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DENISE MENCONI

ESSAYS ON ART ECONOMICS

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Dissertação apresentada à Escola de Economia da Fundação Getulio Vargas como requisito para obtenção do título de Mestre em Economia

Orientador: Prof. Dr. Paulo Sérgio Tenani

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ABSTRACT

This thesis applies the Fama-French three-factors model, augmented with Momentum and Liquidity factors, to analyze Art as an Investment. It also compares investing in Art to several other traditional and non-traditional investments. There is evidence that Market and Momentum factors explain the risk premia in some Art sub-segments. The Market Beta, in particular, is lower than what is found in the existing literature, whereas the Momentum factor might explain part of the premia of Contemporary Art and Old Masters. There is no evidence, however, that Art and its subsegments command a Liquidity premium. The thesis also discusses the efficient share of Art in a diversified portfolio, and constructs mean-variance efficient portfolios of the different Art subsegments. Moreover, it provides an overview of the role of asymmetric information and other frictions in shaping the structure of the Art market.

Key Words: Art Market; Art as Investment; Art in the Portfolio; Alternative Investments; risk-premium; Fama-French 3-factors; market betas; momentum; liquidity; portfolio diversification; efficient frontier; asymmetric information; imperfect information.

RESUMO

Esta tese aplica o modelo de três fatores de Fama-French, aumentado pelos fatores Momentum e Liquidez, para analisar Arte como investimento. Também compara o investimento em Arte a diversos outros investimentos tradicionais e não-tradicionais. Há evidências que os fatores Mercado e Momentum expliquem os prêmios de risco em alguns subsegmentos de Arte. O Beta de Mercado, particularmente, é inferior ao descrito na literatura existente, enquanto que o fator Momentum pode explicar uma fração dos prêmios de Arte Contemporânea e Old Masters. Entretanto, não há evidências de que Arte ou seus subsegmentos comandem um prêmio de Liquidez. A tese também discute a alocação ótima de Arte em um portifólio diversificado, e constrói portifólios eficientes de média-variância de diferentes subsegmentos de Arte. Além disso, a tese fornece uma visão geral do papel da informação assimétrica e outras fricções em moldar a estrutura do mercado da Arte.

Palavras chave: Mercado da Arte; Arte como investimento; Arte no portifólio; prêmio de risco; 3-fatores Fama-French; betas de mercado; momentum; liquidez; investimentos alternativos; diversificação; fronteira eficiente; assimetria informacional; informação imperfeita.

SUMMARY

1 Introduction

Over the past 20 years developed economies have been characterized by very low and even negative real interest rates. In this environment, alternative investments, such as hedge funds, commodities and real estate, have flourished. Furthermore, as investors continue to search for yield deeper into the risk spectrum, passion investments, or assets that can produce emotional dividends – such as art, wine and other collectibles – have also become instruments of portfolio diversification.

In November 2017 a painting attributed to Leonardo da Vinci, "Salvator Mundi", was sold during an auction at Christie's New York for a staggering US$ 400 million. That was the highest price ever paid at auction – US$ 450.3 million when you compute the auction house taxes. Even amidst the turmoil and uncertainty of the COVID-19, a Francis Bacon triptych was sold for US$ 84.5 million at Sotheby's in June, 2020 – the most expensive artwork sold at auction in 2020, although below price records from previous years.

Art, collectibles and other emotional assets can also be described as consumption luxury goods, with an intrinsic value. In addition to the financial gains of the investment *per se*, emotional assets "provide aesthetic pleasure and social status to the owner" (Goetzmann, 1993). They also have a "consumption value and provide the owner with greater utility in the form of aesthetic value and can act as a signal of the owner's wealth" (Pownall *et al*, 2009). Art owners, indeed, derive aesthetic pleasure and "additional enjoyment from the signal of wealth" (Mandel, 2009). For these reasons, risk and return and the traditional CAPM may be only part of the equation, as art investors demand less compensation for the risk or cost of opportunity, due to the payments received in the form of smoothed consumption over time and utility derived from conspicuous consumption.

That does not mean that art is a riskless asset. The art market is opaque, illiquid, poorly regulated/unregulated, with high transaction costs, and is subject to changes in taste[1] and fashion. Artworks do not generate flow of income or dividends, but require

[1] Baumol (1986) wrote "the evidence of the history of art connoisseurship provides strong warnings of its own. It tells us that the main lesson imparted by the test of time is the fickleness of taste whose meanderings defy prediction".

monthly fees to pay for storage and insurance. By choosing a less liquid asset, the investor expects the higher risk to be compensated by higher returns.

The objective of this thesis is to evaluate whether it makes sense to add art to a diversified financial portfolio, combined to other traditional and non-traditional assets. The focus is on the period from 2000 to 2021, and the risk premium for investing in Art is analyzed in the context of a multi-factor model, composed of market, size, value, momentum and liquidity.

This thesis is composed of five main sections, in addition to this Introduction. Section 2 provides an overview of the art market, focusing on sales results and the interaction among the different agents in the market. Section 3 explores the inefficiencies and asymmetries in the art market, focusing on the role of asymmetric information on the art market structure, which allows some agents to make exceptional profits, while posing additional challenges for art investors and collectors. Section 4 compares the returns of Art to traditional and non-traditional assets, such as LIBOR, US treasuries, inflation-linked bonds, corporate credit (high grade and high yield), equities (S&P500 and MSCI World), hedge funds, real estate, gold and commodities. It concludes that the low correlation of Art with other asset classes may reduce the overall risk of the portfolio. The optimal mean-variance portfolio is also constructed, first for the Global Art Index, and then for the Contemporary Art subindex. Section 5 investigates the risk premium of investing in Art; first from a CAPM perspective and then using the Fama-French three-factors model augmented by Momentum and Liquidity factors. Finally, section 6 concludes.

2 The Art Market

The entity “Art Market” is in fact composed of several submarkets: different categories, creative periods, techniques or genres; and spread across all continents – not only the production of art but also the consumption. Segmentation is usually applied in order to make the study easier.

The art market can be divided into a Primary market and a Secondary market, interrelated and sometimes overlapping.

Primary market is formed by the original sales of the artwork (artist’s new works, offered to the market for the first time) – either through galleries, art fairs or directly from the artist. Prices in the primary market are not only lower but usually more volatile. Buyers face higher degree of risk, by purchasing from normally younger and not well-known artists, of dubious quality. There is no shortage of supply, as most artists are alive. Transaction costs and commissions are often higher, there is less information and this is more incomplete.

Unless if purchased directly from the artist or his dealer, any other art transactions are secondary market. The secondary market is composed mainly by auction houses (and also dealers), and it is when a work of art is re-sold. Differently from most other industries, where things are worth less once used, in art the secondary market reaches higher volumes and prices, as the most valuable pieces are transacted between former and future owners through an intermediary, and not between producer and consumer. Only established artists, that reached a certain degree or importance, make the transition to the secondary market; many of those are already dead, which limits supply and increases prices. On the other hand, there is more information available, at a lower cost, once the artist/artwork make it through the secondary market.

Also contrary to other re-sale markets, artworks tend to appreciate in value over time (instead of depreciating), another reason for values being higher in the secondary market.

2.1 Wealth

Sales in the art market are correlated with several economic variables. The wealth of high-net worth individuals is one of those factors. Art follows money: given the luxury or discretionary feature of the art market, it is important to look at the numbers of millionaires – and trends, behaviour, willingness to engage with the art market - to understand the effects on the art business.

Although the art market and equity markets have different performances and returns in different periods, connections have been noted in academic studies, and financial markets' money flows to the art market. Goetzmann *et al.* (2011) regress the returns on art on stock market capital growth and dividend yields over the 1830-2007 period, to find that a 1% increase in the personal income of the top 0.1% triggers an increase of 10% in the art prices. They conclude that "over the long run, the income of the wealthy, or at least of the highest earners, seems a key factor in the price formation in the art market". Income inequality and concentration seem to lead to a booming art market.

One could argue that stock market performance has an income effect, when periods of positive performance of financial markets offer liquidity and drive more expenditure on art; but, also, a substitution effect, when more "risk-averse collectors shift between financial and real assets such as art depending on the market context, with negative performance or volatility in equity markets driving some to seek safe havens for their capital in these and other tangible assets" (McAndrew, 2019).

In the beginning of 2020, High Net Worth Individuals (HNWI), or dollar millionaires, owned US$ 173.3 trillion, 43.4% of the global net worth. Those almost 52 million individuals (1% of the world adult population) are estimated to reach 63 million people by 2024 (Credit Suisse, 2019), and their wealth could grow to US$ 264 trillion.

The United States has the largest share of millionaires – more than 20 million individuals, 40% of the world total. The total of American millionaires may grow to 23 million by 2024.

China (including mainland, Hong Kong and Taiwan) holds the second place with more than 7 million millionaires (13%), that should become more than 8 million millionaires by 2024. As we will see ahead, United States and China are two of the most important markets for the art world, and the presence of those affluent consumers both in local and international luxury markets will influence the art market over the

coming years. Japan was the third market in numbers of millionaires (6%), followed by United Kingdom (5%).

Most millionaires (88%) hold wealth between US$ 1 million and US$ 5 million, but there is a smaller segment of Ultra-High Net Worth Individuals that have more than US$ 50 million in free assets (the classification may vary, Knight Frank considers UHNWI those with more than US$ 30 million in assets). This cohort of UHNWI (two-thirds are from the US and China) is experiencing even faster growth than “regular” millionaires, and, given their absolute levels of wealth, are crucial for art and luxury businesses.

At the very top of those millionaires, Forbes estimated in December 2020 there were 2,299 billionaires, expected to be 3,300 in 2024 and 5,000 in 2029. McAndrew assumes that if those billionaires continue spending 0.3% of their net wealth on art, the amount could increase US$ 74 billion in 10 years, making up a potential expansion of the art market to US$ 115 billion by 2029. Of the top 200 art collectors listed by ARTnews, 26% are also on the Forbes billionaire list.

Over the next years, a great inter-generational transfer of wealth, with significant amounts of all kinds of assets, including art, is very likely to happen. As those collections change hands, the question is whether new generations will inherit the same taste for art as their parents; or even what kind of difficulties could come up as estates have to be divided. Therefore, there is an expectation for the next decade that a lot of art will change hands, both because money will change hands, but also because fashion, preferences and passions may change from one generation to another.

A UBS Survey with 2,569 art collectors from selected countries show that wealthier collectors are more likely to cross-collect: of those 86% of them had purchased art in the previous 2 years, 83% had also purchased jewellery, precious gems or watches, and 46% had sports investments (such as horses or football teams). Spending levels were also positively correlated with the levels of wealth – the median spending of UHNW collectors (that hold assets above US$ 50 million) was 40 times of those with US$ 1-5 million (Art Basel and UBS Report, 2021).

A similar survey from Credit Suisse with UHNWI found that 70% of them are collectors, and have a “’passion’ that they somehow make part of their investment portfolios, such as watches, jewelry, classic cars, paintings and sculptures, rare wines, and believe it or not even five-star hotels and football clubs” (Credit Suisse, 2020).

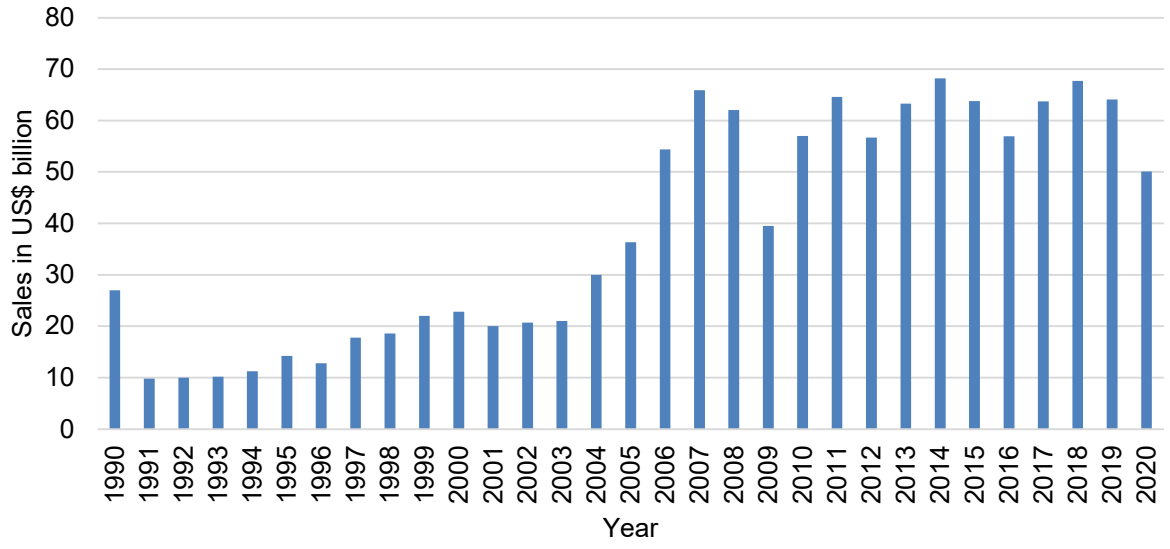
It is important to note that the art market as a whole seems to benefit when there is an increase in global wealth. For luxury, discretionary and nonessential consumption goods such as art, the effect is magnified by the high income-elasticity of demand. But, also, when there is a wider wealth distribution – for instance, growing wealth in emerging economies in Asia or Latin America - art consumption (and production) can profit from geographic diversification and a broadening of the consumer base.

2.2 Sales

The art market is opaque. Measuring global sales figures is a hard task, once there is no official data from the dealer sector or private auction sales. The only official numbers come from public auctions. Arts Economics (artseconomics.com) produces an annual report on the global art market since 2005, crossing public auction data with polling from dealers, fairs and other entities.

In 2020 global sales reached an estimate of US$ 50.1 billion, a decrease of 22% over 2019 and 27% since 2018 (McAndrew, 2021). The COVID-19 pandemic created the worst recession in the art market since the 2008-2009 financial crisis, and this time the bad results were spread throughout all categories and regions.

Figure 1 - Art Global Sales
1990-2020



Source: Elaborated by the author with data from Arts Economics

Sales are geographically concentrated: the three major art hubs (United States, UK and China) have been representing over 80% of the sales in value for the past decade.

The United States has been the main market for most of the past 50 years. In 2020, although sales fell by 24% to US$ 21.3 billion, they represented 42% of global sales in value. Despite the 24% drop, sales in the US remained 76% above the worst level in the decade, after the global financial crise in 2008/2009.

China, encompassing Mainland China, Hong Kong and Taiwan, accounted for 20% of sales in 2020 (US$ 10.0 billion in value). The UK had another 20% of market share (US$ 9.9 billion), followed by France with a 6% share. Those results show where the sales took place, but not the nationality of the purchaser. It is important to remember that millionaires and an emerging elite from emerging economies have second residences in Europe and / or United States, and therefore are probably buying at one of those cities that concentrate almost 90% of the sales. New York, London and Hong Kong are business-friendly hubs, with easier taxation structures, and a well-developed art infrastructure of galleries, experts and auction houses.

There are more than 300,000 businesses and around 3 million people operating directly in the global art market, plus other 300,000 people working in ancillary and support services that generate additional US$ 16.6 billion per year. Most of these ancillary industries are highly specialized and knowledge-intensive jobs, that would not exist without the art market.

2.3 Art Market Players

The Art Market is where sellers, at one side, and buyers, at the other, should meet; but distinct characteristics of the art market – mainly the informational asymmetry to be discussed in the next section – demand the existence of a lot of intermediaries in between.

Among the many participants in the art market, artists might be the first ones to come to mind: without the artists, there is no art. However, despite being the producers and suppliers of the art market, artists do not have any control over their prices.

Museums represent the highest seal of approval to an artist or artwork. Once acquired by a museum institution, the artwork is no longer available for transactions in the market, but other works from the same artist (or school or movement) move automatically to a new baseline. Museums are probably one of the most influential gatekeepers. Many carry much larger collections than they can physically exhibit, and could, in theory, act as suppliers in moments of financial distress, by selling selected pieces of their collections. That is a very controversial issue: first because artworks could be considered public goods (even if out of exhibition for decades), and their alienation will certainly cause public discussion; and secondly, for fear of upsetting private collectors / future donators. Donations are a key source of supply for museums and public institutions, once the competition against wealthy buyers at auctions is frequently won by the latter.

Collectors – from those who buy art purely from passion up to those speculators who see art purely as an investment - also play a very important role: many are *maecenas* who support the arts, and many donate their collections to museums or build open spaces to the public to house their art.

As we will discuss later under Informational Asymmetries, there are other important gatekeepers in the art market, such as curators, critics, art experts and advisors.

This thesis will take a closer look on Dealers/Galleries and Auction Houses, as those are the marketplaces responsible for the transactions taking place.

2.3.1 Dealers

According to UBS and Art Basel, the dealer sector (art galleries and art dealers) accounted for 58% of the art sales in 2020. Sales are estimated, once private business do not inform sales results and data – details of the transactions are confidential. Arts Economics estimates those figures after conducting annual surveys with more than 6,500 dealers globally.

That is a very fragmented market, composed of almost 300,000 businesses, from individual/familiar local stores to international high-end galleries, covering primary and secondary market. More than half of the sales in value of the sector are made up by only 5% of the dealers.

Dealers can work solely in the primary market or in the secondary market or in both. The average turnover is much lower for those galleries working only in primary market.

Dealers usually work very closely with the artists they represent, building their names, brands, bearing costs, promoting and managing exhibitions, mainly on the early stages of their careers – what can mean significant investment without immediate returns. Galleries manage the career of their represented artists, define the selling price and/or the quantities to be offered to the market. They are also responsible for supplying information on the artist: a good job in promoting an artist leads to less uncertainty and better acceptance of new names. Expert and renowned dealers signal quality and add value to the artists they represent, and are therefore able to extract higher margins.

Buyers, at the other end, usually appreciate and value i) the expert advice from galleries and dealers; ii) the possibility to “test-drive” some work at their homes or walls, before deciding on the purchase; iii) some flexibility in the payment terms. Payment flexibility combined to high operational costs (not only to support and promote artists, but also expenditures such as staff, space rental and fairs/travel expenses), mean most dealers face a mismatch in their cash flows. One of the possible consequences is the “potentially detrimental effects on programming and content […] an increase in conservative, commercial artworks being exhibited” (McAndrew, 2020). Dealers would be investing in “more of the same” – same blue-chip, consecrated artists, or same themes – as an attempt to invest in what is safe (what has been selling in the past will continue to perform well). In the end, there is a loss for the art market as a whole, and for new artists, new ideas, innovative works, minorities.

Dealers play crucial roles in the art market: as market makers, they are responsible for establishing price levels for new artists and subsequent production, controlling supply to gradually increase prices and liquidity; as gatekeepers, they provide confidence, guidance, high-level expertise and qualified advice. When dealers decide which name to promote or exhibit, they are deciding what kind of art the market will be consuming. Dealers influence the taste and the trends.

Art Fairs are a very important instrument for the art business, key events that bring together sellers and buyers at a less pretentious environment. During those events, prospect buyers can browse artworks without the pressure of a closed, by-appointment-only traditional gallery. If in the year 2000 there were 55 well-established international art fairs, in 2019 the number of events escalated to at least 300 and represented 42% of the dealers' sales (versus 40% at the physical gallery premises). With the Covid-19, however, most major art fairs were cancelled or converted from in-person exhibitions to online events, and the share of dealers' sales through art fairs was reduced to 13%. This migration of the fairs to online events outlined the importance of price transparency: 90% of the enquiries on Artsy, a digital platform that organizes online art fairs, were on works that had the price published (Art Basel 2021).

Despite the disappointing results in 2020, Art Fairs will continue to play a key role in the art market: first, for the accessibility of the events; second, fairs allow the public to decide what they prefer, instead of relying only on the choice of curators and advisors. Art Fairs and the increasing Online are important structures to give more people the access to the Art World, enlarge the general public participation in the art business, encourage new collectors to engage with the market, and reduce information asymmetries – mainly through online price transparency.

2.3.2 Auction Houses

In 2020, the auction sector accounted for 42% of the sales in the art market (Art Basel, 2021). Unlike dealers, auction market is highly concentrated. The two largest auction houses, Sotheby's and Christie's (founded in 1744 and 1766, respectively), are responsible for 40% of the sales in auctions. The top-5 auction houses are more than half of the market sales in value, and the remaining transactions are conducted through successive tiers of smaller national, local or specialized operators.

Sales are geographically concentrated, also: 81% of the sales in value in 2020 were closed in the US, UK and China. Artworks priced above US$ 1 million represented 54% of the sales in value, being just 1% of the lots sold.

Whereas dealers may work with primary or secondary market or both, the auction sector performs almost exclusively secondary market sales. When the artist is successful and makes it through to the secondary market, the prices are no longer established by dealers, but by the market mechanism of supply and demand. Auction

market success is very dependent on the availability/offer of good works of art: in moments of high economic uncertainty, there is a shortage of supply, as the owners of those highly priced pieces may prefer to hold the sale, and sales results may be lower due to the lack of quality lots; or to engage in a private sale, when the auction house deals directly with seller and buyer, and final results are never publicly known.

Only prices of public auctions are available: that means that auction data is available, reliable, costless and easy to obtain (we will see when discussing price indices that indices and returns are calculated based on those public auction prices). However, it also means that more than half of the transactions in the art world are opaque and final values are never known to the public. Results at auction set a new benchmarking price for artists, even at galleries and primary markets. Auction prices validate the price level for an artist – prices become recorded data and no longer speculation.

Art normally changes ownership because of one of 3 D's: Death, Divorce or Debt – circumstances when usually the secrecy of a private sale is preferred. When a work of art is offered for sale, the vendor has a reservation price. During the auction, if the reserve price is not achieved, there is a buy-in – the artwork failed to find a buyer. Although buy-ins are not in the market figures, they also contain important price information on the price level that an artist is being traded or valued.

The pandemic had a huge impact over all industries, and for the luxury and art markets it was not different. Resilience and adaptability were key factors to survive, and the forced acceleration of the online channel platforms was essential for auction houses. Most auction events took place online, and an old belief that there was a ceiling for online prices proved wrong. But one of the most welcome changes with the online, as already mentioned for the dealer sector with the online artfairs, is the price transparency offered by digital platforms. The accessibility/transparency of prices opens the possibility of broadening the customer base, attracting new buyers and new price levels. Online (and art fairs) offer a less intimidating environment capable of conquering new clients and expanding the art business. The increasing online transactions will open the art market to more transparency and liquidity.

2.4 Pricing and Price Indices

Michael Findlay, art dealer and expert, once wrote: “The price of art, whether sold in the primary or the secondary market, is governed by supply, demand, and marketing”[2].

Sky-high auction prices as those mentioned in the **Introduction** call immediate attention to the art world and make the public wonder how are prices defined in the art business. Goetzmann (1993) wrote: “the subjective nature of aesthetic value would suggest that the only constraint limiting the price of a work of art is the wealth of the collectors who desire it”.

Art can be considered a commodity, a tangible asset, and is subject to the laws of demand and supply. Prices are much more an indicator of the degree of popularity and success of an artist than a certification of aesthetic quality.

Unlike other financial instruments, art is also a consumption good, and owners take pleasure in its intrinsic value, aesthetic pleasure, and, as a luxury good, derive additional enjoyment from the signal of wealth that owning a masterpiece transmits. “It is the mixture of pecuniary and nonpecuniary payoffs to ownership that makes artworks both compelling to purchase and difficult to value” (Mandel, 2009). As we will see under the **Imperfect and Asymmetric Information** section, prices are also an important signaling mechanism.

When an expert evaluates the price of an artwork, there are objective and subjective characteristics, or quantitative and qualitative factors, taken into account. Regarding the artist, features such as alive or dead[3]; nationality; past exhibitions (in galleries, museums, art fairs or important private collections) are considered. Regarding the artwork, authenticity; signature; condition; size; history/provenance; subject matter; artistic movement; medium/technique; rarity. Other criteria could be where the sales took place, the reputation of the vendor, comparison to similar works. Experts’ appraisals also provide a basis/benchmark for a work offered at auction: low estimate (close to the sellers’ reservation price) and high estimate. McAndrew and

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[2] FINDLAY, Michael. **The value of art**. Prestel Verlag, 2012.

[3] Pénasse, Renneboog and Scheinkman (2021) found that premature death raises prices by 54.7% and sales by 63.2%, with a permanent impact for 10 years and beyond. The effect is more pronounced when the artist dies young and of a sudden death.

Thompson (2007), studying data on French Impressionists paintings, concluded that the ratio between final hammer prices over the geometric mean of high and low estimates falls between 0.92 and 0.995 (depending on whether buy-ins are considered in the sample). That is a confirmation that experts' appraisals have an important anchoring effect on selling prices.

Price indices outline general market trends. They allow to estimate returns and compare the results to other assets. They also enable to calculate volatility and correlation to those other financial instruments, thus making it possible to analyze art or any other collectible in the context of a portfolio. Published and reliable price indices give transparency, permitting comparisons and increasing market transactions.

The main difficulty to evaluate the performance of artworks is that goods are heterogeneous and unique. There are two main econometric methods in the literature used to construct price indices: hedonic regressions and repeat-sales regressions.

The hedonic approach was originally developed for the automobile markets, and is largely used for computers and housing. It uses the same characteristics that a market expert would use to evaluate a work of art: size, medium, author, whether the work was signed and dated; and each attribute has a value that contributes (negatively or positively) to the final price of the good. Hence, it allows to calculate the importance of each characteristic even when comparing different artworks. One of the criticisms, however, is that it is prone to a specification bias, once the choice of the characteristics to be considered is subjective. It may also be difficult to find detailed information on each work of art.

The repeat-sales regression method, originally developed for the real estate market, demands at least a second sale of the object being analyzed. Since the same object is compared in two different moments in time, very little information is needed: date of sale and price – no intrinsic characteristics of the goods. One of the negative aspects is that the size of the final sample is reduced, once many sales are discarded because there is not a second sale in the sample to be compared. Another possible bias is that the quality of the good must remain the same between the subsequent sales. The longer the time observed, the better the result, because there are more chances of a resale during the time span. However, there are masterpieces sold to museums or even to a family collection where they stay for generations, that will never show up for sale again. An additional consideration is that the index is revised

constantly, as new sales happen and are taken into account when you extend the time observed.

Art indices are very useful as they enable comparing results of investing in art to other financial assets. Still, one must remember i) that art indices are not tradable, and carry combinations of artworks probably impossible to replicate in the real world; ii) those are independent indices with no formal approval by ratings agency; iii) indices are not exempt from biases; iv) most art indices (including the Artprice used on this thesis) consider only public auctions sales, which make up less than half of the market, and do not take into consideration the market frictions and high transaction costs that will be discussed in the next section.

3 Art Market Inefficiencies

The art market differs from most financial markets because of the uniqueness and heterogeneity of the goods. But it is also much more opaque, illiquid, subject to high transaction costs and taxes, in addition to having several extra costs associated, such as storage, insurance, eventual restorations and even legal fees. Those market frictions may result in a market equilibrium that can be inefficient both in a Paretian as well as in an informational sense. Nevertheless, it may also result in valuable opportunities for those who are able to exploit them – mostly insiders who make profits at the expense of outsiders.

3.1 Imperfect and Asymmetric Information

In August,1970 George Akerlof published his seminal work “The Market for Lemons”, that demonstrated how uncertainty could reduce the overall quality of the goods, along with the potential size of the market.

The author introduces the concept of asymmetric information, and analyzes the market for used cars as an example to illustrate his ideas. The problem arises because there are goods with different quality in the market. The seller knows the actual quality of his products, whereas potential buyers do not. Whenever good cars and bad cars (‘lemons’) trade at the same price in the market, buyers will as an average expect lower quality cars and offer lower prices; that induces sellers to offer even lower quality cars. This continuous adjustment in “quality” and prices may end up driving good products out of the market, in a process called adverse selection.

The art market provides a perfect example of how imperfect and asymmetric information can affect markets. Potential buyers are aware that sellers have more information on the quality of an artwork. If they don’t have a minimum level of trust on the quality of the goods or on the information that can be accessed, they will be discouraged from participating and engaging in transactions. The market becomes smaller and less robust than its potential[4].

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[4] According to Deloitte Art & Finance Report (2019), 75% of collectors declared lack of transparency was the biggest threat to the reputation in the Art Market. If those already engaged in collecting have that opinion, “one can clearly see why potential new art buyers and collectors might shy away from the art market”.

That could be an explanation for why the art market has reached only US$ 50.1 billion in global sales in 2020, while the LVMH luxury conglomerate reported sales of US$ 54.5 billion (LVMH Annual Results, 2020). Or sales of premium and luxury cars only in the US market were of US$ 87.3 billion (Euromonitor).

Markets with imperfect and asymmetric information must create mechanisms to bridge the information gap, allowing consumers to make more informed decisions. As Akerlof points out in his text, "[…] private institutions may arise to take advantage of the potential increases in welfare which can accrue to all parties". He concludes the text by suggesting "Counteracting Institutions", *i.e.*, intermediary market institutions, that could counteract the effect of quality uncertainty and reduce the information asymmetry. Some of his suggestions are guarantees, brand named goods and licensing practices.

Akerlof's proposal of counteracting institutions was further developed by Spence (1973) and Stiglitz (1975), as signaling and screening, respectively, were proposed as possible solutions to solve the adverse selection and asymmetric information problems.

In the art world, products are unique and heterogeneous. There is a lack of price history, since transactions usually occur with very low frequency, and the search for information is expensive both in terms of time and transaction costs. That is the ideal situation for intermediaries - better informed agents with expertise - to step in and narrow the gap, by approximating buyers and artists, improving the efficiency of the market and generating more transactions. Those intermediaries can be institutions such as museums, curators, art dealers, art advisors and experts, whereas the different instruments are exhibitions, appraisals, certifications, *catalogue raisonnés*[5], all mechanisms and warranties that can attest and signal the quality of the product.

Buyers/collectors can educate themselves, but that is costly and takes time. There is a somewhat high entry barrier for an art expert: it takes many years of study, knowledge, personal relationship and commercial transactions, to develop not only enough art knowledge, but also good taste. Most successful dealers, agents and auction houses have many years (decades) of experience in the art business, not to mention influential relationships and complex networks. In fact, there is a whole

[5] The official listing of the artist's work.

environment/entourage around the art system that exists only because of the asymmetric information between artists and buyers. Highly experienced agents can extract impressive profits arbitraging these asymmetries between sellers and buyers – which explains the mark-ups galleries and dealers charge in the primary market (that may go as high as 50% of the selling price[6]), and the fact that auction houses charge commissions both from sellers and buyers.

The uncertainty and asymmetry are larger in the primary market, where artworks come for sale for the first time. Most of the primary market is made of younger and relatively unknown artists, whose quality is difficult to ascertain, and there is uncertainty whether the artist will remain recognized for the next years or decades. In fact, not only artists' names may vanish[7] from the market, but also some techniques or subjects/themes may go out of fashion. Emerging names do not have a tracking history of exhibitions or awards, neither many other comparable sales so that the buyer or collector can have an idea of price positioning.

Galleries and dealers who work in the primary market are responsible for building names and reputations. Dealers control prices and supply for new artists, and manage exhibitions and even "whom to sell to" in order to build an artist's biography in a sustainable manner. They manage careers of new artists in order to establish, for instance, entering prices: a new artist whose price is initially set too low may not communicate an idea of quality; on the other hand, initial prices set too high may not have room for further price increases.

Prices are an extremely important signaling mechanism. In the words of Stiglitz, "price serves a function in addition to that usually ascribed to it in economic theory: it conveys information and affects behavior". Quality is screened according to prices; as art can also be considered a luxury product, of conspicuous consumption, collectors may also value an object in proportion to the higher prices paid to acquire it. A price increase for an artist sends an important information (signal) not only to new clients, but also to frequent buyers, that those artworks are being accepted by the market and the quality of a former acquisition is confirmed. Prices are never reduced to stimulate

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[6] THOMPSON, 2008.
[7] Fewer than half of the Modern and Contemporary artists listed in a Christie's or Sotheby's auction catalogue continued to be offered at auctions twenty-five years later (THOMPSON, 2008).

demand - a price cut could mean something “went wrong” with an artist. Instead, dealers prefer to restrict supply.

Buyers and collectors are aware that risk and uncertainty are larger in primary market and for emerging and contemporary artists, as fewer signals are available. Collectors usually rely on art advisors and keep close relationships with dealers. Another solution often pursued is to keep a collection focused on the same artists or art subsegment. Whilst from an investor’s point-of-view the non-diversification may sound strange, in art this approach is relatively common: highly-specialized collections are validation mechanisms – the collection becomes a reference for the artist or movement. The same choice can be made from the dealers’ side – to specialize in certain niches or clusters – but, again, from an investment perspective, this represents a risk from not properly diversifying.

Information costs are relatively lower in the secondary market – where artworks are transacted for the second time. It is important to remember that, unlike other markets, artworks appreciate in value over time, rather than depreciating as do other durable goods. Artworks and artists able to cross from the primary to the secondary market increase their value and prices. Presence in the secondary market and mainly at auctions is the proof that the artist survived the test of time. In the secondary market, information is more available, there are more price records and trading history. As most of the artists are already dead, the uncertainty in the secondary market comes from different sources, such as provenance, authenticity[8] and general condition of the artwork.

Here again the importance of branding, prestigious names and overall reputation are paramount: the provenance[9], history and registration of previous owners, exhibitions, experts and foundations that may have validated the artwork, or whether the artwork is part of any catalogue or book. Reputation is a very important signaling mechanism to reassure quality to buyers. Galleries, Dealers and Auction Houses also rely on their reputations: in a relatively small market, where the same few

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[8] Provenance is the list of a painting’s previous owners and the places where it has been displayed; Authenticity – who painted it and when – is determined by expert opinion, physical examination and sometimes scientific analysis.

[9] Li, Ma and Renneboog (2021) catalogue Provenance in four dimensions: Pedigree, Exhibition, Literature and Certification. Literature (meaning an artwork has been mentioned in art books or *catalogues raisonnés*) increases the hammer price in 53.5%. Former exhibitions organized by prominent museums increase hammer price by 58.9%.

buyers circulate around the same events, *premières* and art fairs, reputation is a huge asset for those intermediaries.

Most prospect buyers and collectors are wealthy individuals, for whom money is not an issue, but investing time and efforts to search for information is expensive – time is their most valuable asset. Therefore, those HNW collectors, instead of spending time looking for or purchasing an unknown artist, may prefer choosing already established names, following the consensus of curators, advisors, dealers or even more experienced collectors.

One consequence is the rising of Superstars: concentration of business, fame and success on those few names on the top. In a paper published in 1981, Sherwin Rosen describes the "phenomenon of Superstars", where "in certain kinds of economic activity there is concentration of output among a few individuals, marked skewness in the associated distributions of income and very large rewards at the top". In a later article, Adler (1985) returns to the idea arguing that "the phenomenon of stars exists where consumption requires knowledge". Appreciation increases with knowledge and by discussing it with others. Stars may be born because it is easier to discuss about artists that more people know about. In the end it is less costly to concentrate all information on fewer names on the top, whose signaling is more evident – "If there are stars, one is better off patronizing these stars even if their art is not superior to that of others".

A second consequence of the Superstars effect could be a less diversified art market, as preferences are driven by the same specialists, experts, taste makers and gatekeepers, in an endogenous endorsement process, instead of by consumers' own tastes and preferences. The market becomes thinner and more difficult for new talents.

As already mentioned, the increasing volume of sales through the online channel – and the price transparency of the online art market - can reduce information asymmetries, and have a positive impact by enhancing market transparency. The emergence of art market information providers and more available online data help translate results into important information to decision making, and consequently more transactions. Technology can cause a profound impact in the art business, improving transparency, provenance, traceability, authenticity and regulation.

3.2 Other market frictions and inefficiencies

Markets should be frictionless. Apart from the informational asymmetries described above, the art market is also subject to several other market frictions that generate inefficiencies.

3.2.1 Transaction Costs

As already mentioned, transaction costs in Art markets are much more significant than in major financial markets: dealers have markups that may go as high as 50-70% of the selling price; auction houses may charge up to 25% commissions, and commissions are charged from sellers as well as from buyers. These high percentages, in proportion to the value of the art goods, contrast to the insignificant costs you have in the equities market.

In fact, Art can be considered an asset with a negative cash flow: differently from equities, it does not yield monetary dividends. Art ownership can be compared to real estate properties: it can generate some rent to owners, but they incur in extra costs such as storage, insurance, handling, shipping, and eventually restoration services.

3.2.2 Material Risks

As a real, physical asset, art may suffer from material risks, such as theft, or damage, that transform the value of the asset to zero instantaneously. Insurance can protect the owner from this source of risk, but, of course, at an additional cost. For other risks such as fakes[10], forgeries and reattributions (an artwork reassigned to an apprentice instead of the master), the collector must take precautions in advance, via certifications and authenticity documentation, purchasing through renowned agents – that charge for the due diligence.

3.2.3 Liquidity

Liquidity is another important concern. Illiquidity arises due to market imperfections: i) entering those markets is costly in terms of time, money and knowledge/skills; ii) transaction costs are high due to commissions, taxes, due

[10] Up to 40% of the high-end art market is estimated to be made up of forged art (THOMPSON, 2008).

diligence, lawyers, accountants, experts; iii) search frictions, in the sense that it may be difficult to find a buyer with enough capital for some artworks, so the transaction may take longer than expected; iv) funding constraints and absence of credit; and finally v) the asymmetric information already discussed.

Illiquidity manifests itself in infrequent trading, small amounts being traded, low turnover, and intervals between trades that can extend to decades (Ang, 2014). In the Art World, there is a limited market infrastructure for sales transactions, differently from other assets such as equities, bonds and commodities. Transactions take time: large auction events, for instance, happen only a few times per year. There is an intense preparation for those events: the art in consigned, evaluated, checked for authenticity and general conditions of the artwork; the piece is then photographed and a catalogue is usually printed and distributed. All this preparation takes from 3 to 6 months prior to the sales evening. In moments of financial turbulences across the market, the owner may not be able to sell that promptly. (Lack of) liquidity also smooths volatility, making returns look less risky than they actually are.

3.2.4 Holding Periods

All those inefficiencies – illiquidity, transaction costs – cause holding periods in art to be much longer than from any other assets. Kräussl and NasserEdine (2018) find that returns are positively related to the length of the holding period[11]. Longer holding periods, actually, may allow for the reduction and amortization of transaction costs. Mei and Moses (2002) find an average holding period of 28 years in their study, and suggest that “art may be appropriate for long-term investment only so that the transaction costs can be spread over many years”. As a matter of fact, art is frequently perceived as an intergenerational investment, to be liquidated only at estate settlements.

[11] The authors also find, however, an increasing number of “flipping” opportunities (very short-term transactions), that generated the highest return over the sample, which seems to indicate some kind of exceptional arbitrage opportunity. They also found that the average holding period for art has been decreasing recently.

3.2.5 Tax and legal considerations

Last but not least, taxation is also an important issue to be considered, but extraordinarily difficult to be fully assimilated. Collectors usually have their wealth in more than one country, as well as their homes and collections. As previously mentioned, the major art hubs are tax-friendly markets. But an artwork purchased in New York or London is subject to taxation when transferred to Europe or South America. Legislation differs from country to country, or even from state to state within the same country. Art can be subject to lower taxes or tax deductible, but can also be heavily taxed when imported or exported. There are tax benefits and deductions associated with donations and bequests, which could be of special consideration for wealthy collectors. Art collections should be considered as part of tax and inheritance planning.

One consequence of the tax imbroglio are the freeports. These are tax-free zones, originally bonded warehouses designed for manufactured goods temporarily waiting to be transferred from one country to another, without paying taxes such as VAT or customs duties. Those freeports became art galleries where prospective buyers can view the artwork, close the deal, transfer the money and just move the object from the seller's storage area to the buyer's – without even technically entering the country (Thompson, 2018). Beyond the obvious facet of money laundering, artworks in freeports, out-of-sight for decades, raise a discussion about art being deprived of its very essence: works of art that will never be seen[12].

All of the inefficiencies mentioned so far, and the consequent costs, are crucial to understanding the functioning of the art market, the roles played by its agents, and the caution we must exercise when analyzing the performance of art as investment, in the next section.

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[12] "The greatest museums no one can see", in the words of Louvre's director Jean-Luc Martinez (https://www.nytimes.com/2016/05/29/arts/design/one-of-the-worlds-greatest-art-collections-hides-behind-this-fence.html)

4 Art as investment

4.1 Brief review of Art as investment

The idea of art as investment is not a recent practice, and probably can be traced back to the patronage during the Renaissance. According to Frey and Pommerehne (1989), art investing "became an increasingly popular activity since the end of World War II". Peggy Guggenheim, in her memoirs written in 1960, complains after a visit to New York that "the entire art movement has become an enormous business venture", with prices "unheard of", and buyers that "buy merely for investment, placing pictures in storage without even seeing them, phoning their gallery every day for the latest quotation, as though they were waiting to sell stock" (Shnayerson, 2019).

In 1974, the British Rail Pension Fund decided to invest 3% of its Assets Under Management in art, as a manner to diversify their portfolio and hedge against the then high rates of inflation. Between 1974 and 1980 a wide selection of artworks was carefully chosen, with the help of experts from Sotheby's, and acquired through dealers and auctions. After the last auction, in 1996, the average nominal annual return through the 22-year period was of 13.1%. The real rate of return, net of associated costs, was slightly below 6%. "The art portfolio outperformed the Fund's real estate portfolio during that period, and mirrored what the Pension Fund would have earned on UK bonds" (Pesando and Shum, 1999). However, the authors conclude that the relatively successful performance "appears to reflect the timing of these sales: the relatively favorable experience of the Pension fund in its investment in artworks may simply represent – with the advantage of hindsight – a propitious decision as to when to exit from the market".

In "Art as an Asset: Evidence from Keynes the Collector" (2020), Chambers, Dimson and Spaenjers had a unique opportunity to investigate the performance of a real collection (not an aggregate art index) over time. The collection belonged to John Maynard Keynes, an enthusiastic collector of art, books and manuscripts, and was assembled from 1917 to 1945. Upon his death, the 135 artworks were donated to the King's College in Cambridge. Keynes acquired the pieces through different channels, including directly from some of the artists that were friends or acquaintances. But Keynes was also interested in art as an investment: he kept detailed record of all

transactions – date, purchase prices, where it was acquired. The extensive documentation allowed the authors to conclude that Keynes' collection yielded 10.4% nominal annual return and 6.2% real annualized return. "The year 2019 value of the art collection is only 16% lower than what it would have been if Keynes had instead invested his outlays in U.K. equities, reinvesting dividends (costlessly) back into the portfolio; the annualized underperformance relative to the equity market is just 0.2%". The authors also conclude that the high returns could be explained by the "good luck" of his purchases.[13]

The experiment of the British Rail Pension Fund and the Keynes Collection are very important because they provide unique opportunities to evaluate the performance of a collection as a whole – actual results of real-life art portfolios.

In the academic literature covering the results of art as investment, authors have to work with aggregate indices, due to the heterogeneity of artworks and the infrequent sales transactions. The two most used methods are Hedonic Regressions and Repeat-Sales Regressions.

The method of hedonic regressions allows the construction of an index based on the physical characteristics of the object: author, material, size, theme. What you gain in terms of details, on the other hand you may lose because of the difficulty to transform physical attributes that may not be comparable; the method is also more prone to subjectivities of the researcher – what attributes to consider, what artists names to include.

The Repeat-Sales Regression method compares the same artwork sold in two different moments. In contrast to the hedonic method, the RSR does not need any information on the characteristics of the good – only prices and dates (first sale and resale) are necessary. However, this method may suffer from a selection bias, given that only artworks that sold more than once are taken into account. In addition, the RSR requires an initial sale and a subsequent resale, causing a significant reduction of the sample size. There are also artworks and masterpieces that sell just once, for a museum or private collector that holds the piece for generations. That object is therefore out of the market.

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[13] Chambers *et al.* also suggest that Keynes, as a "better informed insider", had the opportunity to outperform the average art investor – "informed art investors can do well in the art market by identifying particularly attractive entry prices".

Whatever method of construction of the price index, one must, however, be aware that prices are observed only when the artwork sells. Indices allow comparison to other financial assets, but are not flawless, may be subject to biases, and are a theoretical exercise – Art indices are not available for transactions in the real world.

Baumol (1986) covered three centuries of art sales prices (1652-1961). Using repeat-sales regressions and the constraint of a minimum 20 years of holding period, he obtained annualized real returns of 0.55% (median 0.85%), compared to an average real return of 2.5% for Government bonds. He compared investing in art to a crap game: “Their prices can float more or less aimlessly and their unpredictable oscillations are apt to be the exacerbated by the activities of those who treat such art objects as ‘investments’, and who, according to the data, earn a real rate of return very close to zero on the average.” He even adds that the imperfect information on transactions and prices “does not matter, in the sense that better information about the behavior of the market really would not help anyone to make decisions more effectively”.

In 1989, Frey and Pommerehne used the same database as Baumol (Reitlinger’s compendium), the same 20-years holding period restriction, but extend the period of study to cover from 1635 to 1987. Their sample had 1,198 repeated sales (in his study, Baumol was able to analyze only 640). Their results were of a mean real rate of return of 1.5% per year (median 1.8%), with a standard deviation of 5% - a result that is half of the 3% of return obtained for public securities. According to the authors, “investing into paintings instead of financial assets implies a (real) opportunity loss of 1.5 percentage points per year for the holder of paintings”. They also suggest that, due to representation bias, collectors overweight those news and media buzz on record auction transactions and “superstars” sales, whereas neglecting and underestimating the effects of inflation on the nominal rates of return. And conclude that “consumption benefits of owing a picture which may consist in pure aesthetic pleasure or in the prestige gained, must play a significant role”.

Goetzmann (1993) also worked with Reitlinger’s data to construct an art index with 3,329 price pairs of 2,809 different paintings over the period from 1715 to 1986. He estimated annual nominal returns of 3.2%, below the 4.3% returns for bonds. However, when analyzing the sub-period 1900-1986, he was able to obtain nominal annual gains of 17.5%, compared to 4.9% for equities and 4.8% for Government

bonds. Despite such positive returns, he suggests that, due to the higher volatility of art prices, art is only for “the nearly risk-neutral investor”. Goetzmann also states that the high correlation between art and stocks and bonds (0.78 and 0.54 respectively) “clearly makes art a poor vehicle for the purposes of diversification”. He finds strong evidence of causal relation from the stock market to the art market – “demand for paintings increased when investors wealth grew”.

One of the several difficulties in studying the art market is the uniqueness of the objects and infrequent trading. Pesando (1993) partially overcame the problem by focusing on a sub-set of the art market and analyzing Modern prints from 1977 to 1992. Once prints are multiples in editions of 50-100, he was able to increase the number of repeated sales to 27,961. The mean real return of 1.51% was below US Government Bonds (2.54%) and far below equities (S&P 500, 8.14%). Although the results for modern prints were lower than bonds or equities, Pesando suggests that “prints could still provide an attractive investment if their inclusion in a portfolio of traditional financial assets would serve to reduce its risk”.

Mei and Moses (2002), in one of the most mentioned works about the return of investing in art, use sales data from public auctions to build a database for the American Market. They covered the period from 1875 to 2000 and analyzed 4,896 repeated sales to construct an annual art index (the Mei and Moses All Art Index - MMAI) as well as sub-indices for American Art, Old Masters, Impressionists and Modern paintings.

The authors find a real return of 4.9% per year in the full period 1875-2000, which is above US Treasury Bills (1.8%), although below equities (6.6% for the S&P 500). When comparing only the second half of the 20th century (1950-1999), the results are even more encouraging: MMAI has a real return of 8.2%, very comparable to the 8.9% of the S&P 500 during the same period, and outperforming bonds and treasury bills. The annual volatility of investing in art is also half in the more recent sub-period (21.3% from 1950-1999 versus 42.8% for 1875-1999), although higher than equities. The authors also show that there is a very low correlation between the art index and equities and bonds for the 2nd half of the century: 4% with S&P 500 and -3% with T-bills.

Mei and Moses note that most artworks are held on average for 28 years, a considerably long time period. They also point out the problem of selection bias and a “backward filled” data bias, once many paintings have been sold at Christie’s and

Sotheby's (high reputation, higher prices). Goeztmann had also raised the issue that "the decision by an owner to sell a work of art may be conditional upon whether or not the value increased". Other possible bias is that items at auction may not be sold for not reaching reservation prices (buy-ins are not considered in the sample). Because of those bias, the authors recommend using the returns "as approximate or an upper bound on the average return obtained by investors […] that could be further reduced by transaction costs". But they remind the reader that "return estimates for financial assets could suffer from the same biases, such as lack of market liquidity, transaction costs and survival".

Campbell (2004) returns to the Mei and Moses Art Index to study two different periods – from 1875 to 2002 and from 1965 to 2002. She finds an average return of 7.23% per year for the period 1875-2002, versus 8.8% for the S&P 500; and an amazing annual return of 10.94% from 1965 to 2002, slightly above the 10.49% for the S&P 500 and above 7.53% for Government Bonds.

She also finds a low correlation between the art index and both equities and bonds, suggesting benefits for including art in a diversified portfolio. Mei and Moses (2002) had also encountered low and negative correlations among art, equities and bonds.

4.2 Art Performance from 2000 to 2020 - Artprice data

This thesis works with a data set from Artprice, a French company that claims to be "the world leader in art market information", providing information and market analysis thanks to its databanks covering more than 750,000 listed artists and information on 6,300 auction houses around the world. The data sample covers a more recent period than the works mentioned in the previous section. Included in the past 21 years we experienced several big shocks, such as the dot-com bubble, the September 11, the Global Financial crisis, and more recently the Coronavirus pandemic.

The Artprice Global Index (AGI) is based on results from Fine Art public auctions from January 1st,1998 (base 100) to December 31st, 2020, quarterly data. Sales results do not include private sales from auction houses, or dealers' sales. Therefore, significant part of the market is not covered. Public auction results include the buyer's

premium, and the indices do not consider buy-ins (artworks at auction that did not meet the reservation price). The method of calculation is the repeat-sales method, *i.e.*, lots that appear in an auction for sale at least for a second time.

The indices provided are also subdivided into a "historical segmentation of creative period"[14] (Old Masters, 19th Century, Modern, Post-War and Contemporary Art); and a "medium category" (paintings, sculptures, drawings, photography and prints). Figures 6 and 7 in the Appendix show the evolution of the sub-indices.

Table 1 presents the summary statistics for the Global Art Index and for each subcategory index, per "creative period" and per "medium", from the 1st quarter, 2000 to the 4th quarter, 2020 – a total of 84 quarters. We present real returns, already deflated by the US Consumer Price Index (CPI):

Table 1 - Art Indices Summary Statistics

	Mean (%)	Median (%)	Standard Deviation (%)	Skewness	Kurtosis
Global Art	-0.83	2.25	29.94	0.37	0.11
Old Masters	-3.87	-3.32	42.10	0.73	0.92
19th Century	-3.59	-0.49	12.74	0.11	0.29
Modern	-2.83	-4.16	14.07	0.20	-0.13
Post-War	1.85	0.85	12.21	0.45	0.34
Contemporary	5.34	7.45	23.06	-0.13	-0.09
Paintings	-1.95	-2.79	8.07	0.67	1.24
Sculpture	-1.47	-1.18	8.95	-0.11	0.64
Photography	-0.99	-0.72	16.13	0.38	0.38
Drawings	0.50	0.84	70.04	1.39	3.34
Prints	1.28	-0.56	12.45	0.12	0.32

Source: Calculated by the author with data from Artprice.com.

The annual return for the Global Art index was of negative 0.83%, with a standard deviation close to 30%. Among the Creative Period sub-indices, we can see

[14] Artprice applies the following historical segmentation of "creative period: "Old Masters" refers to works by artists born before 1760; "19th century" refers to works by artists born between 1760 and 1860; "Modern art" refers to works by artists born between 1860 and 1920; "Post-war art" refers to works by artists born between 1920 and 1945; "Contemporary art" refers to works by artists born after 1945.

Contemporary Art with a solid 5.34% real annual return and a 23.06% volatility. Post-War had a positive 1.85% annual return with nearly half the volatility. The worst result was for Old Masters, with a negative return of 3.87% and a 42.10% volatility.

Among the medium category, Prints had the best return, 1.28% per year, whereas Paintings returned negative 1.95%, but with the lowest 8.07% volatility. Drawings for instance returned positive 0.50% but with a 70% volatility.

It is interesting to analyze how the different sub-indices are correlated within the art market, what we can see in table 2:

Table 2 - Correlation Between Art Indices

	Global Art	Old Masters	19th Century	Modern	Post-War	Contemporary	Paintings	Sculpture	Photography	Drawing	Prints
Global Art	1										
Old Masters	0.038	1									
19th Century	0.199	0.130	1								
Modern	0.315	-0.252	0.098	1							
Post-War	0.223	-0.286	0.400	0.453	1						
Contemporary	0.086	-0.210	-0.045	0.191	0.355	1					
Paintings	0.357	-0.241	0.462	0.665	0.794	0.367	1				
Sculpture	0.321	-0.032	0.383	0.370	0.446	0.215	0.661	1			
Photography	0.302	-0.106	0.265	0.395	0.395	0.103	0.513	0.464	1		
Drawing	0.090	-0.016	0.053	-0.002	0.049	0.000	0.061	0.053	-0.001	1	
Prints	0.218	0.106	0.349	0.280	0.432	0.154	0.535	0.624	0.267	0.043	1

Source: Calculated by the author with data from Artprice.com.

Although all sub-indices feed the Global Art index, it is clear that most categories have a low or negative correlation among each other, and also a low correlation with the Global Art Index. An investor who wants to have a diversified art portfolio could hold different weights of each creative period or medium sub-category, as we demonstrate in Section 4.7.

Following Mei and Moses (2002), the return of the Global Art Index is compared to a variety of other asset classes. Table 3 presents the summary statistics of real returns, already deflated by US CPI:

Table 3 - Summary Statistics - Financial Indices, Global Art and Contemporary Indices

	Mean (%)	Median (%)	Standard Deviation (%)	Skewness	Kurtosis
LIBOR	-0.28	-0.30	1.44	1.85	9.26
S&P 500	2.41	6.23	16.55	-0.56	0.30
MSCI World	0.95	7.39	17.59	-0.45	0.37
US Treasuries	2.68	1.69	5.85	1.26	4.06
Inflation Linked	3.31	3.73	4.95	-0.36	0.73
Credit High Grade	2.79	3.22	3.59	0.47	3.07
Credit High Yield	5.67	6.87	10.29	0.19	3.69
Hedge Funds	0.49	2.36	6.19	-1.16	2.84
REITs	8.58	11.09	20.55	-0.92	3.78
Gold	7.13	12.24	13.24	-0.65	1.28
Commodities	-2.85	0.86	16.95	-0.89	1.64
Global Art Index	-0.83	2.25	29.94	0.37	0.11
Contemporary Art	5.34	7.45	23.06	-0.13	-0.09

Source: Calculated by the author with data from Bloomberg and Artprice.com.

During the time frame we are analyzing – 2000-2020, the annual real returns of equities – S&P 500 as proxy for US equities market and MSCI World for international markets - were much lower than historical returns. Not only returns on equities have been lower than historical average, but also interest rates on developed economies: LIBOR for instance had a negative 0.28% annual return.

The disappointing results for financial assets in general are one of the reasons for the search for alternative investments, such as Arts. However, our Global Art Index did not deliver: during the 2000-2020 period, it did not outperform more traditional assets, and its annual compounded return - negative 0.83% - is only superior to the return for Commodities, but at a much higher volatility (29.94% is the highest volatility among all assets). In fact, the best real returns during the past 21 years were obtained by Housing (average +8.58% per year, with the 2nd largest volatility, 20.55%) and Gold (real return of +7.13% per year).

Due to the superior return of the Contemporary Art Sub-index, and also because this is the most available category (living artists), we included the index in the comparison to the other financial assets. As already mentioned, the Contemporary Art Index delivered 5.34% per year, at a 23% volatility. These historical returns are

superior to equities, Government bonds, and very close to Credit High Yield – but with higher volatility.

If the Contemporary Art sub-index is set aside and we turn our attention to the Global Art Index, the poor performance for the period 2000-2020 is considerably lower than those computed by all other authors mentioned in the previous section. In Pesando (1993), Art returns, represented by Prints, although inferior to bonds and equities, at least were positive. For Mei and Moses (2002), Art returns where not only superior to bonds (8.2% x 1.3%), but very close to the S&P 500. Campbell (2004), using the same Mei and Moses Art Index, computed Art returns even superior to the S&P 500 for the period 1965-2002.

The next step would be to compare the correlation of the Artprice Global Index and the Contemporary Art Sub-index to those other financial assets, to see if a low or negative correlation and the high volatility could make art a good asset in a diversified portfolio:

Table 4 - Correlation between Global Art, Contemporary Art and other financial assets

	LIBOR	S&P 500	MSCI World	US Treasuries	Inflation Linked	Credit High Grade	Credit High Yield	Hedge Funds	REITs	Gold	Commodities	Global Art	Contemporary
LIBOR	1												
S&P 500	-0.259	1											
MSCI World	-0.268	0.964	1										
US Treasuries	0.634	-0.548	-0.544	1									
Inflation Linked	0.127	-0.216	-0.157	0.59	1								
Credit High Grade	0.633	-0.261	-0.251	0.871	0.64	1							
Credit High Yield	-0.309	0.746	0.788	-0.448	0.106	-0.077	1						
Hedge Funds	-0.188	0.643	0.713	-0.419	0.057	-0.152	0.707	1					
REITs	-0.199	0.670	0.658	-0.265	0.046	0.008	0.648	0.517	1				
Gold	0.025	-0.029	0.087	0.253	0.508	0.279	0.113	0.046	0.064	1			
Commodities	-0.492	0.413	0.503	-0.445	0.136	-0.339	0.501	0.561	0.368	0.273	1		
Global Art	-0.038	0.062	0.078	-0.160	-0.034	-0.157	0.103	0.137	0.043	-0.152	0.176	1	
Contemporary	-0.226	0.206	0.163	-0.256	-0.137	-0.330	0.008	0.116	0.209	-0.042	0.294	0.086	1

Source: Calculated by the author with data from Bloomberg and Artprice.com.

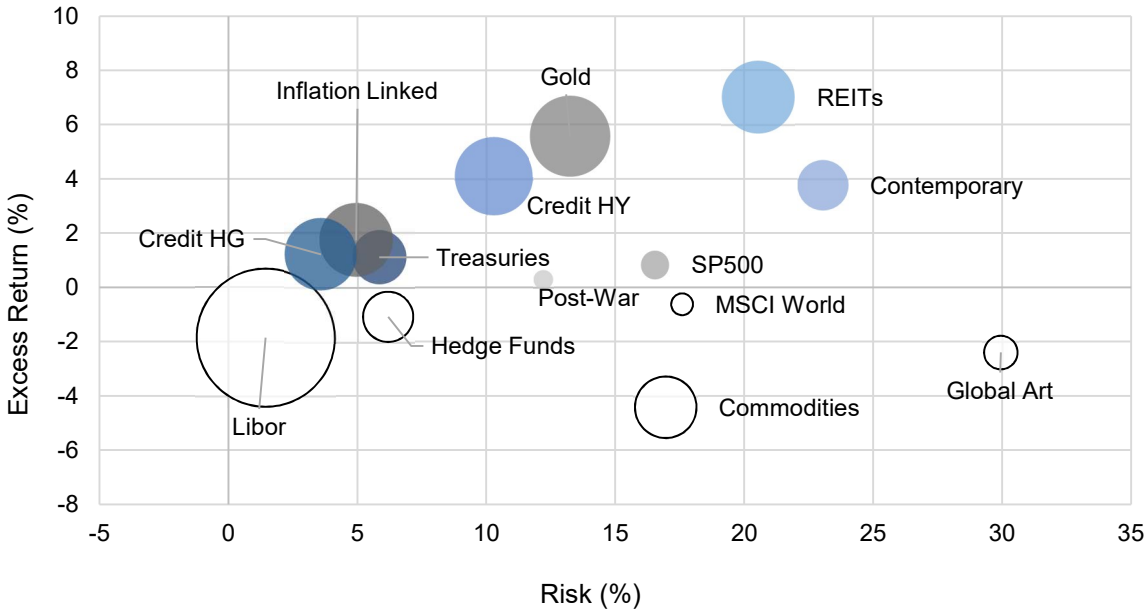
The Global Art Index has a very low or negative correlation with all other assets (from -16% to US Treasuries or Credit High-Grade, to +17.6% to Commodities). Actually, during the time frame we are analyzing, Art has the lowest correlation among all asset classes. Low correlations are exactly what an investor is looking for as part of a portfolio diversification strategy. Contemporary Art also has low correlations with the other financial assets, from -33% with Credit High-Grade to +29% with Commodities.

4.3 Sharpe Ratios

One measure commonly adopted to evaluate the risk-adjusted performance of investments is the Sharpe-Ratio. According to Sharpe (1964), there is a linear relationship between the excess return of the asset over a risk-free rate, and the volatility of the asset. The rational investor can take her decision based on the excess return per unit of risk.

Figure 2 plots in a visual manner the risk, excess returns and Sharpe-ratios for the several financial asset and Global and Contemporary Art indices.

Figure 2 - Excess Returns, Risk and Sharpe-Ratios for different assets



Source: Elaborated by the author. Coloured Spheres have positive Sharpe-Ratios, transparent spheres have negative Sharpe-Ratios, the size of the circle represents the magnitude. Table 12 in the Appendix contains calculated Sharpe-Ratios for all assets and art sub-indices.

Gold had the best Sharpe-ratio, 0.42, followed by Credit High-Yield (0.40), Inflation-Linked bonds (0.35) and REITs and Credit High-Grade (0.34 each). Only Contemporary Art (0.16) and Post-War (0.02), among the Art sub-indices, had a positive Sharpe-ratio.

4.4 Art as part of a diversified portfolio

In 1952, Harry Markowitz wrote his work that introduced the idea of Modern Portfolio Theory and the basis for all asset pricing models that followed. According to Markowitz, rational investors are mean-variance investors, concerned only about risk and return: their utility function maximizes expected return, while minimizes the variance. For two assets with the same return, the investor will always prefer the one with less volatility. When the risk is higher, the investor demands higher return to compensate for the risk. The best portfolios have higher return per unit of risk, or lower risk for a given target return.

Mean-variance investing depends on diversification to work: by exploiting the interaction of assets with each other – the correlation among assets, the investor can increase expected returns while reducing risk. When assets have low correlation, one asset's gains can compensate other asset's losses. The key to improve the risk-return trade-off is diversification.

4.4.1 Portfolio composed of bonds, equities and prints

Pesando (1993) argues that, due to the low correlation between Modern prints and equities and bonds, prints could be included in a diversified portfolio to reduce its risk – "prints do have some capacity to promote efficient diversification in the framework advanced by Harry Markowitz". A minimum-variance portfolio composed of 94% of T-bills and 6% of Prints would return real 2.19% with a standard deviation of 3.19%. In a mean-variance-efficient portfolio with expected return of 3% or more, however, prints would not be included. He restricts short-selling, and notes that returns are "gross of transaction costs", pointing that "although the usual practice", transaction costs associated with buying and selling prints (and art in general) are much higher than those associated with traditional financial assets.

We employ our dataset from 2000 to 2020, and replicate the same assets used by Pesando: US Treasury bills, S&P 500 and Prints. The updated data would generate a minimum-variance portfolio composed of 18.7% of equities, 75.5% of bonds and 5.8% of prints, and return real 2.55% per year with a volatility of 3.92%. Due to the low historical returns of the past 21 years, and restricting short-selling the way Pesando did, it would not be possible to achieve a gain of 3% per year: the optimal mean-variance portfolio would not include Prints either, and would return 2.62% with a

volatility of 3.98%. Table 5 presents the portfolio composed of bonds, equities and prints[15]:

Table 5 - Portfolio composed of Bonds, Equities and Prints
with short-selling restrictions

	Pesando (1977-1992)	Menconi (2000-2020)	
	Minimum-Variance	Minimum-Variance	Optimal Portfolio
Asset			
S&P 500	0%	18.70%	20.65%
US Treasuries	94%	75.50%	79.35%
Prints	6%	5.80%	0%
Return	2.19%	2.55%	2.62%
Volatility	3.19%	3.92%	3.98%

4.4.2 Portfolio composed of bonds, equities and general art index

Campbell (2004) constructed a portfolio combining S&P 500, US Treasuries and an Art index, using data from 1965 to 2002. First she assembles a portfolio composed only with stocks (36.11%) and bonds (63.89%), with a return of 8.60%. Then she includes Art, using the Mei and Moses All-Art Index (MMAI) as proxy for Art. With the inclusion of Art (18.21%) the return of the portfolio increases to 8.97% and has the volatility reduced from 7.76% to 6.87%.

We replicated the same exercise as Campbell, with bonds, equities and an art index, restricting short-selling, and using the updated dataset from the past 21 years. Our results are dramatically different, due to the lower historical returns not only for Art, but also for the S&P 500. Here we use the Artprice Global Index as a proxy for Art, instead of the MMAI[16].

[15] In order to calculate the optimal portfolio, we tried to obtain the highest return with a restriction to short-selling Prints (the same way Pesando did). The best return that can be obtained without short-selling is 2.62%, which corresponds to a risk-aversion of 8.03 and an allocation of 0% to Prints.
[16] The Mei and Moses Art Index was purchased by Sotheby's in 2016 and is no longer available to the public (CHEMALLE, 2019).

Table 6 - Portfolio composed of Bonds, Equities and Art Index
with short-selling restrictions

	Campbell (1965-2002)		Menconi (2000-2020)	
	Mei and Moses Art Index		Artprice Global Index	
	Excluding Art	Including Art	Optimal Portfolio*	Minimum-Variance
Asset				
S&P 500	36.11%	27.69%	20.45%	19.87%
US Treasuries	63.89%	54.10%	79.55%	76.77%
Art	0%	18.21%	0%	3.36%
Return	8.60%	8.97%	2.62%	2.51%
Volatility	7.76%	6.87%	3.98%	3.84%

* The optimal mean-variance portfolio would not allocate any % to art.

The optimal mean-variance portfolio calculated with data from 2000-2020 would not have any allocation to Art. The return would be much lower at real 2.62% per year, with a volatility of 3.98%. We also calculated what would be the minimum-variance portfolio – the results are very close to those of the optimal portfolio: a real return of 2.51% per year, with a volatility of 3.84% and an allocation of 3.36% in Art[17].

Despite our much lower returns, the results seem to point in one clear direction: the inclusion of Art in the portfolio has the benefit of reducing the volatility. That is further explored in the next section.

4.5 Can investment in Art improve a diversified portfolio?

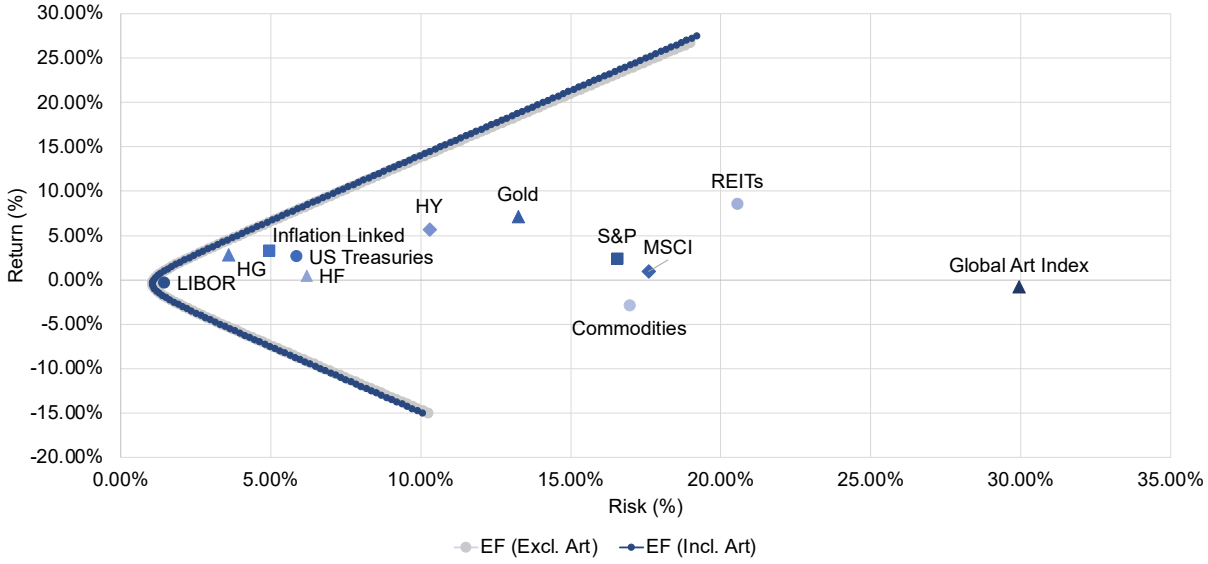
Markowitz' portfolio theory states that an investor can reduce the overall portfolio risk by means of diversification. Mathematically, portfolio variances are indeed reduced when you add imperfectly correlated assets. Economically, low correlations mean that when the rest of your portfolio is not doing well, the low correlated asset is more likely to pay off.

[17] In order to find the risk-aversion used by Cambell (2004), we replicated her work using exactly her data: returns, volatilities, correlations, variance-covariance matrix. We found a risk-aversion of 5.5, and used that risk-aversion to calculate our optimal portfolio, that would have an allocation of 0% to Art.

The theory introduces the efficient frontier, composed of all portfolio combinations with the lowest risk given a desired return, or the highest return given an amount of risk. The rational investor should always be on the line of the efficient frontier. And diversification, or the inclusion of additional assets, should keep moving the efficient frontier to the upper left.

Our first hypothetical portfolio is composed of all financial assets presented in Table 3 and short-sales are allowed. We start the exercise building a portfolio composed only of financial assets. In a second moment, the Global Art Index is included as a proxy for investing in Art. Figure 3 presents the Efficient Frontiers, excluding and then including art:

Figure 3 - Efficient Frontiers
excluding and including Global Art Index
short-selling allowed



Source: Elaborated by the Author.

We can see from the graphic that the inclusion of the Global Art Index pushes the efficient frontier slightly to the upper left. That means that, despite its negative return and the highest volatility, the Global Art Index, due to the negative correlation with some assets and relatively low correlation to others, may improve (very narrowly) the results of a well-diversified portfolio. An investor with a mean-variance utility function, holding this diversified portfolio and allocating 1% of her wealth to the Global Art Index, would have a return of 2.82% per year, with a volatility of 2.46%. In fact, any

portfolio with expected return above 0.52% would have a fraction of the amount allocated to Art.

4.6 The case for Contemporary Art

The Global Art Index used to analyze the diversified portfolio in the previous section is a combination of different artworks, per medium and per creative period.

Contemporary Art is the most recent creative period. In the case of the Contemporary Art Sub-index of Artprice used here, it refers to artists born after 1945. Many contemporary artists are still alive; supply is much less limited than for other art sectors; there are more transactions in the market and therefore more investment opportunities for an investor who wants to start a collection. According to Art Basel & UBS Report 2020, transactions in the Contemporary market represent more than half of the fine auction sales, both in quantity and value. Collectors show pronounced interest in it “in part because they respond to the energy of the art of their own generation”, and also because “so much of earlier art has disappeared into collections and museums, unlikely to be available again for a very long time” (Thompson, 2008); “money flows fastest in those areas with highest supply and turnover” (Knight Frank Wealth Report, 2020).

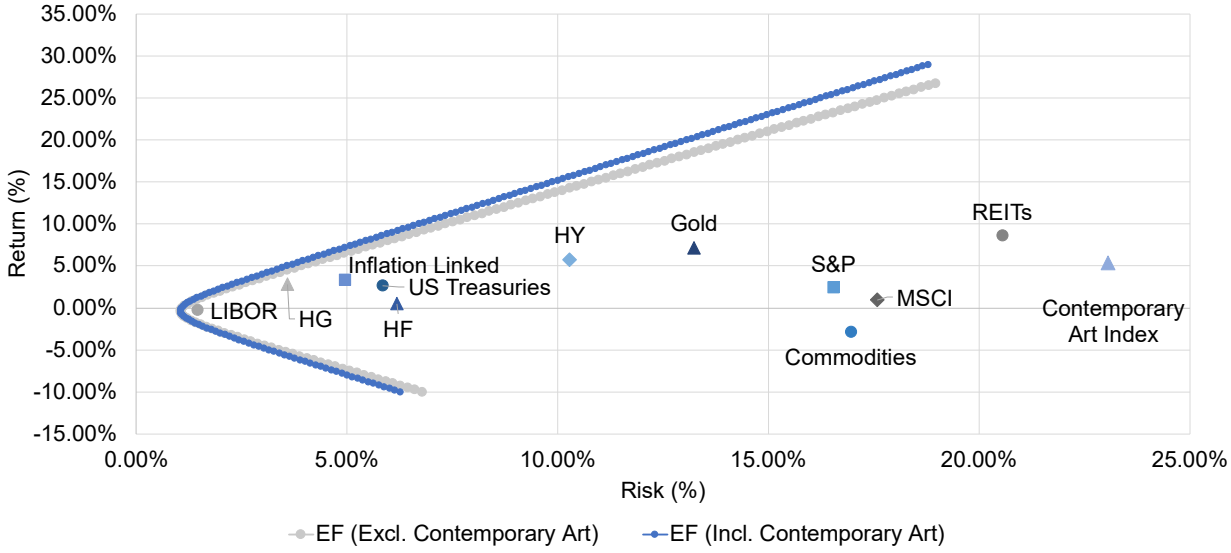
Among the several Artprice sub-indices, we already demonstrated that Contemporary Art presented the best return for the past 21 years. One could argue that there is more risk into those artists and artworks, that still need to survive the test of time, and therefore need to pay higher risk premia. Contemporary artworks have less market and exhibition history, less tracking record. As art is subject to fashions and trends, recent art is more dependent on judgements and definitions – 80% of the art bought from local dealers and local art fairs will never resell not even for its original price (Thompson, 2008). On the other hand, other sources of uncertainty are quite reduced or non-existent: the general condition of the piece is not a concern (as most artworks are relatively new), neither are there authenticity issues (attribution is much easier as many artists are still alive and/or it is easier to obtain documentation).

Contemporary artworks are more available in the market and at auctions. Any investor who just recently decided to include Art in her portfolio can assemble a good collection of Contemporary artworks much more easily than other periods.

4.6.1 The Efficient Frontier using the Contemporary Art index as proxy for Art

All different sub-indices were tested to act as a proxy for Art in the diversified portfolio, instead of the “Global Art Index”. The Contemporary Art Index presented the best results in terms of risk-return, and the best performance in combination with the other financial assets.

Figure 4 - Efficient Frontiers
excluding and including Contemporary Art
short-selling allowed



Source: Elaborated by the Author.

Figure 4 presents the Efficient Frontier when combining the Contemporary Art Index with the other financial assets. Any investor holding this diversified portfolio and with positive real expected return, would have at least 1% allocated to Contemporary Art. Even the minimum-variance portfolio held by a very conservative, risk-averse investor would have 0.41% allocated to Contemporary Art and return a negative 0.36% with a 1.04% volatility.

The optimal portfolio with an expected return of 5% per year would have 7.5% allocated to Contemporary Art and a 3.6% volatility. In fact, allocating 5% in Contemporary Art in the context of this portfolio would have returned 3.12% per year, with 2.45% volatility. Within the present context of very low global interest rates and low returns of traditional financial assets, real 3% return is something very desirable.

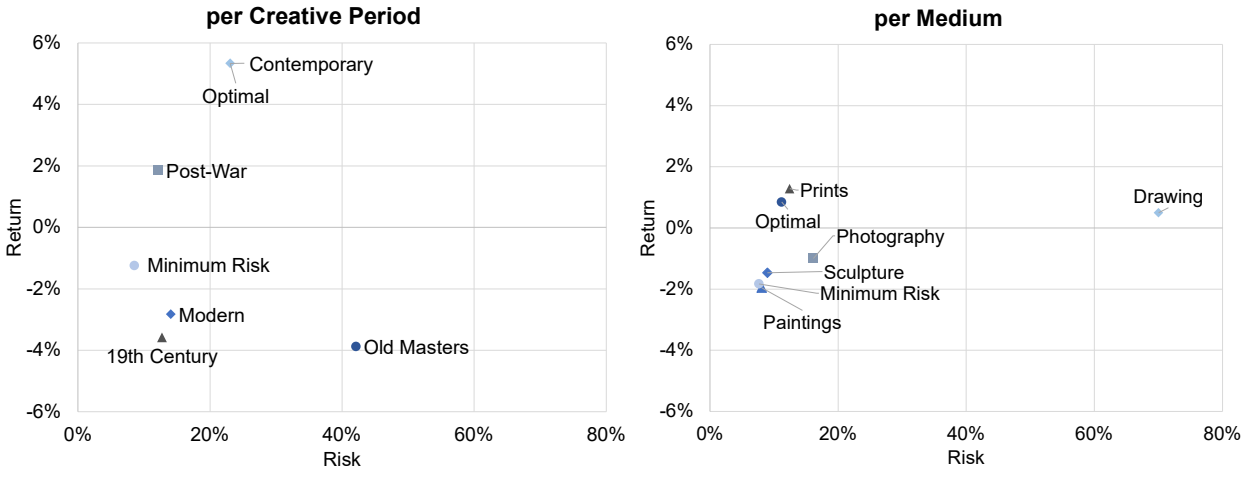
It could be a pleasant surprise to achieve those returns by ‘hanging on the wall’ or displaying in the living room an object of passion.

4.7 Diversification within the Art portfolio

According to a Knight Frank’s 2020 survey, UHNWI, in average, allocate 5% of their global wealth in collectibles such as art. A 2021 survey from Arts Economics reported that 61% of collectors interviewed had more than 10% of their total wealth allocated to art.

Here we investigate the context of an investor that already decided to allocate part of her wealth to art. The exercise is to access what could be the optimal combination per subsegment – among the “creative period” subcategory and among the “medium” subcategory.

Figure 5 - Risk-Return Trade-off



Note: Risk and return of Optimal Mean-Variance portfolios, and minimum-risk portfolios, per Creative Period and per Medium, versus risk and return of each sub-index separately.

4.7.1 Portfolio combination within “Creative Period” subcategory

As already presented in section 4.6, the Contemporary Art Index had the best performance during the 2000-2020 period: +5.34% of real return with a 23% volatility. However, according to portfolio theory, an individual is always better-off by diversifying – diversification removes asset-specific risk and reduces the overall risk of the portfolio (Ang, 2014). We analyze the result of holding a portfolio of Art combining different creative periods.

One constraint when discussing Art as investment is the impossibility to short: you cannot hold short positions in one sub-segment to be long in another. Therefore, portfolios on the efficient frontier are achievable only until a 1.7% return (with a volatility of 10.2%). After the 1.7% return, with short-selling restrictions (all art weights have to be positive), the possible portfolios would be below the efficient frontier limit (constraints will always cause a worse risk-return trade-off).

Table 7 assumes the investor wants to minimize volatility with different expected gains: 1%, 1.7%*, 2%, 3%, 4% and 5% return.

Table 7 - Portfolio combination for different expected returns - per "creative period"

Asset Weights						
Old Masters	10.0%	10.5%	9.9%	3.4%	0.0%	0.0%
19th Century	7.1%	0.0%	0.0%	0.0%	0.0%	0.0%
Modern	9.7%	4.0%	0.0%	0.0%	0.0%	0.0%
Post-War	57.1%	67.5%	69.7%	58.0%	38.4%	9.7%
Contemporary	16.1%	17.9%	20.4%	38.5%	61.6%	90.3%
Return	1.0%	1.7%	2.0%	3.0%	4.0%	5.0%
Volatility	9.6%	10.2%	10.6%	12.8%	16.5%	21.3%
Risk Aversion	6.1	4.7	3.6	1.3	0.7	0.5

We can see from table 7 that a portfolio combining Art from different creative periods – from 10% in Old Masters to 16% in Contemporary – could have gained real 1% return per year. In order to increase the expected return, the investor has to become less risk-averse, as the volatility increases, and the participation of the sub-indices in the portfolio combination changes. As we set higher expected gains, the

portfolio combination tilts to a concentration in Post-War and Contemporary art, until the maximum expected return of 5.34% with 100% in Contemporary.

4.7.2 Portfolio combination within “Medium” subcategory

The same exercise was repeated for an investor who wants to diversify among different kinds of medium category – Paintings, Sculpture, Photography, Drawing or Prints. Based on historical returns of our dataset – first quarter of 2000 to 4th quarter 2020 – the best performing medium was the Print category, with a positive 1.28% return and 12.45% volatility. We restrict short-selling again and reset our expected returns as per Table 8 below:

Table 8 - Portfolio combination for different expected returns - per "material"

Asset Weights										
Paintings	48.0%	42.0%	36.1%	30.2%	24.2%	18.3%	12.4%	6.4%	0.0%	0.0%
Sculpture	25.5%	22.0%	18.6%	15.1%	11.7%	8.2%	4.8%	1.3%	0.0%	0.0%
Photography	1.0%	2.6%	4.2%	5.8%	7.3%	8.9%	10.5%	12.1%	11.8%	0.9%
Drawing	0.9%	1.0%	1.1%	1.2%	1.3%	1.4%	1.6%	1.7%	1.8%	1.7%
Prints	24.7%	32.3%	40.0%	47.7%	55.4%	63.1%	70.8%	78.5%	86.4%	97.5%
Return	-1.0%	-0.8%	-0.5%	-0.3%	0.0%	0.25%	0.5%	0.75%	1.0%	1.3%
Volatility	8.1%	8.3%	8.7%	9.0%	9.5%	9.9%	10.4%	11.0%	11.5%	12.3%
Risk Aversion	6.5	5	4.1	3.4	2.9	2.6	2.3	2.1	1.8	1.2

In the context of a mean-variance optimizer investor, as the Expected Return increases, the portfolio composition moves from Paintings towards Prints, as the investor gets less risk-averse.

We see from exercises 4.7.1 and 4.7.2 that, for an investor already decided to invest in art, there are several weight combinations and allocations into different subsegments (either by creative period oy by medium), that can generate positive gains, above inflation, and at lower volatility than if invested in just one category of art. Those different combinations can produce interesting collections and bring positive real returns.

5 The risk-premium of investing in art

5.1 The single-factor model

Building on the principle of diversification and mean-variance utility introduced by Markowitz' Portfolio Theory – investors improve the risk-return trade-off by diversifying and holding portfolios of many assets –, the CAPM was formulated in the 1960s by Treynor, Sharpe, Lintner and Mossin (Ang, 2014). Under the CAPM assumption, investors can diversify more and more until they hold the most diversified portfolio – that is the market portfolio, the only factor that matters. The risk of one asset is not relevant on itself, but instead it is the assets' Beta (β), the linear relationship between the asset and the market portfolio, that determines the premia paid in compensation for holding that asset. Therefore, the expected return of an asset is proportional to the non-diversifiable risk, or systematic market risk, that affects all assets.

The Beta is a measure of how the asset comoves with the market portfolio. High Betas mean low diversification benefits, whereas low Betas represent assets that pay-off when the market is unstable, and thus are attractive for diversification purposes. Investors do not charge large compensations, *i.e.*, high premia, for holding those low Beta assets, but may even be willing to pay for carrying those assets when the market is crashing, instead of being paid.

The first author to apply the CAPM model to Art was Stein (1977). He tests different regressions of US and UK art auction markets over different stocks indices, and finds only one that is significant: US auction market over the Fisher Index[18]. He finds a $\beta = 0.82$, that leads him to conclude that "paintings are probably a somewhat conservative investment in comparison with equities, with regard to systematic risk." He interpretated the intercept of -0.016 as "psychic returns" of investing in art, as if the investor valued the "viewing pleasure" of art at 1.6% per year. Stein concludes the text by saying "the return to paintings contains a substantial element of nonsystematic risk, a factor that should persuade collectors to keep most of their wealth in other forms.

[18] The Fisher investment-performance Index included all stocks on the New York Stock Exchange, weighting each according to its stock value outstanding, and also accounted for dividend returns.

Any superior performance derivable from paintings can be attributed entirely to the viewing pleasure they provide, not capturable by speculators".

Pesando (1993) worked with modern Prints and used the S&P 500 as proxy for the market portfolio. The Prints portfolio showed lower systematic risk, with a $\beta = 0.315$ and a $\alpha = -0.015$, but statistically insignificant.

Mei and Moses (2002) also estimated the one-factor pricing model for their sample 1875-1999. They used the S&P 500 as the systematic factor, and observed the Art Beta of 0.718. Although higher than the one estimated by Pesando (but lower than Stein), they concluded that "the smaller beta on art compared to the S&P 500 indicates that art has less systematic risk than the S&P 500 thus it should be expected to earn a lower return than the S&P 500 over the long run. It also suggests that the art index tends to move in the same direction as the S&P 500, consistent with a wealth effect from the stock market discussed in Goetzmann (1993). In addition, the higher systematic risk on art compared to bonds implies that art should earn a higher return than bonds over the long run."

Sebastian Edwards (2004), investigating Latin American Art as investment, found a very low degree of correlation relative to an international portfolio of equities. Edwards used the MSCI World as proxy for the market portfolio, and found a Beta = 0.108. In his words, "this means that adding Latin American Art will lower the overall risk of an international portfolio".

We return to our dataset from 2000-2020 to investigate the linear relation between the series of financial assets and art indices. The model is estimated by regressing excess returns of each asset (or index) over the excess returns of the market portfolio proxied by the S&P 500. The excess returns are calculated using the risk-free rate from Kenneth R. French/Dartmouth Data Library[19]. The results can be seen in Table 9:

[19] http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html

Table 9 - CAPM model
S&P 500 as proxy for the Market Portfolio

Asset	Intercept	Beta	Adj R-sq
LIBOR	0.068***	-0.002*	0.032
	(0.007)	(0.001)	
S&P 500	0.000*	1.000***	1.000
	(0.000)	(0.000)	
MSCI World	-0.332	1.026***	0.932
	(0.262)	(0.031)	
Inflation-Linked	1.028***	-0.039	0.005
	(0.275)	(0.032)	
US Treasuries	0.997***	-0.174***	0.334
	(0.229)	(0.027)	
Credit High-Grade	0.877***	-0.037**	0.035
	(0.158)	(0.018)	
Credit High-Yield	1.156***	0.481***	0.569
	(0.394)	(0.046)	
Hedge Funds	0.030	0.257***	0.445
	(0.270)	(0.032)	
REITs	1.907**	0.833***	0.454
	(0.857)	(0.100)	
Commodities	-0.753	0.466***	0.190
	(0.884)	(0.103)	
Gold	2.177***	0.004	-0.012
	(0.743)	(0.087)	
Global Art Index	0.833	0.134	-0.006
	(1.671)	(0.195)	
Old Masters	1.431	-0.178	-0.007
	(2.365)	(0.277)	
19th Century	-0.776	0.141*	0.023
	(0.706)	(0.083)	
Modern Art	-0.338	0.020	-0.012
	(0.793)	(0.093)	
Post-War	0.655	0.107	0.010
	(0.681)	(0.080)	
Contemporary Art	1.810	0.321**	0.042
	(1.282)	(0.150)	
Drawing	5.729	-0.114	-0.012
	(3.950)	(0.462)	
Painting	-0.385	0.111**	0.040
	(0.450)	(0.053)	
Photography	-0.188	0.092	0.040
	(0.863)	(0.101)	
Prints	0.373	0.273***	0.127
	(0.650)	(0.076)	
Sculpture	-0.298	0.201***	0.126
	(0.479)	(0.056)	

Note: Quarterly data 2000-2020; SE in parentesis;
***, ** and * denote significancy at the 1%, 5% and 10%-level.

The Betas capture the systematic (non-diversifiable) risk, while the intercepts (or Alphas) are an estimate of abnormal returns, extra gains that do not depend on market conditions, and are exactly what an investor is looking for when searching for investment alternatives.

We see that Betas are significant for all financial assets, except for Inflation-linked bonds and Gold. Betas lower than 1 (all assets except for MSCI World) help the investor to reduce systematic risk. LIBOR, for instance, has zero correlation with the market portfolio; US Treasuries has the highest negative correlation (β=-0.174). Most of the financial assets also show significant Alphas: there is an extra factor, not captured by the correlation of the asset over the market portfolio.

When we analyze the Art Indices, the first thing to be noticed is that the CAPM does not hold for the Artprice Global Index: neither the intercept nor the Beta are significant, and the adjusted R^2 is virtually zero. The CAPM model does not explain the Global Art Index, neither some sub-indices as Old Masters, Modern Art, Post-War, Drawings or Photography.

We find, however, significant results for some sub-indices: 19th Century, Contemporary Art, Paintings, Prints and Sculpture all have significant Betas. Contemporary Art has the highest β = 0.321. As already mentioned, Betas lower than 1 represent less systematic risk than the market. The contribution of Art to the portfolio is important exactly because of those low Betas: those Art sectors carry less systematic risk than the market portfolio, and therefore offer strong diversification benefits and help reducing the overall risk of the portfolio.

These sub-indices with significant Betas lower than 1 are in line with the results obtained by Stein (1977), Pesando (1993) and Mei and Moses (2002), although with lower correlation (in line also with Edwards (2004) that obtained even lower Beta). Results also indicate that Art moves in the same direction as equities, consistent with the wealth effect suggested by Goetzmann and Mei and Moses.

When we run the CAPM using the S&P 500 as proxy for the Market Portfolio, none of the Art indices display significant intercepts that could indicate art carries something extra that cannot be explained by the market factor. The same analysis is run using the MSCI World as proxy for the market portfolio. All Intercepts and Betas have the same significance and direction, and are very similar in terms of magnitude. The exception is the Contemporary Art sub-index, that did not exhibit a significant Beta,

but displays a significant and positive intercept. Table 13 with MSCI World regression is presented in the Appendix.

We can conclude, after investigating the risk-premium of investing in Art from the single-factor perspective, that the CAPM may not hold for the Global Art Index, but is significant for some sub-indices – including the Contemporary Art - proving that those Art sectors carry less systematic risk than the market portfolio, offer strong diversification benefits and help reducing the overall risk of the portfolio. It also suggests that those art sub-indices move in the same direction as equities, consistent with the wealth effect suggested by Goetzmann and Mei and Moses.

5.2 Multi-factor models

The CAPM was the first model to trace a linear relation between the expected return of the asset and the market portfolio. The asset's Beta determines how the asset covaries with the market, and risk premia or high returns can be interpreted as compensation for losses during bad times.

The CAPM remains the workhorse model of finance, but is firmly rejected by empirical data (Ang, 2014). A growing academic literature during the late 70's and 80's documented other returns not captured by the Betas and not explained by the original CAPM model. The CAPM "anomalies", that could not be explained by the market Beta, became new risk factors on their own, strategies capable of generating excess returns.

In 1993, Fama and French introduced a multifactor model capable of capturing such anomalies. They proposed two other variables, additional to the CAPM's 'market' factor, that could better explain asset returns: a premium for the firm size (SMB - Small minus Big), and a premium for the market value relative to the book value (HML - High minus Low). The inclusion of the additional factors improved the fitting equation that became the Fama-French Three-Factors model. Exposure to risk factors rewards investors for their losses during bad times.

Carhart (1997) found empirical evidence that justified the inclusion of Momentum to the Fama-French model as an investment factor. The Momentum anomaly was described by Jegadeesh and Titman (1993), that demonstrated that stocks that performed well in the previous 3-12 months tend to repeat the abnormal

results in the subsequent period. Winner stocks continue to win, and losers stocks continue to lose – that is why Momentum factor is called WML (Winners minus Losers). Momentum strategies overweight assets that have recently risen in price and underweight assets that have fallen in price.

This thesis uses the Fama-French three-factors and incorporates the Momentum factor – we will refer to it as 4-factor model. The idea is to test whether assets or Art Indices provide premia (return in excess) over the risk-adjusted return. The alpha (intercept) should represent abnormal returns, positive or negative, higher (or lower) than suggested by the exposure to the mentioned investment risk factors.

The regression analyzes the traditional financial assets already mentioned, and the Artprice Global Art Index and sub-indices. They are tested versus the market factor (MKT), size (SMB), value (HML) and momentum (WML). All factors are from French's website, as well as the risk-free rate. We use quarterly data from 2000 to 2020.

Table 10 - 4-factors Model

	Intercept	Market	Size	Value	Momentum	Adj. R-sq	F-stat
LIBOR	0.072***	-0.002**	-0.001	0.000	-0.002	0.027	1.578
	(0.007)	(0.000)	(0.002)	(0.001)	(0.001)		
S&P 500	-0.215	0.898***	-0.177	-0.282***	-0.008	0.912	214.653
	(0.298)	(0.034)	(0.094)	(0.049)	(0.042)		
MSCI World	-0.813***	0.972***	0.053	-0.203***	0.021	0.968	622.716
	(0.191)	(0.022)	(0.060)	(0.031)	(0.027)		
Inflation-Linked	0.963***	-0.025	0.105	0.001	0.031	-0.022	0.562
	(0.297)	(0.034)	(0.094)	(0.049)	(0.042)		
US Treasuries	1.047***	-0.136***	-0.103	-0.010	0.026	0.301	9.822
	(0.250)	(0.029)	(0.079)	(0.041)	(0.035)		
Credit HG	0.899***	-0.027	-0.040	0.007	-0.007	-0.004	0.910
	(0.172)	(0.020)	(0.054)	(0.028)	(0.024)		
Credit HY	1.227***	0.377***	0.244*	-0.050	-0.171***	0.629	35.799
	(0.390)	(0.045)	(0.123)	(0.064)	(0.055)		
Hedge Funds	-0.484**	0.286***	0.159**	0.128***	0.103***	0.658	40.520
	(0.225)	(0.026)	(0.071)	(0.037)	(0.032)		
REITs	1.182	0.764***	0.07	0.397***	-0.056	0.492	20.822
	(0.883)	(0.103)	(0.279)	(0.146)	(0.125)		
Commodities	-2.085**	0.588***	0.371	0.331**	0.313***	0.369	12.973
	(0.834)	(0.097)	(0.264)	(0.138)	(0.118)		
Gold	2.064***	0.043	0.331	-0.185	0.086	0.021	1.444
	(0.780)	(0.091)	(0.247)	(0.129)	(0.110)		
Global Art	0.094	0.158	0.243	0.232	0.258	-0.027	0.47
	(1.803)	(0.210)	(0.571)	(0.298)	(0.256)		
Old Masters	2.531	-0.284	-0.484	0.225	-0.634*	0.009	1.19
	(2.506)	(0.293)	(0.794)	(0.414)	(0.355)		
19th Century	-1.226	0.194**	-0.049	0.202	0.074	0.041	1.89
	(0.747)	(0.087)	(0.236)	(0.123)	(0.106)		
Modern	-0.445	0.014	0.108	-0.062	0.096	-0.036	0.29
	(0.857)	(0.100)	(0.271)	(0.141)	(0.121)		
Post-War	-0.136	0.198**	0.018	0.192	0.287***	0.092	3.09
	(0.696)	(0.081)	(0.220)	(0.115)	(0.098)		
Contemporary	0.561	0.38**	0.195	0.013	0.636***	0.116	3.69
	(1.315)	(0.153)	(0.416)	(0.217)	(0.186)		
Drawing	6.836	-0.488	1.666	-0.043	-0.536	-0.019	0.62
	(4.236)	(0.495)	(1.342)	(0.701)	(0.601)		
Painting	-0.834*	0.133**	0.263*	0.07	0.156**	0.120	3.79
	(0.460)	(0.053)	(0.146)	(0.076)	(0.065)		
Photography	-0.76	0.139	0.421	0.065	0.198	0.028	1.60
	(0.907)	(0.106)	(0.287)	(0.150)	(0.128)		
Prints	0.097	0.262***	0.071	0.029	0.048	0.098	3.22
	(0.705)	(0.082)	(0.223)	(0.116)	(0.100)		
Sculpture	-0.637	0.215***	0.172	0.092	0.042	0.176	5.38
	(0.497)	(0.058)	(0.157)	(0.082)	(0.070)		

Note: Quarterly data 2000-2020; SE in parentesis; all factors and risk-free rate are from French's website; ***, ** and * denote significancy at the 99%, 95% and 90%-level.

The 4-factor model equation fits well most of the financial assets: the F-test is significant for Equities (S&P 500 and MSCI World), US Treasuries, Credit High-Yield, Hedge Funds, REITs and Commodities. If we look at each of the factors separately, we see that MKT is significant for all those assets and Libor. Equities (of course) and REITs are highly exposed to the MKT factor. Size is significant only for Credit High-Yield and Hedge Funds, with a low exposure, whereas Value is significant for Equities, Hedge Funds, Housing and Commodities. Momentum is significant for Credit High-Yield, Hedge Funds and Commodities, but with a low or negative exposure. It is interesting to find out that for Equities Momentum is no longer significant, at least for the time frame here discussed.

When we look into the results for the Global Art Index, we see that none of the factors neither the jointly F-stat are significant – we cannot conclude that any of the factors is statistically different from zero. The equation itself has an explanatory power of a negative 2.7%. Apparently, the 4-factors model cannot explain the art market, at least with regards to the Global Index.

However, if we turn our attention to the Art sub-indices, we see that the 4-factors model is significant for Contemporary Art, Post-War, Paintings, Prints and Sculpture indices. In terms of creative period subindices, MKT and Momentum are significant for Contemporary Art and Post-War. MKT is significant also for 19th Century (although the joint F-stat is not).

Contemporary Art has a relatively high exposure to Momentum, with a β=0.6363. A possible explanation for the higher exposure of Contemporary Art to MKT and Momentum could be because it is the most prevalent category in auctions, and the most recent time category, with no shortage of supply. We see that Old Masters have a high negative exposure to Momentum (β=-0.634, significant at the 10% level, though the joint F-stat is not). In fact, Contemporary Art has the highest exposure to Momentum among all assets, whereas Old Masters has the lowest (or highest negative exposure). Interestingly, each category is also at one end of the creative-period spectrum. Contrary to the other sub-segments, Old Masters seem to move in the opposite direction: when the market as a whole is experiencing high Momentum, Old Masters has a negative return, that will eventually pay-off when the Momentum is over for the rest of the market and Old Masters will probably have a positive result.

Paintings was the only Art category to display significant and negative intercept (Alpha). The presence of significant Alpha means there is something else, not captured

even after the introduction of additional investment factors. Negative intercepts, in this case, could be interpreted as investors that derives non-financial returns: they do not bother to receive a negative return per year for holding the asset, because they derive another benefit (not financial) from having it.

Factor risk premia exist to reward investments carrying those risks during difficult times. According to our dataset, Art has low or no exposure to those different risks. That could be a reason why Art does not need to pay higher returns: the investor accepts holding art because when the whole market tumbles, art is weakly correlated and will keep its value. Contemporary art, for instance, that has a somewhat high exposure to Momentum, has paid the best returns (+5.34%) for the time period analyzed. Paintings, on the other hand, that returned negative 1.95% per year for the past 21 years, exhibited a negative alpha. Possibly the “viewing pleasure” coined by Stein, or the emotional dividend generated by hanging a nice canvas on your wall.

5.3 Liquidity Premium

As discussed in section 3.2, illiquidity is an important market friction, and investors demand higher premia to hold illiquid assets. Actually, it is usually recommended that long-term investors hold illiquid assets, since these alternative options are normally low-correlated to stocks and bonds, and probably carry an illiquidity risk premium. Alternative investments may become difficult to sell when markets collapse, so investors demand higher compensation for bearing the illiquidity risk.

We add the investment factor Liquidity (Pástor and Stambaugh, 2003) to our 4-factor model to check whether there is a premium for investing in illiquid assets. As the Liquidity factor was available only until December 2019, the analysis is re-run for the shorter period 2000-2019. Table 14 in the appendix shows the results.

The addition of the Liquidity factor to the 4-factor model does not improve the explanatory power of our equation. Liquidity is not significant for any of the art indices, neither changes the significancy or analysis run for the coefficients obtained with the 4-factor model. It was interesting to confirm, though, the liquidity discount for LIBOR, Gold and Inflation-linked bonds, as expected.

We conclude that illiquidity is a very important issue in the art world and must be taken into consideration by collectors and investors. But prices do not show any liquidity premium or discount.

After running the Fama-French three-factors model, augmented by Momentum and Liquidity, we can conclude that investment risk factors may not explain the Global Art Index (or Gold), but do affect some sub-segments of Art, as well as other asset classes. The Market risk factor can affect some sub-segments of Art, as well as other asset classes, the same way as it affects stocks, though at a lower risk exposure, which confirms that Art as investment can be very interesting in terms of diversification.

The same conclusion holds for the Momentum factor: some Art sub-indices seem to carry Momentum, as well as other assets, but for equities Momentum is no longer significant, at least for the time frame here discussed. Regarding the Liquidity factor, although liquidity is a problem for an investor who decides to buy art, our model was not able to capture any premium or discount.

Finally, the significant and negative intercept encountered for Paintings could be interpreted as an investor that derives non-financial returns.

6 Conclusion

This thesis analyses the role of Art in a diversified financial portfolio. Our comprehensive dataset, provided by Artprice.com, covers the past 21 years (2000-2020), comprising important moments of distress such as the dot-com bubble, the September 11 attacks, the Great Financial Crisis and the COVID-19 Pandemic.

We find the overall return of the Global Art Index of real -0.83% per year, with a standard deviation of 29.94%, well below most financial assets and at a much higher volatility. However, the subsegment of Contemporary Art, the most recent and available creative period, returned real 5.34% per year - a surprisingly positive result compared to many other assets, despite the 23.02% volatility.

The Global Index and the sub-indices were compared to an array of 11 financial assets, from hedge funds and real estate, to gold, equities and inflation-linked bonds. The results show that Art in general has a very low correlation with other financial assets and thus could be included in a diversified portfolio to reduce its volatility. The low correlation is also valid among art sub-segments, and therefore diversification among art subgenres or schools/categories enables assembling interesting collections while offering positive real returns.

The main contribution of this thesis is to apply the Fama-French 3-factors model, augmented with Momentum and Liquidity, to the Global Art Index and its sub-indices, as well as to the other financial assets. We find Market Betas that are substantially lower than those in the existing literature, suggesting that the inclusion of Art in the portfolio brings strong diversification benefits. In addition, Momentum is significant for some art subsegments and do have an important contribution to determine the risk-premia. On the other hand, our results do not indicate any evidence of Liquidity premium in Art, which is surprising, given that average holding periods in art are substantial.

One must not forget that art is not free from several risks and uncertainties. Due to the lack of transparency and high-specialized characteristic of the Art market, expert advice is required. The investor must be aware of the large extra costs involved, superior to all other financial assets. All the analysis and financial comparisons were performed based on non-investable Art indices, and not real artworks. Art indices cover less than half of the transactions in the art market (only data on public auctions is

available); and indices are not available for transactions in the real world, and should therefore be interpreted just as a raw indicative of performance for real artworks. The performance of an individual collection, with limited exposure to a variety of artists, art schools and even masterpieces or “blue-chips”, can deviate sharply from the indices and the market as a whole.

Due to the inefficiencies, asymmetries, illiquidity and transaction costs, it is recommended that the investor holds Art collections for longer periods. Another drawback for individuals is that, contrary to what happens with stocks, assembling a diversified portfolio of artworks is extremely expensive and would not be feasible to most investors. Therefore, institutional investors, endowments and pension funds, which have a long-term perspective and more substantial capital, can take better advantage of investing in Art as part of a diversified portfolio, than an individual investor.

Our investigation of art was limited to risk and return and financial considerations. There are psychological benefits derived from holding art, that could not be captured by the CAPM, but do affect the risk premium and the price of art. The use of the additional investment factors was an attempt to capture that. Art is an expression of personal passions and individual values, charged with a unique historical, cultural and aesthetical significance. Art provides the owner with emotional dividends and viewing pleasures; collections are a powerful manner of stating one’s values and personality, or to leave a legacy for future generations. As Thompson (2008) puts it, “of course there is no emotional benefit from hanging stock certificates on your wall”.

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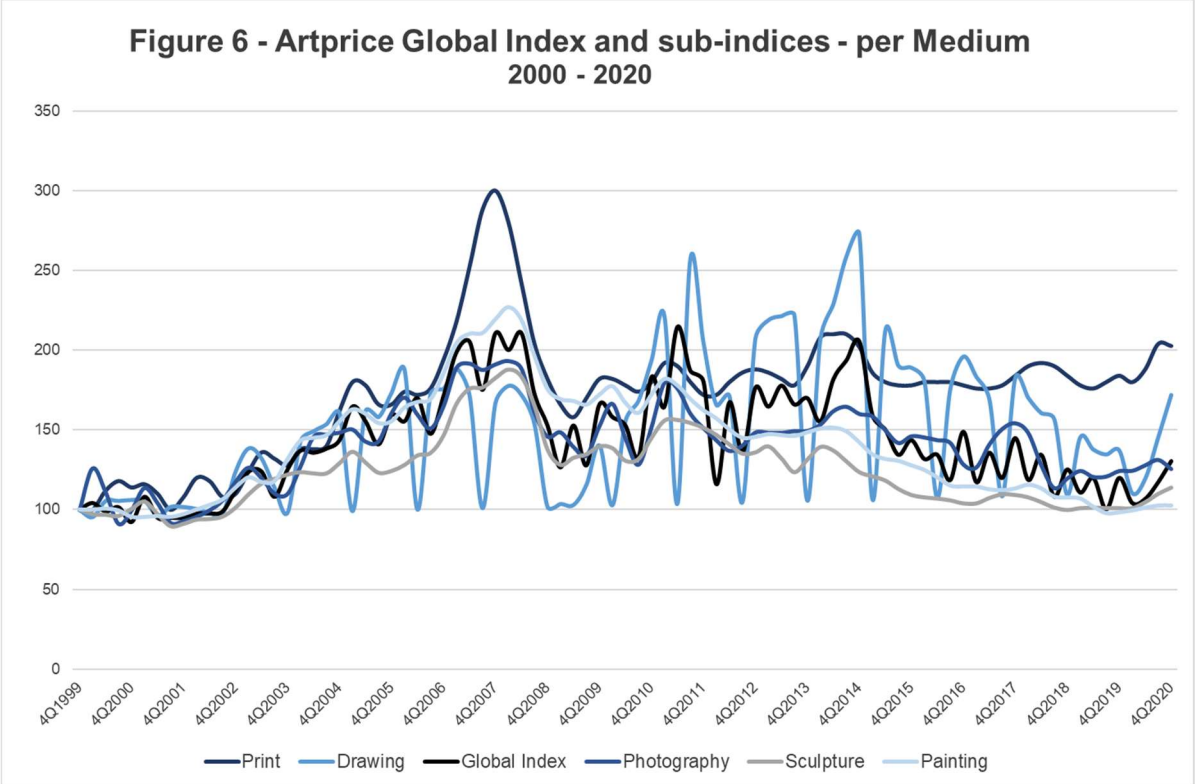
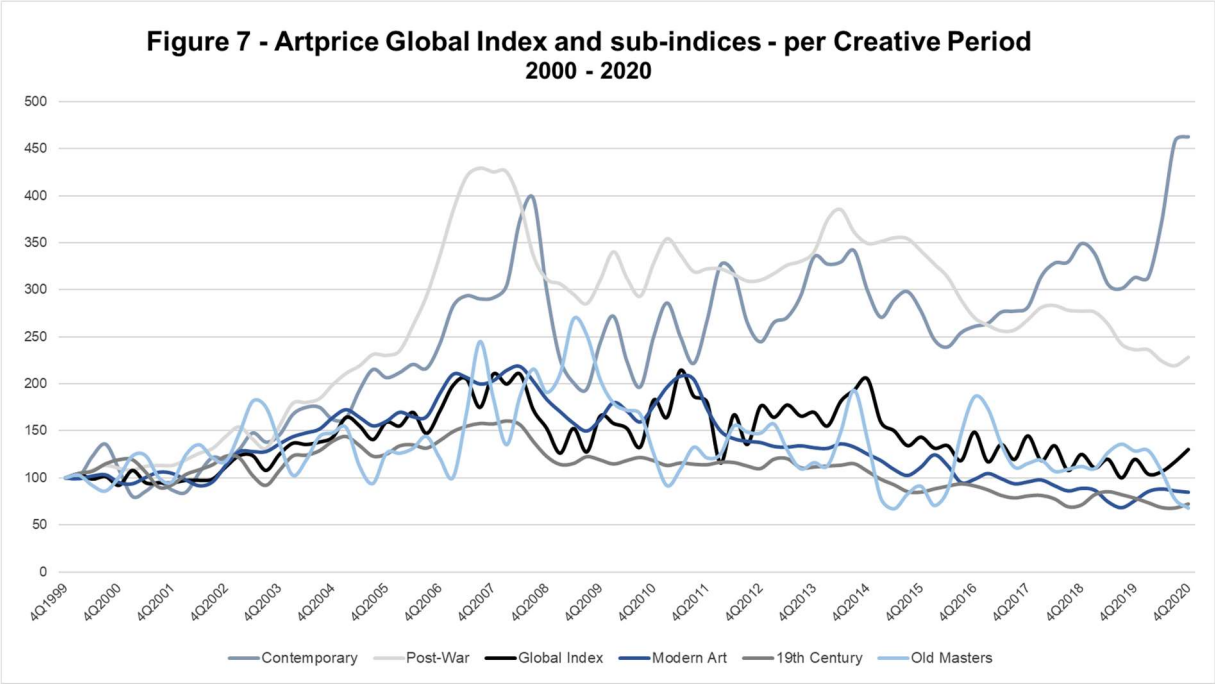
Appendix



Source: Artprice.com; Nominal indices, not deflated by the US CPI.



Source: Artprice.com; Nominal indices, not deflated by the US CPI.

Table 11 - Financial Data

Name		Symbol	Description	Source
LIBOR	1-month LIBOR	US0001M Index	Average interest rate at which banks borrow funds from other banks in the London market	Bloomberg
US Treasuries	iBoxx Treasuries Total Return Index	ITRROV Index	Index that aims to reflect the performance of bonds issued by the US government	Bloomberg
Inflation-Linked	J.P. Morgan US TIPS Index (Justine)	JPILUILA Index	Index that measures the performance of the TIPS market, contaning US government issued inflation-linked bonds	Bloomberg
Credit High-Grade	Barclays Global Aggregate Index	LEGATRUH Index	Basket of high grade debt investments, including treasury, government and corporate bonds	Bloomberg
Credit High-Yield	Barclays Global High Yield	LG30TRUH Index	Basket of high yield debt investments, including US High Yield and Pan-European High Yield Indices	Bloomberg
S&P 500	S&P 500 Index	SPXKK Index	Index that measures the performance of 500 large-cap companies listed on US Stock Exchanges	Bloomberg
MSCI World	MSCI ACWI Index	MXWD Index	Index composed by equities from 23 developed markets and 27 emerging markets	Bloomberg
Hedge Funds	HFRX Global Hedge Fund Index	HFRXGL Index	Index that aims to reflect the overall composition of global hedge funds of all eligible strategies	Bloomberg
Commodities	Bloomberg Commodity Index	BCOM Index	Index tracks prices of futures contracts on physical commodities	Bloomberg
REITs	Dow Jones Equity REIT Total Return Index	REIT Index	Index comprised of REITs that directly own all or part of the properties in their portfolios	Bloomberg
Gold	XAU BGN Currency	XAU BGN Curncy	Gold Spot price, quoted as US Dollars per Troy Ounce	Bloomberg

Table 12 - Excess returns, risk and Sharpe-ratios

	Excess Return (%)	Volatility (%)	Sharpe Ratio
Libor	-1.851	1.442	-1.283
SP500	0.838	16.545	0.051
MSCI World	-0.620	17.586	-0.035
Treasuries	1.108	5.845	0.190
Inflation Linked	1.738	4.946	0.351
Credit HG	1.216	3.587	0.339
Credit HY	4.101	10.287	0.399
Hedge Funds	-1.083	6.188	-0.175
REITs	7.006	20.551	0.341
Commodities	-4.415	16.952	-0.260
Gold	5.563	13.235	0.420
Global Art	-2.397	29.943	-0.080
Old Masters	-5.444	42.104	-0.129
19th Century	-5.155	12.737	-0.405
Modern	-4.397	14.070	-0.312
Post War	0.282	12.207	0.023
Contemporary	3.769	23.061	0.163
Painting	-3.523	8.075	-0.436
Sculpture	-3.037	8.949	-0.339
Photography	-2.564	16.134	-0.159
Drawing	-1.072	70.043	-0.015
Print	-0.288	12.451	-0.023

Table 13 - CAPM regressions over MSCI World

	Intercept	Beta	Adj. R-sq
LIBOR	0.067***	-0.001*	0.032
	(0.007)	(0.001)	
S&P 500	0.376	0.909***	0.932
	(0.246)	(0.027)	
MSCI World	0.000	1.000***	1.000
	(0.000)	(0.000)	
Inflation Linked	1.002***	-0.020	-0.007
	(0.275)	(0.030)	
US Treasuries	0.934***	-0.161***	0.324
	(0.229)	(0.025)	
Credit HG	0.862***	-0.032*	0.028
	(0.158)	(0.017)	
Credit HY	1.306***	0.477***	0.632
	(0.363)	(0.040)	
Hedge Funds	0.101	0.266***	0.538
	(0.245)	(0.027)	
REITs	2.209**	0.771***	0.438
	(0.865)	(0.096)	
Commodities	-0.656	0.522***	0.275
	(0.833)	(0.092)	
Gold	2.112***	0.087	0.002
	(0.734)	(0.081)	
Global Art	1.248	0.142	-0.005
	(1.661)	(0.184)	
Old Masters	1.754	-0.174	-0.007
	(2.359)	(0.261)	
19th Century	-0.361	0.151*	0.033
	(0.705)	(0.078)	
Modern	0.052	0.017	-0.012
	(0.795)	(0.088)	
Post-War	1.060	0.118	0.017
	(0.688)	(0.076)	
Contemporary	2.355*	0.237	0.021
	(1.291)	(0.143)	
Drawing	6.078	-0.118	-0.030
	(3.929)	(0.434)	
Painting	0.019	0.124**	0.059
	(0.452)	(0.050)	
Photography	0.196	0.123	0.008
	(0.853)	(0.094)	
Print	0.847	0.259***	0.126
	(0.655)	(0.072)	
Sculpture	0.138	0.208***	0.150
	(0.479)	(0.053)	

Note: Quarterly data 2000-2020; SE in parentesis; risk-free rate from French Data Library; ***, ** and * denote significancy at the 1%, 5% and 10%-level.

Table 14 - Investment Factors Regression - 3-factors + Momentum + Liquidity

	Alpha	Market	Size	Value	Momentum	Liquidity	Adj. R-sq	F-stat
LIBOR	0.075***	-0.001	-0.001	-0.002	-0.001	-0.002***	0.147	3.692
	(0.007)	(0.001)	(0.002)	(0.001)	(0.001)	(0.001)		
S&P 500	-0.043	0.838***	-0.234**	-0.306***	-0.030	0.057*	0.906	152.100
	(0.299)	(0.042)	(0.095)	(0.054)	(0.044)	(0.031)		
MSCI World	-0.688***	0.972***	0.043	-0.243***	0.028	0.000	0.965	432.900
	(0.194)	(0.027)	(0.062)	(0.035)	(0.029)	(0.020)		
Inflation Linked	0.879***	0.005	0.101	0.000	0.038	-0.063**	0.018	1.284
	(0.303)	(0.043)	(0.097)	(0.055)	(0.045)	(0.031)		
US Treasuries	0.910***	-0.112***	-0.082	0.014	0.031	-0.029	0.249	6.178
	(0.257)	(0.036)	(0.082)	(0.047)	(0.038)	(0.027)		
Credit HG	0.886***	-0.029	-0.057	0.006	-0.011	-0.016	0.023	1.372
	(0.179)	(0.025)	(0.057)	(0.032)	(0.026)	(0.018)		
Credit HY	1.349***	0.392***	0.204	-0.108	-0.160***	-0.062	0.580	22.520
	(0.401)	(0.057)	(0.128)	(0.073)	(0.059)	(0.041)		
Hedge Funds	-0.546**	0.288***	0.171**	0.152***	0.104***	0.004	0.607	25.120
	(0.238)	(0.034)	(0.076)	(0.043)	(0.035)	(0.025)		
REITs	1.206	0.806***	0.114	0.391**	-0.013	-0.034	0.439	13.200
	(0.936)	(0.132)	(0.299)	(0.170)	(0.138)	(0.097)		
Commodities	-2.000**	0.675***	0.386	0.251	0.362***	-0.131	0.307	7.921
	(0.868)	(0.123)	(0.277)	(0.158)	(0.128)	(0.09)		
Gold	1.907**	0.169	0.379	-0.216	0.150	-0.188**	0.051	1.846
	(0.800)	(0.113)	(0.255)	(0.145)	(0.118)	(0.083)		
Global Art	0.283	0.071	0.122	0.204	0.201	0.042	-0.056	0.176
	(1.915)	(0.271)	(0.611)	(0.348)	(0.283)	(0.198)		
Old Masters	2.861	-0.226	-0.401	0.115	-0.553	0.004	-0.033	0.505
	(2.657)	(0.376)	(0.848)	(0.483)	(0.392)	(0.275)		
19th Century	-1.201	0.281**	-0.008	0.122	0.112	-0.102	0.033	1.538
	(0.780)	(0.110)	(0.249)	(0.142)	(0.115)	(0.081)		
Modern	-0.800	0.094	0.234	0.016	0.134	-0.035	-0.043	0.362
	(0.892)	(0.126)	(0.285)	(0.162)	(0.132)	(0.092)		
Post-War	-0.146	0.298***	0.130	0.150	0.352***	-0.056	0.117	3.059
	(0.721)	(0.102)	(0.230)	(0.131)	(0.107)	(0.075)		
Contemporary	0.194	0.500**	0.270	0.085	0.694***	-0.17	0.100	2.732
	(1.360)	(0.192)	(0.434)	(0.247)	(0.201)	(0.141)		
Drawing	7.217	-0.548	1.351	-0.237	-0.623	-0.186	-0.030	0.551
	(4.485)	(0.634)	(1.431)	(0.814)	(0.663)	(0.465)		
Painting	-1.020**	0.217***	0.361**	0.096	0.203***	-0.06	0.173	4.252
	(0.472)	(0.067)	(0.151)	(0.086)	(0.070)	(0.049)		
Photography	-0.943	0.235*	0.553*	0.107	0.268*	-0.052	0.046	1.751
	(0.949)	(0.134)	(0.303)	(0.172)	(0.14)	(0.098)		
Print	-0.110	0.346***	0.150	0.061	0.089	-0.081	0.104	2.818
	(0.735)	(0.104)	(0.235)	(0.134)	(0.109)	(0.000)		
Sculpture	-0.923*	0.283***	0.242	0.140	0.061	-0.063	0.204	5.001
	(0.510)	(0.072)	(0.163)	(0.093)	(0.075)	(0.053)		

Note: Due to the availability of the Liquidity factor, regression is re-run for the period 2000-2019, quarterly data; SE in parentesis;
4-factors and risk-free rate are from French's website, Liquidity from Lubos-Pastor page; ***, ** and * denote significancy at the 1%, 5% and 10%-level

https://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html
https://faculty.chicagobooth.edu/-/media/faculty/lubos-pastor/research/liq_data_1962_2019.txt