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Beyond Aesthetics

Asset Pricing Theory and the Scandinavian Art Market

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Abstract

This study utilizes a hedonic model to examine factors influencing the pricing of Scandinavian paintings, such as size, artist reputation, and auction house. The analysis focuses on prominent painters from Denmark, Sweden, and Norway from 1991 to 2023, constructing a comprehensive price index. Using this index, we evaluate Scandinavian art as an investment, comparing it to traditional asset classes. Additionally, the study applies the Capital Asset Pricing Model (CAPM) to analyze price movements in the Scandinavian art market and other asset classes. This research contributes to understand the dynamics of the Scandinavian art market and assessing whether it might provide an investment opportunity for art enthusiasts.

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1 Introduction

November 2017 - In an electrifying moment that left art enthusiasts and historians worldwide in awe, a new world record was shattered as the gavel at Christie's in New York struck down, marking the sale of Leonardo da Vinci's enigmatic masterpiece, 'Salvator Mundi', for a staggering price of $450.3 million, making it the most expensive artwork ever sold. The New York Times writes, "Leonardo da Vinci's 'Salvator Mundi,'... must surely rank as the most spectacular 'sleeper' in history." In the art trade, a "sleeper" refers to a piece by a renowned artist that goes unnoticed in a sale, fetching a low price, only to be later resold for a significant profit.

What makes this story more intriguing is the fact that the painting's origins were traced to the 1500s. However, its path becomes obscured after the artwork transitioned from Charles II to the Duke of Buckingham, and eventually sold by the latter's son in 1763. It was not until nearly a century and a half later, in 1900, that the trail of the painting reappeared as it was acquired by a British collector oblivious to its true origins. It had been so damaged, overpainted, and so heavily varnished that it was completely unrecognizable and ended up being attributed to Leonardo's student Boltraffio. When sold again in 1958, believed to be a copy of a copy at the time, it fetched less than one hundred dollars.

Yet, the painting's fate would know a turning point in 2005, when it was bought by a group of art dealers and collectors that believed it might be more than just a replica. The painting was brought to Robert Simon, a Manhattan art historian and dealer, who oversaw a five-year restoration process. Detailed high-resolution photographs and X-rays played a crucial role in unveiling a pentimento, authenticating the painting. A different initial placement of Jesus' right thumb, something that a copyist wouldn't usually do was the first hint. Later, using infrared light, reflecting off the white base layer of the panel, unveiled an intriguing detail: the painter had pressed their palm onto the wet paint above Christ's left eye to achieve a distinct sfumato blurring effect—a distinctive technique of Leonardo. Despite this evidence, controversy about the painting's authenticity persists to this day. Critics contend that the considerable damage and subsequent restoration have led to a piece that looks more 'Leonardesque' than Leonardo's own paintings. But, yet again, no one was expecting a Da Vinci painting to emerge. There are fewer than twenty

paintings that have been widely accepted to be attributed to the master and the last one discovered was the ‘Benois Madonna’, found in 1909, more than a century ago.

In the world of art, such captivating tales of extraordinary returns on investment often leave art dealers and investors envisioning the discovery of the next ‘sleeper’ amidst the mundane. The intriguing case of ‘Salvator Mundi’ acquired in 2005 for a modest $1,175, subsequently sold in 2011 for a staggering $80 million, raises fundamental questions about the nature of paintings as assets and whether their appreciation in value predominantly stem from speculative ventures or solid investment strategies. Undoubtedly, stumbling upon the next sleeper masterpiece is often akin to winning a game of chance, and Robert Simon was undeniably one of the luckiest players in the art world of the past century. However, ’Salvator Mundi’ is merely one painting that garnered attention. Countless fortunes have been amassed by individuals who skillfully seek out these concealed artworks, shedding light on an aspect of art that could potentially be perceived as an investment opportunity.

This might draw resemblance to the fundamental analysis strategy used in stock market evaluation. In his book ‘Security Analysis’, Benjamin Graham, a renowned economist, and investor who advocated value investing, writes “an investment operation is one which, upon thorough analysis promises safety of principal and an adequate return. Operations not meeting these requirements are speculative”. If, according to Graham, the distinction between speculative and investment approaches rests on the foundation of a thorough analysis and the belief in a future return, then the principles he laid out might hold relevance not only within the stock and bond markets but also within the art world as well.

Whether to consider art as an investment instrument beyond its aesthetic attributes remains a topic of controversy among art collectors, investors, and scholars. One of the primary challenges lies in the inherent complexity of the art market. First, unlike traditional financial markets, the art market is largely unregulated. This lack of oversight can give rise to issues such as price manipulation, fraudulent activities, and ambiguous sales practices. These unique characteristics of the market have unfortunately made it an attractive avenue for tax evasion among the wealthiest. Artworks often are subject to undervaluation when presented to authorities or overvaluation when utilized as instruments

for tax deductions, donations, or non-cash transactions. This further contributes to the uncertainties around the art market and its tarnished reputation. Additionally, investing in art diverges significantly from more traditional avenues such as stocks and bonds. First, artworks are known to be extremely illiquid. Their sale or purchase involves a more complex and time-consuming process. Finding a suitable buyer or seller for a particular artwork can take a significant amount of time, as it requires connecting with potential collectors, galleries, or auction houses that specialize in the specific artist or art style. Negotiations, due diligence, and establishing provenance further add to the time and effort involved in buying or selling artworks. Second, art pieces are remarkably heterogenous. Unlike standardized financial instruments, each art piece is unique and carries its own set of attributes, adding to its individual value and appeal. Artworks differ in terms of style, genre, medium, historical significance, cultural context, and the reputation of the artist. These factors, among others, contribute to the diverse and subjective nature of the art market and pose a significant challenge to investors. The subjective nature of art means that the value of an artwork can vary significantly depending on personal taste and market trends. However, as heterogenous commodities, it is believed that artwork prices can, to some extent, be determined by the piece's characteristics. It is this hypothesis that sparked the growing interest among scholars to examine the art market from a financial standpoint. By considering the specific attributes of individual artworks, it becomes possible to construct an index that reflects the overall performance and trends within the art market. By constructing an art index, numerous researchers attempted to study the risk and return characteristics associated with art investments. However, I noticed that most of the existing literature predominantly focuses on West European and American art. This relative lack of studies on the Scandinavian art market was somewhat surprising. Scandinavian countries have a rich and longstanding artistic legacy. They have given rise to internationally renowned artists whose contributions have had a significant impact on the global art community. In addition, their favorable geographical proximity to Europe has made art trade of a significant importance in the region, attracting a notable international interest to the local art scene. In this paper, I will attempt to fill this gap.

In previous research, scholars construct an art index in one of two ways. The first, referred to as the 'repeat-sales method', would track the evolution of recorded sale prices of a selection of artworks over time. This method is very similar to the one used for

the Consumer Price Index (CPI), where prices for a basket of representative goods and services commonly consumed by households is tracked over a specific period. It is the more intuitive method of the two. The second method, often called the 'hedonic model method', consists of constructing the index by utilizing the time dummy variables coefficients of a regression, where the artwork's sale price is the dependent variable, and its characteristics and the said time estimates are the independent variables. In this research paper, I opted for the latter method. I elaborate on my rationale for this choice and discuss the advantages and limitations associated with both methods in the Methodology section.

Since I will be conducting a regression of the sale price of each painting based on its characteristics, the hedonic model approach inherently requires a comprehensive dataset for each painting. For this purpose, I referred to the centralized website, artprice.com. In addition to acquiring detailed information about each painting's features, I was also able to get access to recorded sales data from various auction houses. This proved to be invaluable for our study, as it allowed us to capture sales of artworks by well-known artists that may not have been offered in prominent auction houses.

Furthermore, previous studies that aimed to develop an art index have typically gathered artwork data by adhering to a predefined list of artists, often selected based on their influence and historical significance. However, I believe that this traditional approach for data collection is highly subjective. Such a list may differ from one person to another or even evolve over time, potentially leading to a sample of artists that does not accurately reflect the market in which an investor would typically invest. For this purpose, I chose to rely on more objective criteria for my selection, namely the market capitalization of each artist and the availability of their paintings on the market. I dive deeper into the selection approach in the Data section.

Finally, for the regression, I followed the existing research and estimated my model using ordinary least squares. I included several variables as both dummy variables and continuous variables. On one hand, the artist's name, the auction house where the artwork was sold, the medium employed, and the time of sale were treated as dummy variables. On the other hand, the size of the painting calculated as its surface in centimeters was included as a continuous variable. The time estimates and the artists' estimates will be reported, providing detailed insights into the evolution of the art index over time and

the comparison of the artists' influence on the Scandinavian art market. Afterwards, I compare the investment properties of Scandinavian art with a few more traditional asset classes. In conclusion, I estimate the capital asset pricing model (CAPM) for the art portfolio and each other asset class.

Our empirical findings reveal that the annual geometric return on Scandinavian art stands at 1.12%, which is the second lowest among all the asset classes I examined, surpassed only by the real estate index. Interestingly, the annualized standard deviation of returns on the art index is also the second lowest, measuring 9.55%, just behind that of the hedge funds index. Furthermore, our analysis demonstrates that during economic downturns, the art index exhibits relatively smaller fluctuations compared to other indices. This suggests that while investing in art may not deliver substantial returns during periods of economic prosperity, it may serve as an effective hedge during challenging times.

2 Literature Review

For decades, scholars in financial literature have been captivated by the art world's complexity and particularly that of paintings. As Stein (1977) put it, "In a number of ways, paintings are extraordinary economic goods". First, paintings are extremely heterogenous. Their values can range from a few dollars to a few million dollars, independently of the genre, style or even the artist. Paintings are also speculative goods. While a painting's demand determines its future price appreciation, the expected future price appreciation determines demand itself. Additionally, a painting can be considered at once a durable consumer good and a financial asset. While the price of a painting includes a portion that can be thought of as being paid for the social status or the aesthetic purposes of owning the said art piece, some other portion can be thought of as representing an investment opportunity for the art collector. Paintings are durable assets that can be preserved for centuries, and it is reasonable to assume that, if preserved correctly, a painting's value might appreciate over time. In this sense, paintings can be viewed as investment assets, much like stocks or bonds, capable of generating future cash flows for their owners upon resale.

It is this particular facet of art that has long intrigued researchers. Numerous scholars endeavored to discover whether art could potentially be considered a viable investment asset or not. In his paper 'The Monetary Appreciation of Paintings', Stein (1977) selected a sample of paintings sold at auction for the period between 1946-68 creating one of the first art price indices. His index yielded an average annual return of 1.6% for the period under study. Stein concluded that investors should allocate most of their wealth to alternative assets and that any superior returns obtained from paintings are to be attributed entirely to the viewing pleasure provided, not capturable by speculators. Similarly, Baumol (1985) constructed an art index from multiple sales of paintings extending for more than three centuries extracted from the famous Reitlinger compilation collected from six thousand prices of paintings sold at auctions. His index brought remarkably low rates of returns with an annual compounded rate of 0.55% in real terms. And although some of the paintings yielded an average annual return for as high as twenty-seven percent, Baumol (1985) argued that collectors should not "be lured into the purchase of art by the illusion that they can beat the game financially and select with any degree of reliability the

combination of purchase dates and art works that will produce a rate of return exceeding the opportunity cost of their investment." He argued that investing in the art market isn't as different from investing in the stock market as it may initially appear and while the two markets differ in terms of transaction frequency, public availability of transaction details, and the process of price determination, both the stock market and the art market exhibit a random walk in their price movements and are therefore highly unpredictable. In contrast, Buelens and Ginsburgh (1993) challenged Baumol's premise, asserting that 'The fact that in the very long run (Baumol's 300 years) rates of return are low does not preclude shorter time intervals during which returns are much higher or specific painters or schools that do much better than average.' They consider the same data as Baumol but subdivide the three-century time span into five subperiods while subdividing the paintings between broad schools. They found that rates of return vary significantly by subperiods and schools and that there were periods during which art investments outperform other financial assets. However, their method had an extremely important weakness. Upon dividing the paintings into genres and subperiods, they found that some of the categories had a very limited number of observations, making it challenging to draw any significant conclusions. Similarly, Goetzmann (1993) also employed a repeat sales model spanning three centuries. Nonetheless, his interest extended beyond art returns, as he sought to explore the correlation between the art price index and various asset classes, including the Bank of England, Consol bonds, and the London Stock Exchange returns for the same timeframe. His findings revealed a robust correlation between his repeat-sales art index, spanning from 1715 to 1986, and the London Stock Exchange. He concludes it as compelling evidence that demand for art increases with the wealth of art collectors and contrary to the commonly held belief, art does not serve as an effective hedge against stock market fluctuations. In contrast, Mei and Moses (2002) reached different results. They observed that their art index, constructed through repeated sales of paintings spanning from 1875 to 2000, exhibited lower volatility and significantly less correlation with more conventional asset classes. They assert that artworks might play an important role in a diversified portfolio. While Hodgson and Vorkink (2004) used a hedonic regression model to construct an art index based on Canadian paintings. They found that the risk-return characteristics of Canadian art are considerably inferior to those of financial assets and deduce that art should not be included in portfolios for diversification purposes.

Many of these papers were written during a period when data collection relied on manual efforts. Collecting data on art sales was a challenging task, which constrained the available data to a subset of sales, often from prestigious auction houses. These auction houses typically maintained more extensive and regularly updated sales records. For instance, Bryan (1985) art index was developed using data exclusively collected from Sotheby's. Similarly, the Mei Moses Fine Art Index, created by Jianping Mei and Michael Moses, relies exclusively on sales recorded at Sotheby's and Christie's. Nevertheless, solely depending on the prestigious auction houses archives would result in overlooking numerous other sales records. Even in cases where the art index concentrated solely on renowned painters, many paintings by prominent artists were auctioned through venues other than the most prestigious ones. As a result, the studies conducted during that time, limited by the available data, likely lead to a skewed representation of the art market. By collecting data from a centralized platform, I overcome this selection bias and gather information on public sales from almost any auction house, a crucial feature in constructing a representative art index.

I will follow the steps of Rosen (1974) in constructing a hedonic model to price heterogenous goods. The model should allow to conduct an empirical analysis to value paintings created by major Scandinavian artists. The results of this regression would then allow me to estimate the influence of the different characteristics of a painting on its auction price. Among them are the period (semi-annual) in which a painting was sold. As a result, this will allow me to construct an art index of Scandinavian paintings and compare its return and risk characteristics to more traditional asset classes. Finally, I will conduct tests of the returns in the framework of the capital asset pricing model (CAPM) of Sharpe (1964).

3 Data

This section delves into the methodologies and rationales employed during the data collection process for Scandinavian artists. I collected sales records from artprice.com, a widely acknowledged website for hosting an extensive repository of art price data, encompassing over 800,000 painters and 15 million auction prices. In this section, I aim to elucidate the criteria behind my data collection approach, including the amalgamation of the Scandinavian countries, the artists' selection criteria in the index, the variables chosen to construct the hedonic model, and the identification of the asset classes for comparison with the art index.

3.1 Scandinavian Countries

The first key decision I encountered in developing the art index revolved around the selection of countries for my analysis. This decision involved striking a balance between including artists who shared certain commonalities, such as geographic location, to enhance the index's representativeness and analytical value, and the potential benefits of incorporating a larger region to gather more data. My objective was to create an index that effectively tracked market trends within a specific region. However, expanding the geographic area too extensively could potentially affect the reliability of the index and the statistical significance of the coefficients. I ultimately decided to focus on the Scandinavian countries—Sweden, Denmark, and Norway—for several reasons. First, these nations shared cultural heritage have fostered cross-pollination of artistic influences and exchanges, leading to notable similarities in art styles. With its breathtaking landscapes, mystical folklore, and rich mythology, the Scandinavian region has served as a significant source of inspiration for painters and artists from all three countries allowing them to draw upon these common themes. In this sense, geographical proximity has played a crucial role. Many art styles and movements, such as the Nordic Classicism or the National Romanticism, have emerged as a result of this geographical proximity making it challenging to attribute them to one specific nation. Furthermore, due to the relatively small size of the Scandinavian art market, it is quite common for art collectors to purchase artworks from neighboring countries. An art investor in Scandinavia is likely to have

equal knowledge about and access to paintings from Sweden, Denmark, and Norway. Consequently, these three art markets tend to evolve in similar ways, which makes having a common art index a viable choice. Finally, considered individually, each country does not possess a substantial amount of data. However, when combined, the collective dataset of paintings improves significantly. Having a bigger sample under study, I would be able to construct a more robust hedonic model, which in return would result to a more accurate art price index.

3.2 Artists' Selection

The selection of the artists is arguably the most crucial aspect of constructing my index. An art index, much like a stock index, should outline any general trends in the market and provide a reliable reference for art collectors and investors to make sound decisions. This suggests predefining a set of objective selection criteria based on the main aim of the index. In the literature, different research papers have implemented different selection approaches. For instance, Candela et al. (2004) focused on the era of the artwork by taking Modern and Contemporary, Old Master, and 19th century paintings. Others have studied the return of certain artists; for example, Pesando and Shum (1999) examined Picasso's artworks. While other scholars have analyzed art collections, such as Chambers, Chambers et al. (2020) who studied the collection of the well-known economist, John Keynes. Furthermore, one of the most widely used art indices, the Mei Moses All Art Index, have utilized a combination of these selection criteria. It is mainly based on auction sales located in New York and London from Sotheby's and Christie's, certain styles, namely Contemporary Art, Impressionism, Modern Art, Old Masters, Post-War, and 19th-Century Art, and because it is a repeat-sales index, only on paintings that have been sold twice or more.

However, by collecting sales records from artprice.com, I used an approach that deviates from the traditional method of collecting data in this type of study. In past research, the common procedure has been to collect data from a selection of auction houses, generally the most renowned ones as data there are usually readily available and regularly kept up to date, and thereafter to identify a list of the 'most influential' painters among them. For instance, to construct an art index of Canadian paintings, Hodgson and Vorkink (2004) collected sales records from Campbell, Sotheby's and Westbridge, three prestigious auction

houses in Canada and then restricted their analysis on artists that 'were considered to have made contributions of some lasting importance to the development of Canadian art'. They considered an artist important if their work was included in Reid's (1973) survey of the history of Canadian painting.

Nevertheless, in my opinion, this common way might lead to selection biases. First, by collecting data from few auction houses, we might exclude paintings of major artists that were sold elsewhere. This could undermine the reliability and credibility of the index since prestigious auction houses predominantly handle well-known artworks, whereas every artist may have lesser-known pieces that can be sold through different channels. Second, restricting the analysis to a limited selection of artists, based on their 'influence', can present significant challenges. Indeed, creating such a list, as informed by most art experts and professors I approached, is rather a subjective task. First, the definition of the word 'influential' itself might differ greatly from one art lover to another. An artist who is important to some other artists, and influential in that way, might not be very well known to the public or the rest of the art community, and the other way around. And even with a predefined and fixed definition in place, the list of influential artists would most certainly vary over time since our aesthetic preferences constantly change. This is what Pierre Bourdieu, a prominent sociologist who conducted extensive research on art, has called the 'cultural capital theory'. He suggests that the art world is structured by economic and cultural capital, where certain institutions hold most of the power over the production and distribution of art. This, in return, makes artistic taste and value subjective and easily influenced. What art is considered valuable and worthy of recognition becomes a product of a closed circle of powerful individuals. To address this issue, I have chosen to pursue a different approach to data collection. Rather than relying on a preconceived list, I have sought to compile an exhaustive list of Scandinavian artists. I researched extensively in art history literature, including renowned sources such Norsk Kunstnerleksikon and Swedish art history, delved into articles from prominent auction houses, and meticulously examined archives from national museums in Oslo, Copenhagen, and Stockholm. This comprehensive exploration has allowed me to compile a preliminary list of painters who have either been exhibited or have a history of exhibition. However, every painter on the list had to meet two seemingly reasonable criteria. First, the artist had to be from a Scandinavian country. In other words, born in either Norway, Sweden, or Denmark.

This turned out to be a bit more challenging than expected for some cases. Let's take Camille Pissarro (1830-1903) for example. Camille was born in St. Thomas in the U.S. Virgin Islands and spent his childhood on the island before moving to France and residing most of his life there. However, in 1830, when Camille was born, the U.S. Virgin Islands were under the Danish colony and known as the Danish West Indies. And although, Pissarro was highly influenced by the French culture and became a pillar of the French Impressionist movement, I have included him in the list of Danish painters. I followed this rather simplistic approach to deal with ancestry and nationality of painters to avoid any subjectivity in the data collection. I do not think that I have the adequate artistic expertise to judge an artist's source of influence and the country they should be attributed to. The second criterion is rather more straightforward. The artist needed to have at least one public recorded sale of a painting in an auction house.

With this approach, the number of painters collected and for whom I have at least one recorded sale amounted to 442 artists, 85 are from Norway, 156 are from Sweden and 200 are from Denmark, and the total number of sales in the data amounted to 52,129. It should be noted that I did not take time to discard resales observations of the same painting. I highly suspect that the number of resales is small compared with the total number of sales, as it has always been much more difficult to collect data to conduct a repeat sales method of constructing a price index.

Table 3.1: Nationality Distribution of Artists and their Market Capitalization

The following table illustrates the Nationality Distribution of Artists, presenting the number of observations (No. Obs.), the total number of artists (No. Artists), and the aggregated market capitalization in euros (Market Cap) for Danish, Swedish, and Norwegian artists in my data.

Nationality	No. Obs.	No. Artists	Market Cap (EUR)
Danish	24,253	200	356,006,776
Swedish	21,353	156	352,285,886
Norwegian	6,523	85	260,679,265

From this point, and after collecting the most exhaustive list of Scandinavian painters I could think of, I needed to refine the list to construct the art index. I sorted my list based on the 'market capitalization' of each artist. I defined an artist's market cap by the sum of the hammer prices of their publicly sold paintings. I deemed this method to be, unlike the common approach followed in the literature, less subjective and more

aligned with financial principles. Afterwards, to construct the index, I chose to keep the first one hundred painters. The exact number of painters does not really matter unless it can be judged representative of the preliminary list I collected or as I like to think, of the Scandinavian paintings market overall. I chose one hundred for two straightforward reasons. The first, the top one hundred artists' market capitalization covers around 90.36% of the draft list. In comparison, the S&P 500 covers approximately 80% of the total available market capitalization of the US equity market. The second reason was that it simply seemed appropriate to construct an index with the number one hundred. It makes it slightly easier to work with and analyze.

This emphasis on the 'blue chip' artists is not uncommon in the literature. Given this paper's main interest is to study art as an investment vehicle, one should discard 'minor' painters from the index as their reputation typically do not carry as much weight among the art community and their paintings tend to be low priced. An art collector's motivation to own paintings from such artists would rarely be considered for investment purposes. Finally, as Kraeussl and Elsland (2008) argued, from an investor's perspective, the availability of artworks is as important as the artist's status. Thus, the index should represent artists that are frequently traded on the market as well. Therefore, in the top one hundred artists, I only included painters that had at least fifty recorded auction sales. This will increase the influence of artists that are relatively more liquid on the market.

Lastly, it should be noted that I only considered paintings for my data, excluding drawings and print-multiples. However, I did not restrict neither the medium nor the support of the paintings. Nonetheless, most of the paintings are oil on canvas.

3.3 Hedonic Model Variables

For each painting, I collected the hammer price, the estimated value before the auction, the medium and support, the height and width in centimeters, the auction house where it was sold and its location, and the half-year during which the painting was sold. Auctions are typically held in concentrated periods (autumn auctions are usually held in October and November, while spring auctions in April and May). By constructing a semi-annual time index, I am following the standard practice in the literature on art pricing using an art index. As of hammer prices, it is defined as the final bid price for an item at the art

auction, usually determined by the fall of the auctioneer's hammer or another signaling method to indicate the end of the bidding. In other words, it is the highest price buyers participating in the auction are willing to pay. This price, however, does not include the buyer's premium or any additional taxes or fees. On my part, no effort has been made to adjust the hammer prices to include such commissions, taxes, or fees. However, it is important to note that this method of collecting art prices might still introduce selection biases. Because the data relies on auction transactions, and auction houses have little incentive to hold sales for art that lacks public interest, it implicitly excludes artworks that do not have enough popularity to attract several potential buyers. Consequently, most auction records, may not accurately reflect price fluctuations for paintings that lack broad demand. In addition, the total number of paintings consigned and not sold during the auction is usually not published. These unaccounted numbers not only introduce an upward bias to the estimated return on art investment, but one might also expect that their impact varies over time. During periods of increasing prices, it is conceivable that fewer paintings would be expected to be bought in (failing to sell at the auction). Goetzmann (1993) suggests that because of these biases, the mean return of the art index should be regarded as an approximate and possibly as an upper bound on the average return that may be obtained by investors, especially since the auction prices I am using do not include the transaction costs and fees associated with the sale. As far as I know, there is no paper that took private sales into account when constructing an art index, as collecting these sales records present inherent challenges.

Furthermore, it is important to acknowledge the rationale behind the exclusion of the estimated value as an explanatory variable in the model. In determining a painting's estimated value, experts might refer to its size, the artist's reputation or the auction's house's status, variables that are already controlled for in the regression, but also to other factors that might be more difficult to account for in the model, such as the painting's history, previous sales records, contextual significance, provenance, and condition at the time of the sale. These factors have a significant impact on the price of an artwork and including them, as I have tested, can greatly improve the model's goodness-of-fit with the adjusted R-squared reaching as high as 0.92. If the primary objective of the model is to assess the accuracy of painting price predictions, it would be meaningful to examine the relationship between the logarithm of artwork prices and the logarithm

of their estimated values. In this case, I will aim to determine if the estimated value exhibits a coefficient of unity, indicating a rational assessment of artwork prices, while other variables exhibit zero population coefficients. However, if the analysis shifts towards estimating a hedonic price model, which aims to determine the marginal values of various painting characteristics, including the estimated value in the equation can introduce complications. In the context of a hedonic model, incorporating the estimated value of the painting becomes redundant. Including it as an independent variable implies holding one measure of value (price estimation) constant while examining the effects of other characteristics. This contradicts the fundamental principle of the hedonic model, which seeks to isolate the impact of specific attributes on the price or value of the product. Therefore, in the case of a hedonic model, it does not make sense to include the estimated value as an independent variable, as it would be treated as both an input and an output of the model simultaneously.

3.4 Alternative Asset Classes

The primary objective of my paper is to assess the viability of art as an investment asset class. For this matter, I chose to compare the risk and return characteristics of Scandinavian paintings as an asset with other more conventional asset classes. Nonetheless, the question remains as to which assets should I use for my comparison. Naturally as my index aims to reflect the Scandinavian art market, I shall use a stock market index that is based on Scandinavian companies. I chose the MSCI Nordic Countries Index for this matter. It captures large and mid-cap representation across Norway, Denmark, Sweden, and Finland. With 85 constituents, the index covers approximately 85% of the free float-adjusted market capitalization in each country. In addition, since the early 2000s, Scandinavian art has gained significant attention from foreign investors and art enthusiasts. According to the data, 37% of the paintings constructing the index were sold outside of Scandinavia, mainly in New York, London, and Paris. These cities are known to be the center of the art world and prime destinations for art collectors seeking to buy and sell high-value masterpieces. Thus, I shall use a global equity index as well, as it is important to examine whether this will yield different empirical results. I selected the MSCI World Index for this purpose, a global index that captures large and mid-cap representation across 23 developed countries with 1,507 constituents, covering approximately 85% of the

free float-adjusted market capitalization in each country.

Table 3.2: Sales distribution by geographic location

The following table presents the Sales Distribution by Geographic Location, detailing the volume of sales and corresponding Hammer Prices (EUR). The Market Cap percentage represents the proportion of each location's contribution to the total market capitalization, both individually and cumulatively. Notably, Stockholm, Sweden, emerges as the leading market, followed by Copenhagen, Denmark, London, United Kingdom, New York NY, United States, and Oslo, Norway, each contributing distinctively to the overall market dynamics.

Location Sold	**Hammer Price (EUR)**	**Market Cap %**	**Market Cap Cumul. %**
Stockholm, Sweden	278,536,534	28.75	28.75
Copenhagen, Denmark	205,068,389	21.16	49.91
London, United Kingdom	191,150,654	19.73	69.64
New York NY, United States	110,457,771	11.4	81.04
Oslo, Norway	76,881,458	7.93	88.97

Furthermore, I believe that to gain a broader perspective on the overall market trends and correlations, I shall utilize a series of additional indices. I chose the MSCI Real Estate Index to represent the real estate sector in Europe. It is a free float-adjusted market capitalization index that consists of large and mid-cap equity across 15 European developed countries. I selected the LPX Europe to represent the performance of Listed Private Equity companies that are listed on a European stock exchange, the Bloomberg Commodity Index to track different commodity markets measuring price movements across various commodities, including energy, metals, and agricultural products, and the Credit Suisse Hedge Fund Index to evaluate the performance of hedge funds. Finally, for the risk-free rate, I use the yield on six-month to maturity FTSE World government bonds ending in June and December.

4 Methodology

The primary objective of my paper is to evaluate Scandinavian paintings as investment assets. In order to achieve this goal, I would need to rely on a tool that can track the performance of the Scandinavian art market over a certain period. Numerous art indices have been established in previous studies and some of which have gained recognition as valuable resources for art investors. However, despite the significance of the Scandinavian art market in the art community and its rich historical background, there is currently a notable absence of art indices specifically tailored to track the performance of this particular market. Thus, in this paper, I will attempt to fill this gap and construct such an index.

4.1 The Hedonic Model - Theory

In the literature, numerous methods were developed to construct a price index. The selection of a specific index depends on the research question at hand. However, two main approaches have been followed to develop an art index. Scholars have either utilized a 'repeat-sale regression' or a 'hedonic regression'. The repeat-sale method measures the performance of certain assets by tracking their prices over a defined period. In this case this method would rely on paintings that have been sold twice or more during the period under study. A rate of return of the painting in question would then be calculated based on the different sale prices recorded. Afterwards, an average rate of return of the sold art is calculated for each period. Finally, the art index can be generated by combining these rates. While this method seems straightforward and intuitive, it has some important drawbacks. First, by relying solely on paintings that have been sold twice or more in the period under study, I am significantly limiting the size of my sample. Most paintings are rarely sold more than once and even in that case, I would still need a way to track the recorded sales over time. Unless the artwork is described by a reference number, a practice that is not universal, one cannot be certain that it is the same artwork, as it is common among auction houses to translate a painting's title into different languages depending on the country where the painting is sold. For instance, Edvard Munch's 1902 painting 'Girls on a bridge' was sold at Sotheby's in 2008 with its English name, but when

it was sold again in 2016, it was referred to as 'Pikene på broen'. Identifying an artwork by other means can be tricky as well. Even the recorded dimensions of a painting can differ from one auction to another. Finally, one cannot exclude that this selection method might possibly cause selection biases as one might argue that only 'high-quality' artworks often appear on markets.

In contrast, a hedonic approach would allow an inclusion of all publicly traded paintings. At its core, the hedonic model is based on the principle that an asset can be deconstructed into components and then using some sort of ordinary least squares method, investigates how each segment contributes to the overall value of the asset in question.

Introduced in 1939 by Court, the first hedonic model was used to create a pricing index for automobiles. The main idea behind it is that to truly understand changes in the prices of products over time, it is necessary to go beyond inflation rates. Relying solely on inflation would be insufficient to predict future prices. Instead, one should also study the gradual change in quality. This principle made the hedonic model widely used to construct indices; the consumer price index is probably the most famous example. It measures the average change over time in the prices of a fixed basket of goods. However, if the quality of the goods in the basket changes over time, predicting the future value of the index would be inaccurate. Let's imagine trying to predict the price of an iPhone today based on the pricing information of its release year. An iPhone costs more today than it did back in 2007. While inflation played a role in the increase, it is not the sole factor. The significant improvement in the features of an iPhone today plays a crucial role as well. The processing power is 50 times faster, the storage capacity is 15 times larger, and the camera quality improved drastically over the years. By constructing a hedonic model, I would be able to price these features' improvements in the customers eyes and deduct a price premium for the improved phone. As Lancaster (1966) has stated, I can estimate the 'utility' of the improved product based on the additional individual improvements of its components over time. Specifically, Lancaster argued that an item's utility can be thought of as the sum of the individual utility of each of its characteristics.

Nonetheless, although Lancaster was the first to introduce the hedonic utility theory, it was not until 1974 that Rosen applied it to pricing goods. Rosen argued that an asset's total price should be the sum of individual prices of its characteristics. Based on this

reasoning, one can argue that an asset's price can be regressed on its characteristics to determine each feature's contribution to the total price. Since Rosen's work, the application of hedonic pricing models became widely prevalent, particularly in real estate, as they are often used to correct for heterogeneity among properties. It is for this precise reason that hedonic models were adopted for pricing artworks as well. Each artwork is a unique object, exceptional creation, crafted within a specific context and imbued with a unique story. Artworks are the result of an artist's creative vision, influenced by their surroundings, experiences, and personal perspectives. The context in which a painting was created encompasses a multitude of factors such as historical events, cultural influences, artistic movements, and individual motivations, which have a significant impact on its value. As the American art critic Danto dispute, if two works of art may look identical in their physical properties but are judged differently based on their cultural and historical significance, they will still differ in artistic value and quality.

Hedonic regressions have been used countless times since Lancaster's theory and Chanel et al. (1992) even concluded that although both the repeat-sales and hedonic price index methods yielded an unbiased market-wide effect, the coefficient estimates' variance were significantly lower in the hedonic regression. The fundamental approach is to collect records on art sales for a predetermined period and then to regress the price of each artwork (or its logarithm) on its characteristics. The number and the nature of the regressors will depend on the data available. However, they would usually include some continuous variables, such as the size or the age of the artwork, and dummy variables such as the artist, the auction house, the location of the sale, and most importantly the dates or periods of the deal. The time dummy variables can be considered as representing the variation of the price of an 'average' painting throughout the period under study, after controlling for its other specific variables. Constructing this index will allow us to mimic the return of an art collector or investor holding a well-diversified collection of Scandinavian paintings, just as a stock market index would reflect the variation in a well-diversified stocks portfolio. Therefore, it should be acknowledged that this index will most likely be inaccurate in predicting the value of an individual artwork.

However, hedonic models still have their limitations. Ginsburgh et al. (2006) highlighted that the outcome of the model depends on the independent variables controlled for and

on the functional form of the regression, which introduces a level of subjectivity and uncertainty into the analysis. These variables, representing the artwork's characteristics, are often limited by data availability, which might restrict the accuracy of the model as well. Furthermore, hedonic models may struggle to account for changing market dynamics and evolving tastes over time. Artistic trends and preferences can shift, leading to variations in the valuation of the different characteristics. By assuming constant coefficients over time, hedonic models might struggle to adapt to these changes. Finally, in my endeavor to model the demand function for paintings based on auction prices, I must acknowledge that these prices stem from the interaction between supply and demand functions. Consequently, I am always bound to encounter an implicit identification problem.

4.2 The Hedonic Model – Econometric Model

A hedonic model should typically be used in the case of heterogenous products, where products differ in their attributes and characteristics. However, the nature of the assets to be analysed can also affect the form of the function to be used. The response variable either takes a level form or a logarithmic form. The level 'additive' hedonic model is used in the case where the heterogenous items can be easily replaced. This is because the model assumes that the value of each asset's attribute is independent from the value of all others and, therefore, the asset's total value is simply the sum of its individual components' values. On the other hand, in the case of irreplaceable or unique products, for example, a housing property or an artwork, non-linearities often arise in the hedonic structure and the dependent variable takes a logarithmic form. Therefore, I present my econometric model as such:

$$\ln pi = \sum_{t=1}^{T} \gamma_t \delta_{it} + \sum_{k=1}^{K} \alpha_k X_{ik} + \epsilon_i, \; i = 1, ..., n, \tag{4.1}$$

Where pi is the price of the recorded sale i. The main advantage of using a log-level form is the robustness of the approach. The art market is particularly characterized by the presence of outliers that can sell for extremely high amounts compared to the 'average' artwork. These masterpieces make the sample mean significantly higher than the median and the sample distribution becomes right skewed. Using the logarithmic form of the

dependent variable assures a normality of the sample distribution. Another advantage of using a log-level form is that it allows the value of a certain characteristic to vary proportionally with the value of the other characteristics, which is not the case in linear models. It also assures non-linearity of the continuous variables' effects. As one might guess, the price of a painting, for example, is positively correlated with its size, however, it makes sense that the size effect decreases as size increases.

δ_{it} is the value of the period dummy variable. It can either take the value of 1 if a painting i was sold in the semi-annual period t or zero if not. T equals 65 and is the number of the semi-annual time periods in the data. Auctions that are held between January and June belong to the first semi-annual of the year, while auctions held between July and December belong to the second. Constructing a semi-annual time index is quite a standard practice in the literature on art pricing. This is primarily because auctions tend to be concentrated in two major periods throughout the year: the spring months of March, April, and May, and the fall months of September, October, and November. Therefore, dividing the year into two semi-annual periods aligns with the typical pattern of auction activity in the art market and allows the price index to account for these seasonal effects. Additionally, it enables the index to be generally more sensitive to changes in prices over shorter time intervals, reflected in a more accurate representation of price fluctuations in the art market.

The explanatory variables X_i represent the other characteristics of the painting i. They include 100 dummy variables for the artists, 61 for the auction houses, and 7 for the type of paint used. In all these cases, one dummy variable was omitted to avoid perfect multicollinearity, forming a reference group. The intercept term in the regression model captures the average price for this reference group, assuming all other variables are held constant. It represents the baseline value of the response variable when all the dummy variables are set to their reference group values. The coefficients of the remaining dummy variables are often called implicit prices or characteristics prices. They indicate how the prices deviate from this reference group. For instance, if I omit the "oil" category from the regression and treat it as the reference paint dummy variable, the estimated coefficients associated with the other paint variables would indicate the percentage point difference in a painting's price compared to using oil as the paint type. Positive coefficients would

indicate a higher average price compared to using oil, while negative coefficients would suggest a lower average price. Similarly, the coefficients for the artist dummy variables may be interpreted as reflecting the market value of each respective artist compared to the reference artist. The coefficients associated with the auction house dummy variables can be perceived as the reputation or prestige of each auction house relative to the reference auction house, and while this analysis may only allow comparison within a reference group, if cautiously interpreted, it can still provide us with valuable insights into how specific characteristics or attributes of the artworks influence their prices.

Additionally, I considered the size both in its area form, which is obtained by multiplying the height and width of the painting, and in its logarithmic form. Furthermore, after performing a backward elimination, I chose not to include the surface used of the painting as a dummy variable as it was found to be statistically insignificant.

I can rewrite the econometric model (4.1) more concisely as such:

$$\ln pi = Z_i\beta + u_i,\ i = 1, ..., n, \tag{4.2}$$

where $Z_i = (\delta_{i1}, ..., \delta_{iT}, X_{i1}, ...X_{iK})$ and $\beta = (\gamma_1, ..., \gamma_T, \alpha_1, ..., \alpha_K)$, with T = 65 semi-annual periods and K = 168. After deriving the time-period semi-annual coefficients, I can proceed to derive the price index by computing the rate of return between two period $t + 1$ and t as such:

$$r_{t+1} = \exp(\gamma_{t+1} - \gamma_t) - 1 \tag{4.3}$$

In the estimation of regression models (4.1) and (4.2), I employ ordinary least squares (OLS). Similar to prior research, I anticipate potential heteroskedasticity issues and deviations from normality. To address this, I adopt heteroskedasticity-robust standard errors. Additionally, I believe that the large sample size of the dataset will ensure robustness in assessing the normality assumption.

5 Analysis

I estimate the coefficients of the hedonic regression (4.1) and (4.2) using ordinary least squares (OLS) and present the results in Tables 5.1, 5.3, and 5.4 for the period dummy variables, the painters dummy variables, and the auction houses dummy variables respectively.

In the regression analysis, I detected heteroskedasticity using the Breusch-Pagan test (p-value < 0.05). To address this issue, I use heteroskedasticity-robust standard errors, which produced wider confidence intervals for the majority of the regressors. However, the results still show statistically significant estimates for all the period dummy variables at the 1% level running from 1997:2 to 2023:1. This is extremely important for the analysis as I will be using these time dummies to construct the price index.

I will discuss the results in three major parts. In the first, I will focus on the time dummy variables, arguably the most important element for constructing the art price index. I summarize these coefficients in table 5.1. Additionally, I illustrate the art index in a comparison graph with more traditional asset classes in three figures. In the second part, I will delve into the painters' related parameters. In table 5.3, I present a ranking of the top 30 painters based on their market capitalization and discuss the potential interpretations of their coefficients. Lastly, I will briefly discuss the remaining factors within the model, with particular attention given to auction houses. Overall, I aim to provide a comprehensive understanding of both the economic and statistical significance of the parameters.

5.1 Time Series Price Index

In table 5.1, I report the semi-annual dummy estimates of the hedonic model. For each semi-annual period, I have provided the number of observations or recorded sales in the data, the dummy estimate, its standard error, the market capitalization, or turnover generated by the chosen artists for that period and the estimated nominal and real rates of return. I later use the calculated estimated nominal returns to plot the evolution of the Scandinavian art index compared to the other asset classes in figures 5.1 and 5.3, and to plot the evolution of the semi-annual returns in figure 5.2.

Table 5.1: Time dummies and estimated returns (semi-annual)

The following table captures the regression model results for the time dummy variables and their corresponding statistical attributes. The table includes the number of observations (No. Obs.) for each semi-annual period, coefficient estimates, standard errors, statistic, the combined market capitalization in euros (Market Cap), and the estimated nominal returns derived with equation 4.3. Importantly, all estimates are found to be statistically significant at the 1% level, underscoring the robustness of the derived findings.

Time Period	No. Obs.	Dummy Estimates	Std. Error	statistic	Market Cap (EUR)	Estimated nominal return (%)	Index
1998:1	700	0.5331	0.0598	8.9087	11,485,066	0.25	100.00
1998:2	729	0.5477	0.06	9.0558	12,480,246	1.48	101.48
1999:1	665	0.5568	0.0590	9.4409	10,165,355	0.91	102.40
1999:2	556	0.5912	0.064	9.2775	7,807,981	3.49	105.98
2000:1	733	0.8471	0.061	13.9823	17,401,727	29.16	136.89
2000:2	590	0.9014	0.061	14.8000	9,968,187	5.59	144.54
2001:1	799	0.8004	0.06	13.4414	17,669,982	-9.61	130.65
2001:2	665	0.7169	0.06	11.9809	13,333,953	-8.02	120.18
2002:1	705	0.7228	0.061	11.8957	29,403,787	0.59	120.89
2002:2	613	0.7498	0.063	11.9303	14,458,272	2.74	124.20
2003:1	605	0.7518	0.061	12.3577	14,112,371	0.20	124.45
2003:2	616	0.7897	0.059	13.4704	10,935,214	3.86	129.26
2004:1	588	0.8657	0.061	14.1167	12,840,389	7.89	139.46
2004:2	515	0.9292	0.065	14.2372	10,247,649	6.56	148.61
2005:1	406	0.9367	0.065	14.5002	12,051,613	0.75	149.73
2005:2	592	1.0129	0.06	16.7715	11,465,900	7.92	161.58
2006:1	639	1.1114	0.061	18.2522	38,400,250	10.35	178.31
2006:2	604	1.1252	0.061	18.4791	16,127,819	1.39	180.78
2007:1	574	1.1226	0.062	18.2081	30,172,067	-0.26	180.31
2007:2	397	1.2172	0.067	18.2705	11,957,562	9.92	198.20
2008:1	626	1.1890	0.061	19.6310	41,002,932	-2.78	192.69
2008:2	519	0.9356	0.062	15.0061	10,500,895	-22.38	149.56
2009:1	408	0.8444	0.064	13.2796	7,636,019	-8.72	136.52
2009:2	394	0.9608	0.064	15.1131	9,483,080	12.35	153.38
2010:1	357	0.9590	0.067	14.2619	9,093,722	-0.18	153.11
2010:2	569	0.9958	0.062	16.1678	15,625,140	3.75	158.85
2011:1	514	0.8899	0.062	14.4476	12,687,439	-10.06	142.88
2011:2	526	0.8923	0.063	14.2500	13,427,700	0.25	143.23

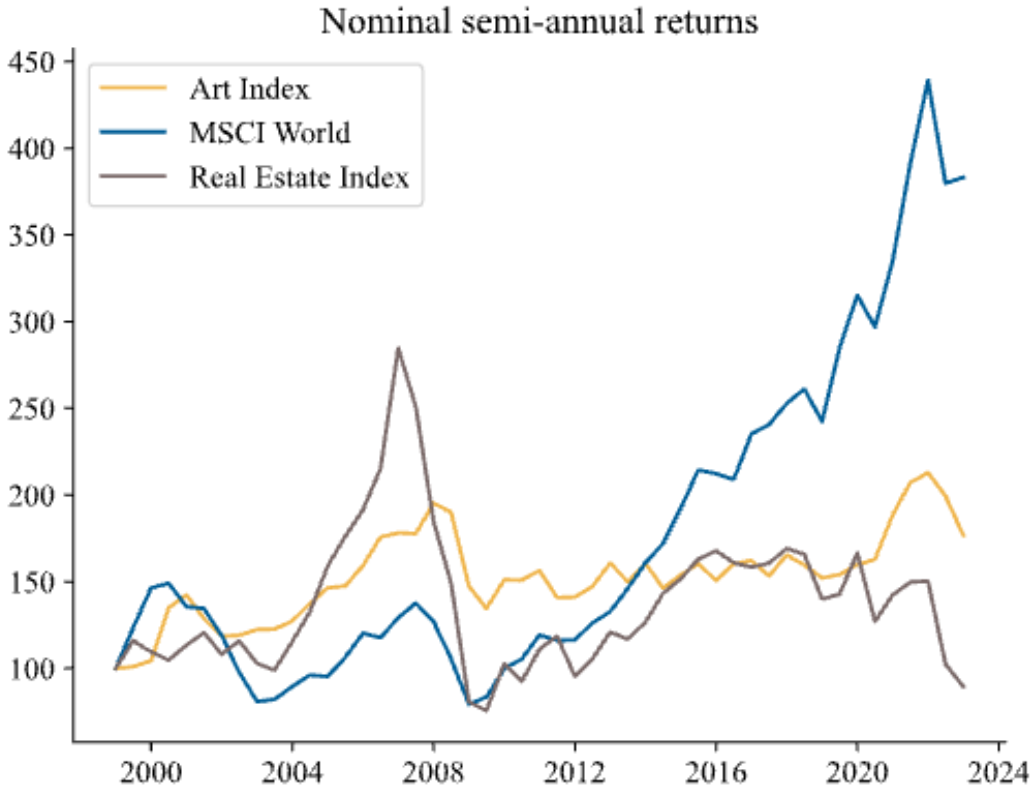
Continued from previous page

2012:1	435	0.9347	0.063	14.8253	20,054,345	4.33	149.42
2012:2	525	1.0226	0.065	15.6261	12,844,046	9.19	163.16
2013:1	478	0.9532	0.065	14.7762	14,768,092	-6.70	152.22
2013:2	523	1.0214	0.064	16.0522	14,561,674	7.06	162.97
2014:1	491	0.9285	0.063	14.6478	13,111,014	-8.88	148.50
2014:2	420	0.9785	0.064	15.1974	10,411,600	5.13	156.11
2015:1	457	1.0203	0.064	15.8600	12,094,272	4.27	162.78
2015:2	437	0.9579	0.061	15.6801	11,508,636	-6.05	152.94
2016:1	423	1.0195	0.069	14.8231	12,732,858	6.35	162.65
2016:2	403	1.0315	0.065	15.8045	8,658,180	1.21	164.61
2017:1	395	0.9755	0.064	15.2529	9,791,450	-5.44	155.65
2017:2	407	1.0512	0.066	16.0168	15,646,963	7.86	167.88
2018:1	368	1.0150	0.067	15.2239	18,318,752	-3.55	161.93
2018:2	502	0.9675	0.061	15.8454	15,621,698	-4.65	154.40
2019:1	442	0.9805	0.067	14.7416	13,262,950	1.31	156.43
2019:2	397	1.0163	0.067	15.1631	16,893,140	3.64	162.13
2020:1	341	1.0353	0.069	14.9000	9,340,176	1.92	165.25
2020:2	436	1.1828	0.064	18.5136	18,143,415	15.89	191.51
2021:1	410	1.2758	0.068	18.7530	14,696,792	9.74	210.17
2021:2	377	1.3032	0.071	18.3591	20,791,762	2.77	215.99
2022:1	402	1.2381	0.067	18.4113	14,468,560	-6.30	202.39
2022:2	415	1.1173	0.066	16.8951	10,331,641	-11.38	179.35
2023:1	98	1.0906	0.11	9.8984	1,992,690	-2.63	174.63

Given the inherent nature of my data, encountering heteroskedasticity in the model was highly anticipated. Artworks can vary widely in prices with some extraordinary masterpieces reaching exorbitant values. While art experts might provide reasonably accurate estimations of these prices before an auction, they usually rely on data that can be challenging to incorporate into the model. Indeed, when estimating a painting's price, experts take into consideration factors that are typically omitted from hedonic models. An artwork's quality, historical context, scarcity, and overall appeal are all crucial factors in determining its selling price. Unfortunately, gathering such information for large datasets remains challenging and as mentioned earlier, including the estimated value as an independent variable to account for these factors introduces bias into the model. Market trends further exacerbate this issue, as periods of hype or economic crises can lead to fluctuations in sales prices.

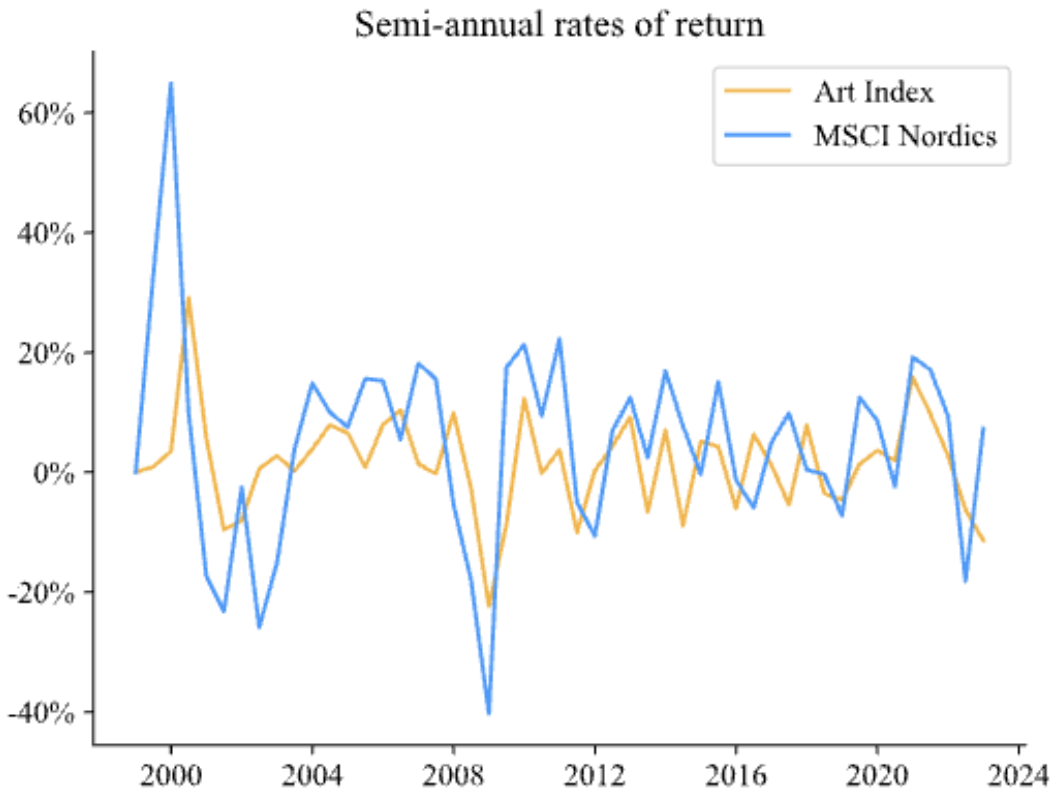
Although heteroskedasticity itself does not cause bias in the Ordinary Least Squares (OLS) estimates, it is still crucial to address it in order to obtain accurate standard errors. By doing so, I can assess the reliability of the art index and make informed decisions when analysing the investment properties of Scandinavian paintings. I detected heteroskedasticity in the model using the Breusch-Pagan test. After incorporating robust standard errors to account for the varying variance of residuals, I found that the results remained highly significant (with extremely low p-values, not reported). This is crucial as I will treat the estimated returns as observed returns further in the analysis.

Figure 5.1: Comparative Evolution of the Art Index, MSCI World Index, and the MSCI Real Estate Index



In figure 5.1, I compare the Scandinavian art index with the MSCI World Index and the MSCI Real Estate Europe Index on a semi-annual rates of return basis, and in figure 5.3, I compare the art index to the LPX Private Equity Index and Credit Suisse Hedge Fund Index on an annual basis. At first glance, several key insights can be already observed from the figures presented. While the rates of return vary significantly across the different

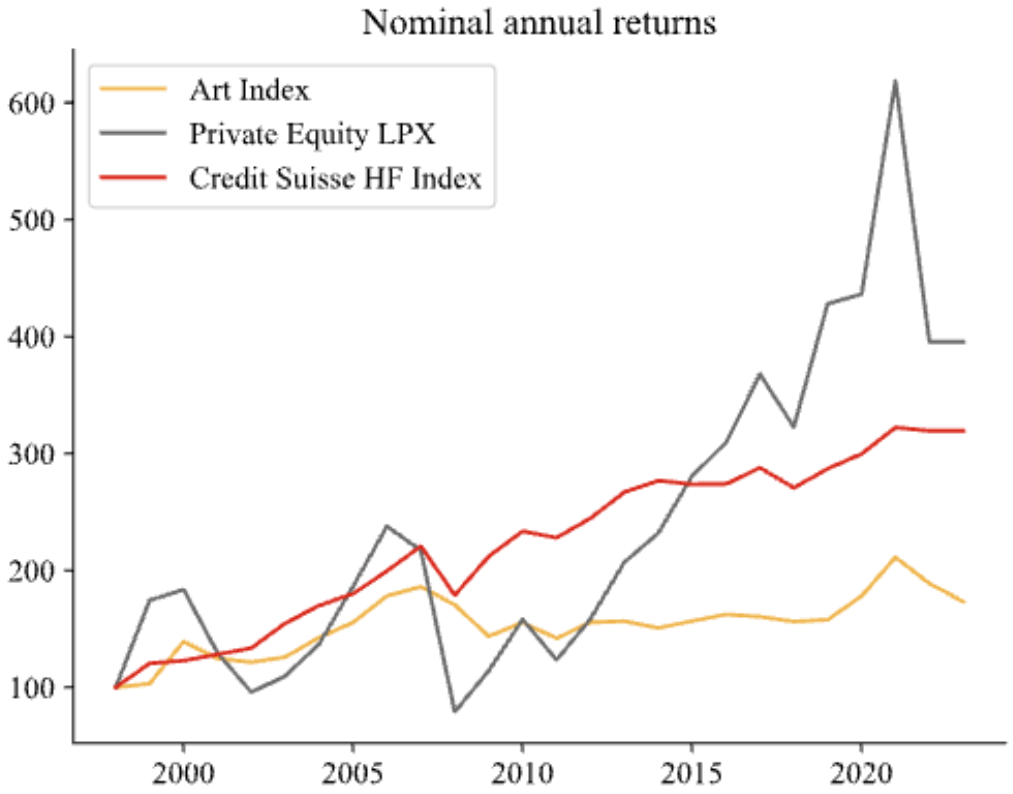
Figure 5.2: Semi-Annual Returns Comparison between the Art index and the MSCI Nordics



indices, they generally exhibit similar directional movement. This consistency can be better observed in figure 5.2, where the focus is on projecting the evolution of semi-annual rates of returns rather than the actual index values. Notably, the rates of return for the MSCI Nordics index and the Art Index display a correlation of 0.4063, indicating a closer relationship of the Art Index compared to the Nordic economies than with the MSCI World Index.

Upon closer observation, we can notice two significant variations in the art index, corresponding to the two major recessions that occurred from the late nineties until today. During the dot-com bubble burst between 2000 and 2002, while the art index did not perform as positively as one might have expected given its reputation as a safe haven asset, it still outperformed the MSCI world index (-45.77%), the MSCI Nordics (-61.14%), and the LPX Private Equity Europe (-53.92%), recording a relatively modest decline of (-9.27%) over the two years. Similarly, during the global financial crisis, the art index

Figure 5.3: Annual Returns Comparison between the Art index, the LPX Private Equity index, and the Credit Suisse Hedge Fund index



experienced a fall of -24.28%, ranking as the second-best performing asset, just behind the hedge fund index (-10.66%). In comparison, the MSCI World and Nordics Indices fell by around 40%, while the Private Equity LPX plummeted by 67%. The most significant decline was naturally observed in the MSCI Real Estate Europe Index, which tumbled by almost 70%.

It is also interesting to observe a noticeable pattern in figure 5.2 when comparing the rates of return of the art index and the MSCI Nordics Index. Notably, the art index seems to exhibit a slight delay in its responsiveness to macro events. Furthermore, when calculating the correlation between the semi-annual returns of the MSCI Nordics Index and the art index, while considering the art index's returns from the preceding semester, a significantly higher correlation of 0.548 is observed compared to the typical correlation of 0.4063. I believe that the observed phenomenon can be attributed to the nature of the art index itself. Unlike a real-time index actively traded by investors, the art index is

constructed based on recorded sales data. Consequently, its reaction to macroeconomic events is not immediate. The process of buying and selling artworks involves various steps, including valuation, marketing, negotiations, and finally, the actual auction or sale. These steps can take a considerable amount of time, sometimes spanning over several months. Additionally, art auctions are not conducted throughout the entire year but are typically scheduled during specific seasons, particularly in spring or autumn. In this way, the art market still reflects the influence of macro events on painting prices, but with a slight delay.

This phenomenon might also explain the lower fluctuations of the art index compared to the other asset classes in reaction to macroeconomic events. During periods of financial market hype, such as the late nineties, art collectors may become more optimistic and willing to pay higher prices for artwork. However, as discussed earlier, the process of selling a painting takes time, and by the time the sale is completed, the initial excitement in the financial market may have already started to fade, which in return might affect the auction prices. In the same way, following a global financial crisis, there might be an increase in the supply of art as collectors attempt to offset their losses. However, the demand for art may simultaneously decline, leading to lower overall prices and fewer recorded sales in general. Nevertheless, as the crisis gradually begins to recover, art sellers may still hesitate to proceed with the sale, causing a time lag in the art market's reaction to the improving economic conditions. This characteristic can make the art index appear relatively stable during times of market turbulence or euphoria, contributing to its reputation as a somewhat more resilient or "safe haven" asset. Nevertheless, as we have previously observed, it is essential to acknowledge that unlike other safe-haven assets, such as gold, the art index did not exhibit a negative correlation with financial markets during periods of turbulence. However, it still demonstrated a relatively low correlation, with the highest being 0.45, observed with the Private Equity index. This implies that investing in art could be regarded as a valuable diversification tool.

Table 5.2: Correlations of Traditional Asset Classes with the Scandinavian Art Index

In the following table, I present the correlation coefficients between the Scandinavian art index and various asset classes. It is noteworthy that among the asset classes analysed, the Scandinavian art index, along with the Bloomberg Commodities Index, exhibits the lowest correlations with the other traditional investments. However, it is important to highlight that none of these correlations are negative, casting doubt on its reputation as a safe haven asset during times of financial crisis.

	Art Index	**MSCI World**	**MSCI Nordics**	**Real Estate**	**Bloomberg Commodities**	**Private Equity**	**Hedge Funds**
ART Index	1						
MSCI World	0.3826	1					
MSCI Nordics	0.4063	0.8345	1				
MSCI Real Estate	0.3358	0.6280	0.4965	1			
Bloomberg Commodities	0.2470	0.3944	0.3994	0.2642	1		
Private Equity	0.4500	0.8915	0.8843	0.7329	0.4259	1	
Credit Suisse Hedge Funds	0.3249	0.6122	0.7326	0.6193	0.5135	0.7608	1

5.2 Painters

In table 5.3, I provide results of the 'Top 30' Scandinavian painters judged according to their dummy estimates in the model ranked in descending order. For each of these painters, I present their dummy estimate and the percentage difference compared to Adolph Tidemand, controlling for every other variable in the regression.

Table 5.3: Top 30 Artists based on the Semi-Annual Coefficients Estimates)

The following table showcases the Top 30 Artists based on Semi-Annual Coefficients Estimates, providing insights into their ranking, nationality, number of observations, dummy variable estimates, standard errors, market capitalization in million euros, and the relative percentage change compared to Adolph Tidemand, our omitted artist in the regression.

Rk	**Artist**	**Country**	**No. Obs.**	**Dummy Estimates**	**Std. Error**	**Market Cap in m€**	**% change rel.**
1	Edvard MUNCH	Norwegian	115	1.8839	0.2232	142.9	557.92
2	Anders Leonard ZORN	Swedish	217	0.8915	0.1948	45.1	143.89
3	Vilhelm HAMMERSHOI	Danish	156	0.7881	0.2219	50.1	119.93

Continued from previous page

4	Carl Fredrik HILL	Swedish	70	0.4872	0.2456	10.8	62.78
5	Alexander ROSLIN	Swedish	67	0.0732	0.2058	3.7	7.60
6	Carl Olof LARSSON	Swedish	64	0.0705	0.2604	7.5	7.31
7	C. W. ECKERSBERG	Danish	146	0.0688	0.2159	11.7	7.13
8	Asger JORN	Danish	859	0.0529	0.1787	54.6	5.43
9	Bror Leonard HJORTH	Swedish	55	0.0270	0.2285	3.4	2.74
10	Peder Severin KRÖYER	Danish	234	-0.2581	0.1921	11.5	-22.75
11	Sigrid HJERTÉN	Swedish	310	-0.2714	0.1846	15.8	-23.77
12	G. ADRIAN-NILSSON	Swedish	273	-0.2724	0.1912	17.3	-23.85
13	Ludwig Peter KARSTEN	Norwegian	91	-0.2855	0.1982	4.6	-24.84
14	Johan C.C. DAHL	Norwegian	139	-0.2903	0.1919	6.2	-25.19
15	Martinus RÖRBYE	Danish	94	-0.3486	0.2272	5.2	-29.43
16	Ivan AGUÉLI	Swedish	246	-0.3731	0.1868	8.9	-31.14
17	Sven Birger SANDZÉN	Swedish	144	-0.3901	0.1951	4.5	-32.30
18	Peder A. BALKE	Norwegian	87	-0.5110	0.2003	2.7	-40.01
19	Ejler BILLE	Danish	116	-0.5524	0.1928	3.1	-42.44
20	Frits THAULOW	Norwegian	429	-0.5839	0.1781	13.0	-44.23
21	Anna ANCHER	Danish	174	-0.7123	0.1888	3.4	-50.95
22	Hans Fredrik GUDE	Norwegian	208	-0.7467	0.1859	7.1	-52.61
23	Jens JUEL	Danish	99	-0.8513	0.1990	1.9	-57.31
24	Egill JACOBSEN	Danish	490	-0.8544	0.1796	9.1	-57.45
25	Bruno LILJEFORS	Swedish	1185	-0.8586	0.1784	30.5	-57.63
26	Vilhelm LUNDSTRØM	Danish	171	-0.8954	0.1951	4.5	-59.16
27	J. T. LUNDBYE	Danish	91	-0.8965	0.2121	1.7	-59.20
28	Leander ENGSTRÖM	Swedish	155	-0.9415	0.2002	5.6	-61.00
29	C-H. PEDERSEN	Danish	340	-0.9594	0.1813	8.3	-61.69
30	Kai FJELL	Norwegian	175	-0.9689	0.1884	4.9	-62.05

As mentioned previously, in constructing the model I omitted one dummy variable for each categorical variable to avoid perfect collinearity. In this case, the Norwegian painter Adolph Tidemand was omitted. This decision was arbitrary and Tidemand was chosen solely because his name appeared first in alphabetical order. As a result, this implies that the estimate of every other painter on the list will be interpreted, at least in theory, as reflecting their market value relative to that of Tidemand. Adolph Tidemand (1814-1876) was a Norwegian painter and one of the leading artists of the Norwegian Romantic Nationalism movement, which might explain the reason why most of the dummy estimates are negative. It is intending that most artists on the index are less valued by the art

market compared to Tidemand.

However, before diving deeper into the matter, few considerations must be borne in mind. First, the displayed estimates vary widely in statistical significance. While several factors might play a role in the significance of an estimate, the sample size is often considered critical. In my case, despite setting a minimum threshold for the number of observations in the selection, it still varies considerably from one artist to another, from 53, the lowest, to 1668 for Paul Fischer, the highest, with a standard deviation of 310. Additionally, it's important to remember that for constructing the index, I gathered a list of the most 'valuable' Scandinavian artists. In other words, I only kept 'major' painters that had an influential impact on the art world or at least were highly valued by the art market. This means that the difference between two painters or, put differently, two variables is much smaller, making it more challenging for the model to distinguish between random variation and a true difference. As a result, it becomes more difficult to have statistically significant estimates. This is particularly observed in significance of the p-values of high ranked or low ranked painters. The further away an artist is ranked from Tidemand, the more significant their respective p-value is, resulting, when plotted, in an almost bell-shaped curve around Tidemand's zero estimate. Finally, it should be emphasized that the estimates imply a comparison with Tidemand only and no other painter. Therefore, the position of an artist in the ranking does not necessarily reflect their overall performance on the art market as much as their performance compared to Adolph Tidemand. This makes it more complicated to interpret the estimates, especially when comparing artists from different eras, genres, or styles than Tidemand.

Nonetheless, the Scandinavian painter the most highly valued on the list is Edvard Munch. This doesn't come as a surprise as Munch's impact on the art world has been significant to say the least. He is considered to be the pioneer of Expressionism and his work has contributed to the development of the Symbolism movement and had a significant impact on the German Expressionism and French Fauvist movements. In addition, his depictions of mental anguish and emotional trauma have been instrumental in the development of the psychoanalytic theory. He also ranks first according to the most 'valuable' painter with €142 million worth of sales and an average Munch painting is estimated to sell as high as five times more than an average Tidemand's. This difference highlights the exceptional

demand and prestige associated with Munch's artwork. While the highest valued Swedish painter is Anders Leonard ZORN with €45 million in auction sales. Zorn is best known for his stunning portraits. He developed a unique technique and a bold, confident style that allowed him to capture the essence of his subjects with remarkable precision. His portraits, in particular, are characterized by a strong sense of individuality and a deep understanding of the human psyche. In late 2021, Zorn's painting 'Sunday morning' sold at Bukowskis for 35 250 000 Swedish Kroner, making it the most expensive Swedish artwork ever sold at an auction. The Danish painter the most highly valued is Vilhelm HAMMERSHOI. Like his Swedish counterpart, Hammershoi holds the record for the most expensive Danish painting. In 2019, his 1900 painting 'Interior from Strandgade 30' was sold at auction for 31.5 million Danish kroner. These record sales, which undoubtedly contributed to an increase in the average sale price of these artists, have likely had a significant impact on their ranking in the list.

The index includes other notable Scandinavian Expressionists as well, including the Norwegian painters Christian Krohg and Harald Sohlberg, the Swedish painters Isaac Grünewald, Sigrid Hjertén and Einar Jolin and the Danish Jens Ferdinand Willumsen. It also includes artists that were associated with other movements that shaped the Scandinavian art world. For instance, the Skagen Painters, Anna and Michael Ancher, Peder Severin Krøyera and Laurits Tuxen, a group of painters that lived and worked in the seaside village of Skagen at the northern tip of Denmark. Their artworks depicted the naturalistic and simplistic everyday lives of fishermen and their families. Or the Norwegian Romantic Nationalism movement with Hans Gude, Erik Werenskiold, Christian Krohg, Kitty Kielland and Adolph Tidemand, the Swedish impressionism with Anders Zorn and Carl Larsson, or the Golden Age of Danish art that dates to the early 19th century with artists like Wilhelm Eckersberg and J. Th. Lundbye, or the Cobra movement that emerged after the World War II and was characterized by a rejection of individualism and emphasis on collaboration among peers in the community, with Danish painters Asger Jorn, Carl-Henning Pedersen, Henry Heerup, and Egill Jacobsen.

It is crucial for the art index to represent as many influential artists and movements as possible. From a financial standpoint, the purpose of an index is to provide a benchmark for investors to evaluate the overall health of a market. Similarly, I believe it essential for

the art index to, at least in theory, track the overall performance of the Scandinavian art market and provide art collectors with a tool to identify trends and patterns.

5.3 Other Factors

I do not report all the coefficients for the other variables of the hedonic model. Instead, I will provide a concise summary of the main results and offer brief comments on their implications.

Before delving into the interpretation of the auction houses coefficients, I need to clarify one crucial point. I acknowledge that the multiple regression model lacks sufficient control over enough variables to establish a direct causal relationship between the independent variables and the sale prices of paintings. Naturally, this applies to the auction houses coefficients as well. An auction house typically follows a thorough evaluation process before deciding on selling a painting. This involves verifying the authenticity of the painting, its condition, its current market demand, the artistic significance of the artwork and more. Prestigious auction houses possess extensive resources and expertise, giving them a competitive edge in conducting these evaluations. This allows them to attract both wealthier customers and more unique artworks, which in return, would lead to higher biddings in the auction. This builds up the house's reputation even more and thus, it receives more consignors and sale offers of artworks in high demand and 'superior' quality, further driving up the selling prices. This circular effect between the auction house and the hammer price variables is also referred to in statistical analysis as the simultaneity bias. It is a common issue where the relationship between the independent and dependent variables is bidirectional or reciprocal. It occurs when both variables are simultaneously influencing each other, making it challenging to determine which one is causing changes in the other. This mutual influence can lead to inaccurate or misleading results when attempting to establish causality or estimate the true magnitude of the relationship between the variables. It is, therefore, essential to exercise caution regarding the reliability of the coefficients, as this interdependence can potentially cause bias and inconsistency in OLS as well. For this matter, I should interpret the auction houses coefficients as indicative of a relative difference rather than a direct causal impact.

The coefficients of the auction houses show expected results in general. Our reference

Table 5.4: Top 7 Auction Houses with Market Capitalization and their Coefficients

In the following table, I present the top 5 auction houses ranked by their market capitalization in the dataset. I have included the number of recorded sales for each auction house, along with their respective coefficient and standard error from the regression model.

Auction House	No. Obs.	Estimates	Std. Error	Market Cap (EUR)
Sotheby's	1181	0.6875	0.0797	184,475,156
Bruun Rasmussen	8436	0.0485	0.0764	161,263,118
Bukowskis	5594	0.2675	0.0743	150,111,153
Christie's	1040	0.4041	0.0801	74,648,559
Stockholms Auktionsverk	2633	0.0449	0.0754	57,834,235
Uppsala Auktionskammare	2029	-0.2473	0.0748	32,292,773
Blomqvist	1153	0.2210	0.0858	31,162,292

variable, Artcurial, is a French auction house located in Paris. It has 127 recorded sales and a turnover of €1.92 million with an average painting sale price of €15,172. I found that a painting is expected to sell, on average, for 97% (using equation 4.3) higher at a Sotheby's auction and 49% higher at a Christie's auction than at an Artcurial's. Naturally, these are the two most prominent players in the art industry. They have an international presence across major art hubs worldwide. They are distinguished by their exceptional expertise in researching and authenticating artworks, which grants them a unique advantage in handling masterpieces. Combined, their sales amount to an impressive €260 million, accounting for 32% of the total recorded sales in the dataset.

Other prominent players include Bruun Rasmussen, Bukowskis, Stockholms Auktionsverk, and Blomqvist. What sets these auction houses apart is their extensive track record of sales compared to the industry giants Sotheby's and Christie's. With 17,816 recorded sales, the average painting price at Bruun Rasmussen, Bukowskis, Stockholms Auktionsverk, and Blomqvist stands at €22 thousand, in contrast to the higher average of €156 thousand at Sotheby's and €75 thousand at Christie's. This suggests that, thanks to their well-established reputation, the latter two auction houses primarily deal with highly valued masterpieces, while the Scandinavian players might have a deeper presence in the Scandinavian art market.

My analysis revealed a statistically significant impact of the medium used by an artist on the selling price of a painting. In the majority of cases, paintings in the dataset were made using oil on canvas. Controlling for other variables, and taking acrylic as the reference

medium, the model indicates that oil paintings tend to sell for 87% more (estimate = 0.626) on average than an acrylic painting. This is reasonable as using oil tends to cost more and requires more time to create a fine artwork. Oil can sometimes take weeks to dry and is usually more durable than other materials, such as watercolour or collage. The size of a painting, on the other, although statistically significant, has a negligible effect on a painting's sale price.

5.4 CAPM Theory

As seen previously, paintings can exhibit a duality – being at once investment assets and consumer goods, and because I am interested in the former side, I have chosen a modeling approach that adopts the investment perspective. For the analysis, I will be using the capital asset pricing model (CAPM) of Sharpe (1964) and Lintner (1965), as represented by equation 5.1:

$$(R^e_{a,t} - R_{f,t}) = \beta(R^e_{m,t} - R_{f,t}) \tag{5.1}$$

This time series application using the Capital Asset Pricing Model (CAPM) was first introduced by Black, Jensen, and Scholes (1972) and later employed for estimating art prices by Bryan (1985). The equation models the relationship between the expected nominal one-year return on an asset ($R_{a,t}$) in time period t and the expected rate of return of the market portfolio ($R_{m,t}$), both adjusted for a risk-free rate ($R_{f,t}$). The coefficient estimate β represents the relative systematic risk of an asset relative to the overall market. A β greater than one suggests that our asset is more volatile and therefore has greater risk than the market portfolio, while a β less than one indicates the opposite. One can further interpret the expected return on paintings ($R_{a,t}$) as having two components: the expected return on consumption ($R_{c,t}$) representing the pleasure that an art collector derives from owning the painting, and the expected investment return ($R_{i,t}$), which represents the financial return that an owner might anticipate to earn from selling off the artwork at a later date. In mathematical terms, I present the expected return on paintings as such:

$$R^e_{a,t} = R^e_{c,t} + R^e_{i,t} \tag{5.2}$$

While it might be challenging to assign a precise number to the value that art owners derive from holding paintings, for simplicity, if we assume that the expected return on consumption is relatively constant over time, we can combine equations 5.1 and 5.2 as such:

$$R^e_{i,t} - R_{f,t} = \alpha + \beta(R^e_{m,t} - R_{f,t}) \tag{5.3}$$

Instinctively, equation 5.3 is the same as 5.2, except for α. In this case, α is equal to the intercept of the financial expected return model, or alternatively, the artwork's financial expected return beyond what would be predicted by its sensitivity to the market portfolio, minus the expected return on the painting's consumption. Because β measures how much an asset's return is generated by its correlation to the market, any persistent return component that is not explained by the market exposure will appear in the intercept α. In a traditional CAPM model, if α is equal to zero, we conclude that the CAPM is the true model to estimate our art returns and would mean that the average art returns are explained by the market exposure. However, if the model is estimating an art index, as suggested by equation 5.2, α can be interpreted as the expected return on the aesthetic return sought by the art collector. We can test for the model's ability to explain an asset's return by a simple α=0 t-test.

I will use the art price index generated from the hedonic model to produce a series of art returns. I construct a series of semi-annual returns (covering the periods July-December and January-June) calculated from the percentage changes in the period dummy variables. I generate excess returns by subtracting the FTSE World government bond index rates as the risk-free rate from the art returns. I will then regress the excess art returns on six different market indices.

In table 5.5, I outline the market indices I will be using for the models. I construct the semi-annual returns for the market portfolio, denoted as ($R_{m,t}$) by calculating the percentage change in this index from July 1st to December 31st and from January 1st to June 30th. Most of the market indices I used have less observations than the art index that starts from 1997. I chose these indices as the most relevant indices displayed in euros, the same currency as the art index. This would ensure consistency in the analysis

and the compatibility with the risk-free rate. I conducted regressions for all the models for the same period starting from the first half of 1999 to the end of 2022. This period corresponds to the inception of the indices with the fewest observations, specifically, the MSCI World and the MSCI Nordics indices in euros.

The highest geometric mean return has been achieved by the private equity index and the lowest by the real estate index. The art index displays the second lowest geometric mean in the sample of assets. However, it has also the second lowest standard deviation indicating that its returns tend to vary less dramatically. As discussed earlier, this implies that the Scandinavian art index is less susceptible to economic downturns and crises than the more traditional asset classes and offers a comparatively more stable investment opportunity.

Table 5.5: Descriptive statistics of alternative asset classes

The following table presents the descriptive statistics and the risk and return characteristics of six financial asset classes on a semi-annual basis from the years 1997 to 2022. The Scandinavian Art 100 index is based on auction records of 100 artists collected from the Artprice database. To track the global asset classes, I use the MSCI World index, the MSCI Nordic Countries Index, the MSCI Europe Real Estate Index, the Bloomberg Commodity Index, the Europe Listed Private Equity Index LPX, and the Credit Suisse Hedge Fund Index. All data are in semi-annual terms. The Sharpe ratio is the annualized arithmetic average return minus the risk-free rate, divided by the annualized standard deviation. The risk-free rate is the yield on six-month to maturity FTSE World government bonds. All the indices were included in Euros to account for currency risk.

	Art Index	**MSCI World**	**MSCI Nordics**	**Real Estate**	**Commod-ities**	**Private Equity**	**Hedge Funds**
Observations	52	49	49	54	64	59	57
Arith. Mean	0.0269	0.0342	0.0491	0.0152	0.0251	0.0575	0.0335
Geom. Mean	0.0172	0.0284	0.0356	0.0026	0.0163	0.0403	0.0318
Median	0.0143	0.0533	0.0742	0.0520	0.0368	0.0963	0.0270
Maximum	0.6998	0.2356	0.6494	0.3605	0.2884	0.4270	0.1623
Minimum	-0.2238	-0.2486	-0.4033	-0.4578	-0.4267	-0.5438	-0.1980
Std. Deviation	0.1230	0.1077	0.1681	0.1533	0.1294	0.1778	0.0582
Sharpe Ratio	0.1983	0.3252	0.3393	0.0493	0.1682	0.3910	0.5841
Skewness	3.1491	-0.6335	0.3139	-0.6066	-0.6475	-0.8687	-0.9865
Kurtosis	16.7442	0.0548	3.0844	1.0317	1.3686	1.2080	3.8473

Additionally, it is worth observing that the Scandinavian art index has the highest level of Kurtosis. This indicates that its distribution has a relatively steep and peaked shape with heavy tails, suggesting a high probability of extreme positive values compared to a normal distribution. It also displays, with the Nordic countries stock index, positive skewness

implying that there is a higher probability of observing larger positive returns compared to extreme negative returns. This confirms the fundamental premise of investing in art. Most art investors seek out exceptional outliers that have the potential to fetch high prices.

When evaluating the trade-off between risk and reward, the Credit Suisse Hedge Fund index outperform all other assets with a Sharpe ratio of 0.5841. The art index is the only asset class with a negative Sharpe ratio, suggesting that collecting art for investment purposes does not compensate for the risk borne. Overall, it appears that the Scandinavian art index is the least promising asset class to invest in.

I present the results from estimating the CAPM on the different market indices in table 5.6.

Table 5.6: CAPM estimations

The following table presents the CAPM estimations for Scandinavian art returns, employing different market indices as benchmarks. The table displays the coefficients (Coef.) and standard errors for the intercept (α) and beta (β) in each CAPM model. The chosen market indices include MSCI World, MSCI Nordics, MSCI Real Estate, Bloomberg Commodities, LPX Private Equity, and Credit Suisse Hedge Fund. Additionally, the adjusted R-squared values provide insights into the explanatory power of each model, shedding light on the relationship between Scandinavian art returns and the diverse market factors represented by these indices.

	α		β		
	Coef.	**Std. Error**	**Coef.**	**Std. Error**	**Adj. R-squared**
MSCI World	-0.0095	0.0128	0.4836	0.1024	0.3120
MSCI Nordics	-0.0111	0.0131	0.3135	0.0700	0.2887
MSCI Real Estate	0.0010	0.0123	0.3546	0.0691	0.3502
Bloomberg Commodities	-0.0060	0.0118	0.4461	0.0764	0.4131
LPX Private Equity	-0.0113	0.0119	0.3333	0.0579	0.4062
Credit Suisse Hedge Fund	-0.0087	0.0107	0.8190	0.1154	0.5121

In all the models, art exhibits lower systematic risk than the market indices, as evidenced by the estimates of β being less than one. All the estimated βs are statistically significant on the 1% level. This implies that the art portfolio (made up of the most selling one hundred Scandinavian painters) is less risky than any other of the market indices presented.

In the traditional asset pricing model, the intercept term α should be equal to zero, implying that the asset's return is fully explained by its exposure to the market. If α is not equal to zero, it suggests that there may be a constant return component not explained by

the asset's beta and the market return. As I explained earlier in equation 5.2, in the case where the CAPM model is estimating an art index, α can be interpreted as the expected return on consumption or the aesthetic return sought by the art collector. My results show very low and, in most cases, negative values of α. However, none of the intercept terms is statistically significant. This applies that, according to the models, there is no additional constant return component beyond what can be explained by the asset's beta and the market return.

6 Conclusion

In this study, I have adopted a similar approach to previous literature to construct an art price index and analyze returns on paintings, subsequently relating them to other market indices through the asset pricing model. Notably, my study contributes to existing research in the development of the first art index for the Scandinavian region. Leveraging a hedonic model and drawing upon a dataset of public sales of paintings spanning from 1999 to 2022, I constructed an art price index representing the work of the top one hundred most influential Scandinavian painters. Additionally, I took a different approach to collecting data compared to the traditional methods found in existing literature. I believe that relying on a set group of auction houses or a predefined list of 'influential' painters can introduce biases into the data. To address this concern, I opted to compile a comprehensive list of Scandinavian artists. I consulted art history books, articles from auction houses, and archives of national museums to identify artists with exhibition history, forming the basis of the initial list of painters. I then derived the top one hundred painters to be included in the art index, based on the market capitalization of each artist while setting a minimum number of public sales, and therefore increasing the influence of artists that are relatively more liquid on the market. This unique contribution enhances the understanding of the art market dynamics in the region and expands the scope of research in the intersection of art and finance.

In addition, I leveraged the estimated art returns to assess and validate the asset pricing model, employing six distinct indices as market portfolios. In the analysis, I observed outcomes consistent with prior research papers. The identification of low, yet statistically significant, positive values for betas aligns with the findings of Chanel et al. (1996), who employed an art index comprising thirty-two French painters, estimating the asset pricing model across five influential stock market indices. Hodgson and Vorkink (2004) similarly discovered analogous results in the context of Canadian paintings. Notably, akin to my own discoveries, none of these studies reported statistically significant alphas.

Nonetheless, it is essential to acknowledge the limitations of the current findings, as the intricacies of the art market demand more comprehensive exploration. For instance, a significant portion of art transactions occurs in private sales, constituting around half of

the market and remaining unobservable in most studies that primarily focus on public auction sales. However, I can think of numerous feasible potential extensions to my work for future research. Firstly, a compelling avenue is to investigate art returns relative to market returns using multi-factor pricing models. Incorporating factors such as measures of real economic activity and aggregate wealth, as suggested by Macklem (1997), could provide a more nuanced perspective on the drivers of art market dynamics. Secondly, building on our earlier discussion, an intriguing area for exploration involves delving into the potential lag in the relationship between art price indices and financial market indices. Unraveling this temporal aspect could shed light on the dynamics influencing the art market's resilience to turbulence.

In summary, my methodology has enabled me to approximate the relative market valuations of individual painters, offering a compelling perspective for art enthusiasts. The derived art price index reveals an annual increase in art prices of 1.12% over the period spanning from 1999 to 2022. Notably, this rate is comparatively lower than the figures reported in prior studies, which often relied on smaller samples of high-quality paintings. In contrast, my analysis, incorporates a vast dataset of over thirty thousand public sales highlighting the nuanced nature of returns in the Scandinavian art market. This also suggests that a substantial portion of paintings, even by renowned artists, may not yield consistently high positive results. Indeed, the majority of artworks do not command high prices; rather, it is a very limited number within the art market that achieves exceptionally high prices, thereby elevating the average returns. Moreover, the Scandinavian art index displays a negative Sharpe ratio. In general, this deems its risk-return profile to be much less attractive to investors than that of financial assets.

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Appendix

A1 List of Painters included in the Scandinavian Art Index (100)

This is the list of the one hundred painters included in the constructed Scandinavian Art Index arranged in alphabetical order. The three numbers between parentheses represent: the number of observations or sales recorded, the dummy variable coefficient in the semi-annual hedonic model, and the associated standard error.

Albin AMELIN (240, -0.3414, 0.0781), Alexander ROSLIN (67, -0.0884, 0.0941), Anders Leonard ZORN (217, -0.0821, 0.0783), Anna ANCHER (174, -0.0927, 0.0788), Asger JORN (859, -0.0473, 0.0742), Axel ENDER (187, -0.165, 0.0747), Bengt LINDSTRÖM (1603, -0.2152, 0.0761), Bengt NORDENBERG (198, -0.2985, 0.0809), Bror Leonard HJORTH (55, -0.1489, 0.0878), Bruno LILJEFORS (1185, -0.2038, 0.075), C.W. ECKERSBERG (146, -0.1129, 0.0841), Carl Frederick SØRENSEN (323, -0.2686, 0.08), Carl Fredrik HILL (70, -0.0817, 0.09), Carl Olof LARSSON (64, -0.0757, 0.0938), Carl Oscar BORG (107, -0.2433, 0.0901), Carl-Henning PEDERSEN (340, -0.1316, 0.076), Christian KROHG (536, -0.1953, 0.0725), Christian SKREDSVIG (145, -0.1478, 0.0782), Edvard MUNCH (115, 0.1154, 0.0826), Edvard WEIE (185, -0.1513, 0.0805), Egill JACOBSEN (490, -0.1135, 0.075), Einar JOLIN (787, -0.1554, 0.0772), Ejler BILLE (116, -0.1431, 0.0782), Endre NEMES (169, -0.0723, 0.0876), Erik WERENSKIOLD(58, -0.1563, 0.088), Ernst BILLGREN (136, -0.3444, 0.0806), Ernst JOSEPHSON (79, -0.2396, 0.0909), Eugène JANSSON (53, -0.1018, 0.1041), Evert LUNDQUIST (589, -0.3007, 0.0772), Frits THAULOW (429, -0.1575, 0.0719), Georg PAULI (210, -0.2938, 0.0821), Gerhard MUNTHE (99, -0.1727, 0.0811), Gösta ADRIAN-NILSSON (273, -0.0909, 0.0775), Gunnar S. GUNDERSEN (115, -0.0324, 0.0778), Gustaf FJAESTAD (251, -0.1377, 0.0788), Hans Andersen BRENDEKILDE (386, -0.2762, 0.0767), Hans DAHL (357, -0.1836, 0.0765), Hans Fredrik GUDE (208, -0.0684, 0.0756), Harald GIERSING (148, -0.1937, 0.0842), Henry HEERUP (427, -0.2409, 0.0771), Hilding LINNQVIST (205, -0.2709, 0.0811), Inge SCHIÖLER (582, -0.2204, 0.0761), Isaac Hirsche GRÜNEWALD (874, -0.174, 0.0756), Ivan AGUÉLI(246, -0.0101, 0.0806), Ivan IVARSON (340, -0.2709, 0.077), J.F. WILLUMSEN (102, -0.0303, 0.0879), Janus Andreas

LA COUR (396, -0.2574, 0.0793), Jens Andersen SONDERGAARD (394, -0.2218, 0.0785), Jens JUEL (99, -0.2133, 0.0803), Johan C.C. DAHL(139, 0.0469, 0.0814), Johan Frederick ECKERSBERG (79, -0.1851, 0.0798), Johan Fredrik KROUTHÉN (611, -0.2191, 0.0768), Johan Laurentz JENSEN (429, -0.1394, 0.0767), Johan Thomas LUNDBYE (91, 0.0571, 0.0957), Johannes LARSEN (192, -0.1571, 0.0803), John Fabian CARLSON (128, -0.2307, 0.0892), Jonas LIE (90, -0.2909, 0.0992), Julia BECK (99, -0.0694, 0.094), Kai FJELL (175, -0.1528, 0.0739), Karl ISAKSON (152, -0.2656, 0.0791), Kitty Christine KIELLAND (62, 0.0622, 0.0963), Kurt TRAMPEDACH (152, -0.1244, 0.0853), Laurits Andersen RING (338, -0.1623, 0.0785), Laurits TUXEN (357, -0.1654, 0.079), Leander ENGSTRÖM (155, -0.1661, 0.0816), Lena CRONQVIST (274, -0.2254, 0.0789), Ludwig Peter KARSTEN (91, -0.0562, 0.0813), Markus LARSSON (190, -0.2265, 0.0809), Martinus RÖRBYE (94, -0.0791, 0.0897), Michael ANCHER (747, -0.1563, 0.0758), Michael KVIUM (250, -0.0938, 0.0817), Nils KREUGER (263, -0.2178, 0.0796), Nils VON DARDEL (79, -0.2845, 0.0876), Ola BILLGREN (423, -0.2342, 0.0767), Olle HJORTZBERG (512, -0.2974, 0.0771), Oluf HØST (362, -0.153, 0.0769), Paul FISCHER (1668, -0.1725, 0.0744), Peder A. BALKE (87, 0.0627, 0.0869), Peder Mork MØNSTED (1573, -0.1771, 0.0755), Peder Severin KRÖYER (234, 0.0019, 0.0869), Pehr HILLESTRÖM (203, -0.173, 0.0803), Per KIRKEBY (270, -0.0844, 0.0781), Peter Christian Thamsen SKOVGAARD (171, -0.168, 0.0826), Peter DAHL (185, -0.2978, 0.0811), Peter Vilhelm ILSTED (179, -0.1967, 0.0806), Richard MORTENSEN (269, -0.1781, 0.0776), Sigrid HJERTÉN (310, -0.1196, 0.0772), Sören Emil CARLSEN (200, -0.2118, 0.085), Sven Birger SANDZÉN (144, -0.0038, 0.0884), Sven ERIXSON (677, -0.3014, 0.077), Sven JONSON (369, -0.2506, 0.0778), TAL R (69, -0.1266, 0.0907), Thomas FEARNLEY (88, -0.0371, 0.09), Vilhelm HAMMERSHOI(156, 0.1035, 0.0856), Vilhelm LUNDSTRØM (171, -0.1671, 0.081), Waldemar LORENTZON (304, -0.2472, 0.0783), Wilhelm FREDDIE (235, -0.2197, 0.0798), Wilhelm VON GEGERFELT(451, -0.4, 0.0785), Åke GÖRANSSON (98, -0.0937, 0.0882)