be bound by restrictions on liquidity. They often have a longer-term horizon and actually want to directly own the art. It is becoming increasingly common for these types of investors to team up with an art fund manager via a private managed account, similar to the way investment banks manage private wealth. Third, the art investment market is continuing to develop in that indices and other market tracking resources are increasingly available from artnet, Artprice and the Mei Moses index, amongst others. Meanwhile, the growth in storage facilities geared towards helping preserve fine art further supports keeping art investments safe.

The art fund industry is today at a crossroads and the ultimate direction of the industry will ultimately be decided by whether art funds are able to convince the investment community that they are not simply a recent curiosity but a valid and permanent part of the alternative investment world and attract capital.

On the one hand, this requires art to be perceived as an attractive investment opportunity, for investors to seek exposure to that asset class; on the other hand, the respective funds must be perceived a trustworthy investment vehicle, for investors to get such exposure. Regarding the former, the first part of this thesis has shown that based on existing literature art investments may in fact constitute a favourable addition to a well-diversified portfolio. From an investor's perspective, besides the potential diversification benefit, art investments carry value in their function in structured finance: Though art may not generate any other cash flows except for the resale price, it may be employed to decrease the owner's cost of debt when used as collateral against a loan, therefore improving the overall rate of return on an investment. Moreover, the ownership of art is said to be able to serve as an inflationary hedge; this appears especially attractive in light of the inflationary monetary policies employed by many countries in response to the 2008 credit crisis and resulting recession.

Concerning the latter, for investors to choose to get the exposure indirectly via funds rather than investing in artworks directly themselves, the opportunities provided must be marketed and possibly even quantified. Costs savings through funds can only be estimated on a theoretical basis as the lack of data does now allow it to further quantification; though, given the variety of associated costs, investments via funds appear convincing if exposure to art is desired. Also, the argument that the "pleasure dividend" is lost when investing via funds, could partially be refuted. Whether (art) funds are generally able to systematically outperform the (art) market is another matter that is neither well understood for the stock market and that needs to be clarified depending on the respective management. Again, due to a lack of data, no direct quantitative analysis can be performed. Nevertheless, based on examined market inefficiencies, it can be concluded that investors are likely to benefit from the information advantage of art and financial experts. As of now, art funds certainly can be seen as a means to bring a certain level of transparency and professionalism that will enable a broader range of investors to diversify into art investments. However, access to the art market is still found to be quite limited to HNWIs, with subscription fees out of reach for an ordinary investor. Going forward, securing an improved valuation framework that incorporates historic as well as future price and valuation data estimates combined with expert opinions should become a priority, for investors to be able to monitor and evaluate the performance of art funds. Most efforts to address the hurdles of art investment funds are driven by technological innovation. Hence, their future outlook will severely depend on the adaptation of such technology.

3. Art Market Performance and Portfolio Diversification

The historical performance monitored by professional indices tends to demonstrate that paintings generate moderate positive real returns that have a low correlation with the return on stocks and treasury bonds, which may give it a place in a well-diversified portfolio of financial assets. This thesis shall now substantiate the theoretical findings that exposure to art via art investment funds is indeed desirable – in form of a pure art portfolio vs. as an addition to an equity setting. Since there is no or only very limited data on the historical performance of art investment funds, a direct systematic analysis of their performance is possible only to a very limited extend. Hence, the following quantitative analysis is based on the idea that one can draw conclusions on the potential of art investment funds, when having established that art itself is a good investment candidate. That is, assuming that art funds are in fact capable of minimizing or at least significantly reducing the transaction costs typically inherent in any art investment; and insinuating that they can – by the means of bundled investments and superior market access – mimic any art movement or category desired to enhance overall portfolio returns. On the basis of 13 broad indices of art categories, as provided by Renneboog and Spaenjers (Renneboog & Spaenjers, 2009), proof of the diversification potential of art in an equity setting shall be found, relying on factor portfolios, provided by Eugene Fama and Kenneth French[7]. In addition to its diversification potential, an analysis shall shed light on the often-discussed inflation hedging potential of art investments, providing supplementary reasons to turn towards art investments.

3.1 Approach and Underlying Data

In analogy to the studies undertaken by Worthington and Higgs (2004), this abstract aims at examining the investment potential of art, analysing its prospects for diversification in portfolios composed primarily of art as well as within an equity setting. In order to do so, various techniques commonly employed for the construction and performance evaluation of equity portfolios will be employed. Based on the findings from the first chapter, it goes without saying that art markets differ substantially from financial markets, and this potentially limits the strict applicability of those techniques. This analysis extends the works of Worthington and Higgs as it builds upon an enlarged database provided by Renneboog and Spaenjers (2009), who originally retrieved the information from the Art Sales Index, a database that contains auction records (at hammer prices excluding transaction costs) extended by the authoritative Grove Art Online database, published by Oxford University Press, and online database Artcyclopedia[8]. As introduced in ch. 1.6, their study focuses on the market for oil paintings, prints and works on paper as those mediums share important features physically and together they represent a great majority of the overall art market. Keeping the selection as broad as possible, thus including all artists of the categories graphic arts, painting and drawing as well as printmaking, who have had an (even minor) impact on art history or who were once considered important, resulted in a broad dataset with worldwide coverage. In order to compare the price evolutions across different art movements, they had compiled a list of 13 broad classifications (as consistent with those of most art history textbooks) from January

[7] cf. CRSP database: https://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html.
[8] cf. http://www.artcyclopedia.com.

1983 to December 2007: 1. Medieval & Renaissance [MedRen]; 2. Baroque; 3. Rococo; 4. Neoclassicism; 5. Romanticism; 6. Realism; 7. Impressionism & Symbolism [ImprSymb]; 8. Fauvism & Expressionism [FauvExpr]; 9. Cubism, Futurism & Constructivism [CuFuCo]; 10. Dada & Surrealism [DadaSurr]; 11. Abstract Expressionism [AbstExpr]; 12. Pop; and 13. Minimalism & Contemporary [MinCont] (Renneboog & Spaenjers, 2009). It is important to note that the aggregation of these art indices already produces a portfolio diversification effect when compared to artists in much the same manner as the aggregation of companies in industries and markets, with the effect varying from classification to classification. The second set of data relates to equities and relies on value-weighted portfolios constructed by Eugene Fama and Kenneth French (in the following referred to as "Fama-French portfolios"), which will be described in more detail in ch. 3.3 below.

The analysis of the art market performance in terms of risk, return and portfolio diversification in this section is made as follows: In a first step, the broad art classifications will be examined in terms of reward-to-risk characteristics. This will be followed by an analogous study of the Fama-French portfolios. Then, a mixed asset portfolio including both, art categories as well as equity portfolios, will be compared. Multiple stages of analysis are pursued in each case: First, the central tendency, dispersion and shape of all series are being examined, along with their time series properties. After a brief study of the (as to be found *high*) correlations amongst one another, a principal component analysis follows. In a next step, naïve, equally-weighted portfolios are being constructed, as well as a more advanced volatility-timing strategy employed. In addition, in line with Markowitz's (1952) well-known portfolio selection theory, combinations of these assets with different risk-return characteristics are constructed. Within this set of all possible combinations, the set of portfolio strategies with the least variance for a given mean return produces the mean-variance frontier. The mean-variance frontier is then further identified as an efficient frontier representing portfolios where portfolio return is maximized for a given level of portfolio risk. A constraint is placed on asset allocation within the portfolios: That is, short positions are not allowed in order to correctly reflect the realities of investments in art as well as stock markets. In addition, neglecting this short-selling restriction, portfolios based on their principal components will be formed when analysing pure art portfolios and pure equity portfolios, respectively. As principal components capture volatility inherent in a data set in which there are a large number of interrelated variables, in order to maximize the variance of a linear combination of the variables, such approach would not be appropriate for a dataset comprising different asset classes that show so little co-movements (as it would be the case for a portfolio of both, art and equities). Where appropriate, the portfolios will lastly be benchmarked against the market excess (i.e. S&P 500[9] minus the risk-free rate based on the three months US Government Treasury Bill[10]); a concluding performance evaluation will be supplemented with the construction of the Value at Risk [VaR] and Expected Shortfall [ES]. The following analysis focuses on a 25-years sample period from 1982 to 2007, for which an average risk-free rate of 4.59% *per annum* (based on the three months US Government Treasury Bill) was determined.

[9] Daily data downloaded from Bloomberg and annualized as the sum of daily log returns *per annum* (ticker: SPX).
[10] Daily data downloaded from Bloomberg and annualized as the sum of daily log returns *per annum* (ticker: USGG3M Index).

3.2 Art Market Performance

The first set of data gives returns for the 13 different art categories of paintings, prints and works of paper is first analyzed individually and then the context of an exclusively art portfolio. That is, MedRen, Baroque, Rococo, Neoclassicism, Romanticism, Realism, ImprSymb, FauvExpr, CuFuCo, DadaSurr, AbstExpr, Pop, and MinCont – as provided by Renneboog and Spaenjers (2009). Within a broad opportunity set of investing in art categories for diversification purposes, this first part aims to introduce distinctive approaches for portfolio diversification within art investments only and compares them based on their respective risk and performance. Moreover, relative advantages and disadvantages of investing into different art categories are analyzed and presented in the following. A naïve equally-weighted portfolio [EW13] of the 13 introduced art classifications is constructed and compared to the risk and return profile of a further developed portfolio based on a volatility-timing strategy [VOLT]. In order to analyze and compare the alternative strategies with respect to the effects of diversification, relevant performance statistics are being determined: The annualized volatility as measure of risk of portfolio returns has been derived, measured by the standard deviation. Equally interesting are studies on the Sharpe ratio to measure the level of returns provided per unit of risk taken. Further descriptive statistics are being considered to extensively evaluate the different investment opportunities, including skewness and kurtosis. Moreover, time-series regressions of the respective portfolio return against (a) the null vector and (b) the (US) market excess return are being applied in order to test whether the chosen investment strategy is able to systematically generate positive returns and/or even to outperform the US stock market; the statistical significance of the results has been estimated based on a .05 significance level (α).

3.2.1 Risk - Reward Relationship

In a first step, the risk and return profile as well as relevant performance statistics are presented to compare the 13 distinct art classifications over the given investment horizon. Based on the given data on price levels of the 13 different art indices (per classification), it is possible to derive the rates of return per annum with the continuously compounded rate of return [CCR] defined as

$$CCR_{t+1} = \ln(1 + r_{t+1}) = \ln\left(\frac{P_{t+1}}{P_0}\right)$$

Equation 2: Rate of Return (continuously compounded)

whereby *ln* denotes the natural logarithm. Using the exponential on the annual log returns one can determine the average return over the sample period per art classification. The respective volatility for the given time horizon is measured as the sample standard deviation of the annual returns.

Renneboog and Spaenjers (2009) have found that the twentieth century, especially the post-war art movements, such as Pop art, give the highest average annual returns (cf. Appendix 3). Between 1982 and 2007 those post-war art movements, AbstExpr, Pop, and MinCont, have shown the highest price appreciations. However, these movements have also been the most volatile (and thus riskier) ones. Romanticism, Realism, ImprSymb, and FauvExpr are amongst those categories that record the lowest mean appreciations over the same time frame. The least volatile art movements during this period were Baroque and Rococo. The same conclusions hold true for both, real and nominal returns.

Furthermore, regressions against the null vector show that only the returns on Baroque and Rococo are expected to be on average non-zero on a statistically significant level (5%). To evaluate the shapes of the distributions, skewness as well as kurtosis are calculated. Except for MedRen and Neoclassicism, all return distributions are negatively skewed (mostly even below values of -1), meaning that the left tail of the distribution is longer than the right. That is, the probability of a result smaller than the expected average is (far) more likely than a result greater than the expected average. Kurtosis, on the other hand, measures the tail-heaviness of the distribution. If the kurtosis is less than zero, then the distribution has light tails (platykurtic distribution), if it is greater than zero, then the distribution has heavy tails (leptokurtic distribution). The heavy tails as found for almost all art classifications imply a higher probability of extreme-value outliers. In combination with the negative skew, this constitutes a relatively unattractive investment profile to risk-averse investors. Analogous to Baumol (1986), a one-sample KS test is carried out in MATLAB in order to test the divergence of the observed distribution from a normal distribution. Transforming the return distributions (mean-centring and scaling by the standard deviation each element of the data vector), MATLAB's "kstest()"-formula can be applied. Though the high level of skewness and kurtosis suggest otherwise, the hypothesis that there is no divergence could not be rejected at a confidence level of 5%, which confirms Baumol's findings. That the returns on art categories approximately follow a normal distribution is visualized in Appendix 4.

3.2.2 Correlations Amongst Art Categories

There goes a saying that one should not put all eggs in one basket. Following modern portfolio theory [MPT], this saying applies in the stock market as well: MPT attempts to determine an efficient frontier for a mix of assets in a portfolio. The goal is to choose assets that have a lower standard deviation for the combined portfolio that is less than the standard deviation of the individual assets. In the construction of a portfolio, it is important to attempt to reduce overall risk by including assets that are lightly or even negatively correlated. This way, whenever the price of one asset decreases, the price of another asset that is negatively correlated increases. The lower the correlation of assets in a portfolio, the higher are the benefits of diversification (Pownall, 2005). For a coefficient of correlation below zero, a contrary movement of the two assets can be observed. For a positive coefficient, there is a more or less parallel movement. A coefficient of correlation equal to zero means that the two assets are independent.

Correlation Amongst Art Classifications

	MedRen	Baroque	Rococo	Neoclassicism	Romanticism	Realism	ImprSymb	FauvExpr	CuFuCo	DadaSurr	AbstExpr	Pop	MinCont
MedRen	1,0000	0,7819	0,5648	0,2651	0,4335	0,4542	0,5425	0,6580	0,5613	0,5401	0,5300	0,6043	0,5333
Baroque	0,7819	1,0000	0,7617	0,5707	0,7059	0,7080	0,7496	0,7681	0,7474	0,8014	0,7975	0,8109	0,8084
Rococo	0,5648	0,7617	1,0000	0,5202	0,6472	0,7369	0,7842	0,7081	0,7063	0,7159	0,7492	0,7117	0,6769
Neoclassicism	0,2651	0,5707	0,5202	1,0000	0,6963	0,6922	0,5701	0,4970	0,4783	0,5574	0,5784	0,4640	0,5306
Romanticism	0,4335	0,7059	0,6472	0,6963	1,0000	0,8409	0,8432	0,7334	0,7117	0,7900	0,7582	0,7240	0,6919
Realism	0,4542	0,7080	0,7369	0,6922	0,8409	1,0000	0,8925	0,7919	0,7847	0,8798	0,8417	0,7808	0,7617
ImprSymb	0,5425	0,7496	0,7842	0,5701	0,8432	0,8925	1,0000	0,8656	0,8749	0,9296	0,8894	0,8343	0,7492
FauvExpr	0,6580	0,7681	0,7081	0,4970	0,7334	0,7919	0,8656	1,0000	0,9305	0,9056	0,8810	0,9357	0,7934
CuFuCo	0,5613	0,7474	0,7063	0,4783	0,7117	0,7847	0,8749	0,9305	1,0000	0,9296	0,9409	0,8981	0,8188
DadaSurr	0,5401	0,8014	0,7159	0,5574	0,7900	0,8798	0,9296	0,9056	0,9296	1,0000	0,9669	0,9199	0,8169
AbstExpr	0,5300	0,7975	0,7492	0,5784	0,7582	0,8417	0,8894	0,8810	0,9409	0,9669	1,0000	0,9226	0,8431
Pop	0,6043	0,8109	0,7117	0,4640	0,7240	0,7808	0,8343	0,9357	0,8981	0,9199	0,9226	1,0000	0,8289
MinCont	0,5333	0,8084	0,6769	0,5306	0,6919	0,7617	0,7492	0,7934	0,8188	0,8169	0,8431	0,8289	1,0000

Table 2: Correlation Amongst Art Classifications

The correlation matrix for the thirteen art categories is shown in TABLE 2. All pairwise correlations are positive and range from 0.27 (Neoclassicism with MedRen) to 0.97 (AbstExpr with DadaSurr). While also FauvExpr

shows a high correlation with Pop (0.94) and CuFuCo (0.93), the MedRen and Neoclassicism show the lowest positive correlations with the remaining art categories. The fact that the art markets are not perfectly positively correlated is suggestive of the potential benefits of portfolio diversification in exclusively art portfolios.

3.2.3 Principal Component Analysis

The high correlations amongst the 13 art categories suggests conducting a principal component analysis [PCA]. The PCA is a method of multivariate analysis (Bilodeau & Brenner, 1999) to capture the structure of returns. The idea is that any data set which contains variables can be transformed into a new set of principal components using PCA, in which each principal component is a linear combination of all the original variables. The original large number of variables can be replaced by a much smaller set of principal components that explain most of the variation. In asset allocation, PCA can be used to decompose a matrix of return into statistical factors. These latent factors usually represent unobservable risk factors that are imbedded inside asset classes. When PCA is applied to a set of art categories, the principal components can be interpreted as uncorrelated risk sources inherent in the original data set (Partovi & Caputo, 2004). For instance, a portfolio of 13 art categories contains 13 uncorrelated risk sources. Therefore, allocating across these may improve one's portfolio diversification. The loadings (eigenvectors) of a PCA decomposition can be treated as principal factor weights. In other words, they represent asset weights towards each principal component portfolio. The total number of principal portfolios equals the number of principal components. Not surprisingly, the variance of each principal portfolio is its corresponding eigenvalue. The eigenvalues of principal components typically decrease quickly and the higher numbered principal components have relatively small eigenvalues. The loadings are designed to have values ranging from negative 1 to positive 1 meaning short sales are possible.

MATLAB's formula "[coeff, score, latent] = pca(_)" returns the principal component coefficients, also known as loadings, for the n-by-m data matrix X (i.e. annual returns per art category over the given time horizon), where rows of X correspond to observations (i.e. *per annum*) and columns correspond to variables (i.e. the different art categories). The coefficient matrix is m-by-m. Each column of "coeff" contains coefficients for one principal component, and the columns are in descending order of component variance (the respective variances are being returned in "latent"). The first principal component is the linear combination with maximal variance, the second one is the linear combination with maximal variance in the orthogonal direction to the first principal component, and so on. The formula also returns the principal component scores in "score", which are the representations of X in the principal component space. Rows of score correspond to observations, and columns correspond to components. By default, MATLAB's pca-formula centres the data and uses the singular value decomposition [SVD] algorithm (MATLAB). The computation of principal components reduces to the solution of an eigenvalue and eigenvector problem for a positive semidefinite symmetric matrix. It is worth mentioning that the PCA method can be effectively used to increase the goodness of results obtained by exploiting different statistical methods.

Analogously to Kim and Jeong (2005), the principal components can be broken down into three parts that correspond to the three kinds of fluctuation of art price changes: First, the first principal component with the

largest eigenvalue represents a market-wide effect that influences all art categories; second, a number of principal components following the market component represent synchronized fluctuations that only happens to a group of art categories; third, the remaining principal components indicate randomness in the fluctuations. Based on the biplots in FIGURE 3, the coefficient structure in the principal components can easily be visualized:

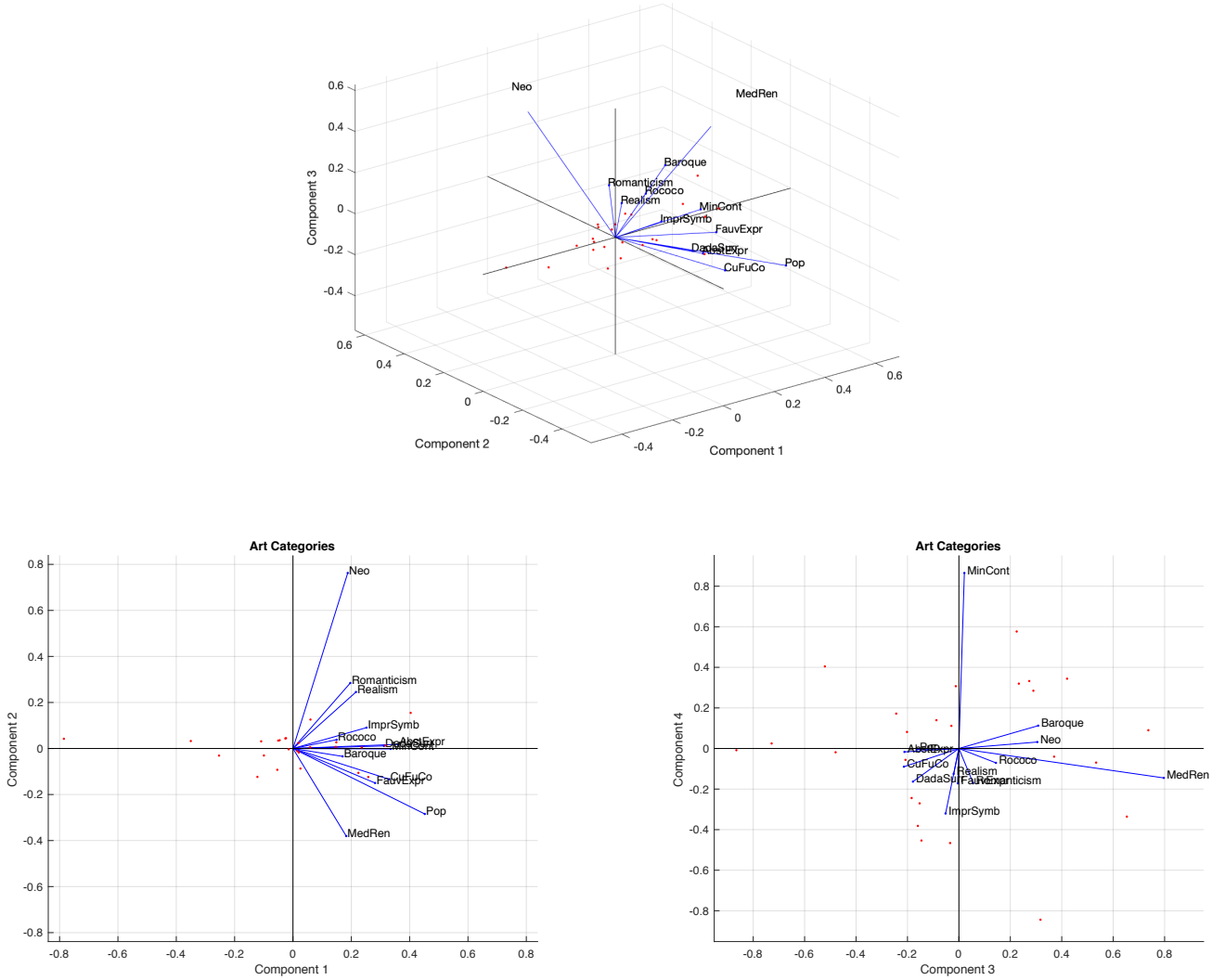

Figure 3: PCA Application to Art Categories

As the first principal component is normally understood as the market component with roughly equal contribution of the underlying stocks, all the coefficients should be positive (compare for example Kim and Jeong (2005)). As shown clearly in the second biplot, every category has the same sign and moreover all the coefficients are positive. Contrary, the second principal component has both positive and negative coefficients. Looking at the third biplot, one cannot draw decisive conclusions about the subsequent principal components, but it can be noticed that there are art categories, as Neo (Neoclassicism) and Pop in the third principal component, with opposite directions; when this happens, it means that the art categories have similar structures but in opposite ways (Pasini, 2017). For principal components three onwards, bi-plots show "star-like" graphs, for which the distinction is less clear-cut and structure is hardly seen.

Another popular approach to enhance diversification in portfolio selection is to rely on principal component portfolios. This way, each portfolio represents a risk source that is uncorrelated to the others. One can diversify a portfolio by holding all these "principal component mimicking portfolios", in which one gains exposure to all the major risk sources in the art market. One can construct portfolios based on the principal components to get an exposure to all the risk sources. However, it seems unreasonable to allocate any risk budget to the higher principal components that are not major risk sources. Portfolios can be constructed based on each of the retained principal components. The most obvious rule in determining the number of components to retain is deciding the cumulative variance desired. PCA was designed so that the variances of the principal components are in descending order with the first principal component explaining the most variance. The number of components to retain is then the smallest number, which exceeds the desired percentage variance explained. Since the correlations among the 13 art categories was rather strong during the given 25 years, one would expect that the first few components would absorb most of the variation and leave less variation in the higher numbered components. This means that in a plot, the slope of the cumulative variance explained will be steep in the beginning and flatten off towards the end, which is indeed confirmed by the data set: In Figure 4, the proportions of total portfolio standardized variance that can be attributed to the respective factors are shown. The first principal component explains 79% of the total variance, hence it should reproduce very well the original portfolio. This is because it can be seen as the market component, so it reproduces rather accurately the new trend. Examining the cumulative variance explained by the components, the first three principal components together explain most of the variation (more than 90% of the total variation).

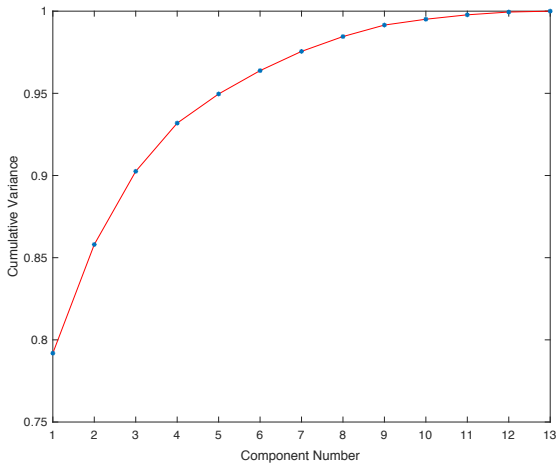

Figure 4: Cumulative Variance

	Eigenvalue	Cumulative Variance (in %)
PC 1	*0,3821*	*79,1887*
PC 2	*0,0319*	*85,8019*
PC 3	*0,0215*	*90,2539*

Table 3: Art Categories Variation

Summing up the results, it can be seen that the three aforementioned components allow for the best description of the variance. It follows that investing in such components turns to be preferable to better control financial risk and at the same time also getting higher returns (Boulesteix, 2005). Choosing a cut-off of 90%, the random part of the art risks is filtered out and the first three principal components that represent the market risk and each risk group are retained. The original set of 13 art categories is being transformed to a principal system, which includes 13 uncorrelated principal components in which the first three principal components identify the major risk drivers of art returns. Essentially, the portfolios constructed based on the principal components are treated as individual investment assets with no correlations. In analogy to Partovi and Caputo (2004), the portfolios constructed based on principal components shall be called "principal portfolios" [PPs]. The purpose of doing this is straightforward: A single risk exposure becomes feasible as investors can choose to hold any principal

portfolio to get exposure to a single risk source that is uncorrelated with the other risks in the market. The performances of principal portfolios also provide means of monitoring single risk exposures. The investment universe is simplified in the sense that the choices are among assets with uncorrelated risks. One can decide whether to include an asset solely based on its variance and return without having to consider its co-movements with the remaining portfolio. Based on the coefficients retrieved from the pca()-function in MATLAB, weights of investment in each art category can be determined: Having established that a positive coefficient indicates a long position while a negative coefficient indicates a short position, the weights of investment in each category is the respective art category's coefficient divided by the sum of all positive coefficients (if it is positive) or divided the absolute value of sum of all negative coefficients (if it is negative). This gives a set of weights in which both, the long positions sum to 1 and the short positions sum to −1, respectively. The portion of short positions is the ratio of the sum of all negative coefficients to the sum of all positive coefficients. The performance statistics help understanding the behavior of the single risk sources: The first principlal portfolio shows little (even negative) correlation with the market (as proxied with the SP500) with a coefficient as little as -0,314. According to Meucci (2009), maximum diversification is achieved when a portfolio has equal exposure to all uncorrelated risk sources. This concept coincides with allocating equal risk budgets to all PPs. Conversely, holding a single risk portfolio is considered under-diversified. So, in theory, in order to achieve maximum diversification, one should include all 13 PPs. However, it is unreasonable to allocate equal risk budget to the major risk sources and the random part of the art price fluctuations. It is found that a portfolio on the fifth principal component seems to provide favourable risk-return statistics (cf. Appendix 5). However, one must recall that this is only achievable when there are no short-selling restrictions –which is hardly implementable. Generally, given the insignificant improvements in terms of risk-return profile over the naïve allocation of budgets (equally-weighted investments across all categories as to be seen in the next section) such strategy proves not feasible. Moreover, it must be noted, that correlations change over time. Thus, weights allocated to the principal components should change over time, accordlingy. Recalling that those art categories do not reflect investible indices, in that they to not incorporate the costs of buying and selling (and even keeping) the artworks underlying the portfolio, should eventually rule out any of the aforementioned diversification benefits.

3.2.4 Exclusively Art Portfolios: Naïve vs. Volatility-Timing Strategy

An equally-weighted portfolio [EW13] of the 13 art classifications is compared to a volatility-timing [VOLT] strategy in terms of risk level and performance. Furthermore, the relative advantages and disadvantages of the approaches, both in general economic terms as well in the context of the results found shall be discussed in the following. Constructing an equally-weighted portfolio, each art investment is assigned a weight of 1/13 (7.69%), accordingly. Over the given sample period, EW13 provides an annualized average return of 5.53% with a standard deviation of 17.42%, giving a Sharpe Ratio of 0.0689 (Figure 3). Looking at the skewness and kurtosis of the distribution, EW13 shows to be lightly negatively skewed and leptokurtic with values of -0.27 and 1.18, respectively. This form of non-normality relates to observing negative returns in greater magnitude

and with a higher probability than implied by the normal distribution. A regression of the portfolio returns against the null-vector provides a t-statistic of 1.49; hence, the portfolio returns are not expected to be on average non-zero on a statistically significant level for the given horizon (cf. Appendix 6). With a regression against market excess returns one finds that the alpha of the regression is slightly positive (0.17), however not statistically significant; thus, within the given investment horizon, it is suggested that the portfolio does not achieve abnormal returns neither above nor below predictions according to the capital asset pricing model [CAPM] (cf. Appendix 7). It is further found that the first principal component shows to be strongly correlated with the EW13 (with a coefficient of 0.64). This supports the thesis that the first principal component is in fact a market component that is replicated the easiest by an equally-weighted portfolio of all art categories.

To create a volatility-timing portfolio, the conditional weight to be invested each year in the risky asset (equally-weighted portfolio) is being determined based on the inverse of the standard deviation of returns for the past three years of the equally-weighted portfolio. Hence, this strategy increases the investment in EW13 when recent volatility was low and decreases the investment in EW13 when recent volatility was high. A graphic illustration shows how the weights invested in the risky portfolio change with volatility: After the dotcom crisis of 2000 when recent volatility reached peaks, any investor following the volatility-timing approach would have decreased the weight invested in the risky asset (Figure 5). To make VOLT comparable to EW13, the conditional weights were rescaled so that the average weight over the full sample equals one. As compared to EW13, the annualized average return over the whole sample period increased to 7.86%. Furthermore, the volatility of returns has decreased to 16.37%. Thus, the Sharpe ratio has increased to 0.20. The chosen strategy proves to show excess returns over zero, as the t-statistic of 1.98 provided by the regression of the portfolio returns against the null-vector shows that the portfolio returns on average exceed zero returns on a 5%-significance level. Furthermore, the regression against market-excess returns shows a positive though statistically insignificant alpha (0.15) suggesting that the portfolio does not achieve abnormal returns neither above nor below what the CAPM predicts, for the given sample period. The return distribution of VOLT shows to be strongly positively skewed and more leptokurtic with values of 2.48 and 9.63, respectively (ibid). Hence, the probability to observe positive returns as well as the magnitude of those returns has increased. The volatility-timing strategy has proven to be very effective in terms of risk management. As opposed to a naïve, equally-weighted strategy, it offers higher expected returns at a lower risk level. Furthermore, the return distribution shows a performance with more positive outcomes, all of which is of great importance to the average risk averse investor. Therefore, contrary to simply constructing a naïve EW13 one would be advised best (in terms of risk-performance management) to take into consideration the volatility-timing approach. Ultimately, the investment decision between these two options would depend on the transaction costs associated with setting up a volatility-timing portfolio, since it only offers slight improvements over what could be achieved with the EW13.

	EW13	VOLT
Target chosen so that average of weight equals	-	*1*
Target volatility	-	*5,26%*
	-	*19,02*
Average rf rate	*4,59%*	
Average return	*7,66%*	*7,86%*
Standard deviation	*0,1745*	*0,1637*
Sharpe ratio	*0,1763*	*0,2001*
t-Stat (null)	*1,4880*	*1,9810*
t-Stat (m_excess; alpha)	*-1,1544*	*-0,5029*
t-Stat (m_excess; beta)	*1,6894*	*1,3878*
Skew	*-0,2707*	*2,4830*
Kurtosis	*1,1827*	*9,6339*

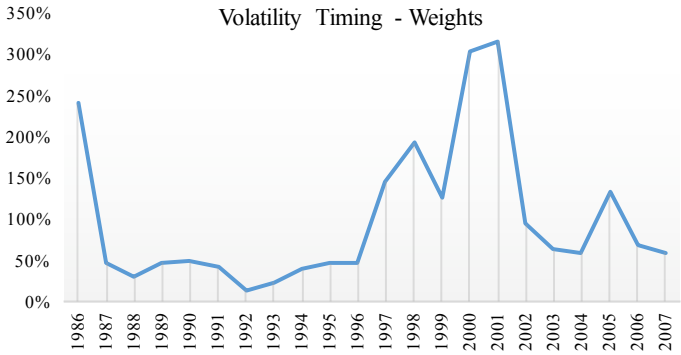

Figure 5: EW13, VOLT – Annualized Performance Statistics, Art

3.2.5 Minimum Variance Portfolios

Markowitz portfolio theory is used to construct the efficient frontier for the exclusively art portfolio. Mean-variance portfolio optimisation is made using the Microsoft Excel-based program Solver: Under the constraint that the total weights invested in each art market sum up to one (again, with each weight being positive under the no short-selling restriction), for any given rate of return the volatility is being minimized. Figure 6 depicts the efficient frontier derived from the various combinations of the thirteen art classifications. Under the no-short-selling restriction, the returns (risks) for the efficient frontier range from 6.05% (11.18%) at the minimum variance portfolio [MVP] to 14.49% (29.25%) at its uppermost. All other things being equal, naïve strategies, where investment is made solely in one art market or equally in all markets, are dominated by the efficient set. None of the art classifications lies on the efficient frontier, neither do the portfolios constructed in the previous section, EW13 or VOLT (marked in green). As expected, individual assets that are plotted farthest from the efficient frontier are excluded from the set of efficient portfolios. In fact, in the case of no short-selling, the efficient frontier is mostly comprised of just four to five of the thirteen art assets included in the calculations. For instance, when the return shall equal to 6.50% (Point A) the only assets included (with their portfolio weight) are MedRen (10.75%), Baroque (42.53%), Rococo (36.08%), and Neoclassicism (10.64%). It is noteworthy that ImprSymb, FauvExpr, CuFuCo, DadaSurr, AbstExpr and MinCont are generally not included in the efficient set through their high risk-low return characteristics over the period in question. It appears that most of the gains from diversification achievable in art can be made with a small number of individual art classifications. However, the performance of individual artists within these classifications may differ from the market as a whole.

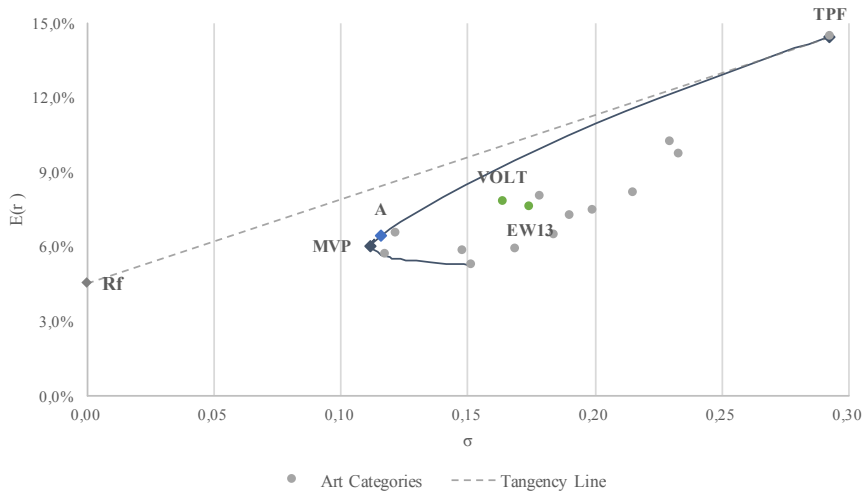

Figure 6: MV Frontier – Art Portfolios

3.2.6 Value at Risk, Expected Shortfall and Securitization Aspects

The Value at Risk [VaR] and the Expected Shortfall [ES] are attempts to provide a single number that summarizes the total risk in a portfolio. The VaR was pioneered by JPMorgan and is widely used by corporate treasurers and fund managers as well as by financial institutions, especially for risk management purposes. It gives an estimate, of how much one can lose from one's portfolio over a given time horizon and a given degree of confidence

$$P(L > VaR) \leq 1 - \alpha,$$

Equation 3: Value-at-Risk

where α is the confidence level and L is the loss, measured as a positive number (Hull, 2015). It is the loss level (L) during a time period that with a certainty of (1- α)% will not be exceeded. The ES is a complementary measure that can produce better incentives for traders than VaR (Hull, 2015). It determines the expected loss during a time period conditional on the loss being greater than the Xth percentile of the loss (negative gain) distribution. Thus, just like the VaR, it is a function of two parameters: the time horizon and the confidence level (X). The ES has better properties than the VaR in that it always recognizes the benefits of diversification. For the following calculations, a confidence level of 95% has been chosen, complemented by calculations with a more conservative 99% confidence level. The loss distribution is critical in computing VaR and ES. Recall that, though the KS-test failed to reject the null hypothesis, the return series are generally skewed and suffer from kurtosis. In this case, risk measures derived from the normal distribution assumption will underestimate the riskiness. Hence, also a historical VaR will be estimated in addition to the normal VaR. It must be noted though, that these measures should be taken together, as any conclusions drawn solely based on historical data are not good indications for future performance.

	MedRen	Baroque	Rococo	Neoclassicism	Romanticism	Realism	ImprSymb	FauvExpr	CuFuCo	DadaSurr	AbstExpr	Pop	MinCont
Normal VaR (90%)	*-14,75%*	*-9,02%*	*-9,33%*	*-17,06%*	*-13,08%*	*-14,09%*	*-15,71%*	*-17,07%*	*-19,43%*	*-18,07%*	*-19,22%*	*-22,99%*	*-20,15%*
Normal VaR (95%)	*-21,23%*	*-13,44%*	*-13,60%*	*-23,96%*	*-18,46%*	*-19,59%*	*-21,84%*	*-23,76%*	*-27,25%*	*-25,30%*	*-27,57%*	*-33,62%*	*-28,62%*
Historical VaR (90%)	*-17,54%*	*-13,49%*	*-13,26%*	*-18,83%*	*-14,10%*	*-13,57%*	*-11,07%*	*-12,36%*	*-13,04%*	*-17,03%*	*-18,53%*	*-23,37%*	*-25,87%*
Historical VaR (95%)	*-27,59%*	*-19,00%*	*-18,26%*	*-20,62%*	*-25,36%*	*-27,48%*	*-32,97%*	*-36,23%*	*-41,17%*	*-38,82%*	*-44,02%*	*-51,24%*	*-37,53%*
ES (90%)	*-21,26%*	*-15,55%*	*-15,03%*	*-19,55%*	*-18,72%*	*-19,58%*	*-20,67%*	*-22,32%*	*-25,53%*	*-26,52%*	*-29,71%*	*-34,55%*	*-30,81%*
ES (95%)	*-26,48%*	*-18,33%*	*-17,95%*	*-20,25%*	*-22,75%*	*-23,37%*	*-26,08%*	*-30,20%*	*-31,82%*	*-32,14%*	*-35,97%*	*-45,57%*	*-34,37%*

Table 4: VaR and ES for Art Categories (1)

Examining the art classifications individually, Baroque and Rococo exhibit the least risky profile in terms of VaR and ES. In contrast, at a confidence level of 90% (95%), with a VaR of 22.99% (33.62%) and an ES of 34.55% (45.57%), investments in Pop are by far the riskiest. However, throughout all art categories, the VaR assuming a normal loss distribution does appear to draw a yet too optimistic picture. The worst case, looking at the historical VaR, at a confidence level of 90% (95%), shows that investments in Pop have a VaR of 23.37% (51.24% - more than half of the investment!). The naïve, equally weighted portfolio as well as the portfolio constructed using the volatility-timing strategy do not improve the risk-profile significantly. In these terms best performing, however, is the portfolio formed based on the first principal component. In this case, normal and historical VaR as well as ES do not exceed 1.47% (even at the more conservative confidence level of 95%). Though the Tangency Portfolio (i.e. a 100% investment in Pop) maximizes Sharpe ratio under the

no short selling condition in a pure-art portfolio, due to its risky profile it seems to be a less attractive option – with an ES of 45.57% at a 90% confidence level.

	EW	VOLT	PP 1	PP 2	PP 3	PP 5	MV	TPF
Normal VaR (90%)	*-14,70%*	*-13,11%*	*-0,88%*	*-7,99%*	*-5,92%*	*5,76%*	*-8,28%*	*-22,99%*
Normal VaR (95%)	*-21,04%*	*-19,06%*	*-1,23%*	*-10,52%*	*-9,29%*	*5,60%*	*-12,34%*	*-33,62%*
Historical VaR (90%)	*-13,82%*	*-9,02%*	*-1,05%*	*-8,11%*	*-7,21%*	*5,60%*	*-11,73%*	*-23,37%*
Historical VaR (95%)	*-31,49%*	*-15,03%*	*-1,72%*	*-14,52%*	*-13,42%*	*5,22%*	*-18,88%*	*-51,24%*
ES (90%)	*-21,40%*	*-11,12%*	*-1,30%*	*-10,91%*	*-9,53%*	*5,44%*	*-14,37%*	*-34,55%*
ES (95%)	*-26,42%*	*-14,74%*	*-1,64%*	*-12,52%*	*-12,68%*	*5,34%*	*-18,12%*	*-45,57%*

Table 5: VaR and ES for Art Categories (2)

Though the dataset of Renneboog and Spaenjers (2009) comprises a broader coverage, it must be pointed out that these indices and ultimately the results on return rates should be understood as only an indication of the painting category movement as they do not capture all the auction house information and any of the dealers or private treaty sales prices. Also, there are not tradable and do not include the costs of buying and selling art that can be large. In light of this, diversification across art categories does not appear to bring much benefit. Despite relatively low correlation amongst art categories, neither EW13 nor VOLT are feasible in terms of construction and management, especially considering it decreases the Sharpe ratio compared to the Tangency portfolio as derived from a mean-variance analysis. Given that the tangency portfolio in fact consists of an investment of 100% into a single art category, namely Pop, also leads to the conclusion that diversification benefits across major art categories are limited and a mean-variance optimizer would be served best to invest in Pop only – due to the inferior risk-return profiles of the remaining art categories. Although it should also be noted at this point that the implementation of such strategy in reality remains doubtful, through the aforementioned impediments.

3.3 Equity Investments

The exact same analysis will now be applied to a second set of data which relates to the Fama-French value-weighted portfolios. Fama and French provide in the CRSP database annual data on various portfolios (equally-weighted as well as value-weighted) formed based on certain factors: The following analysis will focus on seven value-weighted portfolios, with each portfolio being diversified across one of seven factors, respectively: Investment[11], dividend-price ratio, value[12], operating profitability[13], cash flow-price ratio [CF/P][14], size, and E-P[15]. Furthermore, they provide the portfolios in clusters; for each factor portfolio, the best performing percentile (quintile "Q", decile "D", or highest/lowest 30 "Hi"/"Lo") in terms of their

[11] Investment is the change in total assets from the fiscal year ending in year t-2 to the fiscal year ending in t-1 divided by total assets in t-1.

[12] The value factor denotes the book-to-market ratio, which refers to book equity at the last fiscal year end of the prior calendar year divided by market equity at the end of the prior year.

[13] Operating profitability is defined as operating profits (sales minus cost of goods sold minus selling general and administrative expenses minus interest expense) divided by book equity and minority interest at the previous fiscal year end.

[14] CF/P is cash flow (earnings before extraordinary plus after-tax net interest expense plus depreciation and amortisation) at the last fiscal year end of the prior calendar year divided by market equity at the end of the prior year.

[15] E/P is earnings before extraordinary at the last fiscal year end of the prior calendar year divided by market equity at the end of the prior year.

respective coefficient of variation is chosen (i.e. the one with the smallest coefficient across all percentiles), assuming that investors are mean-variance optimizers (i.e. maximize the returns with respect to the levels of risk taken), resulting in seven portfolios: Inv_D4, DP_D8, Value_Q2, OP_D9, CF_P_Hi30, Size_D9, and EP_D7. Here, the same reasoning regarding the portfolio diversification effect for the aggregation of stocks as for art portfolio applies.

Appendix 10 shows that for each individual portfolio, superior risk-return characteristics are to be found (as compared to those of the aforementioned art categories): Returns (risks) vary from 14.35% (10.62%) to 17.72% (14.42%), whereas those for the art classifications vary from 5.28% (11.74%) to 14.49% (29.25%). With 17.72%, EP_D7 gives the highest average annual return at a relatively low standard deviation of 12.60%, giving the maximum Sharpe ratio amongst all equity portfolios of 1,04. The lowest annual average return gives Value_Q2. The lowest Sharpe ratio gives is Size_D9 with 0.81. Again, the geometric mean annual returns are all lower than the arithmetic means for each classification, suggestive of the high volatility in returns over the period under examination. Furthermore, regressions against the null vector show that all portfolios are expected to be on average non-zero on a statistically significant level. However, regressions against the market access do not produce statistically significant alphas different from zero, meaning that none of the portfolios is expected to on average outperform the market (i.e. the S&P 500). Examining the shapes of the distributions shows that all return distributions are negatively skewed (though less than the distributions of returns of the art categories). That is, the probability of a result smaller than the expected average is more likely than a result greater than the expected average. For DP_D8 and EP_D7, returns show a platykurtic distribution). The distributions of the remaining portfolios are leptokurtic, with CF_P_Hi30 and Inv_D4 the most extreme, implying a higher probability of extreme-value outliers. In combination with the negative skew, this constitutes a relatively unattractive investment profile to risk-averse investors, though more attractive than the investment profile of the art categories. Also, a KS test is carried out in MATLAB in order to test the divergence of the observed distribution from a normal distribution. Though the high level of skewness and kurtosis suggest otherwise, the hypothesis that there is no divergence could not be rejected at a confidence level of 5% (visualized in Appendix 9).

Especially compared to the correlations amongst art classifications, correlations amongst equity portfolios are found to be much higher (cf. Appendix 11), however not perfect. This is again suggestive of diversification benefits when investing across them (though these benefits would be expected to be lower than in the case of diversification across art categories). As one would anticipate given these correlations, a magnitude of the volatility (more than 90%) is captured by the first two principal components (cf. Appendix 12), as a PCA exhibits, visualized in the biplots below:

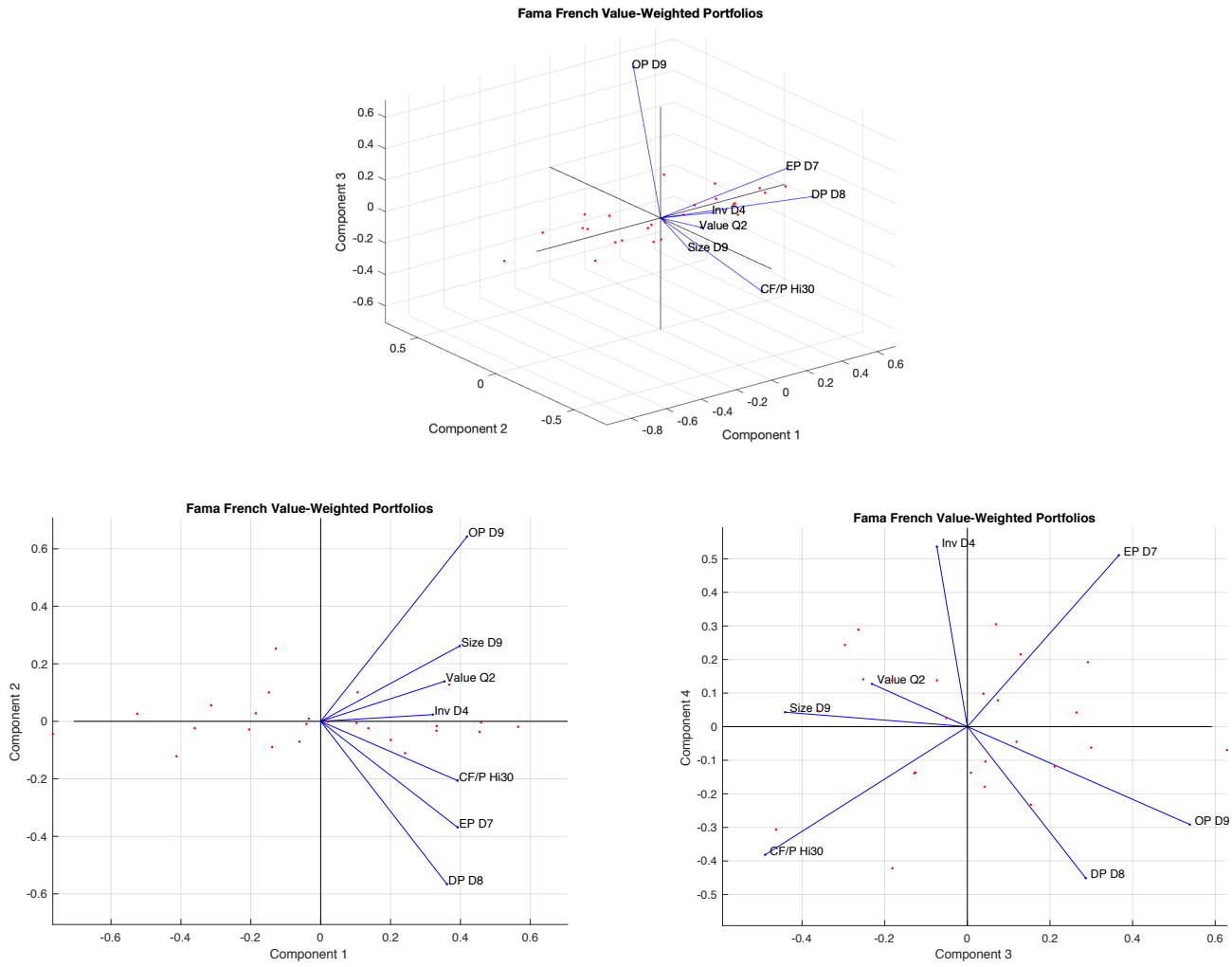

Figure 7: PCA Application to Fama-French Portfolios

Again, the coefficients of the first principal components are all positive which is indicative for the first principal component to indeed constitute the market component, as assumed in ch. 3.2.3. Again, looking at the third biplot, one cannot draw decisive conclusions about the subsequent principal components, but it can be noticed that there are equity portfolios, as CF_P_Hi30 and EP_D7 or Value_Q2 and OP_D9, in the third principal component that move in opposite directions; hence, they have similar structures but in opposite ways. Analogously to the PCA application on art classifications, for principal components three onwards, bi-plots show "star-like" graphs, for which the distinction is less clear-cut and structure is hardly seen. Again, based on principal components, portfolios can be constructed.

	PP 1	PP 2	PP 3	PP 4	PP 5	PP 6	PP 7
Mean	*1,90%*	*5,38%*	*3,91%*	*11,79%*	*-1,35%*	*12,16%*	*1,56%*
Standard Deviation	*0,0146*	*0,0027*	*0,0073*	*0,0575*	*0,0519*	*0,0590*	*0,0221*
Sharpe Ratio	*-1,83*	*2,92*	*-0,92*	*1,25*	*-1,14*	*1,28*	*-1,37*
Coefficient of Variation	*0,7687*	*0,0508*	*0,1878*	*0,4881*	*-3,8520*	*0,4853*	*1,4179*
Skew	*-0,5023*	*-0,5023*	*0,5023*	*-0,5023*	*0,5023*	*-0,5023*	*0,5023*
Kurtosis	*0,12*	*0,12*	*0,12*	*0,12*	*0,12*	*0,12*	*0,12*
t-stat_null	*6,51*	*101,03*	*27,17*	*10,58*	*-1,43*	*10,65*	*3,52*
t-stat _market excess	*-0,12*	*-1,26*	*1,59*	*-0,55*	*1,14*	*-0,55*	*2,06*

Table 6: Fama-French Principal Portfolios – Moments

It is found that a principal portfolio based on the second principal component maximizes the Sharpe ratio (2.92). Again, this is only achievable when there is no short-selling restriction. The fact that the correlation between the first principal portfolio and the market is close to one is against suggestive that the first principal component is indeed a market component. In a next step, again, a naïve, equally-weighted portfolio shall be formed. Furthermore, a volatility-timing strategy will be applied and a minimum-variance portfolio constructed, following Markowitz's portfolio theory. Constructing the equally-weighted portfolio [EW7], each Fama-French portfolio is assigned a weight of 1/7 (14.29%), accordingly. As shown in

Figure 8, over the given sample period, such portfolio provides an annualized average return of 15.00% with a standard deviation of 12.23%, giving a Sharpe Ratio of 0.78 – at a risk-free rate of 4.59%. Looking at the skewness and kurtosis of the distribution, EW7 shows to be slightly negatively skewed and platykurtic with values of -0.27 and -0.1, respectively. With a regression against market excess returns one finds that the alpha is not statistically significant different from zero. Thus, within the given investment horizon, it is suggested that the portfolio does not achieve abnormal returns neither above nor below predictions according to the capital asset pricing model [CAPM]. EW7 is strongly correlated with the first principal portfolio; this again supports the thesis that the first principal component is in fact a market component that is replicated the easiest by an equally-weighted portfolio of all Fama-French portfolios. The EW strategy is then again further complemented by a volatility-timing strategy [VOLT_FF], which increases the investment in EW7 when recent volatility was low and decreases the investment in EW7 when recent volatility was high. As before, a graphic illustration shows how the weights invested in the risky portfolio change with volatility:

	EW7	VOLT_FF
Target chosen so that average of weight equals	-	*1*
Target volatility	-	*10,49%*
	-	*9,53*
Average rf rate	*4,59%*	
Average return	*15,00%*	*12,95%*
Standard deviation	*0,1323*	*0,1541*
Sharpe ratio	*0,7876*	*0,5427*
t-Stat (null)	*5,3205*	*3,9412*
t-Stat (m_excess; alpha)	*1,1313*	*1,3384*
t-Stat (m_excess; beta)	*0,0119*	*0,1490*
Skew	*-0,2728*	*0,3496*
Kurtosis	*-0,1004*	*2,8315*

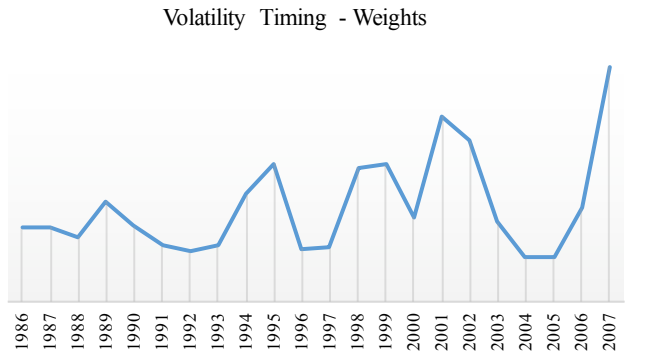

Figure 8: EW13, VOLT – Annualized Performance Statistics, Fama-French

After the dotcom crisis of 2000, any investor following the volatility-timing approach would have decreased the weight invested in the risky asset (Figure 8), just to increase it in the periods before the financial crisis of 2007/2008. It shows that volatility across stocks has recovered much quicker after the dotcom bubble than volatilities of art movements. To make VOLT_FF comparable to EW7, the conditional weights were rescaled so that the average weight over the full sample equals one. As compared to EW7, the annualized average return over the whole sample period in fact decreased to 12.95%. Furthermore, the volatility of returns has increased to 15.41%. The chosen strategy proves to show excess returns over zero, neither the regression against market-excess returns shows a positive and significant alpha, suggesting that the portfolio does not achieve abnormal returns neither above nor below what the CAPM predicts, for the given sample period. The

return distribution of VOLT_FF shows to skewed and more leptokurtic with values of 0.35 and 2.83, respectively. Hence, the probability to observe positive returns as well as the magnitude of those returns has increased. In the case of the Fama-French portfolios, the volatility-timing strategy has not proven to be very effective in terms of risk management.

Given the high correlations amongst equity portfolios, little diversification potential can be assumed from investing across these. In addition to the naïve portfolio and a volatility-timing strategy, the mean-variance frontier was constructed to visualize the benefits of diversification: Figure 9 depicts the efficient frontier derived from the various combinations of the seven portfolios. Under the no-short-selling restriction, the returns (risks) for the efficient frontier range from 15.45% (10.58%) at the MVP to 17.72% (12.6%) at its uppermost. All other things being equal, naïve strategies, where investment is made solely in one art market or equally in all markets, are once again dominated by the efficient set. As EP_D7 lies on the efficient frontier, it is not surprising that it is mostly included in the efficient set. On the other hand, portfolios constructed in the previous section, EW7 or VOLT_FF are not included in the efficient set and outperformed by these combinations. As expected, all individual portfolios that are plotted farthest from the efficient frontier are excluded from the set of efficient portfolios. In fact, in the case of no short-selling, the efficient frontier is mostly comprised of just two to three of the seven equity portfolios included in the calculations. Namely, OP_D9, CF_P_Hi30 and Size_D9 are generally not included in the efficient set through their high risk-low return characteristics over the period in question. It appears that most of the gains from diversification achievable in equities can be made with a small number of factor portfolios.

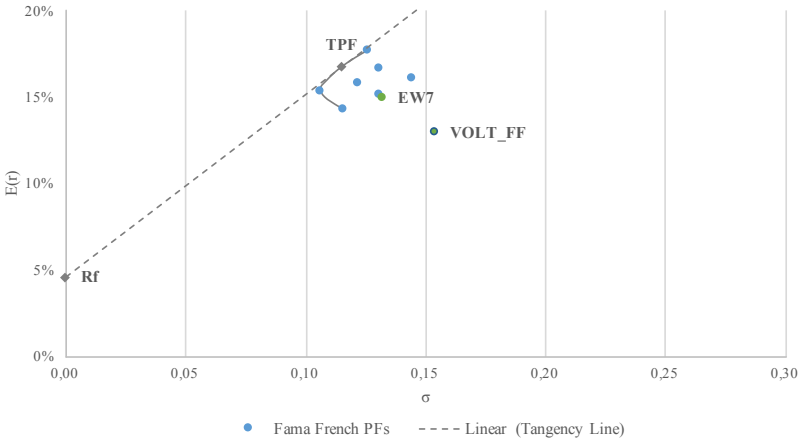

Figure 9: MV Frontier – Fama-French Portfolios

Comparing the mean variance frontiers of both sections, for art categories only and equities only, the efficient frontier is found further "up" for the case of equity investments. That is, at similar risks, the average expected annual returns are higher for equities. Moreover, the respective tangency portfolios (for which the Sharpe ratio is maximized) differ significantly, visible in the slopes of the line: Whereas the maximum Sharpe ratio that can be achieved from combinations of art categories (under the no-short-selling restriction) is only 0.34, a combination of the Fama-French portfolios achieves a Sharpe ratio of 1.06. In the case of a pure art portfolio, recall that the tangency portfolio in fact equals an undiversified investment of 100% in Pop art. Whereas the tangency portfolio of equities is constructed by an almost equally-weighted portfolio including only Inv_D4 and EP_D7. Hence, the diversification benefits amongst those two asset classes by themselves, art and equities, respectively, are limited. Regarding the Fama-French portfolios, this is likely to be the case because significant diversification benefits have already been realized in the computation of each portfolio itself.

3.3.1 Downside Risks

Examining the Fama-French portfolios individually, Inv_D4 shows the most favourable risk profile, in terms of VaR and ES. Even at a confidence level as high as 95%, the VaR is 2.08%. In fact, based on historical performance, at a 90% confidence level, there are no losses to expect. However, in terms of ES, EP_D7 offers highest safety with an expected loss of only 4.9% (7.85%) at 90% (95%) confidence level. Amongst the Fama-French portfolios, OP_D9 and Size_D9 show the riskiest profile. However, compared to the previously examined art categories, they constitute a relatively safe bet, with VaRs of 2.36% (7.6%) and 1.57% (6.31%) and ESs of 11.49% (16.31%) and 10.47% (12.48%) at a confidence level of 90% (95%), respectively.

Since the return series were shown to generally be negatively skewed and suffer from kurtosis, the VaR derived from the normal distribution assumption underestimates the riskiness and is thus lower than the VaR constructed from the historical distribution (cf. Appendix 13).

Again, as expected due to the high correlations across the (already well-diversified) portfolios, diversifying across several factors does not provide significant improvements, neither in terms of VaR and ES: In these terms best performing, is the portfolio formed based on the second principal component. In this case, there are no losses to expect and no value at risk, even at the more conservative confidence level of 95%. (cf. Appendix 14).

All in all, as found by the stream of existing literature, superior risk-return characteristics are found for equity investments, here proxied by the Fama-French portfolios. Diversification benefits from investing across art categories as found by Worthington and Higgs (2004) could not be supported by the data. For the given time period, a mean-variance optimizer would have been served best to invest into Pop (as this investment would have maximized the Sharpe ratio). Yet, there are some caveats to this conclusion, as the art categories themselves already constitute diversification efforts. Though portfolios constructed based on principal components may improve Sharpe ratio, such portfolio management for art investment appears unfeasible, especially for the individual investor. Hence, one would not be best advised to solely invest in art, but a mean-variance optimizer would rather choose to invest his capital in equities. However, in the next section, the potential of art as an addition to a well-diversified equity portfolio shall be tested.

3.4 Mixed Asset Portfolio

It has been shown that diversifying across a broader base of factor (equity) portfolios shows higher diversification benefits and is far more feasible for an investor to implement (as opposed to diversifying across multiple art categories). Finally, based on conclusions drawn from existing literature on the predominant low correlation between art and equities, the diversification potential of art investments in an equity setting shall be investigated. Again, a naïve, equally-weighted portfolio will be constructed, further modified by a volatility-timing strategy. Lastly, a minimum-variance portfolio will be compared in terms of risk-return characteristics, and the implications on the downside risk of each portfolio will be studied.

3.4.1 Correlations between Art and Equities

Presented in Table 7, the pairwise correlations amongst the 13 art categories and seven factor portfolios (resulting in a 20x20 correlation matrix) are shown to be generally negative. The fact that the correlation between art classifications and all of the Fama-French portfolios fare at zero (highlighted in green) is in line with existing literature and once again is suggestive of the potential gains from portfolio diversification involving investments in art. If low or even negative correlations of returns exist among various art segments and equities, diversifying across these may allow investors to reduce portfolio risk while holding expected return constant.

Correlations between Art Categories and Fama-French Portfolios

	Inv_D4	DP_D8	Value_Q2	OP_D9	CF_P_Hi30	Size_D9	EP_D7	MedRen	Baroque	Rococo	Neoclassicism	Romanticism	Realism	ImprSymb	FauvExpr	CuFuCo	DadaSurr	AbstExpr	Pop	MinCont
Inv_D4	1,0000	0,8221	0,9339	0,8513	0,8836	0,9144	0,8979	-0,3839	-0,2218	-0,1261	-0,1003	0,0336	-0,0714	0,0613	-0,0910	-0,1102	-0,0447	-0,1474	-0,1843	-0,1984
DP_D8	0,8221	1,0000	0,8276	0,7373	0,8696	0,7946	0,9116	-0,3336	-0,1628	-0,1538	-0,1249	0,0313	0,1002	0,0730	-0,0685	-0,1008	0,0322	-0,0713	-0,0916	-0,2192
Value_Q2	0,9339	0,8276	1,0000	0,9036	0,9221	0,9675	0,8817	-0,3822	-0,2138	-0,0712	-0,1006	0,0270	0,0399	0,0373	-0,0971	-0,1394	-0,0718	-0,1459	-0,1880	-0,1679
OP_D9	0,8513	0,7373	0,9036	1,0000	0,8572	0,8996	0,8069	-0,3284	-0,1524	-0,0365	-0,0417	0,0580	0,0343	-0,0054	-0,0666	-0,1584	-0,0678	-0,1657	-0,1394	-0,1538
CF_P_Hi30	0,8836	0,8696	0,9221	0,8070	1,0000	0,9235	0,8832	-0,3329	-0,2630	-0,0807	-0,1783	-0,0309	0,0115	0,0351	-0,0921	-0,1602	-0,0871	-0,1484	-0,1640	-0,2320
Size_D9	0,9144	0,7946	0,9675	0,8996	0,9235	1,0000	0,8522	-0,4034	-0,2441	-0,0834	-0,1049	-0,0329	0,0034	-0,0273	-0,1522	-0,2038	-0,1319	-0,2041	-0,2437	-0,1797
EP_D7	0,8979	0,9116	0,8817	0,8069	0,8832	0,8522	1,0000	-0,3958	-0,2735	-0,2114	-0,0829	-0,0386	0,0429	-0,0036	-0,1811	-0,2393	-0,0804	-0,1904	-0,2420	-0,3191
MedRen	-0,3839	-0,3336	-0,3822	-0,3284	-0,3329	-0,4034	-0,3958	1,0000	0,7819	0,5648	0,2651	0,4335	0,4542	0,5425	0,6580	0,5613	0,5401	0,5300	0,6043	0,5333
Baroque	-0,2218	-0,1628	-0,2138	-0,1324	-0,2630	-0,2441	-0,2735	0,7819	1,0000	0,7617	0,5707	0,7080	0,7496	0,7681	0,7474	0,7014	0,8014	0,7975	0,8109	0,8084
Rococo	-0,1261	-0,1538	-0,0712	-0,0365	-0,0807	-0,0834	-0,2114	0,5648	0,7617	1,0000	0,5202	0,6472	0,7369	0,7842	0,7063	0,4783	0,7159	0,7492	0,7117	0,6769
Neoclassicism	-0,1003	-0,1249	-0,1006	-0,0417	-0,1783	-0,1049	-0,0829	0,2651	0,5707	0,5202	1,0000	0,6963	0,6922	0,5701	0,4970	0,4783	0,5574	0,5784	0,4640	0,5306
Romanticism	0,0336	0,0313	0,0270	0,0580	-0,0309	-0,0329	-0,0386	0,4335	0,7059	0,6472	0,6963	1,0000	0,8409	0,8432	0,7334	0,7117	0,7900	0,7582	0,7240	0,6919
Realism	0,0714	0,1002	0,0399	0,0343	0,0115	0,0034	0,0429	0,4542	0,7080	0,7369	0,6922	0,8409	1,0000	0,8925	0,7919	0,7847	0,8798	0,8417	0,7808	0,7617
ImprSymb	0,0613	0,0730	0,0373	-0,0054	0,0351	-0,0273	-0,0036	0,5425	0,7496	0,7842	0,5701	0,8432	0,8925	1,0000	0,8656	0,8749	0,9296	0,8894	0,8343	0,7492
FauvExpr	-0,0910	-0,0685	-0,0971	-0,0666	-0,0921	-0,1522	-0,1811	0,6580	0,7681	0,7081	0,4970	0,7334	0,7919	0,8656	1,0000	0,9305	0,9056	0,8810	0,9357	0,7934
CuFuCo	-0,1102	-0,1008	-0,1394	-0,1584	-0,1602	-0,2038	-0,2393	0,5613	0,7474	0,7063	0,4783	0,7117	0,7847	0,8749	0,9305	1,0000	0,9296	0,9409	0,8981	0,8188
DadaSurr	-0,0447	0,0322	-0,0718	-0,0678	-0,0871	-0,1319	-0,0804	0,5401	0,8014	0,7159	0,5574	0,7900	0,8798	0,9296	0,9056	0,9296	1,0000	0,9668	0,9199	0,8169
AbstExpr	-0,1474	-0,0713	-0,1459	-0,1657	-0,1484	-0,2041	-0,1904	0,5300	0,7975	0,7492	0,5784	0,7582	0,8417	0,8894	0,8810	0,9409	0,9669	1,0000	0,9226	0,8431
Pop	-0,1843	-0,0916	-0,1880	-0,1394	-0,1640	-0,2437	-0,2420	0,6043	0,8109	0,7117	0,4640	0,7240	0,7808	0,8343	0,9357	0,8981	0,9199	0,9226	1,0000	0,8289
MinCont	-0,1984	-0,2192	-0,1679	-0,1538	-0,2320	-0,1797	-0,3191	0,5333	0,8084	0,6769	0,5306	0,6919	0,7617	0,7492	0,7934	0,8188	0,8169	0,8431	0,8289	1,0000

Table 7: Correlations between Art Categories and Fama-French Portfolios

3.4.2 Diversification Benefits of Art in an Equity Setting

While a naïve strategy of investing equal budgets (1/20 = 5%) across all art categories and factor portfolios does increase the Sharpe ratio (to 0,49) as compared to Sharpe ratios obtained through pure art investments, equity investors worsen their position by adding art categories to their portfolios. A volatility-timing strategy does not change the conclusion significantly (Sharpe ratio of 0,53); moreover, given increased transaction costs from implementing such strategy, it does not appear to be feasible (cf. Appendix 15).

In a next step, Markowitz portfolio theory is used to construct the efficient frontier for the exclusively art portfolio and the mixed asset portfolio where art is included alongside equity. Figure 10 depicts the efficient frontier derived from the various combinations of the thirteen art classifications. Under the no short-selling restriction, the returns (risks) for the efficient frontier range from 11.67% (6.74%) at the minimum variance point to 17.72% (12.6%) at its uppermost.

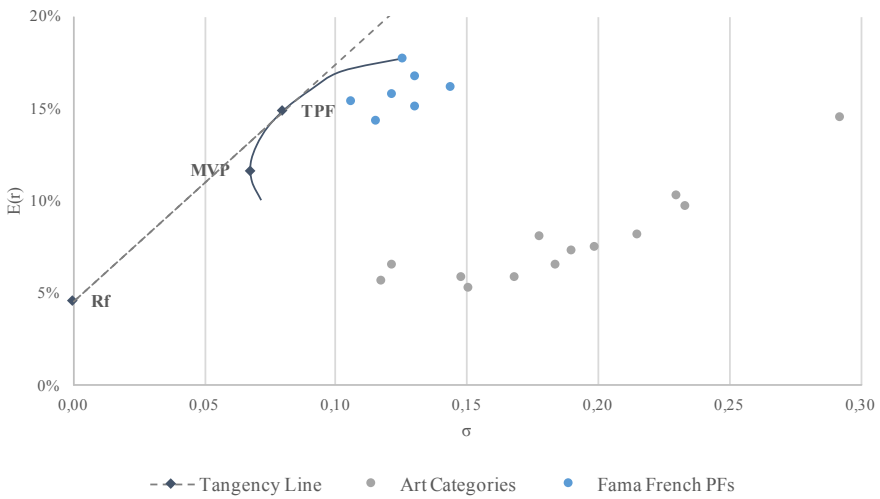

Figure 10: MV Frontier - Art and Equities

All other things being equal, naïve strategies, where investment is made solely in one art market or equally in all markets, are dominated by the efficient set in both cases. None of the art classifications lies on the efficient frontier, neither do the portfolios constructed before, VOLT or EW20. Also in terms of VaR and ES has the risk profile improved significantly when the investment is allocated across art and equities (cf. Appendix16). As expected, individual assets that are plotted farthest from the efficient frontier are excluded from the set of efficient portfolios and this is indeed the case with the naïve strategies of investing in either of the art classifications. In fact, in the case of no short-selling, the efficient frontier is mostly comprised of just four to five of the thirteen art assets included in the calculations. It is noteworthy that Romanticism, Realism, ImprSymb, FauvExpr, CuFuCo, DadaSurr, and AbstExpr are generally not included in the efficient set; neither are DP_D8, Value_Q2, OP_D9, CF_P_Hi30, or Size_D9, through their high risk-low return characteristics over the period in question. It appears that most of the gains from diversification achievable in art can be made with a small number of individual art classifications and factor portfolios. However, the performance of individual artists within these classifications may differ from the market as a whole. Again, it is noteworthy that the mean-variance efficient portfolios outperform the naïve strategies, EW and VOLT, and in some the gains are quite substantial. However, it becomes clear that even though art markets have very low correlations with stocks, their risk-return characteristics are so inferior that they are almost never included in the efficient set.

The findings suggest, for the most part, that the diversification benefits of art in a multi-financial asset portfolio are close to zero. However, at least some diversification benefits were illustrated above. Moreover, as Worthington and Higgs (2004) pointed out correctly, with an increasing number of assets the risk of the overall portfolio collapses to the individual co-variances, such that the creation of a portfolio with much finer detail than the broad art classifications used here should show more benefits of diversification. Also, the consumption value, a potentially substantial return premium on art, is not incorporated in the returns used here for calculations. At the same time, neither transaction and holding costs associated with art investments are incorporated. Hence, if art investment funds do not manage to circumvent (or at least significantly decrease) these peripheral fees, Renneboog and Van Houtte (2002) may in fact have concluded correctly that "the diversification potential of art in an equity setting is limited". Moreover, examining the downside risks of art investments compared to those of equity investments, it becomes obvious that art as an asset class, indeed reflects a riskier venture for lending institutions than the traditional assets; it therefore comes unsurprisingly why still only few financial services engage in and encourage art as a structured finance product, i.e. for art lending. That these findings are much less favourable than the outcomes presented by other researchers, such as Goetzmann (1993) or Mei and Moses (2002), although the chosen time horizon includes an extra boom period, can be explained by the fact that the dataset comprises a broader coverage; that is, it does not only capture the sales and resales by top artists at the biggest auction houses, as Renneboog and Spaenjers pointed out correctly. They do, too, come to the conclusion that buyers of art should expect to reap "non-pecuniary benefits rather than high financial returns, especially because the modest art returns are further diminished by substantial transaction costs" (Renneboog & Spaenjers, 2009).

3.5 Hedging Inflation

Renneboog and Spaenjers have found that real returns from 2002-2007 have been higher over the longer term than bonds (at higher risk though), but lower than stocks which also demonstrate that art is a storage of value and a hedge against inflation. With the great moderation under Alan Greenspan finally come to an end, the aftermath of the 2007/2008 financial crisis is once again dominated by asset price volatility and concerns about inflation. Fisher's (1930) main hypothesis for inflation hedging, known as the Fisher hypothesis, proposes that expected nominal (interest) rates equal expected inflation plus a constant real rate. Therefore, nominal (interest) rates should move one for one with expected inflation. Accordingly, assets hedge against inflation if their real returns move independently from inflation. Common sense would prescribe that the real value of art investments should move independently from monetary indexation, especially considering deceased artists or those who do no longer produce (where the supply is fixed and thus replies to money supply). In that respect, art resembles gold and a comparison should therefore show a similarity.

The correlation coefficients with inflation[16] provide a first glimpse on the inflation hedging characteristics. Indeed, when including all inflation observations, all real returns[17] on art categories exhibit low correlation with coefficients between -0.2629 (Romanticism) and 0.1222 (AbstExpr). This indicates favorable inflation hedging as real returns do not decrease (significantly) with higher inflation. Also, an *ex-post* version of Fisher can be used for long-term analysis and a wider range of asset classes. Given unsystematic forecasting errors between expected and realized inflation and unbiased return expectations, it proposes a one for one relation between realized nominal returns (r_n) and realized inflation (π):

$$r_n = \alpha + \beta\pi + \epsilon.$$

Equation 4: Ex-Post Fisher Equation

An asset with $\beta = 1$ is considered a perfect hedge against inflation. Although an imperfect but stable relation would already suffice to create a synthetic hedge (Schotman & Schweitzer, 2000), transaction costs and the potential necessity of short-selling limit the use of synthetic hedges in practice, especially for retail investors. As already indicated by the low correlation of nominal returns with inflation, high beta coefficients support the notion on the potential of art for inflation hedging. However, this indication is undermined by relatively low t-statistics (cf. Appendix 18). Especially Pop art is found to constitute a near to perfect hedge with a correlation of nominal returns and inflation of zero and a beta coefficient of close to one (1.18). Other studies from investors and some academics apply the Pearson correlation coefficient as a common measure in science for the degree of linear dependence between two variables.

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[16] Inflation as measured by the consumer price index reflects the annual percentage change in the cost to the average consumer of acquiring a basket of goods and services that may be fixed or changed at specified intervals (here annually). The Laspeyres formula is used; data from https://ihsmarkit.com/products/global-economic-data.html.

[17] cf. Fisher's (1930) equation: $(1 + r_n) = (1 + r_r)\times(1 + \pi)$.

For the nominal return (r_n) and inflation (π), it calculates as

$$\rho_{r_n,\pi} = \frac{cov(\ r_n,\pi)}{\sigma_{r_n}\sigma_\pi}\ .$$

Equation 5: Pearson Correlation Coefficient

The higher the correlation, the better an asset's inflation hedging. A coefficient of (minus) one indicates perfect positive (negative) linear correlation. However, the Pearson coefficients show to cluster around a value of zero, ranging from only -0.1951 to 0.1619. The correlation coefficient is a scaled version of the inflation hedging coefficient estimate from the Fisher equation. Accordingly, an ordinary least squares [OLS] estimator calculates as

$$\beta = \rho_{r_n,\pi}\frac{\sigma_{r_n}}{\sigma_\pi},$$

which – unsurprisingly – strongly resemble the beta coefficients obtained from the regression. These measures, however, focus on synchronous movements of returns and inflation and pay relatively little attention to total risk. The shortfall risks can be computed in order to respond to his. From an inflation hedging perspective, total risk relates to real returns. If an asset's real returns are volatile it is an inferior inflation hedge. Viewed in isolation, this measure strongly disadvantages volatile assets. As for the 13 art categories, their real returns are highly volatile, especially compared to alternative investments in equities. Based on their respective shortfall risks, measured in VaR and ES, they would constitute an inferior inflation hedge. Worst performer in this context is Pop, with a historical VaR at the 95%-confidence level of more than 50%. In turn, less risky would be investments in Baroque and Rococo, with beta coefficients from the ex-post regression of -0.92 and 0.72, respectively. Whereas based on such analysis, Baroque would not constitute a good hedging candidate, Rococo could indeed suffice for a synthetic hedge. However, such analysis would become more meaningful in a portfolio context. Again, significant transaction costs must not be disregarded, as well as the fact that the here-used indices are not tradeable, which would limit the use in practice.

Although common sense would prescribe similarities amongst gold and art investments with respect to inflation, applying the same analysis to gold[18] reveals different patterns. Though the correlation between real returns and inflation, as well as the pearson coefficient of nominal returns are relatively low, the beta coefficient from an OLS regression (-5.17) is far from indicating a perfect hedge.

It can be argued that these discrepancies between academic research and common sense arise from a narrow view on the data, with a focus on a time period characterized by crises and a period of low inflation. However, the analysis does not allow for an outright rejection not a general acceptation of the notion of art as an inflationary hedge. Generally, the results do indicate that the exposure to art may indeed bring yet a positive side-effect that potentially makes such an investment worthwhile after all, despite its inferior risk-return characteristics. In addition to decreasing associated transaction and holding costs, art funds may additionally hedge inflation by creating exposure to art. This feature becomes especially relevant in a world where alternative sources of asset management, such as fixed interest, property and cash all look unattractive.

[18] Spot Exchange Rate quotes as USD per Troy Gold downloaded as daily returns from Bloomberg (ticker: XAU BGN Curncy).

3.6 Current Condition of the Art Market – A Bubble?

It has been over ten years since the financial recovery began following the correction of 2008, and few sectors of the market have rebounded as robustly as art – particularly Postwar and Contemporary art, which have been found to have doubled in value since then. Pundits on the sidelines contend that such market growth is unsustainable, warning there is a bubble in the making that is sure to burst (Kräussl, Lehnert, & Martelin, 2014). Market bubbles are generally defined as a dramatic escalation in the volume of trading in assets of a given category at prices that exceed their fundamental value, that is followed by a sudden collapse. However, if the prevailing opinion is that there is no such thing as a fundamental value of artworks, no equilibrium price, how can bubbles form in the art market? And if bubbles cannot even develop in the first place, how would one expect them to burst? Triggers for bubble bursts in capital markets have typically been information becoming that previously investors did not have sight off (Veil, 2013). In order to minimize such risks, disclosure obligations have evolved that shall generate a constant flow of information such that the prices of stocks do not drift too far off their fundamental value until the next correction sets in (e.g. after the publication of any periodic report or *ad hoc* messages) (Veil, 2013). Though this reasoning seems appropriate to some extent, the art market did in fact experience two bubble bursts in the last 30 years only, in the late 1990s and again in 2008. That is, with economies ever expanding, HNWIs started speculating on artworks until real economies weakened. Judging by the current headline-grabbing sales of Postwar and Contemporary works bringing in USD 100m or more, it would seem that a bubble may indeed be forming. More so, it has been shown that for the past year, while the number of lots sold in the fine art auction market grew by 9% year-on-year, the value increased by 13%; 61% of total sales value in the segment accounted for works of art selling at prices in excess of USD 1m but just for 1% of lots sold (cf. ch. 1.3.2), which could indeed be a sign of a bubble forming.

Rational expectations put the fundamental value of an asset at equal to its discounted expected cash flow. As pointed out already, for most assets it is relatively easy to determine such expected cash flows (i.e. dividends in case of stocks or rent for real estate). In the case of art, however, returns are almost never guaranteed, for artworks additionally providing extraordinary, "aesthetic" returns. In order to explore the possibilities of bubbles developing in the current art markets while overcoming the issue of the fundamental value of art, Kräussl, Lehnert, and Martelin (2014) have introduced a new and direct statistical method of bubble detection, by analyzing more than a million auction records over almost 40 years using a statistical modeling tool based on the augmented Dickey-Fuller test. Having established a critical value sequence that allows to see where the market deviates from its standard behaviour, it becomes obvious that since 2011, the markets for Postwar and Contemporary art appear to have witnessed the most dramatic increase ("maniac mode"). In May 2005, ArtTactic has launched an Art Market Confidence Indicator that samples the opinions of a small group of select art insiders; 100 collectors, auction houses, art dealers, advisers and analysts that can provide a valuable insight into the perception about the current and future state of the art market. Indeed, according to the latest ArtTactic Confidence Indicator for September 2018, the confidence in the contemporary art market has dropped 24% in the first six months of 2018, despite a 27% increase in contemporary auction sales for the

same period. It looks like the market has some "concerns about the sustainability of the current boom, on the back of increasing economic and political uncertainty" (ArtTactic, 2018).

3.7 Art Market Disruptions

Looking at the art funds universe, the art market has been found to be struggling to gain momentum. However, it can be said that art investing has moved into a mature stage, which does not mean the market is necessarily going to go down. As the market has evolved, so has its complexity increased. Though growing research in finance and economics as well as data dissemination are fighting that complexity to a point, also technological evolutions must support the positioning of art as a new asset class, further increasing the art market's transparency. New market opportunities and business models in an internet and digital world have emerged and will continue to emerge, such as online auction houses, online databases, online and real-time market data dissemination, online catalogues and fairs, artist websites and new communication channels. Instagram has been fuelling the art market growth, giving access to over 1bn global consumers (Saatchi Art, 2018) and other new sales channels are evolving; augmented and virtual reality can be a way to bring younger generations closer to art by allowing the enjoyment of a multi-dimensional, interactive experience (UBS & Art Basel, 2019). So, the art investor base will continue to grow, as more people are discovering that possessing prized paintings, prints, sculptures and valuable collectibles is now within their reach. As in many other areas, also in the art market "ecosystems" may pose a threat to existing players; in fact, 15% of online platforms believe that a disruption of the art market might as well be triggered by such ecosystems like Amazon (Hiscox, 2018). For the art market to establish and further evolve, several hurdles have yet been identified that must be overcome; with the presumably unpredictable pricing of art leading the list, closely followed by the art market's lack of transparency and complemented by its unique risks including the risk of duplication and piracy. Advances in technology appear to have become the silver lining, a carrier of hope for the future of the art market.

3.7.1 Machine Learning Techniques to Price Art

Setting the right price for a good or service is an old problem in economic theory, more so for pieces of art with the heterogeneity of art works, the impact of trends and tastes, and not least the aesthetic pleasure unique to every individual consumer of art. The emergence of artificial intelligence [AI] raises the question for further application in the art market, i.e. the use of ML to build effective pricing automation solutions. AI is when computational tools start to possess cognitive abilities; the English Oxford Living Dictionary gives this definition: "The theory and development of computer systems able to perform tasks normally requiring human intelligence, such as visual perception, speech recognition, decision-making, and translation between languages.". ML, a subset of AI, is when computational tools and statistical techniques are leveraged to give computers the ability to learn from, and with, data. Namely, a

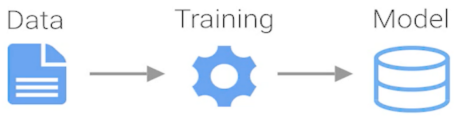

Figure 11: Standard ML-Process

model is trained using datasets in order to make increasingly better and more useful predictions/ inferences; this predictive (trained) model can then be deployed to serve up predictions on previously unseen data. For instance, with AI, a rule based program recognises that the image of an "A" is an "A". Whereas, with ML, given even only pixels of an "A" (a partial image) and a prediction model (which was previously trained in a sample) the program recognizes an "A". As for Deep Learning, with pixels of an "A" (partial image) and non-structured data the program is able to recognise an "A". Hence, ML can be of great help and already has shaped the business models of Amazon, Facebook, Google, or IBM; its power lies in the fact that the developed algorithms can learn patterns from data, instead of being explicitly programmed. ML models can continuously integrate new information and detect emerging trends or new demands (Marr, 2018), thereby helping users navigate millions of artworks enhancing both the search and discovery experience.

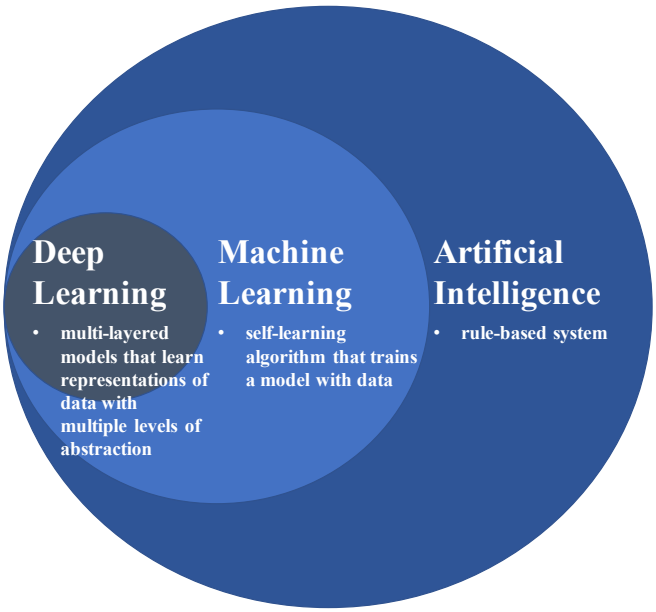

Figure 12: Overview – AI, ML and Deep Learning

"The Green Canvas", one of the first AI valuation projects to study art valuation with a specific focus on paintings, was developed in 2014 by a team around Ahmed Hosny. In order to quantify aesthetics as an extremely subjective and quality-based feature as well as exploring the middle realm between artistic evaluation and scientific statistics, the project involved an incredible amount of manual labour to acquire, scrub and train the AI about art. The team obtained their data from the Blouin Art Sales Index website. Trying to gather an unbiased representative sample of data, the test set included a range of artists, styles and mediums. They analysed over 35k paintings with a total valuation exceeding USD 9bn. Prices included a maximum of USD 119,9m, an average of USD 264,5k and a minimum of USD 3 (Machine Learning for Art Valuation. An Interview with Ahmed Hosny, 2017). Their findings, however, were relatively high-level: For instance, they established that paintings where low corner percentages are detected are more likely to have high sales values; they also found that auctions of valuable pieces tend to coincide with successful exhibitions; and that paintings produced in the 1960s recorded the highest sales. An estimation based on a linear regression specifically fit for paintings by the Spanish artist Pablo Picasso, however, yielded a low prediction rate, measured as the correlation between true and predicted prices. With both the shear amount of data and the massive processing power at disposal nowadays, instead of fitting a model to the data, deep learning feature representations from example data are will be used and automatically learned which can hence understand very complex non-linear relationships. In theory, experts are convinced that ML will indeed be able to differentiate artists by style and eventually be able to price artworks as well, feeding the network with metadata that exceeds information about the style (Art Market Guru, 2018). "Thread" Genius is an AI start-up founded in 2015 and was acquired by Sotheby's in January 2018 (Lunden, 2018). The main use of its technology was a visual search engine that

applied deep learning techniques using artificial neural networks for the fashion industry. By training artificial neural networks, Thread Genius was able to recognize clothing from images to find visually similar ones. Interestingly, Thread Genius also applied this technology to art. The initial efforts involved software development of large scale data pipelines for cleaning and standardizing the troves of historical Sotheby's data in order to identify collector tastes and offer recommendations. Sotheby's has some of the best data in the art market related to historical transactions, individual's preferences for art at every price point, images, object and artwork information, and much more. Leveraging Sotheby's Mei Moses database embodies their efforts around analysing art-as-an-asset. The information is used to analyse how the value of unique objects has moved through time and to compare the investment performance of art as an asset to that of other asset classes. Moreover, Thread Genius aims at providing a lower barrier to help people sell their art, therefore unlocking supply providing price transparency through various ML techniques (Medium, 2017).

It becomes clear that the success of the implementation of ML is heavily dependent on data. For this reason, data acquisition has become the primary goal with prediction modelling taking a backseat for a while. The greatest challenges implementation of AI in the art markets has are the availability of data about art and the accessibility of technologists to the data as well as the subjectivity – both in value and in taste. Even letting subjectivity aside, only to separate obscene images from legitimate libraries of art requires algorithms fattened with data about all the kinds of filth uploaded daily onto the internet; AI networks would need lots of curated, clean data which is expensive and time consuming, thus requiring a heavy up-front investment. Moreover, whenever insights from analyses are discovered, it is vital to validate them against the domain knowledge that specialists possess; the importance of human involvement throughout the process cannot be overstated. Lastly, it can be doubted that artists themselves would approve of algorithms valuing their work. To some extent their creations are "priceless" and the question remains whether any computer power could ever incorporate the emotional/psychic value of any art piece to metadata such as (cost of) material, size, artist, year of creation.

Even excluding this emotional component, there is no guarantee that such network will learn the correct representative features and will give good predictions. As trends and taste changes, these networks will need to be constantly retrained accordingly. Put differently, AI taking over and replacing art professionals is less likely a short-term scenario. Instead, for the foreseeable future, AI has opportunities in expanding the accessibility of art to those who may not have been able to afford it before, or who may have never been exposed to fine art in their everyday surroundings, i.e. in the form of Blockchain technology.

3.7.2 Blockchain Disruption

Going forward, Blockchain – "an open, distributed ledger that can record transactions between two parties efficiently and in a verifiable and permanent way" (Iansiti & Lakhani, 2017) – will continue to disrupt the world we live in. Cryptocurrencies are the predicted entry point for blockchain. Besides its famous application Bitcoin, which runs on a Blockchain paradigm and its major impacts on often discussed fields, amongst many the banking industry, the technology will be deployed in sectors not always associated with it. As it bears fruits in the form of greater security, smart contracts and easier logistics management, it can be expected that in the

upcoming year, the art market will join the evolution, deploying Blockchain in innovative ways. So, in October 2017, Bit2Art.com launched a digital platform to trade fine art in Bitcoin (Hiscox, 2018). The most striking impact of the technology on the art market can be summarized in three areas:

a. Driving Digital Art Sales through Digital Scarcity and Security

A major problem with the production and selling of art is how easily it can be duplicated and pirated. Once something is copied and replicated for free, scarcity is offset and the value drops. Obviously, especially for digital art, the opportunity is immediate. Blockchain is countering the issue by introducing the idea of digital scarcity, issuing a limited number of copies and tying them back to unique blocks proving ownership.
"Ascribe", a Berlin-based start-up, makes use of Blockchain to enable digital artists to maintain control over where and how their work is seen, copied and distributed. It also provides a platform for digital artists to license their work and receive royalties for the reuse of their work. Furthermore, by construction, Blockchain's cryptography will keep online transactions secure. Transparent trading histories will speed transactions and help prove ownership, demonstrating that a seller has the right to trade and thereby securing the online market as trading channel (Bailey, The Blockchain Art Market is Here, 2017). The value of a Blockchain distributed ledger in a transaction can be summarized as shown in the table below:

	Value of Blockchain on Digital Art Sales
Authentication / Attribution	• *Once an artist has authenticated that this work is in fact created by him/her, it cannot be undone as the record of authentication is on the Blockchain and distributed across millions of machines. This protects the investment as collector indefinitely.*
Digital Editions	• *Whenever an artwork is offered in a limited edition, each number within the edition is tracked seperately on the ledger. Neither the artist nor anyone else can later expand the edition as this information is a matter of public record on the Blockchain.*
Proof of Ownership	• *Buyer information is also decentralized and cannot be contested.*
Provenance	• *No matter how many times a piece of art is bought and sold, the original purchase and the purchase of future owners of the work are documented and unalterable, creating a trusted provenance.*

Table 8: Value of Blockchain on Digital Art Sales

b. Democratizing Fine Art Investment

Additionally, Bitcoin is allowing more trading to take place digitally as it opens up to a wider range of people through the creation of platforms such as "Maecenas": In 2018, Maecenas launched the first open blockchain platform that democratizes access to fine art by the so-called "tokenization" of works of art (UBS & Art Basel, 2019). Now people outside the circle of HNWIs who have wished for owning famous paintings can buy shares in a Picasso, Warhol, Monet, amongst others. On the flipside, galleries, museums, and collectors can offer up works from their collection for bid on Maecenas to raise money for the purchase of future works (while leaving their collection intact). Contrary to regular art funds, Blockchain cuts out the middleman, greatly reducing the transaction costs such that, theoretically, as little as fractions of a penny using cryptocurrency can be invested

without taking the hit of transaction fees. Doing so, Maecenas transforms artworks valued at tens of millions of dollars into tiny digital units that can be easily bought and sold in real time. Maecenas essentially constitutes a stock market for art, though with far less frictions or fees. In 2018, the world's first cryptocurrency art auction took place – using the Maecenas platform partnered with London gallery Dadiani Fine Art – buyers were offered the chance to own a fraction of Andy Warhol's "14 Small Electric Chairs" (1980), issuing six million art tokens, with the auction achieving a reported value of USD 6.5m for a 49% share, while the owners of the work retained 51% (UBS & Art Basel, 2019). 31.5% of the Warhol work went up for sale in cryptocurrencies, including Bitcoin and Ethereum (Elhanani, 2018). Such marketplace will further pave the way for change of how collectors own art and use the art they own as it allows more art to be owned jointly by a number of people, or to be used as collateral against loans (DACS, Oxford Internet Institute, The Alan Turing Institute, 2018), therefore increasing the market's liquidity.

c. Improving Provenance and Reducing Art Forgery

Probably the most obvious use of blockchain is to fight art forgery through the establishment of better authentication and provenance. At present, proving a piece's provenance relies too heavily on trust, on outdated, paper-based systems and on single, authoritative bodies. As such, art fraud remains a major issue. At least half of the works examined by the Fine Art Experts Institute in Geneva are fake or have been attributed to the wrong artist (Bailey, 2017). By construction, Blockchain is a distributed ledger in that it can provide an unalterable record of provenance from initial authentication to present ownership. Accordingly, art forgery can be tackled by providing real time verification of artworks using distributed ledger paired with other authentication technology, e.g. image-recognition.

London-based startup "Verisart" or New York-based "Artory" all create blockchain-based digital certificates for artworks and collectables, already working with contemporary artists to create a secure provenance for a piece of art from the moment of its creation (Vaizey, 2019). While this can be expected to become the common practice for new artworks, older pieces will still need to be verified as genuine by a specialist or the artist's estate before being linked to blockchain certificates. Christie's became the first major auction house to apply blockchain technology to its consignments, partnering with Artory to encrypt the provenance and sales records of the Barney A. Ebsworth collection (which sold for USD 323m) (UBS & Art Basel, 2019). Artory, founded in 2016, launched the Artory Registry in November 2018, with the works from this sale as its first entries. The Registry provides a secure, object-centric database that contains vetted data about artworks and collectibles, creating digital records of transactions via cryptography and blockchain technology to record significant events throughout a work's lifecycle. The aim of the Registry is to improve confidence in the provenance and title of works, recording events such as sales, appraisals, and conservation and exhibition histories. Verisart, founded in 2015, builds a global ledger of art and collectibles, including those sold on- and offline. Issuing certificates of authenticity for works of art – initially for those created by living artists, but in a second phase also for older works – Verisart supports the authenticity of online images, which can aid both artists and owners in claiming the rights and commercial value of their digital media (UBS & Art Basel, 2019). However,

there is reason why highly ambitious claims about how blockchain could transform the art market can be met with a degree of scepticism, too: As it is the case in other markets, while certain risks can in fact be mitigated, the new technology may as well open the gates for forgeries, lead to inconsistencies in stored data, and cause scalability and performance issues, all of which could adversely impact the user experience. A key issue in a registry like that of Artory is that the data in the blockchain is only as good as the data inputted. Artory has a vetted list of specialists who verify the information that goes into the blockchain, whereas Verisart does not have that restriction. As of now, no appropriate regulation is in place to enable Blockchain to thrive, ensuring consistency. As discussed, even with a standardized approach in place, however, it is difficult to assess how tracking provenance through Blockchain could be effective with non-contemporary artworks. The closed nature of provenance-tracking on blockchain does not currently allow for later amendments, and may therefore leave permanent inaccuracies related to such works. In addition, any erroneous input to the ledger would not allow for modification, limiting the possibility of audit and correction over time. A remaining challenge for registries is also finding ways to link the real, physical work of art to its blockchain record. Without a secure way to link the item to the digital ledger, it is still possible to replace it with a fake or to misreport its condition. There are several companies working with the registries to address this issue, i.e. using AI-based tools and computer vision to fingerprint objects and issue them with a unique reference number (or "digital passport") (UBS & Art Basel, 2019). In addition, while the often pointed-out ability of Blockchain to reduce or even eliminate transaction costs by cutting out the middlemen has generated renewed interest, in practice, most platforms are still charging fees of between 2-6%; A key issue in the tokenization of art, on- or offline, remains the lack of demand for the concept, which alongside these fees will unlikely support any mainstream interest (ibid). Furthermore, experts oppose the increased implementation of technology in fear of the idea that the art's cultural value tends to get lost as much of the interest in art and Blockchain seems to be coming from people who are not that interested in art but in the idea of monetising opportunities in a new field (Botz, 2018).

While the launch of various start-ups show that the market is catching on, it is evident that more data must be gathered and strategies put in place to avoid the obvious pitfalls and increase consumer confidence. However, it continues to be the case that, rather than massively disrupting the market, there will be a longer and slower adaption to the technological innovations, with the benefits presumably only becoming apparent in the longer horizon (UBS & Art Basel, 2019). For the time being, when buying art, the security of a face-to-face encounter with a specialist is hard to replace, especially with blockchain technology still in its infancy. That being said, innovations in blockchain are helping to lead the technological transformation of the art market, and this looks set to progress in 2019 (Elhanani, 2018).

3.7.3 Performance Outlook

Market analysis is of immense importance to investors. But what main message should be taken from the art market reports of UBS and Art Basel or ArtTactic? Most of all, that should be modesty; with a total market volume of USD 67.4bn., as estimated by the Swiss, the whole market turnover is just as big as that of the

German automotive producer Audi. Despite several million-high auction house transactions records, the market remains a niche. The geographical examination of the art market sheds light as well: Though the middle and far east have created some newspaper headlines, the US was still by far the largest market worldwide, accounting for 44% of sales by value in 2018, with UK being in the position as the second-largest market with 21%, followed by China (19%) (UBS & Art Basel, 2019).

In ten years from 2008-2018, the art market now is at its second-highest level of art sales. For the same time period, the number of transactions achieved a new maximum, showing a 2% year-on-year increase to an estimated 39.8m transactions. However, the volume of global sales has still declined by 9% in the ten-year period between 2008-2018, while the value of transactions has increased by 9% over the same time span. That is, since 2017, China's market share has decreased by 3% year-on year, as expected due to increasing capital controls in the mainland (cf. ch. 1.2.2 above). Despite Brexit worries and a weakened GBP, the UK had a relatively strong year of sales, with values rising 8% to just under USD 14bn. Though in the rest of Europe, performance was mixed in 2018, with many of the larger markets declining, the bottom line still has increased with the strong top three, US, UK and China making up 84% of the global art market. It should be pointed out though, that the demand in these centers is not fuelled solely by national wealth but also by the existence and maturity of the art market itself; art brought into the US, for instance, is often just as likely to be bought by buyers outside (UBS & Art Basel, 2019).

Given political developments and increasing trade tensions – especially with respect to Brexit – which has not yet shown any concrete impact, effects can be expected to manifest in the art market as well. Furthermore, with art is no longer eligible for 1031 exchanges, many art market participants subject to U.S. law will likely hold their art for longer time periods, constituting another cause for a presumably noticeable decline in art market turnover. Paired with the analyses of Kraeussl et al. (2014), there should be a recovery of the art market expected in the nearer future. While recovery from these correction in the market may be underway, returns in art as an investment should remain flat for the time being (Kraeussl, 2015). Even with technology on its way, after all, the general bearish outlook on the (short-term) art market is not unfounded.

Conclusion

Though the demand for alternative assets may be prevailing, the question remains whether investors find the solution in art. This thesis was never aiming to propagate the recommendation to put a great fraction of an investor's net worth into fine arts; however, based on existing literature and common sense, there are plenty of reasons to believe that investments in art can provide value in excess of its "pleasure dividend" – for example, for hedging inflation. The fact that it is almost uncorrelated to traditional investment markets and has consistent performance returns are real reasons why investors would tend to have minor fractions of their investment portfolio in artworks – and art funds could be a cost-effective way to do so.

As most other research papers that have assessed the returns of art as a financial investment in general, or its diversification benefits in particular, the results of this thesis do not allow for a general acceptance, nor an outright rejection, of the notion of art as an investment. However, the outcome tends towards perceiving art as a predominately emotional investment that should primarily yield aesthetical pleasures instead of financial returns. Firstly, in line with the majority of existing research papers, covering different periods, mediums, schools and geographical origins and markets, the findings indicate that the risk-adjusted performance of art is dominated by other asset classes. Based on the data provided, analyses lead to the conclusion that diversification across different art categories does not provide convincing benefits. Arguably, this gap between existing academic research and common sense arises from a narrow view on the data, where portfolios are already diversified. As for stock investments – it is not advisable to only buy a few stocks to get exposure to equity markets and the same should hold true for art. Investors will still need a broadly diversified portfolio of non-speculative art of this type for best effect which becomes costly. Moreover, especially limited pieces of work of deceased artists would price most investors out of the market. Secondly, advocating in favor of seeing art as an investment are the prospects of the still immature art investment funds market. In addition to the funds' ability to decrease overall transaction costs, they exploit the art market's most prominent deficiency: the lack of transparency. This imminent advantage of insiders that comes as a disadvantage to any potential outside investor, in theory, allows funds to assemble a well-diversified portfolio, allocating a portion to this asset class – which would otherwise not be feasible. However, the history of art investment funds, led by experienced professionals with profound market knowledge and exceptional access to different market channels, do not reveal many success stories, which is astonishing, given the advantages such funds have over other market participants. Indeed, though the art market has seen strong growth in the past, it started slowing. This slowdown can be traced back to a lack of confidence amongst investors. It remains to be seen if the art funds market will manage to gain momentum in the future, as its significance amongst a broad base of investors becomes clearer. However, recent macroeconomic events will likely influence their development in the short term, with trade tensions on the one hand, and further technological advancements on the other. Going forward, blockchain and tokenization will allow easier access to the market, diversification of investment, reduced transaction costs, and increased liquidity. And the popularity of art is likely to continue as more people enter the market; with those people, the art market's transparency and thus investability will increase.

Lastly, generally, collectors, galleries or intermediaries, do not agree with the notion of art as a financial investment. Though, ultimately, they each represent an enterprise that has to prove profits in order to survive. Also connoisseurs and enthusiasts, generally do not admit that they are also concerned about financial returns – the authenticity of such statements from generally HNWIs or UHNWIs is though doubtful. They typically refer to a misappropriation when it comes to art as an investment. Especially when it comes to discussions about the price formation of artworks they often argue in the sense of the artist, who certainly had the aesthetics as the ultimate goal. It is often forgotten at this point that even artists are dependent on a living. However, those artists and art enthusiasts who are already attached to a more romantic idealist view may in fact be right in that art should be something completely different from business. Art investments may in fact be one of the only investments one makes where the decision to invest lies in the heart, rather than the bank account. Eventually, investors must carefully consider what they expect from investments in art in terms of return, taking on risk and whether to keep or when to sell. Besides a bountiful pleasure dividend, exposure to art may indeed bring yet a positive side-effect that potentially makes such an investment worthwhile after all, despite its inferior risk-return characteristics. The feature to hedge inflation by creating exposure to art becomes especially relevant in a world where alternative sources of asset management, such as fixed interest, property and cash all look unattractive.

Future research can address a variety of issues. The most urgent, however, seems to be the further exploration of prices of artworks sold through galleries and other sales channels besides the widely explored auction market. This would yield further insight into the relative performance of auction markets, on which the current assessment of art performance is predominately based on. Combining observations of both channels would allow the analysis of the entire life cycle of a painting, and the higher density of observations over time would pave the way for more exact and advanced analysis. Other fields of interest would be the further qualitative and quantitative analysis of both supply and demand in the art market. It would be of interest to what extent artists draw information from the market, and how they change their artistic expression based on such inferences. On the other hand, the behavior of art collectors, especially regarding purchase and selling decisions, deserves further attention. Likewise, costs associated with transactions and ownership of art could be quantified in more detail, especially in order to examine the costs savings realized through investment funds.

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Appendix

Appendix 1: Securities Vs. Stocks

	Securities	Artworks
Supply	• *large number of homogenous securities; perfect substitutes*	• *unique; imperfect substitutes*
Owners	• *independent traders in an almost perfectly competitive stock market*	• *owners of art hold monopoly on the artwork*
Source of Value	• *intrinsic/ asset value*	• *reputation of the artist; emotional value*
Investment Horizon	• *long-, medium- and shortterm*	• *typically longterm*
Liquidity	• *transactions take place frequently; almost continuously*	• *artworks are relatively seldomly resold*
Sources of Information	• *prospectus*	• *catalogue*
Insider Information	• *prices of stocks generally are public information*	• *prices of artworks are generally only known to parties involved in the transaction*
Price Stability	• *very sensitive to information, fluctuating with economy, prone to crises*	• *sensitive to trends and tastes; less sensitive to economic downturns*
Demand	• *generally increasing*	• *generally increasing*
Equilibrium Price	• *discounted future cash flows*	

Appendix 2: Art Tax Matrix (Deloitte)

	Austria	Belgium	France*	Germany	Hong-Kong	Italy
Net Wealth Tax	• *no net wealth tax*	• *no net wealth tax*	• *art assets are excluded from the NWT tax base*	• *no net wealth tax*	• *not applied to works of art owned by individuals or companies*	• *not applied to works of art owned by individuals or companies*
Income Tax	• *calculated on a progressive scale from 0% (if the taxable income does not exceed EUR 11,000) to 50% (from EUR 60,000)*	• *ranges from 25% to 50% (as from EUR 34,330); Additional surcharge may apply: A communal surtaxe, based on the income tax*	• *levied at rates of up to 45%. There are also two further contributions: Additional social security contribution of 15.5% (CSG and CRDS); A high income contribution, e.g. for a married taxpayer, 3% of the difference between EUR 500,000 and EUR 1 million, and 4% of the amount exceeding EUR 1 million*	• *rates are progressive and range from 14% to 45%. A solidarity surcharge of 5.5% (resulting in a top rate of 47.5%) and church tax of 9% (8% in Bavaria and Baden-Württemberg) are levied on income tax*	• *applied at rates of up to 15%*	• *depends on whether the individual is engaged in a commercial activity: For income resulting from a commercial activity, the marginal income tax rates applied range from 19% to 43%. A regional tax on commercial activity is also levied (ordinary rate 3.9%); No tax is levied on income that does not result from a commercial activity*
Corporate Tax	• *25%*	• *33.99%. Reduced graduated tax rates apply on a maximum of EUR 322,500 of taxable income if certain conditions are met*	• *33.33%.There is a mechanism allowing for the taxable deduction of purchases of works of art of living artists over five years*	• *15%. The municipal trade tax rate typically ranges between 14% and 17%. The effective combined tax rate is between 30% and 33%.A solidarity surcharge of 5.5% is levied on corporate income tax*	• *16.5%*	• *27.5%, and a regional tax also applies (ordinary rate 3.9%)*
Capital Gains Tax	• *capital gains made from the sale of private assets (e.g. art assets) held for more than one year are tax-exempt*	• *capital gains on the disposal of cultural property are not taxed if they are carried out as part of the management of private assets*	• *5% tax on sales exceeding EUR 5,000 made by individuals.Possibility to opt for the ordinary scheme of capital gains*	• *capital gains on the disposal of art assets are generally fully taxable. Exemption: capital gains on the disposal of private art assets by individuals are only taxable if the assets were held for a period of less than one year and if the collection is not considered as trade or business*	• *capital gains on the disposal of art assets are not taxed*	• *capital gains on the disposal of art assets are not taxed, and a regional tax also applies (ordinary rate 3.9%)*
Gift Tax	• *no gift tax; However, in some cases a statutory notification for gifts is necessary*	• *gifts are taxed at 3% for direct descendants and at 7% beyond the individual's immediate family*	• *rate according to family relationship. Tax rates range from 5% to 45% (more than EUR 1,805,677) with a deduction of EUR 100,000. 60% rate beyond the fourth degree of family relationships*	• *range from 7% to 50% depending on family relationship. Various exemptions are available (e.g. if specific conditions are met, a 100% tax exemption may apply)*	• *does not apply to art assets*	• *taking into account the non-taxable threshold amounts and depending on the relationship between the transferor and recipient, gift and inheritance tax rates vary between 0% and 8%*
Estate Tax	• *no estate tax*	• *there are complex rate scales depending on the region. Rates vary between 3% and 30% for spouses and direct descendants, and between 30% and 80% for others, excluding charities. Inheritance tax duties can be reduced via manual donations of cultural property*	• *same taxation as for gift tax*	• *range from 7% to 50% depending on family relationship. Various exemptions are available (e.g. if specific conditions are met, a 100% tax exemption may apply)*	• *does not apply to art assets*	• *with regard to inheritance tax only, the value of the art assets subject to tax may be limited to 10% of the entire portfolio transferred*

* Figures from 2013

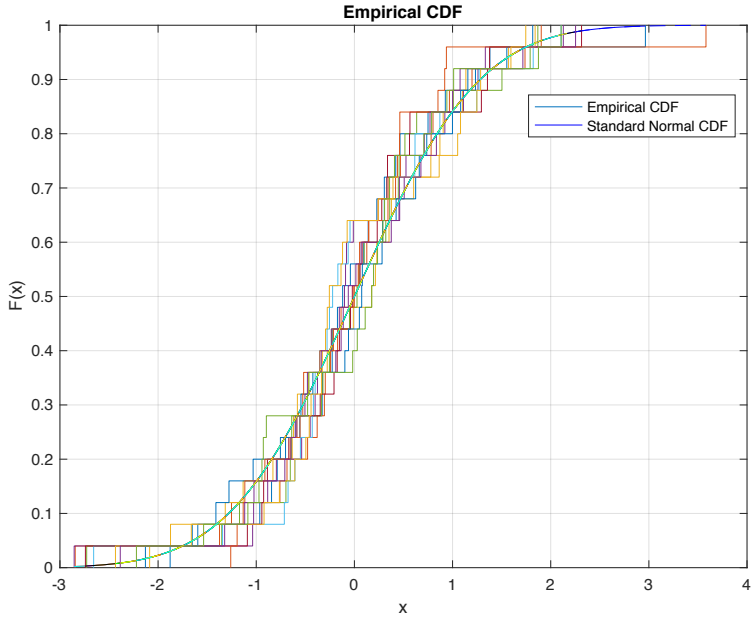
	Luxembourg	Russia	Singapore	Switzerland	United Kingdom	United States
Net Wealth Tax	• *no net wealth tax for individuals. Companies are subject to net wealth tax of 0.5% calculated using their net assets*	• *no net wealth tax*	• *net wealth tax is not applied to works of art owned by individuals or companies*	• *progressive tax scale ranging from 0.3% to 1% for individuals and from 0.05% to 1% for companies. Works of art qualifying as household goods are exempt from Wealth Tax for individuals*	• *no net wealth tax*	• *no net wealth tax*
Income Tax	• *calculated on a progressive scale and ranges from 0% to 40% (from EUR 100.000 class 1 and EUR 200,000 class 2)*	• *different for residents and non-residents: Tax residents are subject to a rate of 13% on most categories of their worldwide income; Non-residents are taxed at 30% on income generated in Russia only*	• *ranges from 0% to 20%.Note that certain eligible art donations (gifts to approved museums, donation of a sculpture for public display) can qualify for a 250% tax deduction. Such schemes apply to both corporate and individual donors*	• *federal rate ranging from 0 to 11.5%. Additional cantonal and municipal rates. Cumulative marginal income tax rate of up to 40%*	• *calculated on a progressive scale and ranges from 20% to 45% (as from GBP 150,000)*	• *marginal income tax rates ranging from 0% to 39.6%. Additional Medicare Hospital Insurance Tax of 0.9% on wages of an employee or self-employment income received during the year in excess of USD 200,000 (USD 250,000 if married and filing a joint tax return). Additional 3.8% tax on net investment income in excess of USD 250,000 for a married taxpayer (USD 125,000 for a married taxpayer filing separately and USD 200,000 for a single taxpayer). Investment income includes capital gains except to the extent derived in the ordinary course of a trade or business. US State taxes should also be considered. These rates apply to citizens or residents of the US, and treaties may apply*
Corporate Tax	• *29.22%, including corporate income tax of 22.47% and a communal business tax of 6.75% in Luxembourg City*	• *20%. Costs for purchase of art assets are unlikely to be deducted for income tax purposes unless there is a proven business need. Company property tax is not applied except for galleries, museums or similar*	• *17%; 75% of the first SGD 10,000 of taxable income, and 50% of the next SGD 290,000 of taxable income, is exempt. New start-up companies may also be exempt from tax on the first SGD 100,000 of taxable income, and on 50% of the next SGD 200,000 of taxable income, for the first three years of assessment. Corporate companies are also entitled to a 30% Corporate Income Tax Rebate (capped at SGD 30,000 p.a.)*	• *ranging from 13% to 23%*	• *between 20% and 21%*	• *the minimum income tax rate for companies is 35%. US State taxes should also be considered*
Capital Gains Tax	• *no tax on capital gains if held for more than six months*	• *the disposal of art assets is a taxable event for individuals (from an income tax standpoint). A property tax deduction equal to purchase costs is available for Russian tax residents. For tax non-residents the whole amount of the Russian source sale proceeds will be subject to a 30% tax. If the asset has been owned by a Russian tax resident for three years or more at the time of sale, no personal income tax applies*	• *at both the personal and corporate levels, Singapore does not tax capital gains, unless the gains are 'trading' in nature.*	• *in general no tax on capital gains related to the disposal of private assets (individual). This exemption does not apply should the art trading activity be qualified as a gainful activity in a self-employed capacity*	• *for individuals 18% or 28% (gains are treated as the top slice of an individual's combined gains and income.Gains exceeding the income tax basic rate band (currently GBP 31,865) are taxed at 28%. There is an annual exemption, currently GBP 11,000*	• *works of art held for one year or less are subject to personal marginal income tax rates of up to 39.6%. Works of art held for more than one year are taxed at a maximum rate of 28%.There is an additional 3.8% tax on net investment income in excess of USD 250,000 for a married taxpayer (USD 125,000 for married taxpayer filing separately and USD 200,000 for single taxpayer). Investment income includes capital gains except to the extent derived in the ordinary course of a trade or business. These rates apply to citizens or residents of the US, and treaties may apply*
Gift Tax	• *gift tax: between 1.80% and 14.40% depending on the family relationship*	• *in Russia there is no gift or estate tax. Personal income tax is levied on a recipient in the case of giving immovable property, vehicles, stocks and shares/units to persons other than close family members*	• *does not apply to art assets*	• *vary by canton and family relationship. Rates range from 0 to 50%*	• *no gift tax. However capital gains tax and/or inheritance tax (IHT) may apply on gifts made during lifetime or on death. Gift to a trust during an individual's lifetime is subject to IHT at 20%. A 40% rate applies to transfers on death. Certain exemptions and reliefs may be available*	• *individuals have an annual and lifetime gift exclusion. The 2014 annual exclusion is USD 14,000 and the 2014 inflation-adjusted exemption amount is USD 5.34 million. The top gift and estate tax rate is set at 40%. These rates apply to citizens or residents of the US, and treaties may apply.* *US State taxes should also be considered*
Estate Tax	• *no inheritance tax for direct descendants up to disposable portion*	• *see gift tax; there is no inheritance tax in Russia. Personal income tax is payable from remuneration received by the heir (successor) of an author (e.g. of works of science, literature or art). Art assets received from an individual as inheritance are not subject to Russian personal income tax*	• *does not apply to art assets*	• *vary by canton and family relationship. Rates range from 0 to 50%*	• *see gift tax*	• *see gift tax*

Appendix 3: Art Classification Moments

	MedRen	Baroque	Rococo	Neoclassicism	Romanticsm	Realism	ImprSymb	FauvExpr	CuFuCo	DadaSurr	AbstExpr	Pop	MinCont
Mean Return	*8,08%*	*6,56%*	*5,72%*	*7,31%*	*5,88%*	*5,28%*	*5,91%*	*6,53%*	*8,17%*	*7,46%*	*10,25%*	*14,49%*	*9,74%*
Geometric Return	*6,44%*	*5,82%*	*5,03%*	*5,36%*	*4,79%*	*4,16%*	*4,55%*	*4,90%*	*6,01%*	*5,58%*	*7,78%*	*10,35%*	*7,07%*
t-Stat (null)	*1,7522*	*2,3274*	*2,0895*	*1,3730*	*1,5826*	*1,3481*	*1,3184*	*1,2983*	*1,3555*	*1,3638*	*1,6289*	*1,6840*	*1,4636*
CAGR	*6,19%*	*5,59%*	*4,83%*	*5,15%*	*4,61%*	*4,00%*	*4,37%*	*4,70%*	*5,77%*	*5,36%*	*7,47%*	*9,94%*	*6,78%*
Volatility	*17,82%*	*12,16%*	*11,74%*	*19,01%*	*14,79%*	*15,12%*	*16,87%*	*18,41%*	*21,54%*	*19,92%*	*22,99%*	*29,25%*	*23,32%*
Coefficient of Variation	*2,2042*	*1,8534*	*2,0543*	*2,6021*	*2,5174*	*2,8625*	*2,8545*	*2,8217*	*2,6360*	*2,6694*	*2,2441*	*2,0183*	*2,3951*
Sharpe Ratio	*0,1963*	*0,1624*	*0,0963*	*0,1430*	*0,0872*	*0,0460*	*0,0785*	*0,1053*	*0,1664*	*0,1444*	*0,2461*	*0,3387*	*0,2209*
Skewness	*0,0265*	*-0,5696*	*-0,4369*	*0,8700*	*-0,4862*	*-0,5573*	*-1,1546*	*-1,0753*	*-1,6670*	*-1,3638*	*-1,7707*	*-1,3371*	*-0,7898*
Kurtosis	*1,2398*	*-0,0352*	*0,0382*	*2,2341*	*0,5850*	*1,4012*	*4,0131*	*3,7724*	*5,7606*	*4,1341*	*5,6911*	*3,5049*	*0,3474*

Values differ from findings as provided by Renneboog and Spaenjers (2009) as calculations are based on annual price data. Conclusions, however, are the same.

Appendix 4: Test for Normality – Art Categories



Appendix 5: Art Principal Portfolios – Moments

	PP 1	PP 2	PP 3	PP 4	PP 5	PP 6	PP 7	PP 8	PP 9	PP 10	PP 11	PP 12	PP 13
Mean	*0,34%*	*0,93%*	*5,96%*	*5,25%*	*6,32%*	*5,18%*	*3,67%*	*3,45%*	*5,71%*	*3,88%*	*2,84%*	*4,31%*	*5,75%*
Standard Deviation	*0,95%*	*6,96%*	*9,27%*	*2,13%*	*0,44%*	*1,56%*	*1,89%*	*2,05%*	*1,68%*	*2,15%*	*2,88%*	*0,10%*	*2,07%*
Coefficient of Variation	*2,8221*	*7,4766*	*1,5552*	*0,4058*	*0,0690*	*0,3009*	*0,5145*	*0,5939*	*0,2939*	*0,5537*	*1,0147*	*0,0230*	*0,3598*
Sharpe Ratio	*-4,4549*	*-0,5251*	*0,1482*	*0,3106*	*3,9772*	*0,3795*	*-0,4848*	*-0,5568*	*0,6711*	*-0,3285*	*-0,6057*	*-2,8251*	*0,5615*
Skew	*0,0265*	*-0,0265*	*0,0265*	*-0,0265*	*-0,0265*	*0,0265*	*-0,0265*	*-0,0265*	*0,0265*	*-0,0265*	*-0,0265*	*-0,0265*	*0,0265*
Kurtosis	*1,2398*	*1,2398*	*1,2398*	*1,2398*	*1,2398*	*1,2398*	*1,2398*	*1,2398*	*1,2398*	*1,2398*	*1,2398*	*1,2398*	*1,2398*
t-stat_null	*2,06*	*-0,01*	*3,30*	*12,59*	*74,71*	*17,01*	*9,85*	*8,51*	*17,46*	*9,15*	*4,93*	*221,71*	*14,25*

Appendix 6: EW13, VOLT – Regression Against Null Vector

EW

t-Test: Paired Two Sample for Means

	Variable 1	*Variable 2*
Mean	0,055279014	0
Variance	0,030360542	0
Observations	22	22
Pearson Correlation	#DIV/0!	
Hypothesized Mean Difference	0	
df	21	
t Stat	1,488047742	
P(T<=t) one-tail	0,075800864	
t Critical one-tail	1,720742903	
P(T<=t) two-tail	0,151601729	
t Critical two-tail	2,079613845	

VOLT

t-Test: Paired Two Sample for Means

	Variable 1	*Variable 2*
Mean	0,066276062	0
Variance	0,02462338	0
Observations	22	22
Pearson Correlation	#DIV/0!	
Hypothesized Mean Difference	0	
df	21	
t Stat	1,981044366	
P(T<=t) one-tail	0,030416358	
t Critical one-tail	1,720742903	
P(T<=t) two-tail	0,060832716	
t Critical two-tail	2,079613845	

Appendix 7: EW13, VOLT – Regression Against Market Excess

EW		
	β	*α*
Coefficients	*-0,7283*	*0,1650*
Standard Errors	*0,5437*	*0,0973*
R^2, SE y	*0,0823*	*0,4341*
F, df	*1,7946*	*20*
SS reg, SS resid	*0,3382*	*3,7691*
t-Stat	*-1,3396*	*1,6955*

VOLT		
	β	*α*
Coefficients	*-0,4380*	*0,1538*
Standard Errors	*0,6225*	*0,1040*
R^2, SE y	*0,0242*	*0,4477*
F, df	*0,4951*	*20*
SS reg, SS resid	*0,0992*	*4,0081*
t-Stat	*-0,7036*	*1,4788*

Appendix 8: Art Classifications - Regression Against Market Excess

MedRen	β	α
Coefficients	-0,0246	0,1312
Standard Errors	0,4878	0,0905
R^2, SE y	0,0001	0,4259
F, df	0,0025	23
SS reg, SS resid	0,0005	4,1714
t-Stat	-0,0504	1,4499

Baroque	β	α
Coefficients	-0,3397	0,1488
Standard Errors	0,7113	0,0938
R^2, SE y	0,0098	0,4238
F, df	0,2280	23
SS reg, SS resid	0,0410	4,1309
t-Stat	-0,4775	1,5862

Rococo	β	α
Coefficients	-1,1403	0,1856
Standard Errors	0,7010	0,0877
R^2, SE y	0,1032	0,4033
F, df	2,6465	23
SS reg, SS resid	0,4305	3,7413
t-Stat	-1,6268	2,1163

Neoclassicism	β	α
Coefficients	-0,3511	0,1479
Standard Errors	0,4514	0,0873
R^2, SE y	0,0256	0,4204
F, df	0,6050	23
SS reg, SS resid	0,1069	4,0649
t-Stat	-0,7778	1,6943

Romanticism	β	α
Coefficients	-0,8500	0,1694
Standard Errors	0,5603	0,0853
R^2, SE y	0,0910	0,4061
F, df	2,3017	23
SS reg, SS resid	0,3795	3,7923
t-Stat	-1,5171	1,9852

Realism	β	α
Coefficients	-0,9984	0,1703
Standard Errors	0,5360	0,0824
R^2, SE y	0,1311	0,3970
F, df	3,4697	23
SS reg, SS resid	0,5468	3,6250
t-Stat	-1,8627	2,0682

ImprSymb	β	α
Coefficients	-0,6657	0,1592
Standard Errors	0,4962	0,0849
R^2, SE y	0,0726	0,4101
F, df	1,8001	23
SS reg, SS resid	0,3028	3,8690
t-Stat	-1,3417	1,8746

FauvExpr	β	α
Coefficients	-0,5255	0,1547
Standard Errors	0,4593	0,0857
R^2, SE y	0,0539	0,4143
F, df	1,3093	23
SS reg, SS resid	0,2247	3,9471
t-Stat	-1,1442	1,8054

CuFuCo	β	α
Coefficients	-0,4833	0,1578
Standard Errors	0,3909	0,0856
R^2, SE y	0,0623	0,4124
F, df	1,5286	23
SS reg, SS resid	0,2600	3,9118
t-Stat	-1,2364	1,8443

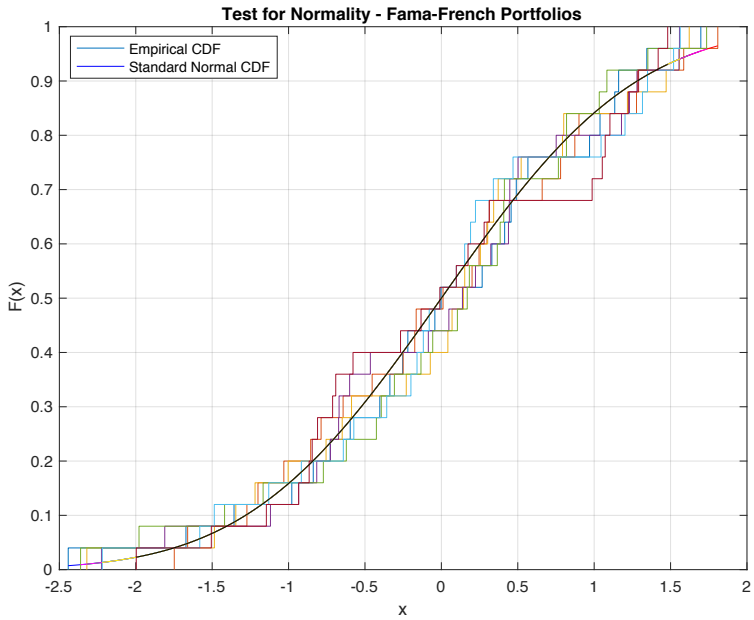
DadaSurr	β	α
Coefficients	-0,5639	0,1603
Standard Errors	0,4202	0,0851
R^2, SE y	0,0726	0,4101
F, df	1,8003	23
SS reg, SS resid	0,3028	3,8690
t-Stat	-1,3418	1,8821

AbstExpr	β	α
Coefficients	-0,5311	0,1694
Standard Errors	0,3615	0,0858
R^2, SE y	0,0858	0,4072
F, df	2,1579	23
SS reg, SS resid	0,3578	3,8140
t-Stat	-1,4690	1,9737

Pop	β	α
Coefficients	-0,3540	0,1645
Standard Errors	0,2879	0,0872
R^2, SE y	0,0617	0,4125
F, df	1,5120	23
SS reg, SS resid	0,2573	3,9145
t-Stat	-1,2296	1,8854

MinCont	β	α
Coefficients	-0,5747	0,1689
Standard Errors	0,3530	0,0842
R^2, SE y	0,1033	0,4033
F, df	2,6508	23
SS reg, SS resid	0,4311	3,7407
t-Stat	-1,6281	2,0059

Appendix 9: Test for Normality – Fama-French Portfolios



Appendix 10: Fama-French Portfolios Moments

	Inv_D4	DP_D8	Value_Q2	OP_D9	CF_P_Hi30	Size_D9	EP_D7
Arithmetic Mean	*15,39%*	*15,81%*	*14,35%*	*16,12%*	*16,72%*	*15,14%*	*17,72%*
Geometric Mean	*14,79%*	*14,99%*	*13,63%*	*15,00%*	*15,80%*	*14,22%*	*16,84%*
t-stat (null)	*6,51*	*5,67*	*5,61*	*5,01*	*5,79*	*5,21*	*6,07*
Jensen's Alpha	*-0,01*	*0,05*	*0,02*	*0,04*	*0,03*	*0,06*	*-0,02*
t-stat (alpha_market excess)	*-0,04*	*0,38*	*0,18*	*0,38*	*0,27*	*0,53*	*-0,13*
Median	*14,30%*	*14,81%*	*15,01%*	*16,84%*	*17,53%*	*14,00%*	*16,19%*
Std Dev	*10,62%*	*12,18%*	*11,54%*	*14,42%*	*13,08%*	*13,04%*	*12,60%*
Sharpe Ratio	*1,0172*	*0,9211*	*0,8459*	*0,7998*	*0,9276*	*0,8092*	*1,0424*
Coefficient of Variation	*0,6902*	*0,7707*	*0,8043*	*0,8946*	*0,7823*	*0,8613*	*0,7111*
Skewness	*-0,7897*	*-0,2059*	*-0,6388*	*-0,6629*	*-0,9842*	*-0,5842*	*-0,2710*
Kurtosis	*0,7181*	*-0,7860*	*0,3416*	*0,2928*	*0,8995*	*0,2170*	*-0,7440*

Appendix 11: Correlation Amongst Fama-French Portfolios

Correlation Amongst Fama-French Portfolios

	Inv_D4	DP_D8	Value_Q2	OP_D9	CF_P_Hi30	Size_D9	EP_D7
Inv_D4	1,0000	0,8221	0,9339	0,8513	0,8836	0,9144	0,8979
DP_D8	0,8221	1,0000	0,8276	0,7373	0,8696	0,7946	0,9116
Value_Q2	0,9339	0,8276	1,0000	0,9036	0,9221	0,9675	0,8817
OP_D9	0,8513	0,7373	0,9036	1,0000	0,8070	0,8996	0,8069
CF_P_Hi30	0,8836	0,8696	0,9221	0,8070	1,0000	0,9235	0,8832
Size_D9	0,9144	0,7946	0,9675	0,8996	0,9235	1,0000	0,8522
EP_D7	0,8979	0,9116	0,8817	0,8069	0,8832	0,8522	1,0000

Appendix 12: Value-Weighted Fama-French Portfolios Variation

	Eigenvalue	Cumulative Variance (in %)
PC 1	*0,1230*	*88,5749*
PC 2	*0,0073*	*93,8295*

Appendix 13: Value-Weighted Fama-French VaR and ES (1)

	Inv_D4	DP_D8	Value_Q2	OP_D9	CF_P_Hi30	Size_D9	EP_D7
Normal VaR (90%)	*1,78%*	*0,19%*	*-0,44%*	*-2,36%*	*-0,04%*	*-1,57%*	*1,57%*
Normal VaR (95%)	*-2,08%*	*-4,23%*	*-4,63%*	*-7,60%*	*-4,79%*	*-6,31%*	*-3,01%*
Historical VaR (90%)	*-2,51%*	*-4,65%*	*-3,75%*	*-7,42%*	*-7,80%*	*-7,15%*	*-1,63%*
Historical VaR (95%)	*-11,20%*	*-8,27%*	*-12,64%*	*-17,98%*	*-15,98%*	*-14,79%*	*-9,64%*
ES (90%)	*-6,17%*	*-5,95%*	*-7,60%*	*-11,49%*	*-10,99%*	*-10,47%*	*-4,90%*
ES (95%)	*-8,93%*	*-7,96%*	*-9,98%*	*-16,31%*	*-14,60%*	*-12,48%*	*-7,85%*

Appendix 14: Value-Weighted Fama-French VaR and ES (2)

	EW_FF	VOLT_FF	PP 2	MV	TPF
Normal VaR (90%)	*-1,95%*	*-6,80%*	*5,03%*	*1,89%*	*2,03%*
Normal VaR (95%)	*-6,75%*	*-12,40%*	*4,93%*	*-1,96%*	*-2,14%*
Historical VaR (90%)	*-2,69%*	*-2,30%*	*4,85%*	*-1,57%*	*-0,11%*
Historical VaR (95%)	*-12,30%*	*-19,55%*	*4,66%*	*-9,99%*	*-9,74%*
ES (90%)	*-6,70%*	*-9,77%*	*4,77%*	*-5,06%*	*-3,93%*
ES (95%)	*-9,90%*	*-14,39%*	*4,71%*	*-7,94%*	*-7,90%*

Appendix 15: Fama-French Principal Components – Regressions

Regressions against US Market Excess:

PP_1	β	α
Coefficients	*7,7592*	*-0,0159*
Standard Erro	*5,8164*	*0,1365*
R^2, SE y	*0,0718*	*0,4103*
F, df	*1,7796*	*23*
SS reg, SS res	*0,2996*	*3,8722*
t-Stat	*1,3340*	*-0,1162*

PP_2	β	α
Coefficients	*43,0562*	*-2,1280*
Standard Erro	*32,2752*	*1,6943*
R^2, SE y	*0,0718*	*0,4103*
F, df	*1,7796*	*23*
SS reg, SS res	*0,2996*	*3,8722*
t-Stat	*1,3340*	*-1,2560*

PP_3	β	α
Coefficients	*-15,8368*	*0,7368*
Standard Erro	*11,8714*	*0,4625*
R^2, SE y	*0,0718*	*0,4103*
F, df	*1,7796*	*23*
SS reg, SS res	*0,2996*	*3,8722*
t-Stat	*-1,3340*	*1,5931*

Regressions against null-vector:

PP_1
t-Test: Paired Two Sample for Means

	Variable 1	*Variable 2*
Mean	0,018748536	0
Variance	0,000207356	0
Observations	25	25
Pearson Corre	#DIV/0!	
Hypothesized	0	
df	24	
t Stat	6,509966804	
P(T<=t) one-t	4,92955E-07	
t Critical one-t	1,71088208	
P(T<=t) two-t	9,85911E-07	
t Critical two-t	2,063898562	

PP_2
t-Test: Paired Two Sample for Means

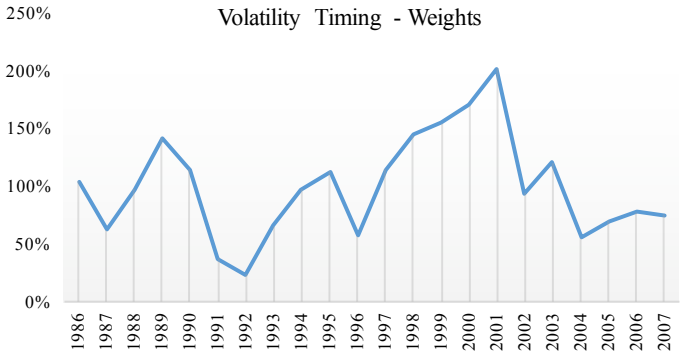
	Variable 1	*Variable 2*
Mean	0,052434507	0
Variance	6,7341E-06	0
Observations	25	25
Pearson Corre	#DIV/0!	
Hypothesized	0	
df	24	
t Stat	101,0292912	
P(T<=t) one-t	2,24033E-33	
t Critical one-t	1,71088208	
P(T<=t) two-t	4,48066E-33	
t Critical two-t	2,063898562	

PP_3
t-Test: Paired Two Sample for Means

	Variable 1	*Variable 2*
Mean	0,038341552	0
Variance	4,97758E-05	0
Observations	25	25
Pearson Corre	#DIV/0!	
Hypothesized	0	
df	24	
t Stat	27,17254914	
P(T<=t) one-t	7,75151E-20	
t Critical one-t	1,71088208	
P(T<=t) two-t	1,5503E-19	
t Critical two-t	2,063898562	

Appendix 16: EW20, VOLT – Art and Equities

	EW20	**VOLT_incl**
Target chosen so that average of weight equals	-	*1*
Target volatility	-	*5,40%*
	-	*18,50*
Average rf rate	*4,59%*	
Average return	*10,23%*	*10,79%*
Standard deviation	*0,1154*	*0,1172*
Sharpe ratio	*0,4891*	*0,5288*
t-Stat (null)	*4,1577*	*4,3155*
t-Stat (m_excess; alpha)	*1,4139*	*0,9840*
t-Stat (m_excess; beta)	*-0,6656*	*-0,0642*
Skew	*0,0368*	*0,9292*
Kurtosis	*-0,4105*	*1,7122*



Appendix 17: EW20, VOLT – Art and Equities

	EW20	VOLT_incl	MV	TPF
Normal VaR (90%)	-4,56%	-4,24%	3,02%	4,62%
Normal VaR (95%)	-8,75%	-8,50%	0,58%	1,72%
Historical VaR (90%)	-4,38%	-4,37%	1,33%	3,07%
Historical VaR (95%)	-11,31%	-5,79%	0,45%	-2,59%
ES (90%)	-7,31%	-4,94%	0,98%	0,79%
ES (95%)	-9,46%	-5,51%	0,61%	-1,39%

Appendix 18: Fama Ex-Post Regression (Inflation Hedging) – Art Categories

MedRen	β	α
Coefficients	*-3,2554*	*0,1821*
Standard Errors	*4,2531*	*0,1381*
R^2, SE y	*0,0248*	*0,1976*
F, df	*0,5859*	*23*
SS reg, SS resid	*0,0229*	*0,8981*
t-Stat	*-0,7654*	*1,3189*

Baroque	β	α
Coefficients	*-0,9553*	*0,0953*
Standard Errors	*2,7569*	*0,0895*
R^2, SE y	*0,0052*	*0,1281*
F, df	*0,1201*	*23*
SS reg, SS resid	*0,0020*	*0,3774*
t-Stat	*-0,3465*	*1,0651*

Rococo	β	α
Coefficients	*0,7457*	*0,0340*
Standard Erro	*2,6671*	*0,0866*
R^2, SE y	*0,0034*	*0,1239*
F, df	*0,0782*	*23*
SS reg, SS res	*0,0012*	*0,3532*
t-Stat	*0,2796*	*0,3924*

Neoclassicism	β	α
Coefficients	*0,4518*	*0,0590*
Standard Errors	*4,9358*	*0,1602*
R^2, SE y	*0,0004*	*0,2293*
F, df	*0,0084*	*23*
SS reg, SS resid	*0,0004*	*1,2096*
t-Stat	*0,0915*	*0,3682*

Romanticism	β	α
Coefficients	*-3,2650*	*0,1603*
Standard Errors	*3,2808*	*0,1065*
R^2, SE y	*0,0413*	*0,1524*
F, df	*0,9904*	*23*
SS reg, SS resid	*0,0230*	*0,5344*
t-Stat	*-0,9952*	*1,5053*

Realism	β	α
Coefficients	*0,5584*	*0,0354*
Standard Erro	*3,3964*	*0,1103*
R^2, SE y	*0,0012*	*0,1578*
F, df	*0,0270*	*23*
SS reg, SS res	*0,0007*	*0,5727*
t-Stat	*0,1644*	*0,3215*

ImprSymb	β	α
Coefficients	*-0,7203*	*0,0815*
Standard Errors	*3,6693*	*0,1191*
R^2, SE y	*0,0017*	*0,1705*
F, df	*0,0385*	*23*
SS reg, SS resid	*0,0011*	*0,6685*
t-Stat	*-0,1963*	*0,6843*

FauvExpr	β	α
Coefficients	*0,0498*	*0,0637*
Standard Errors	*4,0371*	*0,1311*
R^2, SE y	*0,0000*	*0,1876*
F, df	*0,0002*	*23*
SS reg, SS resid	*0,0000*	*0,8092*
t-Stat	*0,0123*	*0,4861*

CuFuCo	β	α
Coefficients	*2,5801*	*0,0014*
Standard Erro	*4,4866*	*0,1457*
R^2, SE y	*0,0142*	*0,2085*
F, df	*0,3307*	*23*
SS reg, SS res	*0,0144*	*0,9995*
t-Stat	*0,5751*	*0,0099*

DadaSurr	β	α
Coefficients	*1,9605*	*0,0136*
Standard Errors	*4,2499*	*0,1380*
R^2, SE y	*0,0092*	*0,1975*
F, df	*0,2128*	*23*
SS reg, SS resid	*0,0083*	*0,8968*
t-Stat	*0,4613*	*0,0989*

AbstExpr	β	α
Coefficients	*3,8959*	*-0,0187*
Standard Errors	*4,7478*	*0,1541*
R^2, SE y	*0,0284*	*0,2206*
F, df	*0,6733*	*23*
SS reg, SS resid	*0,0328*	*1,1192*
t-Stat	*0,8206*	*-0,1216*

Pop	β	α
Coefficients	*1,1821*	*0,1082*
Standard Erro	*6,4438*	*0,2092*
R^2, SE y	*0,0015*	*0,2994*
F, df	*0,0337*	*23*
SS reg, SS res	*0,0030*	*2,0616*
t-Stat	*0,1835*	*0,5170*

MinCont	β	α
Coefficients	*0,8992*	*0,0694*
Standard Errors	*5,2036*	*0,1689*
R^2, SE y	*0,0013*	*0,2418*
F, df	*0,0299*	*23*
SS reg, SS resid	*0,0017*	*1,3444*
t-Stat	*0,1728*	*0,4108*

Appendix 19: Inflation Hedging Analysis – Gold vs. Art

	MedRen	Baroque	Rococo	Neoclassicism	Romanticism	Realism	ImprSymb	FauvExpr	CuFuCo	DadaSurr	AbstExpr	Pop	MinCont	**Gold**
Correlation Real Returns with Inflation	*-0,2095*	*-0,1527*	*-0,0218*	*-0,0243*	*-0,2629*	*-0,0278*	*-0,0989*	*-0,0525*	*0,0685*	*0,0430*	*0,1222*	*0,0000*	*-0,0082*	***-0,3828***
Pearson Correlation	*-0,1513*	*-0,0692*	*0,0559*	*0,0183*	*-0,1951*	*0,0329*	*-0,0393*	*0,0025*	*0,1143*	*0,0919*	*0,1619*	*0,0367*	*0,0346*	***-0,3164***
OLS Estimate	*-3,1252*	*-0,9171*	*0,7159*	*0,4337*	*-3,1344*	*0,5361*	*-0,6915*	*0,0478*	*2,4769*	*1,8821*	*3,7401*	*1,1349*	*0,8632*	***-4,9650***

Gold	β	α
Coefficients	*-5,1718*	*0,1955*
Standard Errors	*3,0890*	*0,1003*
R^2, SE y	*0,1086*	*0,1435*
F, df	*2,8032*	*23*
SS reg, SS resid	*0,0577*	*0,4738*
t-Stat	*-1,6743*	*1,9491*

	Gold
Normal VaR (90%)	*-18,54%*
Normal VaR (95%)	*-23,90%*
Historical VaR (90%)	*-20,72%*
Historical VaR (95%)	*-23,02%*
ES (90%)	*-21,54%*
ES (95%)	*-22,86%*

```
%% one-sided KS Test
% Center Data:

SP500=VCVArt(:,1);
SP500_scale = (SP500-mean(SP500))/std(SP500);
hSP500 = kstest(SP500_scale);

INVD4=VCVArt(:,2);
INVD4_scale = (INVD4-mean(INVD4))/std(INVD4);
hINVD4 = kstest(INVD4_scale);

DPD8=VCVArt(:,3);
DPD8_scale = (DPD8-mean(DPD8))/std(DPD8);
hDPD8 = kstest(DPD8_scale);

ValueQ2=VCVArt(:,4);
ValueQ2_scale = (ValueQ2-mean(ValueQ2))/std(ValueQ2);
hValueQ2 = kstest(ValueQ2_scale);

OPD9=VCVArt(:,5);
OPD9_scale = (OPD9-mean(OPD9))/std(OPD9);
hOPD9 = kstest(OPD9_scale);

CFPHI30=VCVArt(:,6);
CFPHI30_scale = (CFPHI30-mean(CFPHI30))/std(CFPHI30);
hCFPHI30 = kstest(CFPHI30_scale);

SizeD9=VCVArt(:,7);
SizeD9_scale = (SizeD9-mean(SizeD9))/std(SizeD9);
hSizeD9 = kstest(SizeD9_scale);

EPD7=VCVArt(:,8);
EPD7_scale = (EPD7-mean(EPD7))/std(EPD7);
hEPD7 = kstest(EPD7_scale);

MedRen=VCVArt(:,9);
MedRen_scale = (MedRen-mean(MedRen))/std(MedRen);
hMedRen = kstest(MedRen_scale);

Baroque=VCVArt(:,10);
Baroque_scale = (Baroque-mean(Baroque))/std(Baroque);
hBaroque = kstest(Baroque_scale);

Rococo=VCVArt(:,11);
Baroque_scale = (Baroque-mean(Baroque))/std(Baroque);
hBaroque = kstest(Baroque_scale);

Neoclassicism=VCVArt(:,12);
Neoclassicism_scale = (Neoclassicism-mean(Neoclassicism))/std(Neoclassicism);
hNeoclassicism = kstest(Neoclassicism_scale);

Romanticism=VCVArt(:,13);
Romanticism_scale = (Romanticism-mean(Romanticism))/std(Romanticism);
hRomanticism = kstest(Romanticism_scale);

Realism=VCVArt(:,14);
Realism_scale = (Realism-mean(Realism))/std(Realism);
hRealism = kstest(Realism_scale);

ImprSymb=VCVArt(:,15);
ImprSymb_scale = (ImprSymb-mean(ImprSymb))/std(ImprSymb);
hImprSymb = kstest(ImprSymb_scale);
```

```
FauvExpr=VCVArt(:,16);
FauvExpr_scale = (FauvExpr-mean(FauvExpr))/std(FauvExpr);
hFauvExpr = kstest(FauvExpr_scale);

CuFuCo=VCVArt(:,17);
CuFuCo_scale = (CuFuCo-mean(CuFuCo))/std(CuFuCo);
hCuFuCo = kstest(CuFuCo_scale);

DadaSurr=VCVArt(:,18);
DadaSurr_scale = (DadaSurr-mean(DadaSurr))/std(DadaSurr);
hDadaSurr = kstest(DadaSurr_scale);

AbstExpr=VCVArt(:,19);
AbstExpr_scale = (AbstExpr-mean(AbstExpr))/std(AbstExpr);
hAbstExpr = kstest(AbstExpr_scale);

Pop=VCVArt(:,20);
Pop_scale = (Pop-mean(Pop))/std(Pop);
hPop = kstest(Pop_scale);

MinCont=VCVArt(:,21);
MinCont_scale = (MinCont-mean(MinCont))/std(MinCont);
hMinCont = kstest(MinCont_scale);


% h = 0 >>> KS Tests null-hypothesis that x comes from a normal distribution; if h=0↙
then null hypothesis is accepted

% Plot graphs:

cdfplot(MedRen_scale)
hold on
x_values = linspace(min(MedRen_scale),max(MedRen_scale));
plot(x_values,normcdf(x_values,0,1),'b-')
legend('Empirical CDF','Standard Normal CDF','Location','best');
cdfplot(AbstExpr_scale)
hold on
x_values = linspace(min(AbstExpr_scale),max(AbstExpr_scale));
plot(x_values,normcdf(x_values,0,1),'r-')
legend('Empirical CDF','Standard Normal CDF','Location','best');
cdfplot(Baroque_scale)
hold on
x_values = linspace(min(Baroque_scale),max(Baroque_scale));
plot(x_values,normcdf(x_values,0,1),'g-')
legend('Empirical CDF','Standard Normal CDF','Location','best');
cdfplot(CuFuCo_scale)
hold on
x_values = linspace(min(CuFuCo_scale),max(CuFuCo_scale));
plot(x_values,normcdf(x_values,0,1),'c-')
legend('Empirical CDF','Standard Normal CDF','Location','best');
cdfplot(DadaSurr_scale)
hold on
x_values = linspace(min(DadaSurr_scale),max(DadaSurr_scale));
plot(x_values,normcdf(x_values,0,1),'m-')
legend('Empirical CDF','Standard Normal CDF','Location','best');
cdfplot(FauvExpr_scale)
hold on
x_values = linspace(min(FauvExpr_scale),max(FauvExpr_scale));
plot(x_values,normcdf(x_values,0,1),'y-')
legend('Empirical CDF','Standard Normal CDF','Location','best');
cdfplot(ImprSymb_scale)
```

```
hold on
x_values = linspace(min(ImprSymb_scale),max(ImprSymb_scale));
plot(x_values,normcdf(x_values,0,1),'k-')
legend('Empirical CDF','Standard Normal CDF','Location','best');
cdfplot(MinCont_scale)
hold on
x_values = linspace(min(MinCont_scale),max(MinCont_scale));
plot(x_values,normcdf(x_values,0,1),'--r')
legend('Empirical CDF','Standard Normal CDF','Location','best');
cdfplot(Neoclassicism_scale)
hold on
x_values = linspace(min(Neoclassicism_scale),max(Neoclassicism_scale));
plot(x_values,normcdf(x_values,0,1),'--b')
legend('Empirical CDF','Standard Normal CDF','Location','best');
cdfplot(Pop_scale)
hold on
x_values = linspace(min(Pop_scale),max(Pop_scale));
plot(x_values,normcdf(x_values,0,1),'--g')
legend('Empirical CDF','Standard Normal CDF','Location','best');
cdfplot(Realism_scale)
hold on
x_values = linspace(min(Realism_scale),max(Realism_scale));
plot(x_values,normcdf(x_values,0,1),'--y')
legend('Empirical CDF','Standard Normal CDF','Location','best');
cdfplot(Romanticism_scale)
hold on
x_values = linspace(min(Romanticism_scale),max(Romanticism_scale));
plot(x_values,normcdf(x_values,0,1),'--c')
legend('Empirical CDF','Standard Normal CDF','Location','best');
cdfplot(Rococo_scale)
hold on
x_values = linspace(min(Rococo_scale),max(Rococo_scale));
plot(x_values,normcdf(x_values,0,1),'--m')
legend('Empirical CDF','Standard Normal CDF','Location','best');
hold on
title('Test for Normality - Art Categories')

%% Plot graphs - Test for Normality Fama French Portfolios:

cdfplot(INVD4_scale)
hold on
x_values = linspace(min(INVD4_scale),max(INVD4_scale));
plot(x_values,normcdf(x_values,0,1),'b-')
legend('Empirical CDF','Standard Normal CDF','Location','best');
cdfplot(DPD8_scale)
hold on
x_values = linspace(min(DPD8_scale),max(DPD8_scale));
plot(x_values,normcdf(x_values,0,1),'r-')
legend('Empirical CDF','Standard Normal CDF','Location','best');
cdfplot(ValueQ2_scale)
hold on
x_values = linspace(min(ValueQ2_scale),max(ValueQ2_scale));
plot(x_values,normcdf(x_values,0,1),'g-')
legend('Empirical CDF','Standard Normal CDF','Location','best');
cdfplot(OPD9_scale)
hold on
x_values = linspace(min(OPD9_scale),max(OPD9_scale));
plot(x_values,normcdf(x_values,0,1),'c-')
legend('Empirical CDF','Standard Normal CDF','Location','best');
cdfplot(CFPHI30_scale)
hold on
x_values = linspace(min(CFPHI30_scale),max(CFPHI30_scale));
```

```
plot(x_values,normcdf(x_values,0,1),'m-')
legend('Empirical CDF','Standard Normal CDF','Location','best');
cdfplot(SizeD9_scale)
hold on
x_values = linspace(min(SizeD9_scale),max(SizeD9_scale));
plot(x_values,normcdf(x_values,0,1),'y-')
legend('Empirical CDF','Standard Normal CDF','Location','best');
cdfplot(EPD7_scale)
hold on
x_values = linspace(min(EPD7_scale),max(EPD7_scale));
plot(x_values,normcdf(x_values,0,1),'k-')
legend('Empirical CDF','Standard Normal CDF','Location','best');
title('Test for Normality - Fama-French Portfolios')
%% Test for Normality S&P500
cdfplot(SP500_scale)
hold on
x_values = linspace(min(SP500_scale),max(SP500_scale));
plot(x_values,normcdf(x_values,0,1),'r')
legend('Empirical CDF','Standard Normal CDF','Location','best');
hold on
title('Test for Normality - SP500')
%%
% PCA Analysis - On ART (then on FF Value as well as FF Equal)

[coeff,score,latent] = pca(ArtExpressions);
%latent: captures variance of the principal components in descending order
% since I will show data in 3 dimensions, focus on first three principal components
% take first three columns from "scores", i.e. first three components:
x=score(:,1);
y=score(:,2);
z=score(:,3);

vbls =↙
{'MedRen','Baroque','Rococo','Neo','Romanticism','Realism','ImprSymb','FauvExpr','CuFu↙
Co','DadaSurr','AbstExpr','Pop','MinCont'}; % Labels for the variables
biplot(coeff(:,1:3),'Scores',score(:,1:3),'VarLabels',vbls); %plot coeff

title('Art Categories');

%how much variance do the components capture? s. latent

%% Principal Portfolios - Computed in Excel
```

Thesis Summary

Introduction

1. **Art vs. Alternative Asset Classes**
2. **Investment Opportunities: Art Investment Funds**
3. **Art Market Performance and Portfolio Diversification**

Conclusion

Introduction

The perception of art as an investment may raise the eyebrows of those who are passionate about its aesthetical value, which they see as incompatible with any financial interest. Though, art history teaches us that art collections have always been serving not only the prestige and the pleasure of beauty, but also forming a stately fortune (Czotscher, 2006). The fact that art market actors have purely emotional and no monetary interests has long been proven wrong, as shown by relevant literature. What is relatively new is that financial market players who have not been involved in art so far have become aware of this highly exciting market. Not so long ago, there was a perception that the fine art market was reserved for the rich and the very rich. However, fine art markets also follow the laws of capitalism, mainly due to one major phenomenon: globalization. With the long-termed, worldwide trend of increasing wealth, alongside the growth in knowledge about collectible markets, a much larger community has started to be interested in collecting and/or investing in rare collectible assets. Reasons for the rethinking of the economics of art include the growing number of publications on the subject, some sensational increases in the value of works of art and collections, and better access to information for buyers (Kunze, 2002). Regarding art as an investment is no longer reprehensible. The metaphor of a "wall share" nicely outlines what it is all about: on the one hand, a monetary dividend, and on the other hand also an "aesthetic dividend". Based on the findings of art history, the aim of this work is to investigate whether art can be used systematically for wealth creation. It is not only a question of whether art is suitable as a capital investment, i.e. whether it fulfills the requirements of an investor, but also in which form an investor can become active. Given that art is (at least for the time being) mostly (almost exclusively) traded and owned by the rich or ultra-rich only, it seems likely that the price development of art works is decoupled from the general economic situation – since in times of crisis, the rich and the ultra-rich are the ones least affected. As a result, one could naturally conclude that investment in the arts must offer diversification opportunities; this seems to be what many investors are willing to believe, as evidenced by the number of art fund and art market advisory firms that have evolved in recent years. At this point, the option to reach exposure to the art market via art investment funds will be examined and evaluated from the perspective of an investor. Thereby the primary focus does not lie on motives such as passion for art, prestige or speculation, but on solid investment in the sense of systematic asset accumulation. However, of course it would be wrong to consider works of art as purely a financial investment. any truly successful art investor not only understands the market but also recognizes the artistic idea of the artist (Wilke, 2000). Markets have shown a global slowdown throughout 2018. Trade and tariffs remain one of the biggest risks to the general market outlook. In fact, according to the UCLA Anderson Forecast, there's "a very real risk" the national economy will slide into a recession in late 2020 (Daniels, 2019). In light of current market conditions, the examination of alternative assets that would retain their value in the longer term especially in a period of economic uncertainty appears particularly relevant today. 2018 has brought both highs and lows to the art market. Auction records were broken, confidence levels wavered, paintings were shredded, and social media continued to change the artist's role in the industry. One of the most notable changes was the increase in

vibrant conversation around blockchain, which is being introduced to broaden the market's transparency, track ownership and provenance, and provide an infrastructure for the tokenization of fractional artwork sales.

This thesis did not attempt to settle the question of the legitimacy of buying and selling art with the principal aim of obtaining a financial benefit. Instead, it built upon the mere fact that pieces of art are assets, i.e. they can carry a certain financial value, which is – driven by changes in supply and demand – subject to changes over time and therefore harbours an opportunity of a monetary return. It thus attempts to assess the benefits of diversification of art investments in addition to a portfolio of financial assets, in line with finding of Pownall (2005) who has concluded that indeed, significant diversification benefits can be achieved by adding art to an investor's portfolio. Also in line with Pownall (2005), who recommends to buy shares in art investment funds (for those who do not want to invest directly or simply cannot afford to do so), this thesis shall further provide answers to the question whether such funds constitute a favourable vehicle providing a broader investor base with exposure to the art market. This hypothesis is based on the idea that art as an asset class (once established as such) offers opportunities for portfolio diversification. The underlying assumption is that the bundling of investments in the form of a fund should be able to significantly decrease the (as to be found typically high) transaction costs associated with investments in art. As art collectors (and art-collecting institutions) in general are concerned with the price formation in the art market and the return characteristics of art, there is a growing academic literature on art investments apart from the private and corporate research, such as within investment banks. In order to incorporate current developments, journals and reports were consulted.

This paper addressed the assessment of art as an investment in three main chapters. A first section is dedicated to contextual aspects and is devoted to the controversial question of how art qualifies as an investment. In these regards, this section reviewed existing literature on returns in the art market and correlations with other asset classes. It will be found that for its inefficiencies the art market has to be described as "imperfect". These a priori considerations will be essential in interpreting and qualifying the results of the analysis of performance observations. Chapter 2 followed with the introduction of art investment funds as a means to get exposure to the art market. Here, according to the research question, it will be primarily of interest what problems arise in practice with regard to investments in art funds and their performance evaluation. Within the third and last section of the thesis, the evolved hypotheses shall be quantified and tested using real data: The insights obtained after the first two chapters paired with the results from the financial analyses shall then be employed to evaluate the art market potential for systematic wealth management. The thesis concluded with a vivid snapshot of the art market as well as with a prediction in light of current advancements in technology.

1. Art vs. Alternative Asset Classes

Talk of art as an asset class is not quite new. One early art investor was the BRPF, which decided to invest into fine art and collectibles between 1974 and 1980, in an attempt to diversify its portfolio and hedge against inflation. Due to careful buying and smart timing in its purchases and sales, the BRPF generated respectable returns of 13.1% *per annum* (Peers, 1996). But today's investors and potential casual art buyers may not fully appreciate the profound differences in how the art market functions compared with the market for stocks and

bonds. In the following, a closer look shall be taken at how those differences affect the risks and returns of being an art investor. For the purposes of this discussion, "art" is meant to encompass as broad a categorization as possible and may include the following which is by no means a complete list or representation: paintings, sculpture, jewellery, cars, furniture, wine and collectibles, often – and thus as well here – referred to as "fine art". Art is characterized by a multitude of special attributes that differentiates it from other assets; namely, art objects are a product of the creativity of individuals. They are characterized by their heterogeneity: works of art are - except for prints and others multiple - unique, and thus differ from homogeneous goods such as shares or bonds (Throsby, 1994). Although the primary benefit of works of art thus far has undoubtedly predominantly lied in the consumption of its aesthetic qualities (Throsby, 1994), art generally constitutes a financial investment, too, for which price and future performance plays a role in the buying decision. Accordingly, art investors generally reconcile the costs-benefit relations (Wilke, 1999), that is, maximize their utility, both material and ideal, taking into account their respective economic conditions. Hence, art investors are themselves *homines oeconomici* in that, when investing in art, just like it is the case for investing in securities or real estate, they want to ensure that they do not over pay; The trouble is that there is no reliable way of doing that in the art market. As equity investors screen the stock market, art investors must mathematically and unemotionally figure out what a piece of work is worth. Interestingly, the evolution of real estate as a definable and measurable asset provides precedence for art in that real estate and art present similar challenges: each asset is unique; valuations can be challenging given few if any direct comparables exist; there are a myriad of indices with diverse underlying calculations and results; both are highly illiquid; buying, holding and selling costs are considerable. Nonetheless, for the last 20 years, real estate has commercialised as an investment. Many of the basic tools of portfolio management have been applied, though the underlying concepts (i.e. diversification, capital asset pricing models, international investing, structured finance, securitization, hedging, etc.) may be much older (Clayton, et al., 2009). Hence, why would art not be able to overcome its peculiarities and join this movement?

The most striking difference to other assets is, as Baumol (1986) notes, that pieces of art do not have one "true" (equilibrium) price; whereas, for instance, the fair value of an equity share of a company at any given time can be determined by discounting the future cash flows an investor expects from owning the share, such as from dividend payments. Art, however, can be seen as an asset that does not yield any financial revenues that can be discounted except for the income that can be obtained through lending and the price for which one expects it to be resold to a future buyer/ investor. Ultimately, the prices of art objects are determined by supply and demand. Representing the supply side, artists can have an important role regarding the prices of artwork. Artists who are still actively painting, can regulate the market for their artwork either by limiting or extending their output, by adjusting to current tastes and trends in the market and by buying back their own art pieces in order to back the prices of their artwork. Following such reasoning, artists are, together with the galleries who represent them, responsible to foster the demand for their artwork, which deviates from the notion of the artist that does not allow commercial interests to interfere with his artistic freedom. In order to untangle the variety of relevant pricing anchors, it is worthwhile to differentiate between quality-dependent and quality-

independent factors. In general, art investments are worthwhile only at first quality (Wagenführ, 1965). In fact, Renneboog and Spaenjers (2009) find evidence of a positive so-classed "masterpiece effect". That is, high-quality art makes a better investment. High quality of an image, according to Czotscher (2006), is characterized by its art-historical importance, less by whether it is 'well painted'. Whereas real estate or gold have an intrinsic value, the costs of material used for artwork is usually negligible (Czotscher, 2006). The value of works of art would be relatively low if one were to sum up the costs of production, such as the prices for paint, canvas, frame and hourly wage of the artist; it quickly becomes clear that those inputs do not suffice to explain the prices paid on the art market (Kunze, 2002). A work of art is then valuable if it is unique, non-reproducible and characterized by originality (Kunze, 2002). The value of an image is thus determined primarily by the name of the artist. This can be corroborated by the fact that anonymous art only in the rarest of cases obtains a high price (Czotscher, 2006). A further price-increasing influence has the inclusion of a work in a major exhibition, since in a museum usually only works of first-class quality ("museum quality") are exhibited (Kunze, 2002). All the more understandable is for Kunze (2002), the attempt of private collectors to present their collections *en bloc* in a museum. An exhibition where the original work of art can be viewed and examined by various experts, also serves its verification and authentication. The value of a work of art is not determined solely by the fundamentals just defined, but is subject to fashionable trends as well (2006). As Hodgson and Vorkink (2004) note, art also carries a consumption value, subject to a high degree of uncertainty and are thus difficult to quantify: The consumption value may change along with one's own taste, while the value for which the art work may be resold to another investor at a future point in time may vary with the *Zeitgeist*. Anderson (1974) further refines the consumption value by distinguishing between decorative and aesthetic-prestige services. According to him, decorative services refer to the way a painting or another work of art is able to improve the perception of a room or an environment in general. Aesthetic-prestige services, in turn, are derived from the attribution, the artistic merit and the ownership history of art. A different approach can be found in the work of Hutter et al. (2007), who derive the value of art from its communication potential, "the ability to offer opportunities for conversations with others who share knowledge about the same class of commodities". The establishment of a network with a consensus for the work of a certain artist then constitutes a "circuit", which is a major determination factor for the price of a work of art. According to (Czotscher, 2006), marketing is enjoying an increasingly high status in the art market. This is done either through galleries or else directly by the artist. An empirical analysis has shown that the most critical factor for success of gallery owners is to have good communication skills in order to maximize reputation (Bernhard, 2005). Internationally the strongest representatives of such marketing geniuses are Andy Warhol, Jeff Koons or Damien Hirst. According to Perregaux (2007), for a contemporary artist to have a chance of future success and thus an increase in the value of his works, the artist would need first-class management through a gallery and the presence of the artist's work in galleries, at fairs and in museums during the lifetime of the artist. Otherwise, he or she will hardly be able to catch up on the lost market potential in the future, because new generations of artists are constantly coming. Other pricing-related peculiarities of artworks include the effect of provenance and timing of sale, which make it difficult to establish an expected measure of return on investment (cf.

Kraeussl (2016), Czotscher (2006), or Schneider (2005)). When looking at the pricing anchors of artworks, it seems intuitive to suggest further distinguishing between works of art of living (still producing) artists and no longer living artists. In the case of no longer living artists, the art works produces constitute a scarce resource; hence, the pricing of their artwork can no longer be influenced by changing their supply; or as Baumol puts it: "[…] the elasticity of supply is absolutely zero" (Baumol, 1986). Thus, the only price anchor remains with the demand, whereas in the case of living artists who may still be producing (although not perfect substitutes) the pricing of their work is impacted both by the demand as well as by the supply mechanism. The markets for the products of what are considered minor schools work very differently. At this point, Baumol refers to Montias who had pointed out that a sudden rise in the popularity of a group of not noted artists can elicit a flow of their works from attics and basements, thereby rapidly expanding their available supply and thus impacting their pricing (Baumol, 1986). Analogously, another conventional wisdom dictates a near-immediate upswing in prices whenever a famous artist dies as collectors try to get hold of remaining available works (cf. Kraeussl (2013)).

In the stock market, investors around the world rely on various indices, like the S&P 500, representing large, liquid and active markets, that are typically recalculated continuously throughout trading periods to reflect up-to-the-moment pricing data and to indicate the direction and magnitude of the market's price sentiments; That being said, index values can be compared in order to calculate relative performance and to show how the markets have changed over time and to examine their correlations. Generally, a price is standardization of works of art should not be possible due to their heterogeneity and incomparability. However, a historical time series may be relevant to show basic trends for the entire art market as well as for individual art sectors and/or categories. It goes without saying that the informative value of price indices particularly for inhomogeneous goods such as works of art is extremely limited. Though retrospective comparisons may be possible, in contrast, future price developments cannot be predicted (Arends, 2002). At most, art price indices may provide an orientation about what average returns among the different genres can be expected. Of course, no direct conclusions can be derived for individual artworks. Neither for the entire art market it is possible to maintain an exact index for very long periods of time, but only to derive a basic trend (Wilke, 1999). According to Wilke (1999), for both, the overall market and the subsectors, such trend would be significantly upwards in the long term. However, detailed forecast calculations for art prices thus remain an illusion, or – as the economist William Baumol (1986) expressed precisely already more than twenty years ago – a "floating crap game". Especially individual works can show large price fluctuations. However, also the art market as a whole is taken as highly volatile. Journalist Christian von Faber-Castell, specialized in the art market, puts it in a nutshell when he says that the entertainment value of such price indices is greater than their informative value (Perregaux, 2007). As elaborated before, the question of how any collector or investor can recognize, which artists or individual artworks could experience future increases, cannot be answered easily. Serious predictions are not possible, or highly speculative.

The challenges in evaluating prices of heterogeneous investments, which are only comparable to a limited extent, are not confined to works of art. One often applied method for such data sets is the so-called "Hedonic

Regression", which was first applied to cars. A welcomed side-effect of the construction of price indices based on hedonic regressions rather than, for instance, based on a repeated sale regression are the inferences that can be made based on the coefficients for independent variables other than time. However, those conclusions can be challenged because of omitted variables. Another often employed method, e.g. by Mei Moses, is known by the term "Repeated Sales Methodology", which includes only works that have been publicly auctioned more than once (Arends, 2002). The main advantage of the repeated sales regression is its ability to resolve the difficulty that prices of artworks cannot be compared because of the different characteristics that have an influence on the price. However, by solely processing repeated sales, the characteristics are held constant, assuming the painting does not suffer any damage. Another cautionary note about data characteristics only applies for repeated sales regressions: it cannot be excluded that a work of art was purchased and sold through another channel (e.g. gallery or private sale) which does not appear in the publicly available records, resulting in a bias in the calculation of returns. Constituting the main difference to the hedonic regression, the preliminary task of identifying repeated sales from an initial sample deserves special attention. Besides the deficiencies of auction data in general, which affect any analysis based upon, the relation between observed sales pairs and the overall sample has to be examined. This issue becomes more eminent with a decreasing ratio of repeated sales to the total number of sales. Depending on the time range of auction observations and the focus on a certain style, the number of repeated sales in the overall population can be quite low. Much of the available data therefore cannot be processed and is, as Ashenfelter and Graddy (2002) put it, "wasted". In a hedonic regression, in turn, nearly all information can be included in the regression. While this can lead to a much broader base of observation to monitor actual returns for an artist, the critical issue with this method lies in the "arbitrary" specification of the functional form of the regression (Mei & Moses, 2002).

All in all, in order to analyse the performance of an artwork, an artist or art categories, art indices are certainly helpful to a point; however, they only track art offered at auction, less than 50% of the overall market, and typically only successful sales at auction, which account for an even smaller slice. Moreover, buyers are subjective, faddish and emotional, which is likely to massively inflate prices: There could always be someone active in an auction willing and able to pay multiple times what they think they actually should because – for instance – it fills out their collection. All in all, the introduced models all produce errors in their estimates, therefore it is up to the modeller to minimize this error and choose which is more useful to them, or a hybrid of the two, as suggested by Quigley (1995).

When acquiring art, again similar to acquiring real estate, there are numerous additional costs besides to those associated with finding, negotiating and paying the purchase price. Within existing research on the returns on art investments, many researchers do not elaborate on the (transaction) costs that should in fact be deducted from an art work's resale price to account for costs that arise from the acquisition as well as from holding the asset. Like Baumol (1986), most of them mention transaction costs to have a potentially severe impact or have even further specified those to come in form of storage, insurance or commission fees. In fact, Frey & Pommerehne (1993) were the first scholars to take into account transaction costs in their return computation at 0.4% *per annum*. Pownall (2007) has even calculated with a more conservative 1.5% *per annum* estimate.

However, the majority has not quantified the impact but merely referred to associated costs as to be considered. Analogous to equity investments, also investments in art come with transaction costs that depend heavily on the sales channel through which the work of art is being traded, such as in the form of a commission. In existing literature, Mok et al. (1993) consider 10% sales commission to be deducted from the hammer price. Renneboog and Van Houtte (2002) consider a more conservative seller's commission of 10-12% and an additional buyer's premium of 15%. In fact, such numbers still underestimate fees charged by the biggest players, such as Sotheby's who publishes a buyer premium chart as of February 2019, exhibiting premiums of up to 25%, excluding taxes.

With the general rise in art prices in the past decades, theft rates have grown, leading to increased insurance costs. However, contrary to conventional wisdom, the biggest risk stemming from the possession of art is not theft. According to underwriters of fine art, damage from water and fire poses a significantly bigger threat (McDonald, 2004). Besides the risk of theft and damage, insurances also offer protection against the possibility of reattribution. Most contributions on art as a financial investment do not take insurance costs into consideration when computing returns, but mention them as possible upwards bias of their findings (Mok, Ko, Woo, & S., 1993). Stein (1977) estimates insurance costs to range between 0.2-1.0% of the appraisal value, while more recent research by Renneboog & Van Houtte (2002) estimates insurance costs at 0.5% of the appraised value. Moreover, art should be stored in facilities that provide the expertise for proper handling. Specialist art storage facilities provide a detailed facility report that includes information about fire detection and suppression, humidity and temperature control. The physical and environmental conditions in which the art is housed are critical. Hence, for art investors additional costs result from services provided by conservators who specialize in the type of art owned who should be consulted on a regular basis. More threats to the physical security of art arise from improper transportation, improper storage, installation and environmental controls. Costs for storage and maintenance, e.g. cleaning, can vary depending on medium and location and are therefore difficult to estimate. However, it can be assumed that such costs will not lead to a significant impairment of the return of an art investment.

Being in possession of an art piece can have multiple reasons – for the store of wealth, to have a masterpiece to cherish, as a result from a family heirloom, to serve as a part of a trust or estate, or even as a gift to a cultural institution. Whatever the reason is, tax concerns are always relevant. Indeed Frey and Pommerehne (1989) note that tax aspects may provide a rationale for an art acquisition – as art may not be subject to property taxes or death duties. Recent years have seen a number of new free zones springing up around the world. Art dealers, auction houses, and collectors have been among the first to jump on the tax-free bandwagon. The arrival of several new freeports in China and Southeast Asia has provided a boost to the countries' art markets, saving buyers from otherwise high taxes. In the biggest art market worldwide (the US) – outside such freeports – the capital gain tax, may be up to 28% on art in contrast to only 20% for financial securities. Also, the buyer must pay sales tax on the sum of the purchase price and premium or commission, making art investment less attractive. The availability of 1031 exchanges for art has been a very important factor fuelling art market turnover. While the House of Representatives tax bill eliminates the use of 1031 exchanges for art (but

preserves it for real estate investors), it faces, like most legislation, a long and winding road to passage. But if art is no longer eligible for 1031 exchanges, then many art market participants subject to U.S. law will likely elect to hold their art for longer time periods, causing a noticeable decline in art market turnover. In addition, while in the United States and Europe imported goods are not subject to any customs duties, China imposes high import duties, which vary according to the country of origin, further hindering the development of the Chinese art market in addition to recent developments regarding their capital controls. Another reason to worry regarding the flow of capital in the art market give the current Brexit negotiations. Thus far, no impacts seem to have been recorded. It remains to be seen how the Brexit will manifest on capital controls in the UK and thus on international transactions in the art market, with UK being the second largest art market worldwide with 21% market share (UBS & Art Basel, 2019).

Generally, this stream of literature legitimizes art as an investable commodity. The majority of researchers, amongst them Frey and Pommerehne (1989), Mok et al. (1993), or Mei and Moses (2002), come to the conclusion that art is dominated by other asset classes, especially when considering associated transaction costs. They further agree, that art investing is not for short term profit, but its attractiveness increases with the holding period. Hence, some hypothesize that art is only an attractive investment if the consumption value is included in the return calculation (compare Anderson (1974), Stein (1977), or Baumol (1986)). Stein (1977) even quantifies such notion and postulates that if the aesthetic return of art exceeds 1.6%, art would possibly constitute a worthwhile investment. However, the majority points towards the fact that art investing has low correlation with the broad markets and does indeed provide a positive, though lower, average risk-adjusted financial return.

The creative search for new asset classes with low correlation combined with strong returns goes on and has now reached art as a potential candidate (Curry, 1998). Besides by art investment pioneers like corporates and financial institutions, both of which have long been combining art acquisitions and patronage, art works have hardly been employed systematically for portfolio diversification (Czotscher, 2006). According to art investment experts like Wilke (1999), an investment share of 5-10% of the total assets in art is appropriate. The proportion could vary and be significantly higher along with solid technical support or high level of knowledge on the subject. However, there are academic studies that obtain even higher proportions of more than 36% for the very low correlation between the returns on art and the returns on financial assets (Tucker, Hlawischka, & Pierne, 1995). Different empirical studies and their correlation calculations have led to varying results. Some of these differences may be due to the use of different intervals of observation and estimation, or to drawbacks of the repeated-sales regression, the method commonly used to build art indices. Moreover, an old art market wisdom says that art lives off superfluous money (Herchenröder, 1990). Indeed, Renneboog and Spaenjers (2013) find that when individuals' buying power rises, this can be expected to lead to higher art consumption, and thus to a higher price level in the art market. For its particular co-movements, there are further, less obvious factors that could make investments in art relatively more or less attractive compared to alternative asset classes: The assumption is evident that high inflation rates are conducive to the art market. That art performs better in periods of high inflation or rising inflation than other financial assets has also been

confirmed by an analysis made between 1973 and 2012, where art has obtained an average return of 18% whereas equities, bonds and commodities yielded only 2.5% and 13%, respectively (Saatchi Art, 2016). Based on the findings of Renneboog and Van Houtte (2002), who conclude that (only) well-informed collectors could possibly outperform stock markets; and on those of Pownall (2007), who emphasises the low correlation of art with other asset classes; as well as in line with Pesando and Shum (1999), according to whom the high non-systematic risk of art would require diversification efforts; the idea of art funds is born.

Art markets are more closely resembling the real estate or private equity business than the luxury goods market, since they are underdeveloped, the information level is extremely uneven, the valuations are difficult and there are innumerable players. However, the art market cannot be considered detached from the economy, because works of art are in fact exchanged, which automatically results in a "market" (Herchenröder, 1990). So, also the art market basically follows the laws of supply and demand, especially at auctions, but has several peculiarities compared to stock markets. Outside auctions, the prices are not organic, but artificially made, because the gallery owners set prices from the start; for contemporary artists who cannot yet have a track record these price settings appear especially ambiguous. However, the supply and demand behavior is also important here, since only prices are realistic, which result in an actual demand. Nonetheless, clearly the art market is less efficient compared to financial markets. This is primarily due to the limited market transparency. The constituency of the art market reveals some patterns that severely hinder information to reach all market participants. In fact, the predominant information asymmetry in the art industry allows knowledgeable insiders to monetize their information to others. Moreover, most opinions regarding art – e.g. regarding its quality – are highly subjective and can thus not be proven as to be misleading or untruthful in possible legal proceedings. Having access to insider information involving important tips and rumours presumably constitutes an important determinant of returns and those without this privileged access can be expected to be at a significant disadvantage. Moreover, unlike in stock exchanges, there is no one single go-to-shop for persons with buying intentions (Czotscher, 2006). It is not certain that an artist's work will find a buyer or a seller at any time. It follows that costs for research are significantly higher; if an investor is looking for a specific work of art, he may have to undertake extensive research work. Moreover, varying with the level of connoisseurship, art market actors are often in disagreement about quality, authenticity or price levels (Wilke, 1999). Taking the stock market as are reference point, some inferences can be made about the efficiency of the art market looking at its liquidity. Transaction prices of art are significantly higher than for securities, which is likely to restrain the willingness of both buyers and sellers to act in the market when new information is available, since the impact on the valuation stemming from the new set of information would have to be quite high. Extending this point of view from piece of art to a certain artist, the supply is limited, if the artist has deceased. On could also say that the owner holds a monopoly on a piece of art (Baumol, 1986). Contributing to the illiquidity of the market is the time lag between a selling decision and the actual execution, especially when carried out in an auction. In line with Schneider (2005), the lack of liquidity can be listed as one of the major drawbacks of art as an asset class. Also, contradicting the idea of efficient markets, Pesando (1993) reveals systematic differences in auction prices for prints of Modern artists for London, Continental Europe and New York and

reasons that this difference is partly due to the "noise" experienced in auction outcomes, noticing significant differences even for prints with nearly identical properties. While an immediate arbitrage would not be possible because of seller's and buyer's commissions, it remains a puzzle why such a price difference can persist over time for two salesrooms without any geographical barriers. Prevalence of any such aforementioned biases *per se* is not a sufficient indication of market inefficiency, as long as one cannot exploit them systematically. In turn, if prices in the art market just like stock prices do indeed approximate random walks, as the evidence strongly indicates, then there is little that information can do to improve estimates of future prices. In fact, Baumol (1986) finds that the art market does indeed approximate random behavior and lists a few examples that should teach the art investor a lesson regarding the wanderings of general tastes and trends.

2. Investment Opportunities: Art Investment Funds

The unifying factor of all art investment vehicles is their focus on the art market, which is characterized by a lack of regulatory authority, deficient price discovery mechanisms, the lack of transparency in the market and the subjective value and illiquid nature of artworks. On the one hand, these very characteristics generate significant arbitrage opportunities within the market that seasoned art professionals can exploit for the benefit of the fund's investors. On the other hand, such characteristics denote art as the riskiest asset class, thereby creating the potential for substantial investment losses among the fund's investors. Many of the advantages and disadvantages of an art fund correspond to the usual advantages and disadvantages of funds of all kinds. However, there are a number of peculiarities unique to art investment funds. The logic behind art funds can be summed up in three simple facts: first, good quality art (usually) goes up in value; second, the art market is inefficient, so experts should be able to find opportunities to exploit; third, because the art market is separate to other markets, it offers investors benefits for diversification. Everything that makes art a difficult asset class to invest in – lack of data, forgeries, insider information, volatility, etc. – means that true experts have an edge and should be able to generate a return. Though the decrease in the overall AUM in the art fund market over the past few years is found to largely stem from the Chinese art fund and trust business winding down since 2013 presumably due to increased regulations, given its limitations (i.e. illiquidity, limited transparency) and with the art fund industry still in its early stages, it does not come as a surprise that it has been a challenge for art funds to raise sufficient capital and gather momentum. Being able to demonstrate to investors a track record of delivering (superior) returns – that are being audited and can be evaluated – goes a long way toward attracting new capital. Track records are far more important and convincing than ingenious investment philosophies and strategies which, until proven, remain hypothetical. Furthermore, that art can be an attractive investment, still proofs to be difficult. There are only a few cases from the past that reveal positive returns. The two often-cited funds, La Peau de L'Ours and BRPF, have certainly benefitted from extraordinary price hikes - driven by the discovery of Picasso and Matisse and the bubble in the late 1980s, mostly in Impressionists. However, even these days, most articles still cite the impressive annually compounded rate of return generated by the BRPF from 1974 to 1999. Aside from the fact that only 1% of the fund's 2,500 art

objects ultimately accounted for the positive return, are there any other more recent impressive and popular examples to mention since last century? Added to this list of limitations should be the lack of indices for benchmarking the performance of funds as well as the methodological weaknesses in the measurement tools. These generally acknowledged problems make translating high levels of investor interest in art into meaningful shifts in investment capital all the more difficult. Although art funds have struggled to gain momentum among investors, there are new art investment products constantly being developed addressing the pitfalls associated with art investment funds, with the issues of liquidity and price transparency leading the list. The art investment market is continuing to develop in that indices and other market tracking resources are increasingly available from artnet, Artprice and the Mei Moses index, amongst others. Meanwhile, the growth in storage facilities geared towards helping preserve fine art further supports keeping art investments safe. The art fund industry is today at a crossroads and the ultimate direction of the industry will ultimately be decided by whether art funds are able to convince the investment community that they are not simply a recent curiosity but a valid and permanent part of the alternative investment world and attract capital. Further research and potentially the implementation of technology for the risk and return assessment should shed some lights into the art business and help clarify the risks, thus reducing the total level of perceived uncertainty, thereby attracting more capital to the art market.

For the art market to establish and further evolve, several hurdles have yet been identified that must be overcome; with the presumably unpredictable pricing of art leading the list, closely followed by the art market's lack of transparency and complemented by its unique risks including the risk of duplication and piracy. Advances in technology appear to have become the silver lining, a carrier of hope for the future of the art market. Setting the right price for a good or service is an old problem in economic theory, more so for pieces of art with the heterogeneity of art works, the impact of trends and tastes, and not least the aesthetic pleasure unique to every individual consumer of art. The emergence of AI raises the question for further application in the art market, i.e. the use of ML to build effective pricing automation solutions. ML can be of great help and already has shaped the business models of Amazon, Facebook, Google, or IBM; ML models can continuously integrate new information and detect emerging trends or new demands, thereby helping users navigate millions of artworks enhancing both the search and discovery experience. It becomes clear that the success of the implementation of ML is heavily dependent on data. For this reason, data acquisition has become the primary goal with prediction modelling taking a backseat for a while. The greatest challenges implementation of AI in the art markets has are the availability of data about art and the accessibility of technologists to the data as well as the subjectivity – both in value and in taste. Even letting subjectivity aside, only to separate obscene images from legitimate libraries of art requires algorithms fattened with data about all the kinds of filth uploaded daily onto the internet; AI networks would need lots of curated, clean data which is expensive and time consuming, thus requiring a heavy up-front investment. Moreover, whenever insights from analyses are discovered, it is vital to validate them against the domain knowledge that specialists possess; the importance of human involvement throughout the process cannot be overstated. Lastly, it can be doubted that artists themselves would approve of algorithms valuing their work. To some extent their creations are

"priceless" and the question remains whether any computer power could ever incorporate the emotional/psychic value of any art piece to metadata such as (cost of) material, size, artist, year of creation. Even excluding this emotional component, there is no guarantee that such network will learn the correct representative features and will give good predictions. As trends and taste changes, these networks will need to be constantly retrained accordingly. Put differently, AI taking over and replacing art professionals is less likely a short-term scenario. Instead, for the foreseeable future, AI has opportunities in expanding the accessibility of art to those who may not have been able to afford it before, or who may have never been exposed to fine art in their everyday surroundings, i.e. in the form of Blockchain technology.

Going forward, Blockchain will continue to disrupt the world we live in. As it bears fruits in the form of greater security, smart contracts and easier logistics management, it can be expected that in the upcoming year, the art market will join the evolution, deploying Blockchain in innovative ways. For once, a major problem with the production and selling of art is how easily it can be duplicated and pirated. Blockchain is countering the issue by introducing the idea of digital scarcity, issuing a limited number of copies and tying them back to unique blocks proving ownership. By construction, Blockchain is a distributed ledger in that it can provide an unalterable record of provenance from initial authentication to present ownership. Accordingly, art forgery can be tackled by providing real time verification of artworks using distributed ledger paired with other authentication technology. Moreover, Blockchain's cryptography will keep online transactions secure. Transparent trading histories will speed transactions and help prove ownership, demonstrating that a seller has the right to trade and thereby securing the online market as trading channel. Additionally, Bitcoin is allowing more trading to take place digitally as it opens up to a wider range of people through the creation of platforms that allow people outside the circle of HNWIs who have wished for owning famous paintings can buy shares in those. Cutting out the middleman, Blockchain further greatly reduces the transaction costs. Such marketplace will pave the way for change of how collectors own art and use the art they own as it allows more art to be owned jointly by a number of people, or to be used as collateral against loans, therefore increasing the market's liquidity.

3. Art Market Performance and Portfolio Diversification

The empirical analysis extends the works of Worthington and Higgs (2004) as it builds upon an enlarged database provided by Renneboog and Spaenjers (2009) of 13 broad classifications (as consistent with those of most art history textbooks) from January 1983 to December 2007. The second set of data relates to equities and relies on value-weighted portfolios constructed by Eugene Fama and Kenneth French. Since there is no or only very limited data on the historical performance of art investment funds, a direct systematic analysis of their performance is possible only to a very limited extend. Hence, the quantitative analysis is based on the idea that one can draw conclusions on the potential of art investment funds, when having established that art itself is a good investment candidate. The analysis of the art market performance in terms of risk, return and portfolio diversification in this section provides the following insights: All in all, in line with the stream of

existing literature, superior risk-return characteristics are found for equity investments, here proxied by the Fama-French portfolios. Diversification benefits from investing across art categories as found by Worthington and Higgs (2004) could not be supported by the data. For the given time period, a mean-variance optimizer would have been served best to invest into Pop (as this investment would have maximized the Sharpe ratio). Yet, there are some caveats to this conclusion: Though the dataset of Renneboog and Spaenjers (2009) comprises a broader coverage, it must be pointed out that these indices and ultimately the results on return rates should be understood as only an indication of the painting category movement as they do not capture all the auction house information and any of the dealers or private treaty sales prices. Also, there are not tradable and do not include the costs of buying and selling art that can be large. At the same time, the art categories themselves already constitute diversification efforts. In light of this, diversification across art categories does not appear to bring much benefit – and would come at high costs.

The fact that the pairwise correlations between art classifications and all of the Fama-French portfolios fare at zero is in line with existing literature and once again is suggestive of the potential gains from portfolio diversification involving investments in art. If low or even negative correlations of returns exist among various art segments and equities, diversifying across these may allow investors to reduce portfolio risk while holding expected return constant. The findings suggest, for the most part, that the diversification benefits of art in a multi-financial asset portfolio are close to zero. However, at least some diversification benefits were illustrated above. Moreover, as Worthington and Higgs (2004) pointed out correctly, with an increasing number of assets the risk of the overall portfolio collapses to the individual co-variances, such that the creation of a portfolio with much finer detail than the broad art classifications used here should show more benefits of diversification. Also, the consumption value, a potentially substantial return premium on art, is not incorporated in the returns used here for calculations. At the same time, neither transaction and holding costs associated with art investments are incorporated. Hence, if art investment funds do not manage to circumvent (or at least significantly decrease) these peripheral fees, Renneboog and Van Houtte (2002) may in fact have concluded correctly that "the diversification potential of art in an equity setting is limited". Moreover, examining the downside risks of art investments compared to those of equity investments, it becomes obvious that art as an asset class, indeed reflects a riskier venture for lending institutions than the traditional assets; it therefore comes unsurprisingly why still only few financial services engage in and encourage art as a structured finance product, i.e. for art lending. That these findings are much less favourable than the outcomes presented by other researchers, such as Goetzmann (1993) or Mei and Moses (2002), although the chosen time horizon includes an extra boom period, can be explained by the fact that the dataset comprises a broader coverage; that is, it does not only capture the sales and resales by top artists at the biggest auction houses, as Renneboog and Spaenjers pointed out correctly. They do, too, come to the conclusion that buyers of art should expect to reap "non-pecuniary benefits rather than high financial returns, especially because the modest art returns are further diminished by substantial transaction costs" (Renneboog & Spaenjers, 2009).

Moreover, the analysis does not allow for an outright rejection not a general acceptation of the notion of art as an inflationary hedge. Generally, the results do indicate that the exposure to art may indeed bring yet a positive

side-effect that potentially makes such an investment worthwhile after all, despite its inferior risk-return characteristics. This feature becomes especially relevant in a world where alternative sources of asset management, such as fixed interest, property and cash all look unattractive. However, based on their respective shortfall risks, measured in VaR and ES, art would constitute an inferior inflation hedge. Nonetheless, such analysis would become more meaningful in a portfolio context. Again, significant transaction costs must not be disregarded, as well as the fact that the here-used indices are not tradeable, which would limit the use in practice.

Conclusion

Art is undoubtedly an asset in the broadest sense of the word: Besides the invaluable emotional value it may bring to its owner, its aesthetic, cultural, or historical value can be limitless. As art has its price it can very well be expected to serve as a financial asset as well. However, merely based on particular popular examples, where some people happen to own pieces that are more worth today than what they have originally paid for, one cannot and certainly must not draw conclusions on whether buying art in order to make money is somewhat easy to systematically pull off. Identifying the intrinsic value of an artwork and ultimately the fair price to pay for it requires a lot of knowledge and (or) expert help. It also assumes you can get hold of coveted works at a time when plenty of other people are after them and when some buyers are prepared to spend unlimited resources. To get hold of undervalued art pieces, an investor preferably has both, limitless time and vast financial resources. However, despite the most thorough analyses and technological innovations – as of now – the pricing of artworks ultimately remains a puzzle; the value of a work of art can never fully be estimated objectively, even if all these price criteria apply and price trends on the auction market are to be considered. Among passionate collectors there may always arise bidding duels leading to outlier prices. The only rule that seems to truly hold, is that any piece of art is worth exactly as much as the next owner is willing to pay for it. Though the demand for alternative assets may be prevailing, the question remains whether investors find the solution in art. This thesis was never aiming to propagate the recommendation to put a great fraction of an investor's net worth into fine arts; however, based on existing literature and common sense, there are plenty of reasons to believe that investments in art can provide value in excess of its "pleasure dividend" – for example, for hedging inflation. The fact that it is almost uncorrelated to traditional investment markets and has consistent performance returns are real reasons why investors would tend to have minor fractions of their investment portfolio in artworks – and art funds could be a cost-effective way to do so.

As most other research papers that have assessed the returns of art as a financial investment in general, or its diversification benefits in particular, the results of this thesis do not allow for a general acceptance, nor an outright rejection, of the notion of art as an investment. However, the outcome tends towards perceiving art as a predominately emotional investment that should primarily yield aesthetical pleasures instead of financial returns. In line with the majority of existing research papers, covering different periods, mediums, schools and geographical origins and markets, the findings indicate that the risk-adjusted performance of art is dominated

by other asset classes. As for stock investments – it is not advisable to only buy a few stocks to get exposure to equity markets and the same should hold true for art. Investors will still need a broadly diversified portfolio of non-speculative art of this type for best effect which becomes costly. Moreover, especially limited pieces of work of deceased artists would price most investors out of the market. Art investments may in fact be one of the only investments one makes where the decision to invest lies in the heart, rather than the bank account. Eventually, investors must carefully consider what they expect from investments in art in terms of return, taking on risk and whether to keep or when to sell. Besides a bountiful pleasure dividend, exposure to art may indeed bring yet a positive side-effect that potentially makes such an investment worthwhile after all, despite its inferior risk-return characteristics. The feature to hedge inflation by creating exposure to art becomes especially relevant in a world where alternative sources of asset management, such as fixed interest and cash all look unattractive. Advocating in favor of seeing art as an investment are the prospects of the still immature art investment funds market. In addition to the funds' ability to decrease overall transaction costs, they exploit the art market's most prominent deficiency: the lack of transparency. This imminent advantage of insiders that comes as a disadvantage to any potential outside investor, in theory, allows funds to assemble a well-diversified portfolio, allocating a portion to this asset class – which would otherwise not be feasible. However, the history of art investment funds, led by experienced professionals with profound market knowledge and exceptional access to different market channels, do not reveal many success stories, which is astonishing, given the advantages such funds have over other market participants. Indeed, though the art market has seen strong growth in the past, it started slowing. This slowdown can be traced back to a lack of confidence amongst investors. It remains to be seen if the art funds market will manage to gain momentum in the future, as its significance amongst a broad base of investors becomes clearer. However, recent macroeconomic events will likely influence their development in the short term, with trade tensions on the one hand, and further technological advancements on the other. Going forward, blockchain and tokenization will allow easier access to the market, diversification of investment, reduced transaction costs, and increased liquidity. And the popularity of art is likely to continue as more people enter the market; with those people, the art market's transparency and thus investability will increase. However, given political developments and increasing trade tensions – especially with respect to Brexit uncertainties – which has not yet shown any concrete impact, effects can be expected to manifest in the art market as well. Furthermore, with art is no longer eligible for 1031 exchanges, many art market participants subject to U.S. law will likely hold their art for longer time periods, constituting another cause for a presumably noticeable decline in art market turnover. Paired with the analyses of Kraeussl et al. (2014) on the formation of bubbles, there should be a recovery of the art market expected in the nearer future. While recovery from these correction in the market may be underway, returns in art as an investment should remain flat for the time being (Kraeussl R. , 2015). Despite technology on its way, after all, the general bearish outlook on the (short-term) art market is not unfounded.