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Value of art: Analysis of the factors influencing the prices of paintings

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Abstract

The scope of this research paper is to analyze the art market on the case of paintings sold in the period 2006-2016 at Christie's auction house. In particular, this study evaluates which factors affect the prices of paintings by looking at their hedonic characteristics, the places of sale and economic recession. Two regressions were implemented in order to identify which of the features do have an impact. One of the main findings is that the size, signature, monogram and oil positively affect the prices, whereas inscription and frame have a negative influence. In addition, the place where the painting is sold influence the price as well, auctioning a painting at the headquarters being more profitable than doing so in other offices. Lastly, it was found that the financial crisis of 2008 had a strong impact, the biggest drop in prices being observed in the second quarter of 2009.

Introduction

“It is better to idealize commercial things than to commercialize aesthetic things.”

Grand-Carteret, *Vieux papiers* (1896)

Is art a timeless expression of creativity or another way to make money? Nowadays, it is getting more and more difficult to separate the art industry from the economic system, as paintings being sold for millions are not a rarity anymore. Even though the aesthetic value of artworks is priceless for the connoisseurs, pieces of Modigliani, Klimt and Cezanne break records of sales in auction houses. Thus, the question “Should art have a value?” is lately being replaced by “How much value does art have?”. To answer this question, the prices of different artworks should be evaluated to observe an index applicable for all. However, this is not an easy task, because all the paintings are distinctive and cannot be aggregated into large homogeneous groups (Collins, Scorcu, & Zanola, 2009). Therefore, as paintings are heterogeneous commodities, the price of each depends to a certain extent on its own characteristics (Chanel & Ginsburgh, 1992). This type of price assessment is called the estimation of indices based on “hedonic characteristics”, which was initiated by Court (1939). This model determines internal and external features that affect the price of the good (Goodman, 1997).

However, following from the idea that there is not an established correct set of attributes, the examination of prices can be limited to assets which were sold more than once. The estimation of the index is then done by regressing the change in the prices on a set of dummy variables (one dummy for each date of sale) (Chanel & Ginsburgh, 1992). This technique is called “repeat-sales regression” and it avoids the heterogeneity issue, as the main focus is on the difference in prices of the same commodity. In addition, it is less sensible to specification errors than standard hedonic models (Jiang, Phillips, & Yu, 2014). On the other hand, one major drawback of this method is that it takes into account only a small part of all sales, as the percentage of commodities being sold multiple times is not a big one. Thus, repeat sales may not be representative of the whole market and analyzing them would create a significant sample selection bias (Clapp, Giaccotto, & Tirtiroglu, 1991).

For markets with infrequent trades, ordinary hedonic regressions, where all the commodities are included, are a better estimation technique, as the repeat-sales method is not appropriate because of the above-mentioned reasons. The hedonic model’s advantage is that it avoids the fact that the features of the assets might change over time, as it looks at one time

sale (Chanel & Ginsburgh, 1992). In addition, this method attempts to capture the intrinsic value of the goods by analyzing not only physical features, but also by looking at apparently empirically unmeasurable but important characteristics of the commodity. Examples of such can be the fame of the author for artworks, the amiability of the neighbors for houses and the comfort of a car, as these specific traits can be differently evaluated by different people. If significant, these can be integrated in hedonic regressions, by observing and assigning values to them. This however is not easy to do, this type of variables being a challenge for researchers, as an incorrect or irrelevant measure can lead to biased results. Nevertheless, the hedonic approach represents an insightful method to investigate the pricing of heterogeneous commodities, such as cars, real estate and pieces of art.

In this paper, the market for paintings is analyzed. There are two main players in this market, the global sales of art being divided between auction houses and dealers. Their shares are 45% and 55% respectively (McAndrew, 2010). As there is not much data available of dealers' sales, only auctioned artworks are evaluated. All the paintings sold at Christie's auction house in a ten years time span are selected to be investigated. The first research question of this thesis is thus:

Which hedonic characteristics influence the prices of paintings?

Furthermore, after establishing that art indeed has monetary value, other questions appears: "Does its value decline over time?", "Is it a good investment?". These are based on the fact that art is considered an investment, as possessing art, which has financial worth, might be a source of gains. One example of such earnings is the sale van Gogh's "Irises". First, it was acquired in 1947 for \$84000, which equals less than \$0.5 million in today's money. Forty years later, the same person sold the painting at Sotheby's New York for \$53.9 million, which gives a real rate of return of approximately 12% per year (Frey & Pommerehne, 1989). Thus, it is confirmed that there is financial profitability in the art market, therefore artworks can act as investments. This leads to the fact that there is a relationship between the art and financial markets, as investors acquire pieces of art for their portfolios and wait for returns.

One attempt to answer the above-mentioned questions is to, first, evaluate this relationship and analyze whether the monetary valuation of art follows the financial cycle or not. Moreover, we approach this by evaluating how art prices behave during economic recessions, if they are stable or sensible to financial fluctuations. The same data sample is used

and the effect of the 2008 economic crisis is of interest. This leads to the second research question:

Did the economic crisis of 2008 have an impact on the prices of paintings sold at auction houses?

Even though there is plenty of literature that investigates the performance of art as investment, there is no research that would investigate the effect of the recent economic crisis on the art market. Therefore, this thesis is scientifically relevant, as it covers a previously unexplored topic which might shed light on the interconnection between such distinct industries. In addition, it contributes to existing literature about hedonic models by implementing it to a new database. Also, this thesis gives insight regarding Christie's auction house by evaluating how the place of sale impacts the prices of paintings.

In order to answer the above formulated research questions, a data set has been constructed. It consists of information about paintings, such as their price, size, the material used and whether they are inscribed, signed, monogrammed or framed. In addition, it includes the place of sale of each painting and in which year it was auctioned and sold. This information was gathered from the official website of Christie's auction house and the relevant period is 2006-2016. The analysis is performed by applying two regressions on the data set. First, an ordinary least squares (OLS) regression model is constructed with the logarithm of price as the dependent variable and the logarithm of size, the dummy variables inscription, monogram, signature, frame and oil, the dummy variables of places of sale, four quarters and ten years as independent variables. The outcomes show that all the explanatory variables affect the pricing. Namely, if the logarithm of size increases with 1% or if a dummy variable equals 1 then the logarithm of the price will increase or decrease, depending on the sign of the coefficient, by the respective β . The second regression is elaborated based on the first one, but is more complex regarding the time variables. Mainly, the hedonic characteristics and the places of sale are kept the same, but the time variables are now dummy variables of each quarter of each year., 44 in total. This is done to more precisely evaluate the effect of the crisis, as there is seasonality in the data. All the coefficients are significant and thus affect the pricing. Altogether, it has been found that the selected hedonic characteristics influence the pricing, some positively and some negatively and that selling a painting in the headquarters of Christie's, London King Street, will lead to higher profits for the seller than if the artwork

would be sold in other offices, except Hong Kong and Madrid. Also, the results show that the economic recession significantly and negatively influenced the pricing of paintings, the biggest drop being observed in the second quarter of 2009.

The rest of the paper will have the following structure. The second section will summarize the related literature in order to provide theoretical and empirical background on the topic. The third section presents the theoretical framework of this study's research. The fourth and fifth sections incorporate the description of the data and the methodology used, respectively. The sixth section will present the results of the analysis and, lastly, section seven will discuss these results and will underline some limitations of this analysis and recommendations for future ones.

Related literature

The interdependence between the art market and the financial one has been thoroughly examined in previous research. The way artistic work has been created and traded in both well off and discouraging economic periods demonstrates a connection between the two "antithetical" markets. Price determination for artworks, however, still represents a major topic for debates. Generally, there are two fundamental theories regarding this aspect. On one hand, Baumol (1986) suggests that art prices float randomly, investors in visual arts aggravating the unpredictable oscillations of the prices. Therefore, he concludes that there is no stable level for art prices. Frey and Pommerehne (1989), on the other hand, claim that prices are established by market forces that regulate supply and demand and that paintings do not have a "natural price".

Nevertheless, it is certain that one of the determinants of the artworks' values is the price index. In the paper "Credibility and economic value in the visual arts" Bonus and Ronte (1997) claim that, for an artwork to generate economic value, the expert which estimates its value should be credible to the public, as there is no objective method to estimate the quality of visual arts. However, to create an unbiased and improved estimate of the worth of art, several indices were developed by different researchers. Having studied the purchase prices of paintings which were put on sale at least twice over a period of 270 years, Goetzmann (1993) established an art return index. Moreover, with its help, a strong correlation is traced between the fluctuation of painting prices and the stock-market variation. The author interprets this relationship as an indication that an increase in the demand for art is due to growth in the wealth of art collectors. Another price index was developed by Candela and Scorcu (1997) for art

market auctions. It is based on the “representative painting” of the Italian market, which is determined as the same average painting of each auction session from the period 1983-1994. The researchers therefore compare this index with returns on other assets and find that art prices went in line with inflation, but still the returns on visual art were lower than those on financial assets. In addition, they state there is no connection between art prices and financial assets prices in the long term. In the paper “Price indices for artists – A proposal” (Candela, Figini, & Scorcu, 2003), the authors develop indices that show the evolution over time of an artist’s worth. They focus on the available and relevant information about the painters and on analyzing it with respect to the prices estimated, thus ignoring the artistic characteristics of the paintings themselves.

Another approach on the determination of prices for artworks is the hedonic pricing. Chanel and Ginsburgh (1992) in the article “The relevance of hedonic price indices: the case of paintings” explain that the price of some heterogeneous goods, such as houses and paintings, depends to a certain extent on the characteristics of the commodity itself. Moreover, after performing statistical analysis, they claim that for the price indices of paintings to be more accurate, regressions should be performed using extended data sets of sales, rather than using just resales. This method, in their opinion, will lead to a better forecasting of the returns and to a better studying of the art market efficiency. Collins, Scorcu and Zanola (2009) created their own price index that tries to solve the sample selection bias that hedonic regression might encounter, as it corrects the database by accounting for the unsold art objects. The authors used artist’s name, nationality, title of the work, year of production, materials used on the painting, the date and city of sale, prices, the artwork’s dimensions and whether or not the painting was signed as the characteristics of the works they evaluated. Another model for auction prices was developed by Marinelli and Palomba (2008) based on Italian contemporary paintings. They contribute to previous research by revealing that characteristics such as the year of sale and the prestige of the auction house are more significant than what is represented on the painting itself. In addition, the authors conclude that information about the artist, his name and whether he is alive or not, is relevant as well for the price determination. Ursprung and Wiermann (2008) provide an extra insight in the influence of the painter’s living status on the price formation of his artworks. Their findings show two opposite effects of death. On one hand, if we narrow down our interest on the artist’s masterpieces, keeping everything else equal, the prices increase as the author dies. On the other hand, a early or unexpected death might discourage collectors as their desire to own paintings that will gain more value as the artist’s career progresses was ruined. Therefore, in such cases, the impact of death on prices is a negative

one. Thus, the authors conclude that reputation plays a key role in determining the sale values of artworks.

An alternative research on price formation, but not less insightful, is the article “Bringing art to market: The diversity of pricing styles in a local art market” by O’Neil (2008). It comprises interviews with more than fifty visual artists which express their views on what factors determine pricing. Among these, the most common were size, expenses, status, market factors and the artist’s own evaluation. Furthermore, after performing two types of analysis, the author finds that the economic pricing, based on market factors, and pricing formed on the artist’s own perception of worth are not likely be combined.

The related literature mentioned above summarizes the most common ways of determining prices for art. Even though all of them are relevant and applicable, the focus of this paper is the hedonic pricing, as it takes into account the artistic and aesthetic value of paintings, which, in fact, makes these types of investment so unique and interesting to evaluate.

Theoretical framework

Art auctions - Christie’s

Auction houses have been playing an important role in the art market since the 17th century, when the first one was established in Sweden. However, historically, England has been the host of the biggest art auction houses, Sotheby’s and Christie’s, which operate in the “English” or “ascending price” format. This type of auctions is the most common in art-sales and is considered to be completely transparent, as the bidders are usually present at the auction and their identity is known. An “English” auction starts with a low bid and then continues with higher prices until no one proposes more. The last bid is “knocked down” and is called the “hammer price” (Ashenfelter & Graddy, 2006). The price realized that was used as the value of the paintings for this paper is thus the “hammer price” plus a buyer’s premium that Christie’s charge the buyer.

Hedonic pricing

Hedonic pricing represents one of the most insightful methods to determine the value of paintings, as artworks are illiquid assets that possess intrinsic and aesthetic value. It is based on a model which establishes the effects of different features of the object on its price (Ashenfelter & Graddy, 2006). As mentioned in the section above, several researchers applied it to their own indexes, the most commonly chosen characteristics being: the size of the

artwork, the date and city of sale, whether the painting is signed or not and information about the artist (living status, reputation). Thus, certain hedonic characteristics were included in the performed analysis on Christie's database, namely the size of the painting, whether the work is signed or not, if it has an inscription or monogram on it, the material used by the author (e.g. oil, watercolor, pencil) and whether it is sold in a frame or not. These were specifically chosen, because the physical aspect of the painting is of great importance when selling, the signature or monogram of the author supposedly confining authenticity to the work. Also, from a logical perspective, a bigger painting or a framed one would have a higher price than if otherwise. The hedonic model was chosen for this analysis in order to check to which extent, if applicable, these characteristics explain the final price of the artwork and to assess whether auction houses take them into account when establishing values to the lot. The hedonic model has its limitations, the major one being misspecification of the variables. This means that irrelevant variables might be included in the regression or that relevant ones might be omitted (Chin & Chau, 2003). This can lead to biased and inconsistent results.

Economics and art

Even though art is considered a form of investment, it is still not clearly established what is the impact of the financial market on art. There are mainly two visions on this topic. One is based on the findings of several researcher (Mei & Moses, 2002; Ginsburgh & Jeanfils, 1995) which claim that artworks performance is very weakly correlated to stocks and that, in the long run, there is no relation between the two markets. The second vision is asserted by economists that found some positive correlation in the short-run. They argue that the financial market to a certain extent dictate the art market (Chanel, 1995). This paper focuses on the second approach, as only in this case the financial crisis would have had any impact on Christie's art auctions. The demand for paintings grows when the income of the potential buyers increases. As art is seen as a form of investment, many of the potential buyers are investors which want to acquire artworks for their portfolios. Therefore, a booming stock market leads to a growth in investors' wealth, that, in turn, leads to an increase in the demand for art (Goetzmann, 1993). Thus, a strong correlation between the financial and art markets might appear.

The financial crisis of 2008

The 2008 collapse of the financial system is considered to be one of the worst recessions of the last centuries, after the Great Depression in 1930's (Reinhart & Rogoff, 2008). The overheated

real estate sector collapsed, house owners not being able to repay their loans. Banks had started to face liquidity issues and, in the first half of 2008, many of them announced bankruptcy. By the end of the same year, the crisis became felt on the stock market as well. As a consequence, investors started to experience losses, this leading to a decreasing demand in investment assets.

The crisis lasted roughly two years, 2007-2009, and in this period, the economy-dependent markets suffered big contractions, affecting the performance and strategies of the market players. The art industry was influenced as well: the sales of auction houses fell by 32% in 2009 and the contemporary sector experienced the largest decline (60%) in terms of aggregate sales values by the end of 2009 (McAndrew, 2010).

Data

The data is obtained from the official website of the Christie's auction house. It contains information about 141554 paintings that were sold at auctions during the years 2006-2016. This period was chosen because, besides containing the recession years, it also illustrates the pre- and post-crisis sales and thus a more insightful analysis can be performed regarding the economic effects.

The paintings

The following information about the paintings is included:

- *The price realized*: The sale values of the paintings in different currencies were gathered and then converted in the Euro currency, using the corresponding exchange rate of the month in which the artwork was acquired.
- *The size of the painting*: The diagonal of each artwork was calculated using the corresponding length and width that were collected from the website.
- *Inscription*: A dummy variable was created that takes value 1 if there is an inscription on the painting and 0 if not.
- *Signature*: A dummy variable was generated which takes value 1 if the artwork was signed by the author and 0 if otherwise.
- *Monogram*: A dummy variable was created that takes value 1 if there is a monogram, a distinctive symbol created from initials, on the painting and value 0 if not.
- *Frame*: A dummy variable was generated which takes value 1 if the painting was sold in a frame and 0 otherwise.

- *Oil*: The materials used for creating the painting are of interest as well. Thus, a dummy variable was created that takes value 1 if the material used by the painter was oil and 0 - if any other materials such as pencil or watercolor. Specifically oil was selected as a reference because this technique is widely used for paintings, most of the classical masterpieces were executed in oil.

Christie's

The following information about the Christie's auction house is covered:

- *Offices*: In the specified period, fine art was sold in twelve offices: Amsterdam, Dubai, Hong Kong, London South Kensington, Los Angeles, Madrid, Milan, New York, Paris, Rome, Tel Aviv, London King Street. A dummy was generated to test whether the place of sale influences the price of the lot. Eleven offices are compared to the headquarters, London King Street, in order to check if there is a bias in prices regarding the location.

Time

The time framework used for this paper is:

- *Years*: A dummy variable with all the years from 2006 until 2017 was generated. This was done in order to evaluate the differences in prices in distinct years.
- *Quarters*: Each year was also split in quarters to perform a more thorough analysis of the time frame.

Histograms of prices and sizes of paintings were created in order to analyze the data (Figure 1, Figure 3). They showed right-skewness in both cases, which means that the mean is larger than the median. Thus, to normalize the data, the prices and sizes were transformed into logarithms: $\log(\text{Price in EUR})$ and $\log(\text{Size})$ (Figure 2, Figure 4). Below, in Table 1, a statistical description of the created data set is presented.

Figure 1: Histogram of PriceinEUR

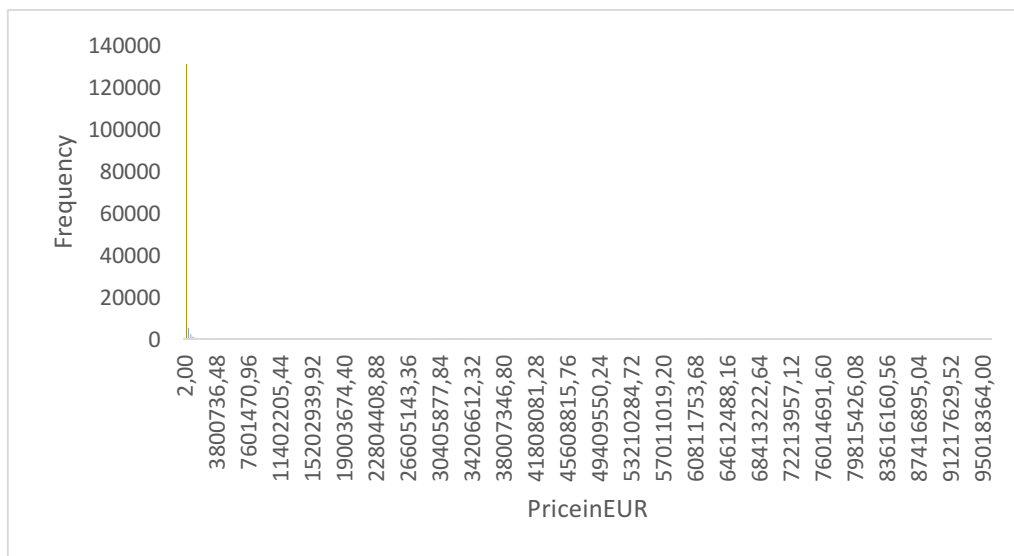


Figure 2: Histogram of logPriceinEUR

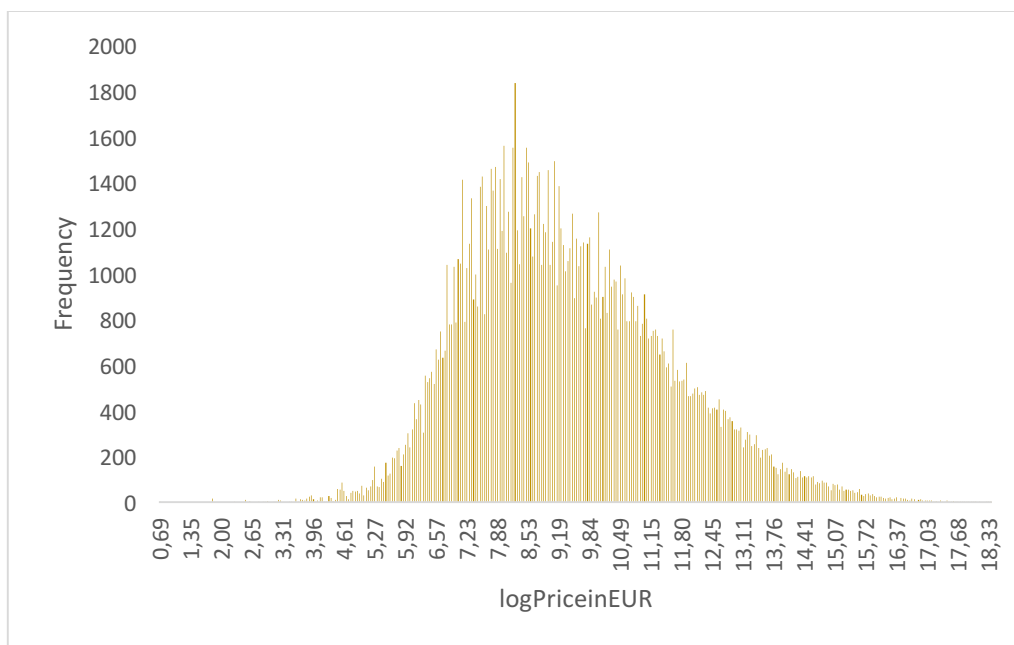


Figure 3: Histogram of Size

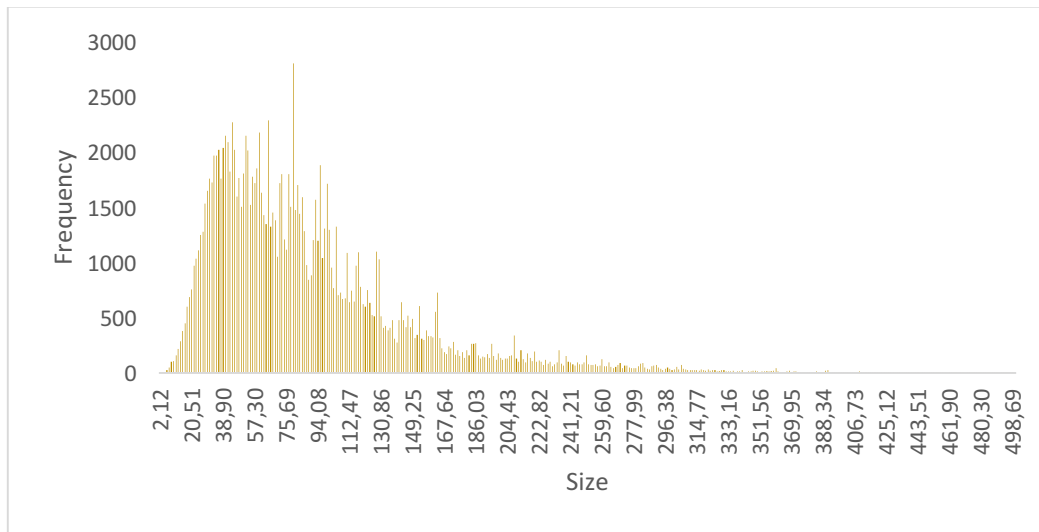


Figure 5: Histogram of logSize

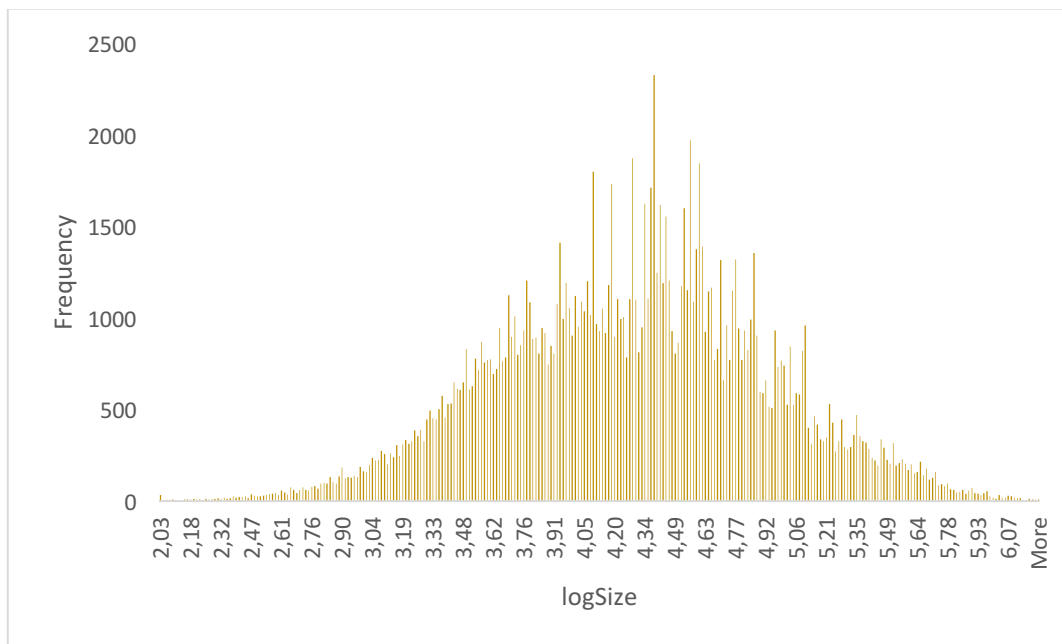


Table 1: Descriptive statistics of the regressed variables

Variable	Observations	Mean	Std. Dev.	Min	Max
logPriceinEUR	141554	9,3328	2,1322	0,6931	19,3802
logSize	141554	4,2723	0,6526	0,7514	7,6229
Signature	141554	0,7129	0,4524	0	1
Inscription	141554	0,1945	0,3958	0	1
Monogram	141554	0,0191	0,1367	0	1
Frame	141554	0,0825	0,2751	0	1
Oil	141554	0,5666	0,4955	0	1
Year2006	141554	0,091	0,2876	0	1
Year2007	141554	0,092	0,289	0	1
Year2008	141554	0,1009	0,3012	0	1
Year2009	141554	0,0856	0,2798	0	1
Year2010	141554	0,0914	0,2881	0	1
Year2011	141554	0,0995	0,2993	0	1
Year2012	141554	0,1086	0,3116	0	1
Year2013	141554	0,0916	0,2885	0	1
Year2014	141554	0,0876	0,2828	0	1
Year2015	141554	0,0872	0,2821	0	1
Year2016	141554	0,0646	0,2459	0	1
Q1	141554	0,2003	0,4002	0	1
Q2	141554	0,3083	0,4618	0	1
Q3	141554	0,1709	0,3765	0	1
Q4	141554	0,3204	0,4666	0	1
London King Street	141554	0,1337	0,3403	0	1
Amsterdam	141554	0,1156	0,3197	0	1
Dubai	141554	0,0003	0,0168	0	1
Hong Kong	141554	0,0572	0,2322	0	1
London South Kensington	141554	0,2693	0,4436	0	1
Los Angeles	141554	0,0024	0,0485	0	1
Madrid	141554	0,0014	0,0377	0	1
Milan	141554	0,0027	0,052	0	1
New York	141554	0,3329	0,4712	0	1
Paris	141554	0,0823	0,2748	0	1
Rome	141554	0,0012	0,0351	0	1
Tel Aviv	141554	0,001	0,0315	0	1

Methodology

The scope of this paper is to analyze the factors that influence the pricing of paintings and to evaluate the impact of the financial crisis on auction sales. A quantitative empirical research will be conducted in order to assess the abovementioned criteria.

Firstly, a linear regression model is applied on the dataset. In this regression, the hedonic characteristics, the place of sale and the time effect are included in order to capture the fluctuations of the dependent variable which are dictated by the explanatory ones. Moreover, the effect of the logarithm of size, of signature, inscription, monogram, frame, oil and of all the offices except the headquarters on the logarithm of paintings' prices will be observed. The headquarters, London King Street, is not included for identification, therefore the sales in the abovementioned offices will be analyzed in comparison to the headquarters' one. In addition, the time effect is added to the regression, namely ten years and four quarters. The year 2016 and the fourth quarter are chosen as the base categories. This means that the time effect of years will be analyzed in comparison to 2016 and the time effect of quarters will be compared to the sales in the fourth one. The proxies were chosen aleatory. The regression model is the following one:

$$\log(\text{Price in EUR}) = \beta_0 + \beta_1 * \log(\text{Size}) + \beta_2 * \text{Signature} + \beta_3 * \text{Inscription} + \beta_4 * \text{Monogram} + \beta_5 * \text{Frame} + \beta_6 * \text{Oil} + \mathbf{x}'\boldsymbol{\gamma} + \mathbf{y}'\boldsymbol{\delta} + \mathbf{z}'\boldsymbol{\theta},$$

where β_0 represents a constant, $\beta_1 - \beta_6$ are coefficients of the respective variables, $\boldsymbol{\gamma}$ is a 11x1 vector of coefficients, \mathbf{x}' is 1x11 vector of the offices' dummies, $\boldsymbol{\delta}$ - a 10x1 vector of coefficients, \mathbf{y}' - a 1x10 vector of dummy years (2006, 2007, 2008, 2009, 2010, 2011, 2012, 2013, 2014, 2015), $\boldsymbol{\theta}$ is a 3x1 vector of coefficients and \mathbf{z}' is a 1x3 vector of dummy quarters (Q1, Q2, Q3).

This model examines the effect of years and quarters on the price separately. It also accounts for seasonality, which consists of regular and predictable changes that occur every year. If there is a pattern in quarter sales, then this model will reveal it. However, we can take a step further and adjust the model even more by splitting each year in quarters. This might provide a more insightful analysis of the time effect. Therefore, another regression is created in attempt to adjust for seasonality. The dependent variable and the hedonic and location independent variables stay the same, but the time frame is changed. For this model, the quarters of each year are added in order to generate a more detailed analysis. The chosen proxy is the

second quarter of the 2009 year, as, supposedly, this is the period where the recession influenced the most the auction sales. Thus, the second regression is the following one:

$$\log(\text{Price in EUR}) = \alpha_0 + \alpha_1 * \log(\text{Size}) + \alpha_2 * \text{Signature} + \alpha_3 * \text{Inscription} + \alpha_4 * \text{Monogram} + \alpha_5 * \text{Frame} + \alpha_6 * \text{Oil} + \mathbf{x}'\tau + \mathbf{q}'\varphi,$$

where α_0 is the constant, $\alpha_1 - \alpha_6$ are coefficients of the respective variables, τ is a 11x1 vector of coefficients of \mathbf{x}' , which is a 1x11 vector of the offices' dummies, φ is a 43x1 vector of coefficients of \mathbf{q}' , a 1x43 vector of dummy quarters of each year (Q1_2006, Q2_2006, Q3_2006, Q4_2006, Q1_2007, Q2_2007 and so on).

Results

Firstly, for the models to give unbiased results, three assumptions of linear regressions have to hold. Based on the above illustrated histograms, the assumption of no extreme outliers holds. Furthermore, the observations were extracted from a large population of art sold on auctions, hence this ensures that the variables are independently and identically distributed. The third assumption states that the independent variables should be uncorrelated with other variables that affect the dependent one. There might be omitted variable bias (OVB) in the model, but all the available measurable characteristics of paintings were included in both regressions. Therefore, it is considered that all three assumptions hold for the created models.

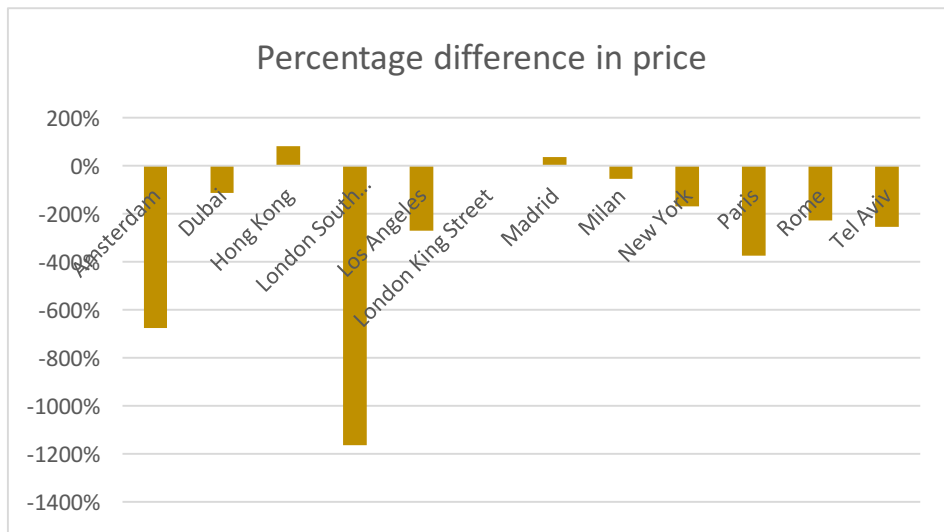
When analyzing the outcomes of the first regression, it can be seen that all the estimated coefficients are significant, the p-values of the 30 variables being lower than 0.05 (Appendix 1). In addition, the coefficients are jointly significant with a $\text{prob}(F) = 0.000$. This implies that the regression equation does fit the data and that the variables indeed explain the dependent variable. The value of the R-squared shows to what extent the variation in the logarithm of price is explained by the regressed variables. For this model, the independent variables explain 39,5% of the variation in the dependent variable. However, this number may be an inaccurate one, as the R-squared statistic increases with the number of variables implied in the regression. Thus, to avoid this bias, the adjusted R-squared is generated, its value taking into account only the explanatory terms that enhance the model. The adjusted statistic is also 40%, this meaning that all the variables explain the logarithm of price and the R-squared is not inflated by the large number of terms (Appendix 2). Furthermore, the constant term indicates what would be the logarithm of price of paintings for which all the independent variables would be zero. Namely, paintings with the diagonal equal to one centimeter, without signature, inscription,

monogram, unframed, painted not in oil, sold in the London King Street office in the fourth quarter in 2016 would have the logarithm of price equal to 9.341. Thus, the price of such a painting would equal 11395.8 euro.

Next, the estimated coefficients of the hedonic characteristics included in the first regression are evaluated. When analyzing the coefficient of the logSize, it can be concluded that, on average, a 1% increase in the diagonal of a painting leads to an increase in price of 0.35% if all the other characteristics stay the same. Assuming that an artwork can either be signed or not, it can be inferred that the presence of a signature increases, on average, the price by 33.5%. In addition, if there are two paintings with the same characteristics, the only difference being the illustration of a monogram on one of them, then the artwork that is not monogrammed will be priced by 18% lower than the other one. The presence of an inscription, however, would decrease the price by approximately 5%. Assuming that two paintings have the same characteristics, one being painted in oil, while the other with some other material, the first one would, on average, cost twice as much as the other one. Another finding is the effect of a frame on the price of an artwork. The presence of a frame decreases the price of the painting by 25.2%.

Furthermore, we will present how the logarithms of price differ depending on the office where the paintings are sold. On average, similar paintings would be sold for a lower price if they were auctioned in Amsterdam, Dubai, London South Kensington, Los Angeles, Milan, New York, Paris, Rome or Tel Aviv rather than in London King Street. In contrast, a significantly bigger price would be charged in Madrid and Hong Kong than in the headquarters (Figure 5). Specifically, the highest prices would be in Hong Kong, paintings costing, on average, by 83% more than in London King Street.

Figure 5: The variation in the price charged in different offices when the headquarters London King Street is taken as reference (it is equal to 0 in the graph)



Moving to the time variables, a clear pattern can be seen in both the quarters and years frameworks. 2016 seems to be the most successful year from all, paintings sold in this period having the highest prices, assuming that artworks that were sold in the 2006-2016 interval were identical. The lowest prices were charged in 2006, they, on average, being by 50% lower than what would have been charged in 2016. A significantly big decrease in comparison to 2016 can be seen in 2008 and 2009 (Figure 6). When analyzing quarters, it can be seen that there are signs of seasonality, as prices tend to show a pattern (Figure 7). Comparing to the fourth quarter, the highest price for the same painting would be charged in the second quarter: the price would be more than 50% higher.

Figure 6: The pattern of changes in the logarithm of price by years

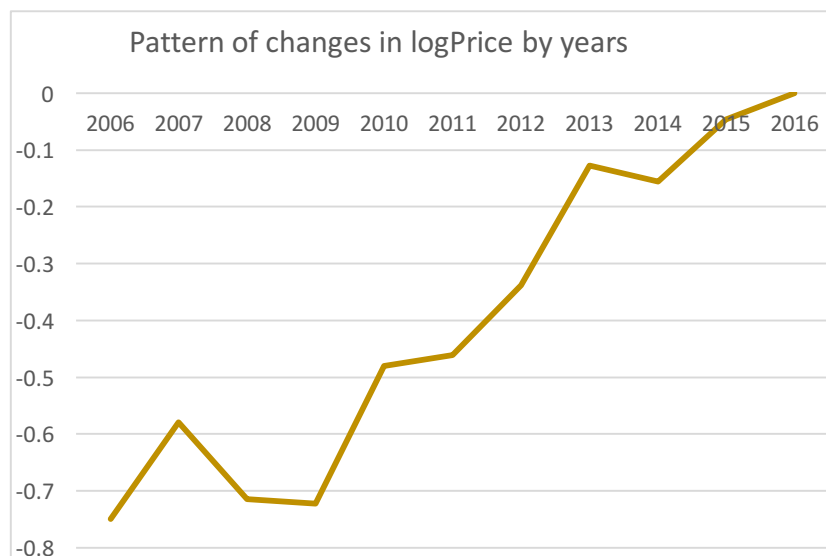
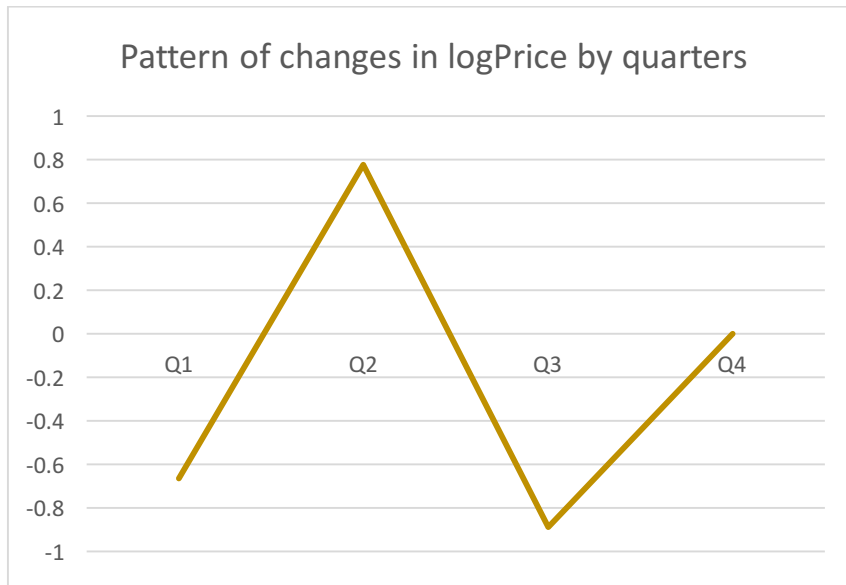


Figure 7: The pattern of changes in the logarithm of price by quarters



The second regression also generates both individually and jointly significant coefficients, having an adjusted R-squared equal to 0.399. Thus, this model explains the variation in the logarithm of price slightly better than the previous one. The constant term is equal to 8.499, this meaning that a painting with a one cm diagonal, not signed, without inscriptions and monogram, unframed and executed in oil sold in the second quarter of 2009 in London King Street would cost 4909.85 euro. The estimated coefficients of the hedonic and office variables are approximately the same in both regressions, as it can be seen in Table 2.

Table 2: The estimated coefficients of the hedonic and office variables of the second regression

Variable	Observations
logSize	0.349
Signature	0.285
Inscription	-0.0514
Monogram	0.160
Frame	-0.281
Oil	0.453
Amsterdam	-2.021
Dubai	-0.760
Hong Kong	1.715
London South Kensington	-2.566
Los Angeles	-1.353
Madrid	0.374
Milan	-0.448
New York	-0.989
Paris	-1.582
Rome	-1.141
Tel Aviv	-1.355

The estimated coefficients of the quarters of each year were regressed in comparison to the second quarter of 2009. A clear pattern can be observed, as the betas fluctuate systematically. As it can be noticed from Figure 8, until 2013 the prices in Q1 and Q3 are significantly lower than in Q2 of 2009. In addition, the logarithms of price in Q2 and Q4 of all years are higher than those in Q2_2009. An additional insight would be to look at the pattern of prices only in quarters two and four, because, as seen before, these two periods seem to exhibit the highest prices of all. From Figure 9 it can be seen that the estimated coefficients of the variables that define the second and fourth quarter of each year are significantly higher than the one representing quarter 2 of 2009. Thus, if a painting is sold in any of these quarters its price would be significantly higher than if the same painting would be sold in the second quarter of 2009.

Figure 8: Pattern of changes in the logarithm of price by quarters of each year

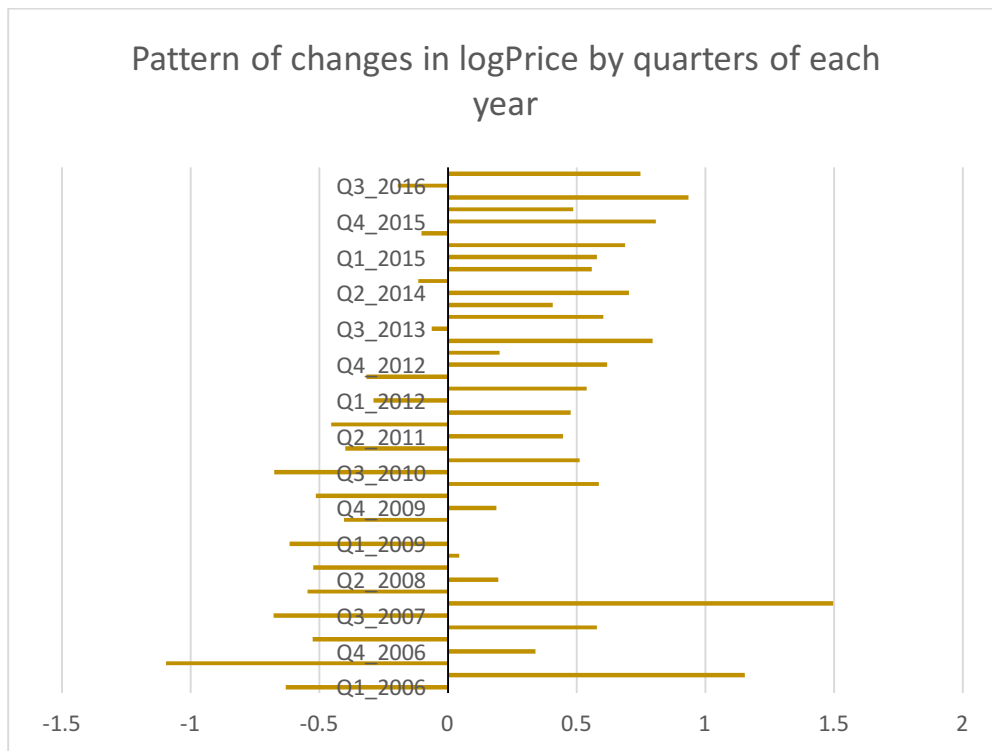
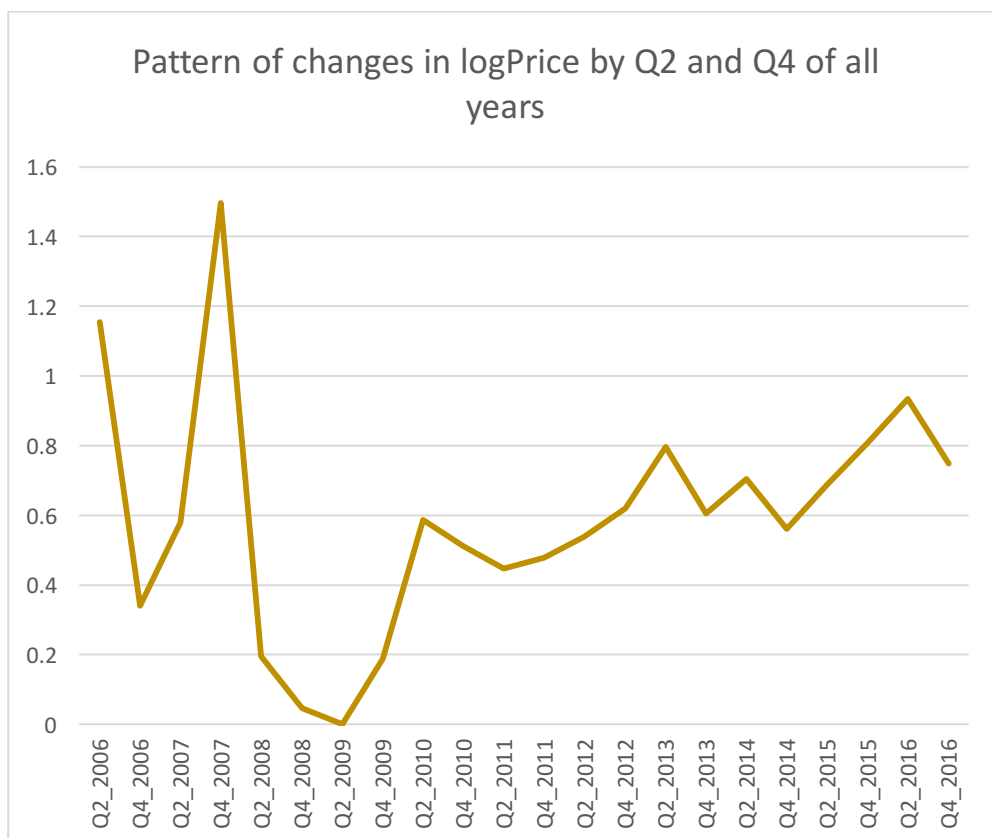


Figure 9: Pattern of changes in the logarithm of price by Q2 and Q4 of all years



Conclusion, Limitations and Recommendations

The aim of this thesis has been to analyze whether specific hedonic characteristics influence the pricing of paintings and to investigate the effect of economic recession on art prices. To observe any relationship, two regression models were applied on an extended data set.

The analysis shows that the size, the presence of signature and monogram and the material used significantly increase the price of a painting, while an inscription and framing the artwork would decrease its price. This finding is partly in line with the results found in existing literature. Namely, it supports the conclusion that several hedonic characteristics explain the money value of art. However, it also adds that some characteristics, such as frame and inscription, might even decrease the prices, thus showing that not all the features of a painting contribute to a higher pricing. One insight behind these results is that the bigger the painting the more difficult and time consuming it was to be created. Therefore, it costs more. In addition, the presence of a signature or monogram on an artwork might signal its authenticity and hence this signaling leads to a higher price. Another interesting insight is that oil paintings seem to be valued greater than similar artworks painted with another material. The reason behind this may be that oil has been widely used by the greatest painters of all times for their masterpieces as oil offers a large spectrum of color possibilities and it also can be reworked (Sporre, 1997).

Furthermore, it was also found that the locations of sale influence the pricing of paintings. As mentioned above, Hong Kong is the office of Christie's where the prices, on average, are the highest. In addition, it also can be concluded that in the headquarters more expensive paintings are sold than in the majority of salesrooms. The reason behind it may be the reputation of this location, as it has a long history and is known as the home of Christie's auction house.

Finally, based on the results of the time effect it can be concluded that the financial crisis had a significant impact on the prices of artworks sold in auction houses. The fact that in the second quarter of 2009 the prices were lower than in any other second quarter suggests that the recession became felt the most in the late spring of 2009 in the art industry. Moreover, this finding illustrates that there is a correlation between the economic sector and the art market. It can be inferred that paintings are seen as investments by the investors and that the demand for artworks was affected by the stock crisis that occurred in 2008. This led to lower prices as the estimates of works of art were kept low to stimulate purchase demand. Thus, from the obtained

results, it can be stated that the recession was visible in the art industry and had significant consequences for auction houses.

As it has already been mentioned, this research was conducted based on a dataset of paintings sold at Christie's. For a more insightful analysis, the data can be expanded by adding artworks from other auction houses like Sotheby's and Phillips. This will ensure the external validity of this type of research. In addition, the time period used was ten years. A recommendation would be to add sales from more years, thus creating a larger framework for investigating patterns and fluctuations. To better explore the influence of hedonic characteristics on pricing, an improvement would be to add more variables that might explain the intrinsic value of the painting. For example, finding a measurable way of how to identify the prestige of the author would represent a great addition to the model formulated above. Namely, the new variable would show that the value of the painting does not only depend on its characteristics but also on the reputation of who created it. Another interesting recommendation for research is to capture the relationship between the art industry and the stock market. This type of analysis would shed some light on the correlation between the two and would explain more in depth how investors acquire stocks and artworks as investments and what is the performance of paintings in an investor's portfolio.

As a conclusion, it is worth mentioning that researching the art market will always remain a challenge, because there are many unmeasurable factors that constitute the value of art. Thus, it is an industry where money cannot fully capture the real aesthetic worth, the art being a victim of the rational economic world we live in.

Appendix

1: Outcomes of the first regression

	(1)
	logPriceinEUR
logSize	0.352***
	(48.23)
Signature	0.289***
	(28.49)
Inscription	-0.0485***
	(-4.50)
Monogram	0.166***
	(5.10)
Frame	-0.290***
	(-18.32)
Oil	0.452***
	(46.95)
Amsterdam	-2.047***
	(-127.94)
Dubai	-0.753**
	(-3.03)

HongKong	1.686 ^{***}
	(74.61)
LondonSK	-2.537 ^{***}
	(-177.33)
LosAngeles	-1.308 ^{***}
	(-16.57)
Madrid	0.442 ^{***}
	(4.92)
Milan	-0.432 ^{***}
	(-6.51)
NY	-0.988 ^{***}
	(-61.34)
Paris	-1.558 ^{***}
	(-70.53)
Rome	-1.187 ^{***}
	(-11.52)
TelAviv	-1.266 ^{***}
	(-13.19)
Year2006	-0.694 ^{***}

	(-30.84)
Year2007	-0.521 ^{***}
	(-23.39)
Year2008	-0.674 ^{***}
	(-32.00)
Year2009	-0.707 ^{***}
	(-32.13)
Year2010	-0.480 ^{***}
	(-22.25)
Year2011	-0.461 ^{***}
	(-21.57)
Year2012	-0.327 ^{***}
	(-15.53)
Year2013	-0.123 ^{***}
	(-5.72)
Year2014	-0.146 ^{***}
	(-6.49)
Year2015	-0.0448 [*]
	(-2.03)

Q1	-0.624 ^{***}
	(-49.10)
Q2	0.0438 ^{***}
	(3.75)
Q3	-0.883 ^{***}
	(-69.79)
_cons	9.341 ^{***}
	(245.92)
N	141554

2: R-squared and Adjusted R-squared statistics for the first regression

R-squared	Adjusted R-squared
0.3949	0.3948

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