Tilburg University

Buying Beauty

Renneboog, L.D.R.; Spaenjers, C.

Publication date:
2009

Citation for published version (APA):
Renneboog, L. D. R., & Spaenjers, C. (2009). *Buying Beauty: On Prices and Returns in the Art Market*. (CentER Discussion Paper; Vol. 2009-15). Finance.

BUYING BEAUTY: ON PRICES AND RETURNS IN THE ART MARKET

By Luc Renneboog, Christophe Spaenjers

March 2009

TILBURG ◆ UNIVERSITY

BUYING BEAUTY:
ON PRICES AND RETURNS IN THE ART MARKET

Luc Renneboog[*] and Christophe Spaenjers[**]

This version: 3 March 2009

Abstract

This paper investigates the evolution of prices and returns in the art market since the middle of the previous century. We first compile a comprehensive list of more than 10,000 artists and then build a dataset that contains information on more than 1.1 million auction sales of paintings, prints, and works on paper. We perform an extensive hedonic regression analysis that includes unique price-determining variables capturing amongst others: the artist's reputation, the strength of the attribution to an artist, and the subject matter of the work. Based on the resulting price index, we conclude that art has appreciated in value by a moderate 4.03% per year, in real USD terms, between 1951 and 2007. During the art market boom period 2002-2007, prices augmented by 11.60% annually, which explains the increased attention to 'art as an investment'. Furthermore, our results show that, over the last quarter of a century, prices of oil paintings and of post-war art have risen faster than the overall market. In contrast to earlier studies, we find evidence of a positive masterpiece effect: high-quality art makes a better investment. Our results are robust to alternative model specifications, and do not seem influenced by sample selection or survivorship biases. When comparing the long-term returns on art to those on financial assets, we find that art has underperformed stocks but outperformed bonds. However, between 1982 and 2007, bonds yielded higher average returns (at a lower risk) than art. Buyers of art should thus expect to reap non-pecuniary benefits rather than high financial returns, especially because the modest art returns are further diminished by substantial transaction costs.

JEL classification: G1, Z11

Keywords: Art investments; Art market; Art returns; Auction prices; Hedonic regressions; Long-term stock returns; Long-term bond returns; Masterpiece effect

[*] Department of Finance, CentER, Tilburg University, P.O.Box 90153, 5000 LE Tilburg, The Netherlands. Tel: +31 13 466 3025. Fax: +31 13 466 2875. Email: Luc.Renneboog@uvt.nl
[**] Tilburg University, Tel: +31 13 466 8760. Fax: +31 13 466 2875. Email: C.Spaenjers@uvt.nl

BUYING BEAUTY:

ON PRICES AND RETURNS IN THE ART MARKET

Abstract

This paper investigates the evolution of prices and returns in the art market since the middle of the previous century. We first compile a comprehensive list of more than 10,000 artists and then build a dataset that contains information on more than 1.1 million auction sales of paintings, prints, and works on paper. We perform an extensive hedonic regression analysis that includes unique price-determining variables capturing amongst others: the artist's reputation, the strength of the attribution to an artist, and the subject matter of the work. Based on the resulting price index, we conclude that art has appreciated in value by a moderate 4.03% per year, in real USD terms, between 1951 and 2007. During the art market boom period 2002-2007, prices increased by 11.60% annually, which explains the heightened attention to 'art as an investment'. Furthermore, our results show that, over the last quarter of a century, prices of oil paintings and of post-war art have risen faster than the overall market. In contrast to earlier studies, we find evidence of a positive masterpiece effect: high-quality art makes a better investment. Our results are robust to alternative model specifications, and do not seem influenced by sample selection or survivorship biases. When comparing the long-term returns on art to those on financial assets, we find that art has underperformed stocks but outperformed bonds. However, between 1982 and 2007, bonds yielded higher average returns (at a lower risk) than art. Buyers of art should thus expect to reap non-pecuniary benefits rather than high financial returns, especially because the modest art returns are further diminished by substantial transaction costs.

1. Introduction

Thirty-five years ago, Robert Anderson (1974) started his seminal paper on art investments as follows: "Recent publicity of record prices for art works suggests that paintings may be an attractive investment medium." At the height of the next art hype, Frey and Pommerehne (1989) observed that the accounts of record prices in the popular press create "a widespread belief that the rate of return on such investments is in general and on average very high".

Also during the last few years, there has been a continuous flow of stories about the baffling amounts of money paid for first-tier works of art. According to the Art Sales Index[1], no less than 1,143 works sold for more than USD one million at auctions in 2007. In the same year, the total

---

[1] http://www.artinfo.com/artsalesindex

fine art turnover at public auctions amounted to USD 9.2 billion, a 43.8 percent rise compared to 2006 (Artprice.com, 2008).

Hence, it seems natural to conclude that the art market systematically offers great investment opportunities. This is also what many investors are willing to believe, as evidenced by the number of art funds, art market advisory firms, and art investment guidebooks that have popped up in recent years. However, one should keep in mind that there have been booms (and busts) in this market before, and that the prices paid in May 1990 for Van Gogh's 'Portrait of Dr. Gachet' and Renoir's 'Au Moulin de la Galette' – which both sold for about USD 75 million – are still auction records in real terms.

In any case, it is clear that the dramatic growth in the number of multi-million dollar sales in the last five years has led to increased attention to art as an alternative asset class. However, this financial scrutiny of the investment opportunities in the art market is also driven by the impressive expansion of the population of "high net worth individuals", who often consider converting part of their wealth into art and other "investments of passion" (Cap Gemini, 2008). Another exogenous factor driving the explosive growth in the number of studies in the field is that electronic sales databases have made the art market much more transparant – and therefore easier to analyze – than before.

Apart from the private and corporate research, for example within investment banks, there is a growing academic literature on art investments. Researchers have looked at the prices and returns, the diversification value, and even the collateral value (McAndrew and Thompson, 2007) of art. It is clear that this body of research is not only relevant to individuals and institutions for whom art is just another asset class, next to stocks, bonds, real estate, and commodities. Art collectors (and art-collecting institutions) in general are concerned with the price formation in the art market and the return characteristics of art.

This paper goes back to the basics of modern economics of the arts by investigating what are the main determinants of art prices and how the returns on art compare to those on financial assets (Throsby, 1994). In the previous academic literature on art markets, some practical problems and methodological issues arose. First, most researchers have considered relatively small data sets. Second, the studies that applied a hedonic pricing framework have started from very limited sets of hedonic (and thus price-determining) characteristics, while those using repeat-sales regressions often suffer from sample selection problems. Third, very few studies take into account that every submarket within the art world has its own dynamics. For all these reasons, it is still unclear whether art delivers "an irresistible combination of pleasure and profit" (Higgs and Worthington, 2005). This paper tries to fill this knowledge gap.

To investigate the price formation in the art market, we first compile a comprehensive list of more than 10,000 artists that created paintings, prints, and works on paper (watercolors, gouaches, drawings). For each of these artists, we collect additional biographical information. Second, we extract sales data from the Art Sales Index, which contains auction records since the 1920s. Our final dataset includes information on more than 1.1 million transactions. This enables us to perform an extensive hedonic regression analysis: we relate prices (in real USD) to a wide range of price-determining characteristics and construct a solid price index, both for the art market as a whole and for a number of submarkets (by medium and by art movement).

Our results show that the reputation of the artist, the strength of the attribution, and the topic of the work play important roles in the price formation of an art object, in addition to traditional hedonic characteristics, such as size, medium, and the identity of the auction house. On average, art prices have increased by a moderate 4.03% in real USD terms on a yearly basis between 1951 and 2007. Over the last quarter of a century the average annual real return was 4.49%. Only during boom periods, such as 1985-1990 and 2002-2007, the rate of increase has been significantly higher. The index for oil paintings has risen faster over the last 25 years than the index for works on paper. Also, the indices of post-war art movements have outperformed those of other art movements, but the former are also more volatile.

The results are robust to a large number of alternative specifications and robustness checks, which mitigates concerns about sample selection and survivorship issues. Using non-price measures of reputation, we find evidence on the existence of a positive masterpiece effect: the best pictures make indeed better investments. Lastly, we note that our index shows even smaller returns for GBP investors, mostly due to movements in the currency exchange rates during the latest art market boom.

The returns on art calculated in this study are lower than the outcomes in the often-cited studies by Goetzmann (1993) and Mei and Moses (2002), even though our time frame includes an extra boom period. We argue that this can be explained by the fact that our dataset has a much broader coverage than the ones used in earlier papers, and therefore not only captures the (re)sales by top artists at big auction houses.

The remainder of this paper is structured as follows. Section 2 reviews the literature on art indices and returns. Section 3 extensively describes our dataset. Section 4 outlines our results, which are tested for robustness and extended in Section 5. Section 6 compares our returns to those on a number of financial investments and Section 7 concludes.

2. Literature review

Due to the lack of reliable information on private transactions, most studies on art prices and art market returns start from public auction records. It seems reasonable to assume that the price trends observed in public sales are similar to those in the art market in general. At the least, auction prices serve as reference points for the rest of the market (Ashenfelter and Graddy, 2003). A problem with using auction sales data is that art objects that "fall from fashion" are often not sold through auctions (Goetzmann, 1996). However, this bias is probably small in very large datasets which also cover lesser-known auction houses. Also, valuable works that are donated to museums do not occur in auction sales databases either, which may to some extent compensate the "fall from fashion" bias.

Researchers have used different methodologies to calculate the returns on art investments from auction records. A first approach is to consider the auctioned objects in each year as a random sample of the underlying stock of art works. This (unlikely) assumption makes it possible to construct an index based on the *yearly average transaction price*. Stein (1977) was the first to use this method, and tries to uphold the assumption of a fixed underlying population of auctionable paintings by only considering artists already deceased at the beginning of his sample period.

Another rough approach is to calculate the mean appreciation, by taking the average of the (continuously compounded) returns on the works that have sold at least twice during the considered time frame. This *geometric mean estimator* does not, however, result in a price index, since it aggregates data over all periods (Chanel et al., 1996). Baumol (1986) and Frey and Pommerehne (1989) are among the authors to apply this method to the art market.

These simple methodologies do not yield clear insights in the price trends. Therefore, in most recent studies a quality-adjusted price index is estimated to measure price movements. If such an art market index is well-constructed, it can outline market trends, but also provide information on the diversification potential of art and make it possible to look into the determinants of art prices and returns (Ginsburgh et al., 2006). The price index is thus of primary importance in art market research. In general, the methods used to construct price indices for commodities or financial assets can not be applied to art objects, due to the heterogeneity and the illiquidity of the latter. Therefore, researchers resort to hedonic regressions or repeat-sales regressions.

The idea behind *hedonic regressions* is that items are "valued for their utility-bearing characteristics" (Rosen, 1974).[2] Hedonic regressions control for quality changes in the transacted goods by attributing implicit prices to specific value-adding characteristics. A time dummy can then capture the pure time effect – and thus be used to build a quality-adjusted hedonic price index. Formally, a (semilog) hedonic regression can be represented as follows:

$$\ln P_{kt} = \sum_{m=1}^{M} \alpha_m X_{mkt} + \sum_{t=1}^{T} \beta_t \delta_{kt} + \varepsilon_{kt} \qquad (1),$$

where P_{kt} represents the price of good k at time t, X_{mkt} is the value of characteristic m of object k at time t and δ_{kt} is a time dummy variable which takes the value 1 if good k is sold in period t (and 0 otherwise). The coefficients α_m reflect the attribution of a shadow price to each of the m characteristics, while the (antilogs of the) coefficients β_t are used to construct a hedonic price index.[3]

When establishing a hedonic pricing model, one of the key difficulties is the choice of characteristics (Ginsburgh et al., 2006). As Ashenfelter and Graddy (2003) note, there is a strong assumption behind the use of hedonic regressions, namely that the set of included attributes captures almost all of the uniqueness of the work of art. Several studies have proposed hedonic characteristics for the markets for paintings, prints, and works on paper. Anderson (1974), the first author to apply a hedonic regression on art prices, only included size and a price-based measure for artistic reputation in his analysis. Anderson also mentions other characteristics in his study, but he believed most of these characteristics (such as the strength of the attribution to a certain artist) not to be quantifiable, while other variables turned out statistically insignificant in his regressions. In later decades, several studies – consider, for example, Buelens and Ginsburgh (1993), Chanel et al. (1996) and Agnello and Pierce (1996) – have broadened the range of hedonic variables. In general, easily observable and quantifiable characteristics such as artist (dummies), size, auction house (dummies), and medium (dummies) are the most popular independent variables in hedonic regression models. Other often-used variables are dummies that indicate whether the artist was alive or dead at the time of the sale and whether the work was signed or not. However, in most cases the number of hedonic variables is relatively limited.[4] The literature has also failed to systematically include variables that measure price-determining

---

[2] Hedonic regressions were first used by Court (1939), and the methodology was revived in the 1960s by Zvi Griliches. Both researchers were concerned with adjusting automobile price indices for quality changes. For an excellent overview of the hedonic pricing methodology, see Triplett (2004).

[3] Triplett (2004) notes that the antilog of the OLS regression estimate of β_t is not an unbiased estimate of the time dummy effect, but he shows that this is not problematic in the context of hedonic indices.

[4] The studies that focus on one artist are notable exceptions: Czujack (1997) and Lazzaro (2006), who look into the pricing of Picasso prints and Rembrandt prints respectively, have been able to include a wide range of hedonic characteristics in their analyses.

concepts like the reputation of an artist. Finally, we have no knowledge of a study that measures the impact of the strength of attribution to an artist, although this is probably one of the most important price-determining factors, especially for Old Masters (Robinson, 2005).[5]

Repeat-sales regressions, originally developed to analyze the real estate market (Ginsburgh et al., 2006), only consider items that have been sold at least twice. This makes it possible to control explicitly for differences in quality between works, which explains the popularity of this methodology. The repeat-sales regression estimates the average return of the underlying portfolio of assets in each time period, based on the purchase and sale prices of each item. Influential repeat-sales studies are those of Goetzmann (1993) and Mei and Moses (2002). Next to the practical difficulty of identifying all resales, there are two notable disadvantages to the use of the repeat-sales methodology. First, since art objects trade very infrequently, only considering repeated sales decimates any data set to a small number of observations. Second, there is an important sample selection problem, since "a sample based on repeat-sales items may not represent the properties of the population" (Zanola, 2007). This may be especially relevant when only resales at the big auction houses are included. In this context, it is also important to realize that most collectors and museums do not consider resale (Anderson, 1974).

Each of the four methodologies outlined in the previous paragraphs can be used to estimate the historical returns in the art market. Table 1 gives an overview of published return studies, partitioned by the methodology employed.[6] It immediately becomes clear that the estimated returns vary widely. Table 1 shows that in most studies the sample size is relatively small, especially when the repeat-sales methodology is used. We have no knowledge of a study in which the total sample (sometimes covering extremely long time frames) includes more than 100,000 observations, even more than 100,000 of fine art objects are auctioned in any given year over the last quarter of a century. Also, many earlier studies have relied on data from Reitlinger's books on the "economics of taste", published between 1961 and 1970. Reitlinger provides a relatively large amount of data, but his series are not free from selection biases which seriously distort the analyses based on this dataset (Guerzoni, 1995; Candela and Scorcu, 1997).

[Insert Table 1 about here]

---

[5] An exception is the study by Lazzaro (2006), which distinguishes between original prints by Rembrandt and posthumous copies.

[6] If a study applies more than one methodology (often for reasons of comparison), we focus on the core analysis of the paper. We report the real return results whenever possible.

3. Data and methodology

3.1. Data

The starting point of this study is the Art Sales Index, a database which contains auction records[7] for oil paintings, prints, works on paper, photographs, sculptures, and miniatures. The first datapoints in the Art Sales Index date from the beginning of the 1920s, making the database unique in its coverage. Unfortunately, though, no data are available for eleven different years prior to 1951 (including the WWII period 1940-45). The latest auction records available for this study are from the autumn auctions of 2007. The dataset only includes London sales until 1969, but it has worldwide coverage for the next four decades.[8] In this paper, we focus on the market for oil paintings, prints, and works on paper. These mediums share some important features, both physically and in terms of their market. Taken together, they account for about 90% of all sales in the auction market.

We compile our sample of sales as follows:

Step 1: We first create a list of artists whose sales we want to include in our analysis. As we want to keep this selection as broad as possible and intend to include all artists who have had an (even minor) impact on art history (or who were once considered important), we consult the authoritative Grove Art Online database.[9] Published by Oxford University Press, the Grove Art Online database consists of all articles of the 34-volume 'The Dictionary of Art' (1996) as well as 'The Oxford Companion to Western Art' (2001). Articles are updated and added on a regular basis. From the Grove Art Online database, we select all 9,775 individual artists of the categories 'graphic arts', 'painting and drawing', and 'printmaking' and include these in our dataset. We then expand our list by means of another online art database, Artcyclopedia[10]. This selection process results in a comprehensive list of 10,211 artists.

Step 2: As one of our goals is to compare the price evolutions across different art movements, we compose a list of 13 broad movements: 1. Medieval & Renaissance; 2. Baroque; 3. Rococo; 4.

---

[7] The prices in the Art Sales Index are hammer prices, exclusive of transaction costs. Ashenfelter and Graddy (2003) mention average buyer's premiums of 10% to 17.5% and seller's commissions of 10%. Historically, the Art Sales Index has not included buy-ins, which implies that we only observe prices that exceed the reserve price. The reserve prices in the art market tend to follow recent sales prices, which can lead to a return measurement bias when the market reverses (Goetzmann and Peng, 2006), but over longer time periods this should not make a significant difference.

[8] The coverage since the 1970s is excellent: the data contain virtually all auctions worldwide, including those from local auction houses as well as unique castle sales.

[9] Grove Art Online is part of Oxford Art Online [http://www.oxfordartonline.com] and was redesigned mid-2008.

[10] http://www.artcyclopedia.com

Neoclassicism; 5. Romanticism; 6. Realism; 7. Impressionism & Symbolism; 8. Fauvism & Expressionism; 9. Cubism, Futurism & Constructivism; 10. Dada & Surrealism; 11. Abstract Expressionism; 12. Pop; and 13. Minimalism & Contemporary. This classification – also outlined in the first column of Table 2 – is consistent with that of most art history textbooks.

[Insert Table 2 about here]

Step 3: Whenever possible, we classify our artists into one of the above categories. The third and fourth columns of Table 2 show how the 'Styles and Cultures' from Grove Art Online and 'Art Movements' of Artcyclopedia relate to the art movements listed in Step 2. This classification process enables us to put 4,132 artists into one or more of our 13 art movements.

Step 4: We then expand our dataset in two more ways, to correct for the possible underrepresentation of modern and contemporary art. First, we compare the index of the influential book 'Modern Art' (Britt, 1989) to our dataset and add 62 modern artists that were not yet included to our list. This book also enables us to assign another 87 artists that were already in our dataset, but were not classified, to a specific art movement (see the fifth column of Table 2). Second, in order to have a representative and up-to-date sample of contemporary artists, we take the 'List of Contemporary Artists' from Wikipedia[11]. The online encyclopedia defines contemporary artists as "those whose peak of activity can be situated somewhere between the 1970s and the present day". This way , we add 169 artists to our dataset. Another 40 unclassified artists who were already in our list, can now be classified as 'Minimalism & Contemporary'. This process culminates in a list of 10,442 artists, of whom 4,490 are classified in one or more[12] of our art movements.

Step 5: We then collect data on all relevant sales of oil paintings, prints, and works on paper by manually matching our list of artists with the names of the artists in the Art Sales Index. We check for pseudonyms and different spellings of the artist's name when relevant.[13] As a last validation of our data collection process, we check that our database does not contain double

---

[11] http://en.wikipedia.org/wiki/List_of_contemporary_artists was consulted on 15 April 2008.

[12] We have four artists who are in three different movements and 153 artists who are in two categories, which reflects the ambiguity of the borders between art movements. The sales of these artists will thus contribute to the estimation of more than one movement-specific art index in Section 4. We argue that this makes sense: prices for works by Edgar Degas (who saw himself as a Realist, but is often identified as an Impressionist), for example, will increase both when Realism and Impressionism are in vogue.

[13] In the 16th and 17th century, many non-Italian artists used Italian-sounding pseudonyms. For example, the French painter Jacques Courtois is also included in the database as Giacomo Cortese. Other artists' names can be spelled in different ways. For example, the family name of the Belgian painter Hippolyte Boulenger is sometimes written as Boulanger. Similarly, the surname of Jaroslav Cermak, a Czech painter, can be spelled as Czermak.

entries. This results in a final sales dataset of no less than 1,152,173 sales, of which about 60% are works by artists who carry an art movement classification.

The ten artists with the highest number of sales in our dataset are Pablo Picasso (13,389), Marc Chagall (6,973), Andy Warhol (6,443), Raoul Dufy (4,794), Joan Miro (4,735), Rembrandt van Rijn (4,227), Auguste Renoir (3,827), Maurice De Vlaminck (3,655), Maximilien Luce (3,637), and David Teniers the Younger (3,551).[14] Table 3 shows the number of observations in our dataset by year and by type of art (oils, prints, works on paper). Most of our sales data refer to oil paintings or works on paper; prints are only systematically included as from the mid-1990s. Table 3 also illustrates that, since the middle of the 1970s, our data set includes more than 15,000 auctioned objects a year. With the art market boom of the 1980s, this number rises to more than 25,000 a year.

The sheer size of our dataset is an important advantage, because it will enable us to draw a comprehensive and reliable picture of the price formation and the returns in the art market as a whole.[15] This stands in marked contrast to previous studies that have mostly focused on the top of the art market, or are based on very selective samples.

[Insert Table 3 about here]

3.2. Methodology and variables

This study uses the hedonic regression framework to construct a price index for the art market and several of its submarkets. We first translate all nominal prices in our dataset to prices in mid-2007 USD[16], using the US CPI to measure inflation. In real terms, the five most expensive sales in our dataset are (in decreasing order): 'Portrait du Dr. Gachet' by Vincent van Gogh (May 1990), 'Au Moulin de la Galette' by Auguste Renoir (May 1990), 'Garçon à la Pipe' by Pablo Picasso (May 2004), 'Irises' by Vincent van Gogh (November 1987), and 'Dora Maar au Chat' by Pablo Picasso (May 2006). With the exception of 'Portrait du Dr. Gachet', which was auctioned at Christie's New York, all of these sales took place at the New York offices of Sotheby's.

---

[14] Note that these numbers also include works which the auction catalogue identifies as "attributed to" the artist, "in the style of" the artist, etc.
[15] Our dataset is somewhat less comprehensive in covering the very low-end of the auction market. It is hard to grasp the dynamics of this 'junk' market, due to the lack of reliable information. In this paper, we are concerned with art that at least been recognized as such.
[16] We will also calculate returns for a GBP investor (see infra).

Figure 1 depicts the evolution of the mean real price of all sales in our database, as well as the sales volume per year. Obviously, it is impossible to build an index out of these raw data, as these prices are not quality-adjusted. The graph is consistent with the common feeling that there have been two important boom periods in the art market over the last three decades: one at the end of the 1980s[17] and one in the last few years. Also note that Figure 1 suggests a positive correlation between the average art price level and the art sales volume.

[Insert Figure 1 about here]

In Section 4, we will calculate the art returns by relating the natural logs of the real USD prices to year dummies while controlling for a wide range of independent variables that capture the characteristics of the artist, of the work, and of the sale.[18] The descriptive statistics for these hedonic variables are presented in Table 4.

3.2.1. Characteristics of the artist

In addition to the artist dummies capturing each artist's uniqueness, we also consider a number of variables related to the artist's reputation and career path:

- *Grove Art Online word count*. The publishers of Grove Art Online provided us with information on the length of each of the articles in their database, which enables us to introduce a variable WORD_COUNT that proxies for the perceived importance of an artist and the art historical relevance of his output.[19] (In our hedonic models, we include the word count variable with exponents 1 to 4 in order to capture possible non-linearities in the relationship between reputation and price.) The ten artists with the highest word counts in our dataset are (in decreasing order): Michelangelo, Leonardo Da Vinci, Caravaggio, Alberti, Picasso, Claude Lorrain, Rubens, Anthony van Dyck, Vasari, and Le Corbusier. A small fraction of our artists are not included in the Grove Art Online database and thus have a WORD_COUNT equal to zero. Since this variable measures the article length in 2008, it is not entirely exogenous. At the same time, however, it should be noted that most articles in this database were written before the mid-1990s. Besides, there is a strong persistence in this type of academic recognition of artistic quality.

---

[17] The art market boom in the late 1980s was partly driven by strong Japanese investor demand (Hiraki et al., 2009).

[18] We start from real prices because the shadow prices of the hedonic characteristics (as measured by the hedonic coefficients) would otherwise be impacted by inflation over our time frame.

[19] For artists who feature in Grove Art Online as part of a family, we divide the word count for the family by the number of individuals of that family in our dataset.

- *Gardner textbook dummy*. As a second reputation measure and an exogenous proxy for changing tastes, we checked which of our artists were included in one of the five editions of the classic art history text book 'Gardner's Art Through the Ages'. We have manually checked the editions of the following years: 1926, 1959, 1980, 1996, and 2004. In total, 652 of our artists are listed in one or more of the five Gardner books that we considered. The dummy variable ART_HISTORY_BOOK equals one if the artist was featured in the edition of – or the last edition prior to – the year of sale.

- *Documenta exhibition dummy*. As a last unique proxy for reputation, and one that is more relevant for modern and contemporary artists, we introduce the variable EXHIBITION. It equals one, once the artist has been represented at the prestigious Documenta exhibition in Kassel. We argue that inclusion in the Documenta has an important certification effect, and thus also proxies for the artist gaining recognition in the art world. In total, 680 of our artists were represented at one of the eleven exhibitions between 1955 and 2002.

- *Artist deceased at time of sale*. It is often assumed that prices for art works increase after the death of an artist. The dummy variable DECEASED, which equals one when the sale occurs subsequent to the artist's death, captures this effect.

- *Artist nationality dummies*. Since the nationality of an artist is often deemed important within the context of an art movement, we introduce the dummy variables AMERICAN, BRITISH, DUTCH, FRENCH, GERMAN, and ITALIAN for all artists classified in one of the art movements since the Baroque era. These are the biggest nationality groups in our set of classified artists. Whenever an artist has a double nationality, we use the nation in which he lived during his adult – and thus creative – life.

[Insert Table 4 about here]

3.2.2. Characteristics of the work

In this category, we consider a range of price-determining variables that capture the attribution and authenticity, the medium, the size, and the subject matter of the work of art:

- *Attribution dummies*. Attribution can be an important factor influencing the price of art objects, especially of older works. There are different levels of attribution that are used in the auction world, reflecting different levels of certainty: ATTRIBUTED (to), STUDIO (of), CIRCLE (of), SCHOOL (of), AFTER, and (in the) STYLE (of).

- *Authenticity dummies*. We want to investigate whether SIGNED, DATED, and INSCRIBED works sell at a premium.

- *Medium dummies*. We introduce dummies for the different medium categories: OIL, PRINT, and PAPER.

- *Additional print dummies*. For prints, we have additional dummies for NUMBERED (which equals one if the print is numbered) and NUMBERED1 (which equals one if the print is numbered and is the first one of a series).

- *Additional work on paper dummy*. For works on paper, the dummy WATERCOLOR equals one when the object is a watercolor or gouache, as opposed to a drawing.

- *Size*. The height and width in inches are represented by HEIGHT and WIDTH, with the squared values being HEIGHT_2 and WIDTH_2.

- *Topic dummies*. We categorize the art works in different topic groups based on the first word(s) of the title. We create the following eleven topic categories, based on the search strings that can be found in Appendix 1: ABSTRACT, ANIMALS, LANDSCAPE, NUDE, PEOPLE, PORTRAIT, RELIGION, SELF-PORTRAIT, STILL_LIFE, UNTITLED, and URBAN. Furthermore, we create a dummy STUDY that equals one if the title contains the words "study" or "etude".

3.2.3. Characteristics of the sale

In addition to the year dummies that we need to construct the price index, we also include additional dummies related to the timing of the sale and a number of variables related to the reputation and location of the auction house[20]:

- *Semester dummy*. We introduce the dummy variable SEMESTER2, which equals one if a sale takes place in the second semester. This variable should account for possible semester effects in the quality of the objects offered at auction. It is sometimes argued that the best works are offered in the autumn auctions rather than in the spring ones.

- *Month dummies*. Important sales are often clustered in specific months. We therefore include dummies capturing the month of the sale.

- *Auction house dummies*. We make a distinction between different fine art auction houses that have been important throughout our sample period. The four big British auction houses – Sotheby's (founded in 1744), Christie's (founded in 1766), Bonhams (founded in 1793), and Phillips (now Phillips de Pury & Company, founded in 1796) – receive auction house specific dummy variables. For the two biggest institutions (Sotheby's and Christie's), we introduce

---

[20] In our adjacent year regression model (see Section 5), we will also include a number of variables based on the entry in the auction catalogue for all years as of 1998. We are not able to introduce these variables here since the auction catalogue entry data are incomplete for some periods.

dummy variables for their London, New York, and other sales (e.g. SOTH_LONDON, SOTH_NY, and SOTH_OTHER). For Bonhams and Phillips, we make a distinction between their London sales rooms and their other activities (e.g. BON_LONDON and BON_OTHER). We also create two additional dummies to account for the sales by large European auction houses with international reach (AUCTION_EUROPEAN) and for important American auction houses (AUCTION_AMERICAN). The list of auction houses included in these last two categories can be found in Appendix 2.

4. Empirical results

In this section, we outline the results of different hedonic regression models on the pooled data. An overview of the estimated models is given in Table 5. In all cases, the model is estimated using OLS and the dependent variable is the natural log of the real price is USD. Model (1) only includes time dummies, while regression (2) adds artist dummies to the model. The third regression adds all other relevant hedonic variables. In model (4), we replace the artist dummies by the word count variables, which proxy for the importance and quality of an artist.[21] This allows us to check whether our baseline results from model (3) hold even if we do not include a separate dummy variable for each of our artists. We consider specifications (3) and (4) as our benchmark models.

[Insert Table 5 about here]

Table 5 also reports the adjusted R-squared for models (1) to (4). The explanatory power increases from 4% to 34% when we include the artist dummies, and augments further to 62% when adding the hedonic variables.[22]

Regressions (5a) to (5c) and (6a) to (6c) repeat models (3) and (4) for each of the three different mediums: oil paintings, prints, and works on paper. For prints and works on paper, we add some extra information: NUMBERED and NUMBERED1 in the case of prints, and the dummy WATERCOLOR in the case of works on paper.

Finally, we perform two regression analyses for each of our thirteen art movements: the models (7a) to (7m) are based on benchmark model (3), and thus include artist dummies, while

---

[21] Multicollinearity issues prevent us from including the word count variables in model (3). Artist nationality dummies are only included in the movement-specific models.

[22] It is no surprise that model (3), which includes a separate dummy for each artist, has a higher adjusted R-squared than model (4). However, the latter model, which replaces the artist dummies by a single reputational measure, still explains much of the variation in prices.

(8a) to (8m) are based on model (4), in which the artist dummies are replaced by the word count variables. To estimate these models, we apply a hedonic model on all sales by all artists classified in the art movement. For each art movement, we only include topic dummies for topic categories with at least 100 works included in the movement-specific subsample, which allows us to focus on the relevant subject matters. The dummy variables EXHIBITION and DECEASED are only included for Fauvism & Expressionism and all subsequent art movements (see Table 2) as these dummies are not relevant in the context of earlier movements. Moreover, we exclude the attribution dummies for the movement Fauvism & Expressionism and later art paradigms. Also, in model (8), where the word count variables substitute for the artist dummies, we add artist nationality dummies for the three biggest nationality groups in each movement.[23]

In the remainder of this section, we first discuss the coefficients on the hedonic variables of the general benchmark models. We will observe that in most cases the coefficients are statistically and economically significant and have the expected sign. This gives credibility to our general art price indices, which are presented in the second part of subsection 4.1. The medium- and movement-specific models (5) to (8) are discussed in subsections 4.2 and 4.3, respectively.

4.1. General hedonic models

4.1.1. Hedonic characteristics

Table 6 gives an overview of the parameter estimates of the hedonic variables in models (3) and (4). Model (3) shows that works are on average priced about 12% higher after the inclusion of the artist in 'Gardner's Art through the Ages' (ART_HISTORY_BOOK).[24] This shows that inclusion in the canon of art is valued by the art markets. In contrast, the Documenta dummy (EXHIBITION), which indicates that a (modernist or contemporary) artist has exhibited as this prestigious art event, is not statistically significant in model (3). The sales of works of dead artists (DECEASED) have a significantly negative coefficient. Although the coefficient is economically very small (-3%), this result is remarkable, as it goes against the conventional wisdom in the art market that an artist's death increases the demand (and hence the prices) for his works.

---

[23] We do not include nationality dummies in the Medieval & Renaissance model because it is frequently hard to classify these artists by today's nationalities.
[24] The 'price impact' of each hedonic variable can be calculated by taking the exponent of the coefficient, and substracting 1. However, it is important to note that the regression coefficients reflect correlation, not causality, and therefore we will often refrain from interpreting the results as causal relationships. For example, the coefficient on the ART_HISTORY_BOOK dummy is probably positive because the variable proxies for changing tastes and the recognition of the artist in academia, not because of a direct certification effect of the Gardner text books.

As expected, the strength of the attribution has an important effect on the price of an art object. Whenever an attribution dummy comes into play, the average price level drops by more than 50%. Moreover, the results of model (3) show that a work by someone from the school or circle of an artist is clearly priced at a lower level than a work by the studio of the artist or a work that is attributed to the master himself. The largest discounts are recorded for works that are "in the style of" or "after" an artist (and thus are hardly associated with the master himself). We also observe that signed and dated works carry higher prices: a signature increases the price by as much as 30% on average, while a date adds about 20% in value. The impact of an inscription is economically very small. Prints and works on paper are clearly priced lower than oil paintings, with prints being almost 90% less costly on average. Furthermore, prices increase with size, up to the point that the work becomes too large to hang in a house. Regarding the topic dummies, it is clear from model (3) that there are significant discounts associated with studies and paintings that depict nudes or are portraits. Untitled works and works with animals or landscapes also fetch lower prices. In contrast, self-portraits trade at a premium, as do urban scenes and – maybe surprisingly – still lifes.

[Insert Table 6 about here]

The coefficients on our additional time-of-the-year dummies show that there is a clear semester effect (captured by the variable SEMESTER2), with more valuable works being sold in the second half of the year. The most expensive auctions seem to be clustered in the periods May/June and November/December, which is indeed when the most important sales traditionally take place.[25] In general, the highest prices in the art market are reached at the New York and London branches of Sotheby's and Christie's. Sales at the other offices of these big auction houses, at the London headquarters of Bonhams and of Phillips, and at important European auction houses are also correlated with premiums, but to a lesser extent.

From the artist dummy coefficients (not reported) of model (3) we can infer who are, on average, the 'most expensive' artists at auctions, while controlling for all hedonic characteristics. Since we only want to include artists that trade regularly (and consistently sell for high prices), we restrict the analysis to the coefficients of artists with at least 100 sales in our dataset. The top-15 is (in decreasing order): Van Gogh, Cezanne, Monet, Seurat, Pieter Bruegel (the Elder), Sisley, Homer, Degas, Schiele, O'Keeffe, Kandinsky, Modigliani, Renoir, Pollock, and Manet.

---

[25] Note that the coefficient on the semester dummy (SEMESTER2) should be added to the coefficient on the month dummy for the months in the second half of the year.

In model (4), we substitute the word count variables for the artist dummies from model (3). In general, the hedonic variables of model (4) are qualitatively similar to those of model (3). Exceptions are, however, the variables that (partially) proxy for the artist's quality, such as ART_HISTORY_BOOK, EXHIBITION, and DECEASED. As we leave out the artist dummies in model (4), the coefficients on these variables are now all positive and both statistically and economically strongly significant.[26] The word count variables are also highly significant, implying that an artist's reputation greatly influences the price.[27]

4.1.2. Price indices

Table 7 outlines the coefficients and the implied index values from 1951 until 2007 for models (3) and (4).[28] We left the dummy for the year 1978 out of the regression, which implies that we standardize the price level in 1978 to 100.[29] Figure 2 depicts the index values of Table 7. Although the two models are based on different specifications (dummies for each individual artist versus one word count variable capturing reputation and quality), they yield similar results.

[Insert Table 7 and Figure 2 about here]

Using the index of model (3), we calculate that, on average, art has appreciated at a yearly real rate of 4.03% between 1951 and 2007. Over the last 25 years, the mean real return is slightly higher (4.49%).[30] In boom periods, prices can increase very fast: they more than tripled in real terms between 1982 and 1990. The average yearly increase in prices between 1985 and 1990 was no less than 22.91%. However, prices also rapidly decreased after 1990, and no large changes in

---

[26] This can be explained by the fact that the effects of these variables are only estimated over the *changes* in these variables over time in model (3), but on the *levels* of these variables in model (4). Due to the inclusion of artist dummies in model (3), the ART_HISTORY_BOOK and EXHIBITION dummies were irrelevant as long as they did not change in value. In the new set-up, however, the same variables also proxy for the general quality and overall reputation across artists, even when no changes take place. Similarly, DECEASED now captures the preference for works created by dead artists rather than the price impact of the death of an artist itself.

[27] The coefficients imply that prices strongly increase with reputation in the lower (between 0 and 3,000 words) and higher (more than 11,000 words) segments of the word count distribution.

[28] Prior to the 1950s, several years have either no or few observations.

[29] Choosing 1978 as the base year allows a clear insight in the price evolution over the last three decades. Also, 1978 is the first year for which we have 20,000 data points, which guarantees that we have ample observations for each of our submarkets considered later in this section. In any case, choosing a different base year is just a matter of scaling, so it would not influence the results and conclusions.

[30] The nominal equivalents are 7.97% (1951-2007) and 7.65% (1982-2007). The nominal returns are obtained by correcting the indices for the year-to-year changes in the US CPI series.

price levels occurred between the mid-1990s and the first years of the 2000s. In the most recent art boom period (2002-2007), the price appreciation averaged 11.60%.

<u>4.2. Medium-specific hedonic models</u>

4.2.1. Hedonic characteristics

The results for the medium-specific models (5) and (6), respectively based on benchmark models (3) and (4), are shown in Table 8. As most coefficients on the hedonic characteristics in the paintings and works on paper models are in line with the results from the more general "all art" models, we limit our attention to the differences in results relative to the findings of Table 7.[31] The EXHIBITION dummy is positive and statistically significant in the oil model (5a) and the works on paper model (5c), but its economic impact is still small. The same holds for DECEASED, which becomes positive and significant in the prints (5b) and works on paper (5c) model. Model (5b) also shows that lower prices are paid for prints that are numbered, although this discount is mitigated when a print is labeled as the first one of a series (NUMBERED1). In line with our expectations, we find that in model (5c) watercolors or gouaches (WATERCOLOR) are priced higher than other works on paper, such as drawings.

[Insert Table 8 about here]

4.2.2. Price indices

Figure 3 shows the evolution of the price indices for oil paintings and works on paper since 1951 and for prints as from 1996. The coefficients are based on the specification including artist dummies (model (5)), but – as before – the results are similar when the artist dummies are replaced by the word count variables.

[Insert Figure 3 about here]

---

[31] The remarkably lower adjusted R-squared and F-values on the print regressions are due to the small number of observations of prints in our dataset, especially before the mid-1990s, when almost no data points are included. This is also reflected in the coefficients in these models, which are not always in line with the other regression results in this and other tables. Therefore, we will mainly focus on the regressions for oil paintings and works on paper here.

The price trend for oil paintings differs from that for works on paper. While our hedonic price index shows a price level for oil paintings that is higher in 2007 than it was on its previous peak, the work on paper index still has not reached the peaks of 1989 and 1990. Over the last 25 years, prices for oil paintings have appreciated at a yearly average real rate of 5.10%, while works on paper have increased by 3.75% annually.[32] Between 1951 and 2007, the average annual price increase is almost identical for both mediums. Following the rest of the art market, the prices for prints have increased during the last decade, but the upward trend is less outspoken than the one for oil paintings.

4.3. Movement-specific hedonic models

4.3.1. Hedonic characteristics

Table 9 shows the estimation results of our movement-specific models. Model (7) is based on benchmark model (3), while model (8) is a slightly adapted version of model (4).[33] As explained in the beginning of this section, the models for the movements up to Impressionism & Symbolism slightly differ from those movements starting from Fauvism & Expressionism. Also, as outlined before, topic dummies and nationality dummies (in model (8)) are only included when relevant for the art movement in question.

[Insert Table 9 about here]

We start by focusing on models (7a) to (7m), which include the artist dummies. The ART_HISTORY_BOOK dummy is only significantly negative in the Minimalism & Contemporary model (7m). This may reflect the fact that contemporary art is valued by other standards than art from earlier movements. Works of art by artists who have exhibited at Documenta (EXHIBITION) are priced significantly higher especially for works belonging to Dada & Surrealism (7j), Abstract Expressionism (7k), and Minimalism & Contemporary Art (7m). As in the general model, there is no evidence that the death of an artist (DECEASED) has historically increased his works' market values. However, the significant positive coefficient in the Minimalism & Contemporary model (7m) suggests that there might be a 'death effect' in the contemporary art market.

---

[32] The nominal equivalents for this period are 8.25% for oil paintings and 6.90% for works on paper.
[33] To save space, we only report the coefficients on the nationality dummies for model (8).

In general, the results for the attribution dummies, authenticity dummies, medium dummies, and size variables are in line with the findings in the general benchmark model (Table 6), so we do not go into further detail here. The coefficients and significance of the topic dummies vary somewhat with the art currents. However, in none of the art movements, works depicting animals or nudes, and untitled works receive a premium. Only in the Pop art model (7l), studies and works with nudes have a positive coefficient. Abstract art is only priced higher in Cubism, Futurism & Constructivism (7i), whereas the sole positive coefficient on landscapes is found in the Medieval & Renaissance model (7a). Self-portraits are in general sold at a premium: we only see a (non-significant) negative coefficient in the Cubism, Futurism & Constructivism model (7i). Depictions of urban life never get a significantly negative coefficient, and seem especially valuable within the earliest art movements.

The changing coefficients on the sale's timing variables reflect the different dynamics of each submarket. For example, the second semester effect (SEMESTER2) is significantly positive for the art movements starting from Neoclassicism. Also, whereas for earlier art movements the most important sales take place in January and July, the most valuable modern and contemporary sales are clearly clustered in May/June and November/December. Even though the highest price levels are always associated with a Sotheby's and a Christie's branch in London or New York, the importance of the auction houses differs from one movement to the other. This implies that some auctions houses specialize in specific art movements or specialize in higher or lower quality works wihin a specific art movement. For instance, auctions at Bonhams and Phillips generate lower prices for the earliest art movements, such as Medieval & Renaissance (7a), Baroque (7b), and Rococo (7c). In contrast, auctions at the large continental European auction houses (AUCTION_EUROPEAN) generate premiums for these movements. Phillips clearly specializes in Pop (7l) and Mimimalism & Contemporary (7m). The category of important American auction houses (AUCTION_AMERICAN) only gets a significantly positive coefficient in the Romanticism model (7e).

From the nationality dummies in model (8) of Table 9, we learn that the highest prices are paid for Dutch Baroque, Italian Rococo, French Neoclassicism, American Romanticism, French Realism and Impressionism & Symbolism, German Fauvism & Expressionism, American Cubism, Futurism & Constructivism, and German Pop Art. Somewhat surprisingly, we do not see premiums for American post-war art.

We now present the 'most valuable artists' for each art movement, as measured by the coefficients on the artist dummies in model (7). Again, we restrict the lists to artists for whom we have at least 100 transactions. The top-10 artists per art movement is presented in Table 10 along

with the number of sales for each artist. It seems that Pieter Bruegel (the Younger), Rubens, Goya, Ingres, Degas, Van Gogh, Kandinsky, Morandi, Picasso, Pollock, Klein, and Guanzhong are at the top of their league, at least financially. The lists contain no big surprises as most included names are recognized as the main representatives of their art movements. This strengthens our belief that our hedonic regression model is correctly capturing price variations.

[Insert Table 10 about here]

4.3.2. Price indices

The indices for each art movement are plotted in Figure 4 from 1971 onwards. All art paradigms move with the same trends, but it is remarkable how the twentieth century – and especially the post-war – art movements have outperformed the earlier ones during the art boom periods. For example, between 1985 and 1990 and between 2002 and 2007, the price index of Pop Art has increased at yearly rates of 39.28% and 20.14%, respectively. Likewise, all other art movements from Fauvism & Expressionism onwards have appreciated at real rates of more than 25% annually during the first boom period and of more than 10% during the last one.

[Insert Figure 4 about here]

However, the overall picture is less impressive. In Panel A of Table 11, we report the average yearly real returns for the different art movements since 1951 (whenever possible) and since 1982.[34] We also include the standard deviation, as a measure of volatility, over the last 25 years. Since 1951, the indices for the art movements from Medieval & Renaissance until Realism have increased by between 2.10% and 5.83% on average per year. Between 1982 and 2007 only the post-war art movements Abstract Expressionism, Pop, and Minimalism & Contemporary have shown real price appreciations of more than 6% per annum, on average. However, these movements have also been the more volatile (and thus riskier) ones. Romanticism, Realism, Impressionism & Symbolism, and Fauvism & Expressionism record mean appreciations of less than 4% over the same time frame. The least volatile art movements during this period were Baroque and Rococo.

Panel B of Table 11 repeats the analysis, but now based on nominal returns. The same conclusions hold: over the last quarter of a century, the highest returns (but also the highest

---

[34] We are not able to report the returns of all modern movements over the whole time frame, as a sufficient number of observations for these movements in the 1950s (or even in later decades for the more recent art movements) is lacking.

standard deviations) are generated by the post-war art movements. The average annual nominal returns since 1982 range from 6.65% (Realism) to 11.60% (Pop).

[Insert Table 11 about here]

5. Robustness checks and extensions

5.1. Alternative specifications

Previous research suggests that there might be a relationship between the *age of the artist* and the value of the work (Galenson and Weinberg, 2000). Therefore, as a first robustness check, we control for a (possibly non-linear) age-price relationship in our data by adding the artist's age at the time when he or she created the auctioned art object. We do this for all artists born since the start of Romanticism, which limits our sample to art created over the last 300 years, and to objects for which we know the year of creation. The resulting price indices are very similar to the ones in our benchmark models.[35] Second, as the *topic* dummies may only capture the subject matter rather imprecisely, we also re-estimate our benchmark models leaving out these topic dummies. Still, this only marginally alters the relevant time dummy coefficients (or any of the other coefficients in the model for that matter). Third, since the data from the first half of the twentieth century are incomplete (some years – the WWII period - are missing and relatively few sales are recorded in the for most of the other years), we also re-estimate the model *leaving out all sales prior to 1950*. This does not have a significant impact on our time index since 1951. Fourth, the focus of the Art Sales Index on *London auctions* for the 1950s and 1960s may be a source of bias. When we estimate two separate models, one using all observations from 1951 up to 1969, and one including all transaction data since 1970, we conclude that the returns in the latter period are not influenced by the inclusion of the auctions of the older time window.

5.2. Changing tastes

A potential problem with the hedonic approach applied in Section 4 is that the coefficients are constrained to be stable across the whole sample window. This is a strong assumption as tastes may change. We have attempted to reduce the impact of changing tests by including the Gardner

---

[35] The coefficients on the age variables (up to the fourth power) indicate that prices increase with the age of the artist at the time when he created the work up to the age of about 34 years, after which prices start to decrease with age.

dummy variable (ART_HISTORY_BOOK). Still, Triplett (2004) argues that the "adjacent period approach" is a good alternative methodology as it does not pool the data over all periods, but considers two adjacent periods (for example, years) at a time. The hedonic coefficients are only fixed over short time frames. Therefore, the resulting index (constructed by the period to period changes in prices as estimated by the coefficient on the time dummy in each model) theoretically not only controls for changes in quality, but also for fluctuations in the shadow prices of each characteristic measuring this quality.

We apply the adjacent period regression approach to our dataset by performing a separate hedonic regression for each period of two adjacent years (AY). For example, we pool the data of 2006 and 2007, and estimate the difference in price level between these two years by including a year dummy variable for 2007, next to all other hedonic variables.[36] Then we pool the data of 2005 and 2006, and so forth. As before, we set 1978 as our base year such that the index of that year equals 100. This procedure results in the index depicted in Figure 5.

From the early 1970s onwards, the AY model generates results that are very similar to the ones we obtained from the pooled data. This lends further support to our benchmark indices. However, prior to 1970, the AY index is higher than our benchmark index. This may be explained by the smaller (and more selective) samples in the earlier decades of our dataset. While a pooled hedonic regression standardizes every observation with the information available over the whole dataset, an AY regression can only use the information available in two years. As the Art Sales Index covers sales by the main auction houses in the 1950s and 1960s the year-to-year changes will then lead to an overestimation of the true price level in these decades.

[Insert Figure 5 about here]

5.3. Selected sample and survivorship issues

In this subsection, we investigate the robustness of our results to two different, but related biases. First, a lot of research in the art market suffers from what Mei and Moses (2002) call the

---

[36] We include the same hedonic variables as in model (4), since we want to avoid including the whole set of artist dummies in each of the smaller samples containing the sales of not more than two years. For the years since 1998, we also include three extra dummy variables: (i) PROVENANCE, which equals 1 if if the catalogue entry for the auctioned item mentions the ownership history, (ii) LITERATURE, which equals 1 if the catalogue refers to the art history literature on the auctioned object, and (iii) EXHIBITION_HISTORY, which equals 1 if the catalogue lists the exhibition history. These variables thus also proxy for the perceived quality and importance of the work. The coefficients on these variables turn out to be very significant, both statistically and economically – in general, the price of a work of art is more than 60% higher when one of these dummy variables equals one.

"*backward-filled data bias*": the sales of an artist are included in the dataset because of the artist's fame at the time of the research or the high prices paid for his work. This form of survivorship bias could lead to an overestimation of the index values – and thus of the returns on art. Second, Goetzmann (1996) argues that sales by artists who "*fall from fashion*" are not considered in most databases based on auction transactions. This could as well lead to an upward bias in the estimated returns.

Given our broad selection procedure, and the very large number of artists, auction houses, and sales included, these two biases should not apply to our database. However, we perform a first formal robustness check by repeating our general hedonic regression analysis from Section 4 on all sales by artists who were already included in the previous Gardner textbook – and thus established – at the time of the sale. (In other words, we only include sales for which the ART_HISTORY_BOOK dummy equals one.) We thus explicitly exclude (early) transactions that hypothetically might only be included because of the later 'rise to fame' of an artist.[37] Figure 6 compares this new hedonic index to the index from model (3). We do not witness lower index values; on the contrary, the return on this index is higher.[38] So, our index is not likely to be influenced by the 'backward-filled data bias'.

[Insert Figure 6 about here]

We also construct a subsample of sales by the artists who seem to have lost some of their popularity and historical relevance over our time frame. This set of artists who are 'fallen out of fashion' (see Appendix 3) consists of those artists who were included in the 1926, 1959 or 1980 edition of Gardner's Art through the Ages, but not in the 1996 or 2004 edition.[39] For this subset of sales, the survivorship bias identified by Goetzmann (1996) should play much less of a role. Figure 6 also depicts the art index resulting from a new hedonic regression analysis based on these sales. The index is not very different from our benchmark index from model (3), which is evidence that our benchmark models do not overestimate the true price trend due to a neglect of

---

[37] We thus exclude, for example, sales by Francis Bacon from before 1959 and sales by the (in recent years almost unaffordable) Mark Rothko from before 1980 – transactions which would have turned out to be incredibly good investments ex-post.

[38] If anything, Figure 6 hints of the occurrence of a positive masterpiece effect, an issue we pick up in the next subsection.

[39] One could argue that this procedure still suffers from a survivorship bias, since most of these artists are included in our dataset because they occur in the Grove Art Online database or in Artcyclopedia in 2008. However, given the exhaustiveness of these two databases (which are completed by Britt (1989) and Wikipedia in the way described in Section 3) it would be nearly impossible to construct a large enough sample of artists who were popular somewhere in the last century and have sales over our period of interest but are not included in our dataset.

'fallen out of fashion' art. The above findings strengthen our belief that our analysis is not biased upwards by sample selection or survivorship issues.

5.4. The "masterpiece effect"

Most of the recent research on the masterpiece effect was triggered by Pesando (1993), although it was John Ruskin who wrote in his 1857 book 'A Joy for Ever (And Its Price in the Market)' that "in the long run, the dearest pictures are the best bargains". There is conflicting evidence on whether masterpieces under- or outperform the overall art market. Much of the research suffers from the fact that masterpieces are identified endogeneously, based on prices, which makes a negative masterpiece effect hard to discern from simple mean reversion in prices. There is thus a need for studies in which masterpieces are identified by means of another criterion than price, as also pointed out by Ashenfelter and Graddy (2006).

First, we define a masterpiece as every work by an artist with a word count which is in the highest 5 percent of all artists. We apply benchmark model (3) on this dataset to check in how far the estimates of the returns change when we only consider highly reputable artists. Second, we repeat this analysis, but now on a dataset which includes the sales by artists which were featured in all five Gardner art history textbooks (1926, 1959, 1980, 1996, and 2004). These artists (listed in Appendix 4) can be considered as the ultimate 'blue chip' artists, for which over the last 80 years there has been no doubt about their art historical relevance. Third, to get an indication about what the best works of these masters sell for, we estimate an additional index only including the Sotheby's and Christie's sales in London and New York of this last set of 'blue chip' artists. It is important to note that this reduces our original dataset by almost 98%, and thus limits the analysis to the very top of the market.

We plot the new hedonic indices in Figure 7 and compare them to the baseline model. We observe that the index based on the artists with the highest 5 percent word counts shows an average annual increase of 4.74% since 1951, and thus clearly outperforms the benchmark index (whose return is 4.03%, annually). The index based on the artists that were featured in all Gardner editions has known an even sharper increase over the last few decades (5.60% on average), while the index based on the most stringest selection criterion (Sotheby's or Christie's, London or New York) shows the most impressive increase since 1951 (6.23%). Over the last 25 years, this last index has increased by 7.03% per year, while the average price appreciation of our general art index is 4.49%. We consider this as clear evidence of a positive masterpiece effect.

[Insert Figure 7 about here]

It thus seems to pay off to invest in works by top-quality artists, aesthetically as well as financially. The high-end section of the market is also more susceptible to speculation, conspicuous consumption[40], and bidding wars between high-profile investors. These aspects can dramatically drive up the prices for first-tier works in boom periods. In 2007, the average price for an oil painting in our sample of Sotheby's and Christie's sales by 'blue chip' artists amounted to USD 2,489,955. Therefore, we can only agree with Agnello (2002), who advises to "buy the very best you can afford, so long as you can afford to buy the very best".

5.5. GBP regressions

Up to now, we have considered the price evolution in the art market from the perspective of a USD investor. We did this for reasons beyond the fact that the USD has been the dominant currency in international markets since World War II. The United States has been the largest art auction market for the last few decades, at least in terms of turnover. More importantly, USD investors have also been the largest group of buyers in the international art market for a long time.[41]

However, since the art market is international, one can repeat the analysis from different points of view, and investigate how this influences the results. Therefore, we translate all transaction prices to real prices in GBP.[42] We then run our benchmark models (3) and (4) again, but now with the new GBP denominated prices as our dependent variables. Not surprisingly, the coefficients on the hedonic characteristics are nearly identical. We get, however, different coefficients on our time dummies, and thus a different price index. We plot both the USD and GBP indices for model (3), which includes artist dummies, in Figure 8.

[Insert Figure 8 about here]

---

[40] However, note that expected returns on masterpieces should in theory be lower if agents derive utility from conspicuous consumption (Mandel, 2008).

[41] Already in 1921, The New York Times reported on "plenty of American buyers" at the London auctions "to acquire fresh supplies for America's insatiable appetite" (The New York Times, 1921).

[42] We use the RPI (retail price index) to deflate our prices. The RPI is the most common measure of inflation in the UK, according to the UK Office for National Statistics. It has monthly data going back to 1948. For the years 1922-1947 we use monthly averages of the yearly changes in RPI.

Figure 8 clearly shows the impact of changing the currency perspective. While the USD-index has increased at a yearly average of 4.03% between 1951 and 2007, the GBP-index has only appreciated by 2.77% per year over the same time frame. The strengthening of the GBP (and the weaking of the USD) against other currencies for much of the period between 2002 and 2007 is reflected in the growing divergence between the two indices in those years. The GBP-denominated art index is still far away from the record levels of 1989 and 1990. It thus seems that at least some of the art hype in recent years finds its origins in the fact that (record) art prices are often measured in USD.

6. Comparison with returns on financial assets

This section compares the returns on art, based on our benchmark model in USD, to the returns on a number of financial assets. We collect data from Global Financial Data on indices measuring total returns on US treasury bills, 10-year US government bonds, Dow Jones corporate bonds, the GFD global index for government bonds, S&P 500 stocks, and the GFD world index for equity.[43]

Panel A of Table 12 shows the average yearly real returns, volatility, and ex-post Sharpe ratios calculated over the period 1951-2007, while Panel B reports the outcomes for the same measures over the last 25 years of our dataset. To calculate the ex-post Sharpe ratios, we used the returns on the T-bill index as our measure of the risk-free return.

Over the longer time frame (since 1951), the art index clearly underperforms stocks. The S&P 500 and the GFD global equity index have appreciated at average real rates of 8.90% and 7.23%, respectively, while our art index increased by 4.03% annually over the same period. Also the reward-to-variability, as measured by the Sharpe ratio, is higher for stocks than for art. However, between 1951 and 2007, the art index has a higher average return and higher Sharpe ratio than both government bond indices. If one only considers the last quarter of a century, the picture of the art markets looks bleak: the reward-to-volatility of an investment in art is low compared to that of bonds or stocks. This is due to the low average real return (4.49%, compared to 6.64% and 9.92% on the global indices for government bonds and stocks, respectively) and relatively high riskiness of art.

Panels C and D of Table 12 repeat the analysis for nominal returns. The reported results lead to very similar conclusions: while on the long term art has outperformed bonds but not stocks, it has performed relatively worse over the last 25 years.

---

[43] For each of these indices, we calculate yearly returns on the basis of the index values in the middle of each year, since our art index aggregates data per calendar year.

It should also be noted that we only take into account the volatility of the art *index* here, and that, in general, it is much easier to have a diversified portfolio of stocks than a diversified portfolio of art. Finally, the high buyer's premiums and seller's commissions at auctions would reduce the reported art returns much more than transaction costs would alter the returns on financial investments.[44]

[Insert Table 12 about here]

7. Discussion and conclusion

> *[...], my beauty, though but mean,*
> *Needs not the painted flourish of your praise:*
> *Beauty is bought by judgment of the eye, [...]*
>
> [Shakespeare, Love's Labour's Lost, 1588]

Although beauty is in the eye of the beholder, "it is no sin to think of what a painting may be worth in terms of market price", as Richard Rush wrote in the preface of his 1961 book 'Art as an Investment', one of the first publications on the topic. Rush adds that "only a very foolish man would buy a painting without thoroughly understanding the market and price for the artist and for his school of art".

In this paper, we have studied the historical prices and returns in the art market (and several submarkets), and looked into the determinants of art prices. Our analysis builds on the most extensive set of auction data ever used (1.1 million auctioned paintings, prints and works on paper), which enables us to explain the variation in prices across works, and to plot the evolution in art prices since the middle of the last century.

We use a hedonic regression framework, which relates the auction prices of art to time dummies, controlling for important price-determining covariates. The results shed a new light on the price formation in the art market: the reputation of the artist and the strength of the attribution to an artist are shown to be important determinants of the final price. The topic of the work matters as well: for example, we see significant premiums for self-portraits and urban scenes. Next, our regression results confirm previous findings that the size, the medium, and the degree of visible authenticity (signature, date) influence the priceoutcome. Finally, we find that differences in prices are strongly correlated with variations in the timing of the sale, and the

---

[44] Note that there are still other significant costs related to an investment in art, such as insurance and storage costs.

identity and location of the auction house: especially pieces sold at sales in May/June or November/December at Sotheby's or Christie's in London or New York are highly valuable.

The coefficients on the year dummies in our hedonic model can be used to build a general art price index. Based on this index, we conclude that art prices have increased by not more than 4.03%, annually, in real USD terms between 1951 and 2007. During art market booms, however, prices can skyrocket. We find, for example, an average yearly real price appreciation of 22.91% between 1985 and 1990. Between 2002 and 2007, our index shows a real return of 11.60% per year. This helps to explain the attention to 'art as an investment' in recent years.

Based on the results of our medium-specific models, we conclude that, in the last quarter of a century, oil paintings have much more increased in value than works on paper. We also perform an analysis of thirteen art movements, and find that post-war art movements (such as Abstract Expressionism and Pop art) have outperformed earlier paradigms. In contrast, Romanticism, Realism, Impressionism & Symbolism, and Fauvism & Expressionism have increased by less than 4% yearly (in real terms) over the last 25 years. The large average price increases of post-war art movements have been accompanied by a high volatility in these indices, while Baroque and Rococo show the least volatile trends.

Our results are robust with respect to alternative specifications, and are not influenced by sample selection or survivorship biases. Using non-price measures of reputation, we find that the average return is significantly higher for masterpieces: high-quality art makes a better investment. If one takes the perspective of a GBP investor, the average returns over our time frame are even smaller than the USD returns. Also note that the art market has shown signs of slowing down in the second half of 2008, which would imply that our returns are estimated near the top of a boom period.

Our rates of return on art are remarkably lower than the outcomes in two earlier, influential studies based on repeat-sales regressions. Based on UK sales, Goetzmann (1993) reports an annualized real return of 13.3% over the period 1900-1986, with a "long and strong bull market" from 1940 to 1986. Goetzmann's art index significantly outperforms the stock market. In their much-cited paper, Mei and Moses (2002) report an average real return of 8.2% between 1950 and 1999. In contrast, our index appreciates by 3.61% over the same period (excluding 1950, for which we do not have data). The lower returns in our study can be explained by the fact that we start from a very comprehensive dataset, including all identifiable sales of works by more than 10,000 artists. This implies that we investigate the art market in general, and not merely the resales at the higher end of the market.

Our results thus suggest that art is not as good an investment as is often assumed or hoped for. Our art index has underperformed several financial alternatives. It seems safe to conclude that one should buy art primarily for non-financial reasons, and hope that the appreciation in value can compensate for the high transaction costs related to an investment in art. Anything else, our study shows, is wishful thinking.

References

Agnello, R.J. and Pierce, R.K., 1996. Financial returns, price determinants, and genre effects in American art investment. *Journal of Cultural Economics* 20, 359-383.

Agnello, R.J., 2002. Investment returns and risk for art: evidence from auctions of American paintings. *Eastern Economic Journal* 28, 443-463.

Anderson, R.C., 1974. Paintings as an investment. *Economic Inquiry* 12, 13-26.

Artprice.com, 2008. Art market trends 2007. [http://img1.artprice.com/pdf/trends2007.pdf]

Ashenfelter, O. and Graddy, K., 2003. Auctions and the price of art. *Journal of Economic Literature* 41, 763-786.

Ashenfelter, O. and Graddy, K., 2006. Art Auctions. In: Ginsburgh, V.A. and Throsby, D., eds. *Handbook of the Economics of Art and Culture*. Elsevier, Amsterdam.

Baumol, W.J., 1986. Unnatural value: Or art investment as floating crap game. *American Economic Review* 76 (AEA Papers and Proceedings), 10-14.

Britt, D. (ed.), 1989. Modern art: Impressionism to post-modernism. Thames & Hudson, London.

Buelens, N. and Ginsburgh, V., 1993. Revisiting Baumol's "art as a floating crap game". *European Economic Review* 37, 1351-1371.

Candela, G. and Scorcu, E., 1997. A price index for art market auctions. *Journal of Cultural Economics* 21, 175-196.

Cap Gemini, 2008. World Wealth Report. [http://www.us.capgemini.com/worldwealthreport08]

Chanel, O., Gérard-Varet, L.-A. and Ginsburgh, V., 1996. The relevance of hedonic price indices: the case of paintings. *Journal of Cultural Economics* 20, 1-24.

Court, A.T., 1939. Hedonic price indexes with automotive examples. In: *The dynamics of automobile demand*. General Motors, New York.

Czujack, C., 1996. Picasso paintings at auction, 1963-1994. *Journal of Cultural Economics* 21, 229-247.

Frey, B.S. and Pommerehne, W.W., 1989. Muses and markets: Explorations in the economics of the arts. Basil Blackwell, Oxford.

Galenson, D.W. and Weinberg, B.A., 2000. Age and the quality of work: The case of modern American painters. *Journal of Political Economy* 108, 761-777.

Ginsburgh, V., Mei, J. and Moses, M., 2006. On the computation of price indices. In: Ginsburgh, V.A. and Throsby, D., eds. *Handbook of the Economics of Art and Culture*. Elsevier, Amsterdam.

Goetzmann, W.N., 1993. Accounting for taste: Art and financial markets over three centuries. *American Economic Review* 83, 1370-1376.

Goetzmann, W.N., 1996. How costly is the fall from fashion? Survivorship bias in the painting market. In: Ginsburgh, V.A. and Menger, P.-M., eds. *Economics of the Arts: Selected Essays*. Elsevier, Amsterdam.

Goetzmann, W.N. and Peng, L., 2006. Estimating house price indexes in the presence of seller reservation prices. *The Review of Economics and Statistics* 88, 100-112.

Guerzoni, G., 1995. Reflections on historical series of art prices: Reitlinger's data revisited. *Journal of Cultural Economics* 19, 251-260.

Higgs, H. and Worthington, A., 2005. Financial returns and price determinants in the Australian art market, 1973-2003. *The Economic Record* 81, 113-123.

Hiraki, T., Ito, A., Spieth, D.A., and Takezawa, N., 2009. How did Japanese investments influence international art prices? Forthcoming in *Journal of Financial and Quantitative Analysis.*

Lazzaro, E., 2006. Assessing quality in cultural goods: The hedonic value of originality in Rembrandt's prints. *Journal of Cultural Economics* 30, 15-40.

Mandel, B.R., 2008. Art as an investment and conspicuous consumption good. Forthcoming in *American Economic Review.*

McAndrew, C. and Thompson, R., 2007. The collateral value of fine art. *Journal of Banking and Finance* 31, 589-607.

Mei, J. and Moses, M., 2002. Art as an investment and the underperformance of masterpieces. *American Economic Review* 92, 1656-1668.

Pesando, J.E., 1993. Art as an investment: the market for modern prints. *American Economic Review* 83, 1075-1089.

Pesando, J.E. and Shum, P.M., 1999. The return to Picasso's prints and to traditional financial assets, 1977 to 1996. *Journal of Cultural Economics* 23, 183-192.

Pesando, J.E. and Shum, P.M., 2008. The auction market for modern prints: Confirmations, contradictions, and new puzzles. *Economic Inquiry* 46, 149-159.

Renneboog, L. and Van Houtte, T., 2002. The monetary appreciation of paintings: From realism to Magritte. *Cambridge Journal of Economics* 26, 331-357.

Robinson, I. (ed.), 2005. Understanding international art markets and management. Routledge, New York.

Rosen, S., 1974. Hedonic prices and implicit markets: product differentiation in pure competition. *The Journal of Political Economy* 82, 34-55.

Rush, R., 1961. Art as an investment. Bonanza Books, New York.

Stein, J.P., 1977. The monetarty appreciation of paintings. *The Journal of Political Economy* 85, 1021-1036.

The New York Times, 1921. American art buyers keen. October 14, 1921.

Throsby, D., 1994. The production and consumption of the arts: A view of cultural economics. *Journal of Economic Literature* 32, 1-29.

Triplett, J. 2004. Handbook on hedonic indexes and quality adjustments in price indexes. OECD Science, Technology and Industry Working Papers 2004/9.

Worthington, A.C. and Higgs, H., 2004. Art as an investment: risk, return and portfolio diversification in major painting markets. *Accounting and Finance* 44, 257-271.

Zanola, R., 2007. The dynamics of art prices: The selection corrected repeat-sales index. Paper presented at the Art Markets Symposium, Maastricht, March 2007.

Appendix 1: Titles and topics

This appendix lists the search strings used on the first word(s) of the title of a work to create the topic dummies used in this study. Although most titles in our database are in English, we also account for French titles by including French keywords in the analysis. We try to avoid search strings that can be used in different contexts. For example, "figure" can refer to a person, but also to an abstract concept. Finally, if a word (e.g. "chat") can be used as part of a totally different other word (e.g. "chateau"), then we only search for titles that are not longer than the word itself or in which the relevant word is followed by a space (e.g. "chat_"). These are the topic categories, along with their search strings:

1. ABSTRACT: "abstract", "composition"
2. ANIMALS: "horse", "cheval", "chevaux", "cow_", "cows", "vache", "cattle", "cat_", "cats", "chat_ ", "dog_", "dogs", "chien", "sheep", "mouton", "bird", "oiseau"
3. LANDSCAPE: "landscape", "country landscape", "coastal landscape", "paysage", "seascape", "sea_", "mer_", "mountain", "river", "riviere", "lake", "lac_", "valley", "vallee"
4. NUDE: "nude", "nu_", "nue_"
5. PEOPLE: "people", "personnage", "family", "famille", "boy", "garcon", "girl", "fille", "man_", "men_", "homme", "woman", "women", "femme", "child", "enfant", "couple", "mother", "mere_", "father", "pere_", "lady", "dame"
6. PORTRAIT: "portrait"
7. RELIGION: "jesus", "christ_", "apostle", "ange_", "angel", "saint_", "madonna", "holy_", "mary magdalene", "annunciation", "annonciation", "adoration", "adam and eve", "adam et eve", "crucifixion", "last supper"
8. SELF-PORTRAIT: "self-portrait", "self portrait", "auto-portrait", "autoportrait"
9. STILL_LIFE: "still life", "nature morte", "bouquet"
10. UNTITLED: "untitled", "sans titre"
11. URBAN: "city", "ville", "town", "village", "street", "rue", "market", "marche", "harbour", "port_", "paris", "london", "londres", "new york", "amsterdam", "rome_", "venice", "venise"

Appendix 2: Important European and American auction houses

The EUROPEAN category includes all sales by the following auctioneers: Lyon & Turnbull (Scotland, founded in 1826), Francis Briest / Artcurial Briest (France), Ader, Picard & Tajan / Ader & Tajan / Tajan (France), Bruun Rasmussen (Denmark, founded in 1948), Dorotheum (Austria, founded in 1707), Koller (Switzerland, founded in 1958), Lempertz (Germany, founded in 1845), Neumeister (Germany, founded in 1958), Finarte (Italy, founded in 1959), Bukowskis (Sweden, founded in 1870), Stockholms Auktionsverk (Sweden, founded in 1674).

The AMERICAN category includes all sales by the following auctioneers: Butterfields (founded in 1865, until takeover by Bonhams in 2002), Swann Auction Galleries (founded in 1941), Skinner, Doyle New York (founded in 1962), Freeman's (founded in 1800), Leslie Hindman Auctioneers (founded in 1982).

Appendix 3: List of 'fallen from fashion' artists

This appendix lists these artists in our dataset that were included in the 1926, 1959 or 1980 edition of Gardner's Art through the Ages, but not in the 1996 or 2004 edition. This results in a list of 220 'fallen from fashion' artists:

Abate, Nicolo dell'; Abbey, Edwin Austin; Albright, Ivan; Alexander, John White; Allston, Washington; Ando Hiroshige; Atl, Dr; Bakst, Leon; Baldovinetti, Alesso; Bartlett, William Henry; Bartolommeo, Fra; Beal, Reynolds; Bellini, Jacopo; Bellows, George; Bermejo, Bartolome; Bernard, Emile; Berruguete, Alonso; Berthon, George Theodore; Bingham, George Caleb; Bladen, Ronald; Blakelock, Ralph Albert; Blashfield, Edwin Howland; Blondeel, Lanceloot; Bloom, Hyman; Blume, Peter; Bocklin, Arnold; Borch, Gerard ter; Bourdelle, Emile-Antoine; Brown, Ford Madox; Brush, George de Forest; Bulfinch, Charles; Burchfield, Charles; Bury, Pol; Cabanel, Alexandre; Cabrera, Miguel; Campendonk, Heinrich; Carr, Emily; Carra, Carlo; Charlot, Jean; Chase, William Merritt; Chasseriau, Theodore; Chodensu Mincho; Cione, Nardo di; Cousin, Jean; Couture, Thomas; Cox, Kenyon; Crome, John; Cullen, Maurice; Curry, John Steuart; David, Gerard; Dewing, Thomas Wilmer; Domenico Veneziano; Dongen, Kees van; Dore, Gustave; Doughty, Thomas; Dufy, Raoul; Durand, Asher B.; Duveneck, Frank; Epstein, Jacob; Evans, Walker; Evergood, Philip; Falconet, Etienne-Maurice; Feininger, Lyonel; Feke, Robert; Ferber, Herbert; Friesz, Othon; Fromentin, Eugene; Fry, Roger; Fuller, George; Glackens, William J.; Gleizes, Albert; Goncalves, Nuno; Gris, Juan; Gropper, William; Harding, Chester; Harnett, William Michael; Harpignies, Henri-Joseph; Hartigan, Grace; Hassam, Childe; Haydon, Benjamin Robert; Heade, Martin Johnson; Heckel, Erich; Herschel, John; Hesselius, John; Hilliard, Nicholas; Hishikawa Moronobu; Hofmann, Hans; Hollar, Wenceslaus; Hooch, Pieter de; Hovenden, Thomas; Huguet, Jaume; Hunt, William Holman; Huszar, Vilmos; Ibarra, Jose de; Ike Taiga; Inman, Henry; Inness, George; Ippitsusai Buncho; Isoda Koryusai; Israels, Jozef; Ito Jakuchu; Jawlensky, Alexei; Johnson, Eastman; Justus of Ghent; Kane, Paul; Kensett, John Frederick; Kienholz, Edward; Kneller, Godfrey; Krieghoff, Cornelius; Krimmel, John L.; Kuhn, Justus Engelhardt; La Farge, John; La Fresnaye, Roger de; Lane, Fitz Hugh; Lawson, Ernest; Le Secq, Henri; Leck, Bart van der; Ledoux, Claude-Nicolas; Lely, Peter; Leslie, C. R.; Levine, Jack; Ligorio, Pirro; Lippi, Filippino; Lissitzky, El; Lorenzo Monaco; Luks, George; Macke, August; Marca-Relli, Conrad; Marcks, Gerhard; Marees, Hans von; Marin, John; Marquet, Albert; Marsh, Reginald; Martin, Homer Dodge; Masolino; Masson, Andre; Maurer, Alfred H.; McIntire, Samuel; Meissonier, Ernest; Mena, Pedro de; Merida, Carlos; Mestrovic, Ivan; Metcalf, Willard Leroy; Metzinger, Jean; Milne, David B.; Montenegro, Roberto; Mori Sosen; Morrice, James Wilson; Morse, Samuel F. B.; Motherwell, Robert; Mount, William Sidney; Murillo, Bartolome Esteban; Ni Zan ; Ogata Kenzan; Opalka, Roman; Orley, Bernard

van; Pacher, Michael; Panini, Giovanni Paolo; Paolozzi Eduardo; Peale, Charles Willson; Peruzzi, Baldassare; Pickett, Joseph; Pinturicchio, Bernardino; Pisanello; Posada, Jose Guadalupe; Pratt, Matthew; Prendergast, Maurice; Rejlander, O. G.; Remington, Frederic; Revett, Nicholas; Riopelle, Jean-Paul; Roberti, Ercole de'; Roerich, Nicholas; Ronald, William; Roszak, Theodore; Rousseau, Theodore; Russolo, Luigi; Sakai Hoitsu; Schinkel, Karl Friedrich; Schmidt-Rottluff, Karl; Scorel, Jan van; Shinn, Everett; Shirlaw, Walter; Signac, Paul; Siqueiros, David Alfaro; Sisley, Alfred; Smibert, John; Soane, John; Soga Shohaku; Soutine, Chaim; Still, Clyfford; Stuart, Gilbert; Su Shi; Sully, Thomas; Sutherland, Graham; Suzor-Cote, Marc-Aurele de Foy; Tanguy, Yves; Tarbell, Edmund C.; Thayer, Abbott Handerson; Theus, Jeremiah; Thomson, Tom; Tissot, James; Toshusai Sharaku; Trumbull, John; Tura, Cosimo; Utrillo, Maurice; Van de Velde, Henry; Vanderlyn, John; Vantongerloo, Georges; Vedder, Elihu; Villon, Jacques; Waterhouse, Alfred; Weber, Max; Weir, Julian Alden; Wilson, Richard; Wood, Grant; Wu Wei; Wyant, Alexander Helwig; Wyeth, Andrew; Zoffany, Johan.

Appendix 4: List of 'blue chip' artists

This appendix lists the artists in our dataset that occurred in all five considered editions of Gardner's Art through the Ages. We exclude a small number of individuals who are included in the Gardner text books as architects. This results in a list of 69 'blue chip' artists:

Angelico, Fra; Bellini, Giovanni; Botticelli, Sandro; Caravaggio, Michelangelo Merisi da; Cezanne, Paul; Chardin, Jean-Simeon; Claude Lorrain; Constable, John; Courbet, Gustave; Daumier, Honore; David, Jacques-Louis; Delacroix, Eugene; Duccio; Durer, Albrecht; Dyck, Anthony van; Eyck, Jan van; Fouquet, Jean; Gainsborough, Thomas; Gauguin, Paul; Giorgione; Giotto; Gogh, Vincent van; Goya, Francisco de; Greco, El; Hals, Frans; Hogarth, William; Holbein, Hans; Ingres, Jean-Auguste-Dominique; Katsushika Hokusai; Leonardo da Vinci; Lippi, Filippo; Ma Yuan; Mantegna, Andrea; Martini, Simone; Masaccio; Matisse, Henri; Memling, Hans; Michelangelo; Millet, Jean-Francois; Monet, Claude; Ogata Korin; Perugino; Picasso, Pablo; Piero della Francesca; Piranesi, Giovanni Battista; Pollaiuolo, Antonio; Poussin, Nicolas; Puvis de Chavannes, Pierre; Raphael; Rembrandt van Rijn; Renoir, Auguste; Ribera, Jusepe de; Rodin, Auguste; Rubens, Peter Paul; Ruisdael, Jacob van; Sargent, John Singer; Sarto, Andrea del; Tintoretto, Jacopo; Titian; Toyo Sesshu; Turner, J. M. W.; Uccello, Paolo; Vasari, Giorgio; Velazquez, Diego; Vermeer, Johannes; Verrocchio, Andrea del; Watteau, Antoine; Weyden, Rogier van der; Whistler, James McNeill.

Table 1: Overview of earlier return studies

Table 1 gives an overview of published studies that calculate returns in the art market. Real return are reported where possible. The table also includes the year of publication of the study, the sample and time period, the number of observations, and the most important data source(s). We classify the studies by the main methodology employed.

Study	Year	Sample	Period	N	Nominal return	Real return	Data
1. Average per year							
Stein	1977	Pre-WW II paintings (in US)	1946-1968	8,950	10.47%		Art Prices Current
		Pre-WW II paintings (in UK)	1946-1968	35,823	13.12%		Art Prices Current
Worthington and Higgs	2004	Paintings	1976-2001	94,514	2.54%		Art Market Research
2. Geometric mean estimator							
Baumol	1986	Paintings	1652-1961	640		0.55%	Reitlinger
Frey and Pommerehne	1989	Paintings	1635-1987	1,198		1.5%	Reitlinger
		Paintings	1950-1987			1.7%	Reitlinger
3. Hedonic regression							
Anderson	1974	Paintings	1800-1970	> 13,000	3.3%		Reitlinger and Mayer
Buelens and Ginsburgh	1993	Paintings	1750-1961	ca. 5,900		0.91%	Reitlinger
Chanel et al.	1996	Paintings	1855-1969	1,972		4.9%	Reitlinger
Agnello and Pierce	1996	American paintings	1971-1992	15,216	9.3%		Art Sales Index
Renneboog and Van Houtte	2002	Belgian paintings	1970-1997	10,598	5.6%		Art Sales Index
Higgs and Worthington	2005	Australian paintings	1973-2003	37,605	6.96%		Austr. Art Auction Records
4. Repeat-sales regression							
Goetzmann	1993	Paintings	1716-1986	3,329		2.0%	Reitlinger and Mayer
		Paintings	1900-1986			13.3%	Reitlinger and Mayer
Pesando and Shum	1999	Picasso prints	1977-1996	8,257		1.48%	Gordon's Print Price Annual
Mei and Moses	2002	Paintings	1875-1999	4,896		4.9%	Mei & Moses
		Paintings	1950-1999			8.2%	Mei & Moses
Pesando and Shum	2008	Modern prints	1977-2004	80,214		1.51%	Gordon's Print Price Annual

Table 2: Overview of art movements

Table 2 outlines the different art movements used in this study. The second column indicates how many of the artists in our dataset are classified to each art movement. The column 'Grove Art Online' shows which 'Styles and Cultures' of that online database are considered for each of our art movements. The column 'Artcyclopedia' does the same with the 'Art Movements' of the website Artcyclopedia.com, while the column 'Britt (1989)' lists the relevant chapters in the art history textbook 'Modern Art', edited by David Britt. The website Wikipedia.com was consulted in April 2008 to identify contemporary artists.

Movement	N	Grove Art Online	Artcyclopedia	Britt (1989)	Wikipedia
Medieval & Renaissance	1,289	Medieval art Renaissance & Mannerism			
Baroque	1,285	Baroque	Baroque		
Rococo	182	Rococo	Rococo		
Neoclassicism	208	Neoclassicism & Greek Revival	Neoclassicism		
Romanticism	244	Romanticism Hudson River School	Romanticism Hudson River School		
Realism	255	Realism & Naturalism Social Realism Pre-Raphaelitism	Realism Social Realism Pre-Raphaelites		
Impressionism & Symbolism	325	Impressionism & Symbolism Aesthetic Movement Art Nouveau	Impressionism Post-Impressionism Symbolism Art Nouveau	Impressionism Symbolism & Art Nouveau	
Fauvism & Expressionism	123	Fauvism Expressionism Bauhaus	Fauvism Expressionism	Fauvism & Expressionism	
Cubism, Futurism & Constructivism	118	Cubism Futurism Constructivism	Cubism Futurism	Cubism, Futurism & Constructivism	
Dada & Surrealism	126	Dada Surrealism	Dada Surrealism	Dada & Surrealism	
Abstract Expressionism	106	Abstract Expressionism	Abstract Expressionism	Abstract Expressionism	
Pop	69	Pop & Nouveau Réalisme	Pop	Pop	
Minimalism & Contemporary	321	Minimalism	Minimalism	Pluralism since 1960	'List of Contemporary Artists'

Table 3: Number of observations per year and per medium

Table 3 displays the number of observations (per medium and in total) in our dataset for each year from 1922 to 2007.

	Oil	Print	Paper	Total		Oil	Print	Paper	Total
1922	59	0	24	83	1966	2,023	123	670	2,816
1923	234	0	57	291	1967	1,993	40	618	2,651
1924	29	0	0	29	1968	2,335	84	1,052	3,471
1925	50	0	7	57	1969	2,284	122	1,018	3,424
1926	96	0	7	103	1970	3,359	454	1,064	4,877
1927	359	8	63	430	1971	6,362	0	1,301	7,663
1928	84	0	41	125	1972	7,896	1	1,608	9,505
1929	550	9	25	584	1973	10,641	2	2,015	12,658
1930	63	0	15	78	1974	11,160	14	2,620	13,794
1931	67	1	2	70	1975	10,117	5	3,418	13,540
1932	8	0	0	8	1976	11,296	1	6,145	17,442
1933					1977	12,460	4	7,090	19,554
1934	82	3	0	85	1978	13,291	3	7,185	20,479
1935					1979	13,527	7	9,278	22,812
1936	21	0	5	26	1980	14,521	5	9,849	24,375
1937					1981	14,453	7	10,073	24,533
1938	157	0	26	183	1982	12,390	2	8,541	20,933
1939	83	0	2	85	1983	13,991	4	9,618	23,613
1940					1984	16,342	2	10,942	27,286
1941					1985	17,036	8	11,300	28,344
1942					1986	17,238	6	11,066	28,310
1943					1987	20,215	4	13,742	33,961
1944					1988	21,277	4	14,038	35,319
1945					1989	24,640	18	16,700	41,358
1946	505	7	51	563	1990	21,318	12	14,839	36,169
1947	53	0	0	53	1991	15,759	3	10,742	26,504
1948	36	0	3	39	1992	15,938	6	10,855	26,799
1949					1993	16,393	23	11,770	28,186
1950					1994	18,492	3	14,253	32,748
1951	68	0	1	69	1995	19,819	118	14,115	34,052
1952	73	1	5	79	1996	20,592	2,169	14,292	37,053
1953	418	3	39	460	1997	21,000	4,213	14,885	40,098
1954	443	1	103	547	1998	23,522	4,257	15,762	43,541
1955	542	0	57	599	1999	23,120	3,765	14,423	41,308
1956	612	0	28	640	2000	21,926	4,321	14,905	41,152
1957	838	0	252	1,090	2001	20,411	4,237	15,111	39,759
1958	1,038	5	151	1,194	2002	18,280	4,155	14,891	37,326
1959	1,184	15	292	1,491	2003	19,120	5,068	16,049	40,237
1960	1,118	9	402	1,529	2004	22,388	5,963	18,302	46,653
1961	1,153	15	350	1,518	2005	25,260	6,947	20,802	53,009
1962	1,624	43	710	2,377	2006	24,975	7,796	20,345	53,116
1963	685	0	246	931	2007	15,209	3,866	11,655	30,730
1964	1,685	97	549	2,331					
1965	2,202	152	914	3,268	**Total**	**660,588**	**58,211**	**433,374**	**1,152,173**

Table 4: Descriptive statistics hedonic variables

Table 4 displays the descriptive statistics for the hedonic variables used in this study. WORD_COUNT is the number of words in the artist's entry in the Grove Art Online database, as measured in February 2008. ART_HISTORY_BOOK is a dummy variable that equals one if the artist was included in the last edition of 'Gardner's Art Through the Ages' (1926, 1959, 1980, 1996, or 2004) prior to the sale. EXHIBITION is a dummy variable that equals one once the artist has exhibited at the Documenta art exhibition in Kassel, Germany. DECEASED is a dummy variable that equals one if the artist has died prior to the sale of the work. The artist nationality dummies AMERICAN, BRITISH, DUTCH, FRENCH, GERMAN, and ITALIAN equal one if the artist has the indicated nationality. The attribution dummies ATTRIBUTED, STUDIO, CIRCLE, SCHOOL, AFTER, and STYLE equal one if the auction catalogue identifies the work as being "attributed to" the artist, from the "studio" of that artist, from the "circle" of the artist, from the artist's "school", "after" the artist, or "in the style of" the artist, respectively. The authenticity dummies SIGNED, DATED, and INSCRIBED take the value one if the work carries a signature of the artist, is dated, or has an inscription, respectively. The medium dummies OIL, PRINT, and PAPER indicate whether the work is an oil painting, a print, or a work on paper (drawings, watercolors, etc.). The additional print dummies NUMBERED and NUMBERED1 take the value one if a print is numbered or carries the number '1', respectively. WATERCOLOR is a dummy variable that equals one if a work on paper is a watercolor or a gouache (as opposed to a drawing). The variables HEIGHT and WIDTH measure the height and the width of the work in inches. The topic dummies are based on the first word(s) of the title of the work: see Appendix 1. SEMESTER2 is a dummy variable that equals one if the sale takes place in the second half of the year. The month dummies indicate the month of the sale. The auction house dummies SOTH_LONDON, SOTH_NY, SOTH_OTHER, CHR_LONDON, CHR_NY, CHR_OTHER, BON_LONDON, BON_OTHER, PHIL_LONDON, and PHIL_OTHER equal one if the sale takes place at Sotheby's London, Sotheby's New York, another branch of Sotheby's, Christie's London, Christie's New York, another branch of Christie's, Bonhams London, another office of Bonhams, Phillips London, or another sales room of Phillips, respectively. AUCTION_EUROPEAN and AUCTION_AMERICAN are dummy variables that take the value one if the sale takes place at a large Continental European or a large American auction house, respectively: see Appendix 2. For each variable, we report the number of observations (N), the mean value, and the standard deviation (S.D.). For dummy variables, we also report the number of zeros and ones.

	N	Mean	S.D.	0	1
Artist characteristics					
WORD_COUNT	1,152,173	1,279.06	2,270.39		
ART_HISTORY_BOOK	1,152,173	0.15	0.36	980,346	171,827
EXHIBITION	1,152,173	0.24	0.42	879,904	272,269
DECEASED	1,152,173	0.88	0.32	137,396	1,014,777
Artist nationality dummies					
AMERICAN	610,753	0.13	0.33	534,066	76,687
BRITISH	610,753	0.07	0.26	567,715	43,038
DUTCH	610,753	0.11	0.31	543,635	67,118
FRENCH	610,753	0.30	0.46	430,288	180,465
GERMAN	610,753	0.07	0.25	568,107	42,646
ITALIAN	610,753	0.10	0.31	547,129	63,624
Work characteristics					
Attribution dummies					
ATTRIBUTED	1,152,173	0.04	0.20	1,104,502	47,671
STUDIO	1,152,173	0.00	0.07	1,146,561	5,612
CIRCLE	1,152,173	0.02	0.15	1,127,240	24,933
SCHOOL	1,152,173	0.01	0.08	1,145,108	7,065
AFTER	1,152,173	0.01	0.10	1,140,113	12,060
STYLE	1,152,173	0.03	0.16	1,120,862	31,311
Authenticity dummies					
SIGNED	1,152,173	0.59	0.49	466,970	685,203
DATED	1,152,173	0.32	0.47	781,580	370,593
INSCRIBED	1,152,173	0.15	0.35	982,449	169,724
Medium dummies					
OIL	1,152,173	0.57	0.49	491,585	660,588
PRINT	1,152,173	0.05	0.22	1,093,962	58,211
PAPER	1,152,173	0.38	0.48	718,799	433,374
Additional print dummies					
NUMBERED	58,211	0.41	0.49	34,530	23,681
NUMBERED1	58,211	0.01	0.08	57,810	401
WATERCOLOR	433,374	0.44	0.50	243,967	189,407
Size variables					
HEIGHT	1,139,401	20.69	14.91		
WIDTH	1,139,237	21.54	15.90		

Table 4: Descriptive statistics hedonic variables (cont.)

	N	Mean	S.D.	0	1
Topic dummies					
STUDY	1,152,173	0.01	0.12	1,135,387	16,786
ABSTRACT	1,152,173	0.02	0.16	1,123,671	28,502
ANIMALS	1,152,173	0.01	0.10	1,139,931	12,242
LANDSCAPE	1,152,173	0.04	0.20	1,104,652	47,521
NUDE	1,152,173	0.01	0.09	1,142,641	9,532
PEOPLE	1,152,173	0.04	0.19	1,108,620	43,553
PORTRAIT	1,152,173	0.06	0.24	1,083,108	69,065
RELIGION	1,152,173	0.02	0.13	1,133,430	18,743
SELF-PORTRAIT	1,152,173	0.00	0.06	1,148,292	3,881
STILL_LIFE	1,152,173	0.02	0.15	1,124,878	27,295
UNTITLED	1,152,173	0.03	0.17	1,119,575	32,598
URBAN	1,152,173	0.01	0.11	1,136,772	15,401
Sale characteristics					
SEMESTER2	1,152,173	0.44	0.50	605,903	546,270
Month dummies					
JANUARY	1,152,173	0.03	0.16	1,120,303	31,870
FEBRUARY	1,152,173	0.04	0.20	1,101,822	50,351
MARCH	1,152,173	0.09	0.29	1,047,968	104,205
APRIL	1,152,173	0.09	0.28	1,052,787	99,386
MAY	1,152,173	0.14	0.35	993,039	159,134
JUNE	1,152,173	0.14	0.35	991,216	160,957
JULY	1,152,173	0.05	0.23	1,089,656	62,517
AUGUST	1,152,173	0.01	0.11	1,137,506	14,667
SEPTEMBER	1,152,173	0.03	0.18	1,114,285	37,888
OCTOBER	1,152,173	0.09	0.29	1,046,740	105,433
NOVEMBER	1,152,173	0.17	0.37	959,026	193,147
DECEMBER	1,152,173	0.12	0.32	1,019,555	132,618
Auction house dummies					
SOTH_LONDON	1,152,173	0.12	0.33	1,012,273	139,900
SOTH_NY	1,152,173	0.09	0.28	1,050,831	101,342
SOTH_OTHER	1,152,173	0.05	0.22	1,091,083	61,090
CHR_LONDON	1,152,173	0.10	0.30	1,040,547	111,626
CHR_NY	1,152,173	0.07	0.25	1,076,093	76,080
CHR_OTHER	1,152,173	0.07	0.25	1,073,120	79,053
BON_LONDON	1,152,173	0.01	0.10	1,140,323	11,850
BON_OTHER	1,152,173	0.01	0.08	1,145,289	6,884
PHIL_LONDON	1,152,173	0.01	0.12	1,135,540	16,633
PHIL_OTHER	1,152,173	0.01	0.09	1,141,843	10,330
AUCTION_EUROPEAN	1,152,173	0.13	0.34	999,061	153,112
AUCTION_AMERICAN	1,152,173	0.02	0.15	1,125,702	26,471

Table 5: Overview of the hedonic regression models

Table 5 outlines the hedonic regression models estimated in this paper. Model (1) only includes year dummies. Artist dummies are added in model (2). Models (3) and (4) are our general benchmark models: model (3) includes a dummy variable for each artist, while model (4) replaces the artist dummies by a word count variable. Models (5) and (6) are medium-specific and estimate separate hedonic models for (a) oil paintings, (b) prints, and (c) works on paper. Models (7) and (8) are movement-specific and estimate separate hedonic models for all thirteen art movements. All models are estimated using OLS. In all cases, the dependent variable is the natural log of the price in 2007 USD. For the definitions of the independent variables: see Table 4.

Model	(1)	(2)	(3)	(4)	(5a-c)	(6a-c)	(7a-m)	(8a-m)
Type of data considered	All	All	All	All	Medium	Medium	Movement	Movement
Year dummies	yes	yes	yes	yes	yes	yes	yes	yes
Artist characteristics								
Artist dummies	no	yes	yes	no	yes	no	yes	no
WORD_COUNT (and exponentiations)	no	no	no	yes	no	yes	no	yes
ART_HISTORY_BOOK	no	no	yes	yes	yes	yes	yes	yes
EXHIBITION	no	no	yes	yes	yes	yes	if appl.	if appl.
DECEASED	no	no	yes	yes	yes	yes	if appl.	if appl.
Artist nationality dummies	no	no	no	no	no	no	no	if appl.
Work characteristics								
Attribution dummies	no	no	yes	yes	yes	yes	if appl.	if appl.
Authenticity dummies	no	no	yes	yes	yes	yes	yes	yes
Medium dummies	no	no	yes	yes	no	no	yes	yes
Additional print dummies	no	no	no	no	if appl.	if appl.	no	no
WATERCOLOR	no	no	no	no	if appl.	if appl.	no	no
Size variables	no	no	yes	yes	yes	yes	yes	yes
Topic dummies	no	no	yes	yes	yes	yes	if appl.	if appl.
Sale characteristics								
SEMESTER2	no	no	yes	yes	yes	yes	yes	yes
Month dummies	no	no	yes	yes	yes	yes	yes	yes
Auction house dummies	no	no	yes	yes	yes	yes	yes	yes
Number of observations	1,152,173	1,152,173	1,139,165	1,139,165				
Adjusted R-square	0.04	0.34	0.62	0.42	see Table 8		see Table 9	
F-value	576.84	71.79	220.17	6,253.16				

Table 6: General hedonic regressions

Table 6 presents the hedonic regression results for general benchmark models (3) and (4) described in Table 5. All models are estimated using OLS. The dependent variable is the natural log of the price in 2007 USD. For the definitions of the independent variables: see Table 4.

Model	Model (3)		Model (4)	
Type of data considered	All		All	
	Coefficient	p-value	Coefficient	p-value
Year dummies	[incl.]		[incl.]	
Artist characteristics				
Artist dummies	[incl.]		[not incl.]	
WORD_COUNT	[not incl.]		8.37E-04	<.0001
WORD_COUNT_2	[not incl.]		-1.68E-07	<.0001
WORD_COUNT_3	[not incl.]		1.24E-11	<.0001
WORD_COUNT_4	[not incl.]		-2.82E-16	<.0001
ART_HISTORY_BOOK	0.1145	<.0001	0.3882	<.0001
EXHIBITION	-0.0481	0.1236	0.3369	<.0001
DECEASED	-0.0288	<.0001	0.3441	<.0001
Work characteristics				
Attribution dummies				
ATTRIBUTED	-0.7367	<.0001	-0.6699	<.0001
STUDIO	-0.7697	<.0001	-0.6222	<.0001
CIRCLE	-1.0333	<.0001	-0.9225	<.0001
SCHOOL	-1.4022	<.0001	-1.3395	<.0001
AFTER	-1.7381	<.0001	-1.7111	<.0001
STYLE	-1.5480	<.0001	-1.3530	<.0001
Authenticity dummies				
SIGNED	0.2677	<.0001	0.2069	<.0001
DATED	0.1876	<.0001	0.1083	<.0001
INSCRIBED	-0.0064	0.0227	-0.0035	0.2904
Medium dummies				
OIL	[left out]		[left out]	
PRINT	-2.0567	<.0001	-1.5315	<.0001
PAPER	-0.9377	<.0001	-0.8656	<.0001
Size variables				
HEIGHT	0.0200	<.0001	0.0152	<.0001
WIDTH	0.0247	<.0001	0.0192	<.0001
HEIGHT_2	-6.26E-05	<.0001	-5.12E-05	<.0001
WIDTH_2	-7.77E-05	<.0001	-5.83E-05	<.0001
Topic dummies				
STUDY	-0.2505	<.0001	-0.3354	<.0001
ABSTRACT	-0.0482	<.0001	-0.1419	<.0001
ANIMALS	-0.1657	<.0001	-0.3033	<.0001
LANDSCAPE	-0.1248	<.0001	-0.1230	<.0001
NUDE	-0.1880	<.0001	-0.2336	<.0001
PEOPLE	-0.0257	<.0001	-0.0300	<.0001
PORTRAIT	-0.2354	<.0001	-0.3836	<.0001
RELIGION	-0.0990	<.0001	-0.0674	<.0001
SELF-PORTRAIT	0.1328	<.0001	0.0497	0.0094
STILL_LIFE	0.0549	<.0001	0.2775	<.0001
UNTITLED	-0.1480	<.0001	-0.2485	<.0001
URBAN	0.0431	<.0001	0.1845	<.0001

Table 6: General hedonic regressions (cont.)

Model	Model (3)		Model (4)	
Type of data considered	All		All	
	Coefficient	**p-value**	**Coefficient**	**p-value**
Sale characteristics				
SEMESTER2	0.0882	<.0001	0.2258	<.0001
Month dummies				
JANUARY	[left out]		[left out]	
FEBRUARY	-0.1020	<.0001	-0.0458	<.0001
MARCH	0.0389	<.0001	0.1453	<.0001
APRIL	0.0884	<.0001	0.2443	<.0001
MAY	0.1517	<.0001	0.3652	<.0001
JUNE	0.1671	<.0001	0.3997	<.0001
JULY	[left out]		[left out]	
AUGUST	-0.1413	<.0001	-0.2111	<.0001
SEPTEMBER	-0.2402	<.0001	-0.3564	<.0001
OCTOBER	-0.0775	<.0001	-0.1154	<.0001
NOVEMBER	0.1101	<.0001	0.1727	<.0001
DECEMBER	0.0758	<.0001	0.1749	<.0001
Auction house dummies				
SOTH_LONDON	0.6362	<.0001	0.8228	<.0001
SOTH_NY	0.7193	<.0001	1.0628	<.0001
SOTH_OTHER	0.3069	<.0001	0.4416	<.0001
CHR_LONDON	0.6441	<.0001	0.8288	<.0001
CHR_NY	0.6510	<.0001	1.0059	<.0001
CHR_OTHER	0.1461	<.0001	0.1995	<.0001
BON_LONDON	0.1304	<.0001	0.0493	<.0001
BON_OTHER	-0.1100	<.0001	-0.3267	<.0001
PHIL_LONDON	0.2044	<.0001	0.1684	<.0001
PHIL_OTHER	0.1159	<.0001	0.0982	<.0001
AUCTION_EUROPEAN	0.1203	<.0001	0.1293	<.0001
AUCTION_AMERICAN	-0.0567	<.0001	-0.0075	0.3331
Number of observations	1,139,165		1,139,165	
Adjusted R-square	0.62		0.42	
F-value	220.17		6,253.16	

Table 7: Coefficients on time dummies in models (3) and (4)

Table 7 displays the hedonic regression results for the time dummies since 1951 in models (3) and (4). All models are estimated using OLS. The dependent variable is the natural log of the price in 2007 USD. The values in the column 'Index' are calculated by taking the exponents of the coefficients. The index values in 1978 are set equal to 100.

	Model (3)		Model (4)	
	Coeff.	**Index**	**Coeff.**	**Index**
1951	-1.3405	26.17	-1.0930	33.52
1952	-1.5702	20.80	-1.2377	29.01
1953	-1.3599	25.67	-1.0739	34.17
1954	-1.2262	29.34	-0.9855	37.33
1955	-1.2416	28.89	-0.9937	37.02
1956	-1.3052	27.11	-0.9215	39.79
1957	-1.1106	32.94	-0.7632	46.62
1958	-1.1686	31.08	-0.8310	43.56
1959	-0.8692	41.93	-0.5316	58.76
1960	-0.8480	42.83	-0.5224	59.31
1961	-0.7794	45.87	-0.5534	57.50
1962	-0.7460	47.43	-0.5579	57.24
1963	-0.3177	72.78	0.0197	101.99
1964	-0.7000	49.66	-0.5946	55.18
1965	-0.5457	57.94	-0.3605	69.73
1966	-0.4233	65.49	-0.1938	82.38
1967	-0.3687	69.16	-0.1777	83.72
1968	-0.2315	79.34	-0.1492	86.14
1969	-0.2256	79.80	-0.1693	84.43
1970	-0.3326	71.71	-0.1572	85.45
1971	-0.1275	88.03	0.0814	108.48
1972	0.0566	105.83	0.2166	124.19
1973	0.3226	138.07	0.4354	154.55
1974	0.2241	125.12	0.3622	143.65
1975	-0.0059	99.42	0.0975	110.24
1976	-0.1274	88.03	-0.0442	95.67
1977	-0.1330	87.54	-0.0996	90.52
1978	[not incl.]	100.00	[not incl.]	100.00
1979	0.0771	108.01	0.0600	106.19
1980	0.0829	108.65	0.0578	105.95
1981	-0.0483	95.29	-0.0635	93.85
1982	-0.2263	79.75	-0.2321	79.29
1983	-0.2029	81.64	-0.2200	80.25
1984	-0.1882	82.85	-0.2268	79.71
1985	-0.0971	90.74	-0.1391	87.01
1986	0.1421	115.27	0.1242	113.23
1987	0.4575	158.00	0.4416	155.51
1988	0.6595	193.38	0.6602	193.51
1989	0.8773	240.43	0.8990	245.72
1990	0.9344	254.57	0.9446	257.17
1991	0.5427	172.07	0.5041	165.55
1992	0.4401	155.28	0.4115	150.90
1993	0.2767	131.87	0.2441	127.65
1994	0.2654	130.40	0.2367	126.71
1995	0.2816	132.52	0.2515	128.60
1996	0.2894	133.57	0.2761	131.80
1997	0.2821	132.58	0.2593	129.60
1998	0.3090	136.21	0.2709	131.12
1999	0.3616	143.56	0.3315	139.31
2000	0.3282	138.85	0.2833	132.74
2001	0.2617	129.92	0.2176	124.31
2002	0.3237	138.23	0.2775	131.98
2003	0.4346	154.43	0.3834	146.73
2004	0.5443	172.34	0.4981	164.57
2005	0.5751	177.72	0.5477	172.93
2006	0.6693	195.29	0.6419	190.00
2007	0.8726	239.31	0.8708	238.88

Table 8: Medium-specific regressions

This table displays the hedonic regression results for medium-specific models (5) and (6). All models are estimated using OLS. The dependent variable is the natural log of the price in 2007 USD. For the definitions of the independent variables: see Table 4.

Model	Model (5a)		Model (5b)		Model (5c)		Model (6a)		Model (6b)		Model (6c)	
Type of data considered	Oil		Print		Paper		Oil		Print		Paper	
	Coeff.	p-value	Coeff.	p-value	Coeff.	p-value	Coeff.	p-value	Coeff.	p-value	Coeff.	p-value
Year dummies	[incl.]		[incl.]		[incl.]		[incl.]		[incl.]		[incl.]	
Artist characteristics												
Artist dummies	[incl.]		[incl.]		[incl.]		[not incl.]		[not incl.]		[not incl.]	
WORD_COUNT	[not incl.]		[not incl.]		[not incl.]		9.58E-04	<.0001	1.71E-04	<.0001	8.18E-04	<.0001
WORD_COUNT_2	[not incl.]		[not incl.]		[not incl.]		-2.18E-07	<.0001	-2.77E-08	<.0001	-1.45E-07	<.0001
WORD_COUNT_3	[not incl.]		[not incl.]		[not incl.]		1.71E-11	<.0001	1.77E-12	<.0001	1.04E-11	<.0001
WORD_COUNT_4	[not incl.]		[not incl.]		[not incl.]		-4.03E-16	<.0001	-3.73E-17	<.0001	-2.36E-16	<.0001
ART_HISTORY_BOOK	0.1180	<.0001	-0.0846	<.0001	0.1070	<.0001	0.5689	<.0001	0.0373	0.0004	0.3396	<.0001
EXHIBITION	0.0954	0.0272	0.4504	0.5464	0.0784	0.0619	0.5346	<.0001	-0.0041	0.6901	0.2428	<.0001
DECEASED	0.0100	0.2469	0.0719	0.0339	0.0997	<.0001	0.5190	<.0001	0.1609	<.0001	0.2261	<.0001
Work characteristics												
Attribution dummies												
ATTRIBUTED	-0.7736	<.0001	-0.2002	0.1869	-0.7837	<.0001	-0.6897	<.0001	-0.1459	0.2675	-0.5652	<.0001
STUDIO	-0.7321	<.0001	0.4758	0.5148	-1.1400	<.0001	-0.6188	<.0001	0.4796	0.2233	-0.6711	<.0001
CIRCLE	-1.0267	<.0001	0.2212	0.7635	-1.0882	<.0001	-0.9382	<.0001	-0.5620	0.3129	-0.7469	<.0001
SCHOOL	-1.3426	<.0001	0.4493	0.2298	-1.3816	<.0001	-1.3553	<.0001	0.3854	0.2751	-0.9049	<.0001
AFTER	-1.7774	<.0001	0.0012	0.9655	-1.6731	<.0001	-1.8563	<.0001	0.0719	0.0061	-1.3156	<.0001
STYLE	-1.5226	<.0001	-0.6888	0.0149	-1.4407	<.0001	-1.3661	<.0001	-0.6119	0.0399	-1.0988	<.0001
Authenticity dummies												
SIGNED	0.2379	<.0001	0.0692	<.0001	0.2214	<.0001	0.1890	<.0001	-0.0206	0.0331	0.1665	<.0001
DATED	0.1933	<.0001	0.0111	0.3294	0.1236	<.0001	0.1163	<.0001	0.0188	0.0497	0.0680	<.0001
INSCRIBED	-0.0183	<.0001	0.0533	<.0001	-0.0167	<.0001	-0.0711	<.0001	0.0568	<.0001	0.0353	<.0001
Additional print dummies												
NUMBERED	[not incl.]		-0.1019	<.0001	[not incl.]		[not incl.]		-0.1506	<.0001	[not incl.]	
NUMBERED1	[not incl.]		0.0659	0.0827	[not incl.]		[not incl.]		0.0317	0.4335	[not incl.]	
WATERCOLOR	[not incl.]		[not incl.]		0.4321	<.0001	[not incl.]		[not incl.]		0.2657	<.0001
Size variables												
HEIGHT	0.0185	<.0001	0.0113	<.0001	0.0339	<.0001	0.0113	<.0001	0.0080	<.0001	0.0338	<.0001
WIDTH	0.0230	<.0001	0.0129	<.0001	0.0326	<.0001	0.0188	<.0001	0.0059	<.0001	0.0230	<.0001
HEIGHT_2	-4.66E-05	<.0001	0.0000	<.0001	-1.60E-04	<.0001	-3.07E-05	<.0001	-2.99E-05	<.0001	-1.48E-04	<.0001
WIDTH_2	-6.83E-05	<.0001	0.0000	<.0001	-1.05E-04	<.0001	-5.61E-05	<.0001	-2.09E-05	<.0001	-6.96E-05	<.0001
Topic dummies												
STUDY	-0.2902	<.0001	-0.0828	0.1552	-0.1773	<.0001	-0.3647	<.0001	-0.0988	0.1030	-0.2623	<.0001
ABSTRACT	-0.0829	<.0001	-0.1587	0.0001	-0.0876	<.0001	-0.2630	<.0001	-0.3006	<.0001	-0.1074	<.0001
ANIMALS	-0.1874	<.0001	-0.1063	0.0040	-0.1290	<.0001	-0.3825	<.0001	-0.1557	<.0001	-0.1826	<.0001
LANDSCAPE	-0.1495	<.0001	0.1197	0.0007	-0.1081	<.0001	-0.1691	<.0001	0.0889	0.0147	-0.0734	<.0001

Table 8: Medium-specific regressions (cont.)

Model	Model (5a)		Model (5b)		Model (5c)		Model (6a)		Model (6b)		Model (6c)	
Type of data considered	Oil		Print		Paper		Oil		Print		Paper	
	Coeff.	p-value	Coeff.	p-value	Coeff.	p-value	Coeff.	p-value	Coeff.	p-value	Coeff.	p-value
NUDE	-0.0886	<.0001	-0.0024	0.9418	-0.1415	<.0001	-0.0601	0.0056	0.0499	0.1452	-0.2871	<.0001
PEOPLE	-0.0233	0.0009	0.0734	<.0001	-0.0221	0.0007	-0.0284	0.0013	0.0681	<.0001	-0.0167	0.0341
PORTRAIT	-0.2617	<.0001	0.1000	0.0017	-0.0528	<.0001	-0.4601	<.0001	0.1793	<.0001	-0.0109	0.2427
RELIGION	-0.0790	<.0001	0.0324	0.2081	-0.0705	<.0001	-0.0939	<.0001	0.0518	0.0526	0.0269	0.1543
SELF-PORTRAIT	0.0021	0.9306	0.2430	<.0001	0.2780	<.0001	-0.1412	<.0001	0.2410	<.0001	0.2251	<.0001
STILL_LIFE	-0.0162	0.0284	0.1202	0.0001	0.1018	<.0001	0.2712	<.0001	0.2638	<.0001	0.1287	<.0001
UNTITLED	-0.1981	<.0001	-0.1192	<.0001	-0.1478	<.0001	-0.4373	<.0001	-0.1100	<.0001	-0.1616	<.0001
URBAN	0.0422	<.0001	0.0010	0.9801	0.0492	<.0001	0.2451	<.0001	-0.0822	0.0513	0.0594	<.0001
Sale characteristics												
SEMESTER2	0.0762	<.0001	0.2545	<.0001	0.0573	<.0001	0.2532	<.0001	0.1766	<.0001	0.1732	<.0001
Month dummies												
JANUARY	[left out]		[left out]		[left out]		[left out]		[left out]		[left out]	
FEBRUARY	-0.1234	<.0001	0.0487	0.2778	-0.0723	<.0001	-0.0689	<.0001	-0.0225	0.6196	-0.0459	0.0004
MARCH	0.0347	<.0001	0.1687	<.0001	0.0202	0.0353	0.1661	<.0001	0.1325	0.0007	0.0915	<.0001
APRIL	0.1021	<.0001	0.2897	<.0001	0.0521	<.0001	0.2778	<.0001	0.2484	<.0001	0.1852	<.0001
MAY	0.1244	<.0001	0.2991	<.0001	0.1314	<.0001	0.3668	<.0001	0.2666	<.0001	0.3114	<.0001
JUNE	0.1265	<.0001	0.4192	<.0001	0.1484	<.0001	0.3922	<.0001	0.3915	<.0001	0.3304	<.0001
JULY	[left out]		[left out]		[left out]		[left out]		[left out]		[left out]	
AUGUST	-0.1706	<.0001	-0.1694	0.0035	-0.0381	0.0092	-0.3320	<.0001	-0.2351	<.0001	-0.0357	0.0399
SEPTEMBER	-0.2389	<.0001	-0.1462	<.0001	-0.1887	<.0001	-0.3971	<.0001	-0.1314	<.0001	-0.3108	<.0001
OCTOBER	-0.0585	<.0001	0.0073	0.7386	-0.0534	<.0001	-0.1541	<.0001	0.0348	0.1275	-0.0614	<.0001
NOVEMBER	0.0932	<.0001	0.0252	0.2325	0.1088	<.0001	0.1586	<.0001	0.0783	0.0004	0.1559	<.0001
DECEMBER	0.0963	<.0001	0.0361	0.0916	0.0396	<.0001	0.2024	<.0001	0.0768	0.0006	0.0935	<.0001
Auction house dummies												
SOTH_LONDON	0.5854	<.0001	0.3511	<.0001	0.5900	<.0001	0.8877	<.0001	0.3884	<.0001	0.7189	<.0001
SOTH_NY	0.6727	<.0001	0.3761	<.0001	0.6643	<.0001	1.1249	<.0001	0.3755	<.0001	1.0071	<.0001
SOTH_OTHER	0.2723	<.0001	0.1142	<.0001	0.3129	<.0001	0.4261	<.0001	0.1608	<.0001	0.4854	<.0001
CHR_LONDON	0.5729	<.0001	0.3430	<.0001	0.6566	<.0001	0.8873	<.0001	0.3575	<.0001	0.7862	<.0001
CHR_NY	0.6181	<.0001	0.3674	<.0001	0.6237	<.0001	1.1035	<.0001	0.3765	<.0001	0.9809	<.0001
CHR_OTHER	0.1396	<.0001	-0.0108	0.6077	0.1478	<.0001	0.2067	<.0001	0.0411	0.0497	0.2313	<.0001
BON_LONDON	0.0258	0.0271	0.0432	0.3363	0.2731	<.0001	-0.0137	0.3505	0.0092	0.8374	0.1779	<.0001
BON_OTHER	-0.1228	<.0001	-0.0646	0.0493	-0.1301	<.0001	-0.3455	<.0001	-0.1051	0.0023	-0.3627	<.0001
PHIL_LONDON	0.1892	<.0001	0.0375	0.5155	0.2234	<.0001	0.2257	<.0001	0.0575	0.3397	0.1340	<.0001
PHIL_OTHER	0.0567	<.0001	0.4375	<.0001	0.1888	<.0001	0.0812	<.0001	0.5797	<.0001	0.1557	<.0001
AUCTION_EUROPEAN	0.1734	<.0001	-0.0394	0.0030	0.0538	<.0001	0.2000	<.0001	-0.0498	0.0003	0.0597	<.0001
AUCTION_AMERICAN	-0.0690	<.0001	-0.0497	0.0001	-0.1435	<.0001	-0.0068	0.5370	-0.0968	<.0001	-0.1315	<.0001
Number of observations	655,183		55,510		428,472		655,183		55,510		428,472	
Adjusted R-square	0.64		0.27		0.62		0.40		0.15		0.42	
F-value	159.87		16.85		108.83		3,353.77		90.19		2,435.33	

Table 9: Movement-specific regressions

This table displays the hedonic regression results for movement-specific models (7) and (8). Panel A contains the full results for model (7), while Panel B presents only the results for the nationality dummies (model (8)) for reasons of parsimoniousness. All models are estimated using OLS. The dependent variable is the natural log of the price in 2007 USD. For the definitions of the independent variables: see Table 4.

Panel A: Model (7)

Model	Model (7a)		Model (7b)		Model (7c)		Model (7d)		Model (7e)		Model (7f)		Model (7g)	
Type of data considered	Medieval & Ren.		Baroque		Rococo		Neoclassicism		Romanticism		Realism		Impress. & Symb.	
	Coeff.	p-value	Coeff.	p-value	Coeff.	p-value	Coeff.	p-value	Coeff.	p-value	Coeff.	p-value	Coeff.	p-value
Year dummies	[incl.]		[incl.]		[incl.]		[incl.]		[incl.]		[incl.]		[incl.]	
Artist characteristics														
Artist dummies	[incl.]		[incl.]		[incl.]		[incl.]		[incl.]		[incl.]		[incl.]	
ART_HISTORY_BOOK	0.1135	0.0157	0.0546	0.0146	0.1813	0.0001	0.2201	<.0001	0.1487	<.0001	0.0967	<.0001	-0.0064	0.7423
EXHIBITION	[not incl.]		[not incl.]		[not incl.]		[not incl.]		[not incl.]		[not incl.]		[not incl.]	
DECEASED	[not incl.]		[not incl.]		[not incl.]		[not incl.]		[not incl.]		[not incl.]		[not incl.]	
Work characteristics														
Attribution dummies														
ATTRIBUTED	-0.6581	<.0001	-0.6958	<.0001	-0.9735	<.0001	-0.7505	<.0001	-1.0953	<.0001	-1.2552	<.0001	-1.3858	<.0001
STUDIO	-0.6950	<.0001	-0.6754	<.0001	-1.0193	<.0001	-0.8222	<.0001	-0.9782	<.0001	-1.6968	<.0001	-1.3554	<.0001
CIRCLE	-0.9867	<.0001	-0.9786	<.0001	-1.3202	<.0001	-1.1994	<.0001	-1.5467	<.0001	-1.7152	<.0001	-1.9047	<.0001
SCHOOL	-1.2354	<.0001	-1.2217	<.0001	-1.6505	<.0001	-1.3474	<.0001	-1.8015	<.0001	-2.2868	<.0001	-2.4520	<.0001
AFTER	-1.8523	<.0001	-1.6922	<.0001	-2.0805	<.0001	-1.7343	<.0001	-2.1521	<.0001	-2.0196	<.0001	-2.0465	<.0001
STYLE	-1.5963	<.0001	-1.4610	<.0001	-1.9240	<.0001	-1.6495	<.0001	-2.0598	<.0001	-2.2936	<.0001	-2.4680	<.0001
Authenticity dummies														
SIGNED	0.4225	<.0001	0.3231	<.0001	0.1490	<.0001	0.2824	<.0001	0.2107	<.0001	0.3372	<.0001	0.4089	<.0001
DATED	0.2163	<.0001	0.2868	<.0001	0.2556	<.0001	0.2983	<.0001	0.2823	<.0001	0.2435	<.0001	0.2030	<.0001
INSCRIBED	0.0200	0.3140	0.0347	0.0020	-0.0154	0.5171	0.0319	0.2857	-0.0525	0.0020	0.0084	0.4982	-0.0261	0.0115
Medium dummies														
OIL	[left out]		[left out]		[left out]		[left out]		[left out]		[left out]		[left out]	
PRINT	-1.1717	<.0001	-1.3384	<.0001	-1.8193	<.0001	-1.4335	<.0001	-1.1263	<.0001	-1.5766	<.0001	-1.9032	<.0001
PAPER	-0.6278	<.0001	-0.8923	<.0001	-0.8875	<.0001	-0.9441	<.0001	-0.9071	<.0001	-1.0022	<.0001	-1.1111	<.0001
Size variables														
HEIGHT	0.0101	<.0001	0.0047	<.0001	0.0130	<.0001	0.0118	<.0001	0.0126	<.0001	0.0379	<.0001	0.0404	<.0001
WIDTH	0.0146	<.0001	0.0201	<.0001	0.0168	<.0001	0.0289	<.0001	0.0291	<.0001	0.0311	<.0001	0.0431	<.0001
HEIGHT_2	-3.69E-05	<.0001	-5.11E-06	0.0227	-2.17E-05	0.0005	-5.03E-05	<.0001	-4.33E-05	<.0001	-2.39E-04	<.0001	-2.85E-04	<.0001
WIDTH_2	-4.97E-05	<.0001	-5.88E-05	<.0001	-2.65E-05	<.0001	-9.34E-05	<.0001	-7.45E-05	<.0001	-1.03E-04	<.0001	-2.16E-04	<.0001
Topic dummies														
STUDY	-0.0668	0.1139	-0.0244	0.3306	-0.1658	0.0005	-0.3592	<.0001	-0.3276	<.0001	-0.3512	<.0001	-0.4420	<.0001
ABSTRACT	[not incl.]		[not incl.]		[not incl.]		[not incl.]		[not incl.]		-0.3177	<.0001	[not incl.]	
ANIMALS	[not incl.]		-0.1563	<.0001	-0.1231	0.2186	[not incl.]		-0.1878	<.0001	-0.2567	<.0001	-0.3863	<.0001
LANDSCAPE	0.0545	0.3300	-0.0057	0.6565	-0.0241	0.4895	-0.1018	0.1508	-0.1715	<.0001	-0.2648	<.0001	-0.1947	<.0001

Table 9: Movement-specific regressions (cont.)

Model	Model (7a) Medieval & Ren.		Model (7b) Baroque		Model (7c) Rococo		Model (7d) Neoclassicism		Model (7e) Romanticism		Model (7f) Realism		Model (7g) Impress. & Symb.	
Type of data considered	Coeff.	p-value	Coeff.	p-value	Coeff.	p-value	Coeff.	p-value	Coeff.	p-value	Coeff.	p-value	Coeff.	p-value
NUDE	[not incl.]		[not incl.]		[not incl.]		[not incl.]		[not incl.]		-0.3816	<.0001	-0.1869	<.0001
PEOPLE	0.0123	0.8098	0.0085	0.6455	-0.1214	0.0008	-0.1572	0.0051	-0.1497	<.0001	-0.0511	0.0053	-0.0212	0.1364
PORTRAIT	0.0383	0.1181	-0.1511	<.0001	-0.1316	<.0001	-0.0098	0.7428	-0.1339	<.0001	-0.3958	<.0001	-0.2944	<.0001
RELIGION	-0.0200	0.2038	-0.0684	<.0001	-0.0956	0.0037	-0.2600	0.0002	-0.2259	0.0021	-0.3908	<.0001	-0.0358	0.4575
SELF-PORTRAIT	[not incl.]		0.1654	0.0010	[not incl.]		[not incl.]		[not incl.]		0.2697	<.0001	0.2134	0.0002
STILL_LIFE	[not incl.]		0.1032	<.0001	-0.0915	0.2711	[not incl.]		-0.0442	0.6262	-0.0354	0.2606	-0.1308	<.0001
UNTITLED	[not incl.]		[not incl.]		[not incl.]		[not incl.]		[not incl.]		-0.5111	<.0001	-0.2257	0.0303
URBAN	0.1611	0.0633	0.0751	0.0025	0.2681	<.0001	[not incl.]		0.1099	0.0268	-0.0109	0.7128	0.0288	0.2046
Sale characteristics														
SEMESTER2	0.0061	0.8546	-0.0141	0.3736	-0.0212	0.5303	0.1730	0.0024	0.2314	<.0001	0.1950	<.0001	0.3077	<.0001
Month dummies														
JANUARY	[left out]		[left out]		[left out]		[left out]		[left out]		[left out]		[left out]	
FEBRUARY	-0.5737	<.0001	-0.4577	<.0001	-0.3935	<.0001	-0.1275	0.0451	-0.0608	0.1002	0.1852	<.0001	0.2381	<.0001
MARCH	-0.2466	<.0001	-0.2126	<.0001	-0.2166	<.0001	0.0053	0.9224	0.1472	<.0001	0.2550	<.0001	0.3343	<.0001
APRIL	-0.2100	<.0001	-0.1550	<.0001	-0.1650	<.0001	-0.0271	0.6281	0.2837	<.0001	0.3495	<.0001	0.4222	<.0001
MAY	-0.2489	<.0001	-0.2112	<.0001	-0.2041	<.0001	0.0163	0.7567	0.2338	<.0001	0.4495	<.0001	0.5721	<.0001
JUNE	-0.1035	0.0011	-0.1112	<.0001	-0.0484	0.1302	0.1529	0.0032	0.2577	<.0001	0.4385	<.0001	0.5578	<.0001
JULY	[left out]		[left out]		[left out]		[left out]		[left out]		[left out]		[left out]	
AUGUST	-0.9850	<.0001	-0.8210	<.0001	-0.8925	<.0001	-0.7242	<.0001	-0.2133	<.0001	0.0067	0.8846	0.1370	<.0001
SEPTEMBER	-0.5949	<.0001	-0.4300	<.0001	-0.3751	<.0001	-0.4737	<.0001	-0.2963	<.0001	-0.1825	<.0001	-0.1550	<.0001
OCTOBER	-0.4105	<.0001	-0.3131	<.0001	-0.2815	<.0001	-0.2234	<.0001	-0.0414	0.1414	0.0814	0.0024	-0.0314	0.1360
NOVEMBER	-0.1868	<.0001	-0.1311	<.0001	-0.1186	<.0001	-0.0806	0.0684	0.0654	0.0088	0.2807	<.0001	0.2861	<.0001
DECEMBER	-0.0436	0.0582	-0.0212	0.0523	0.0017	0.9452	-0.0843	0.0647	0.0533	0.0492	0.2349	<.0001	0.2085	<.0001
Auction house dummies														
SOTH_LONDON	0.5403	<.0001	0.4812	<.0001	0.5936	<.0001	0.6424	<.0001	0.8732	<.0001	0.7830	<.0001	0.7158	<.0001
SOTH_NY	0.5773	<.0001	0.5435	<.0001	0.6175	<.0001	0.8743	<.0001	0.8258	<.0001	0.8749	<.0001	0.7467	<.0001
SOTH_OTHER	0.2904	<.0001	0.2838	<.0001	0.3727	<.0001	0.3751	<.0001	0.4642	<.0001	0.2287	<.0001	0.2500	<.0001
CHR_LONDON	0.4526	<.0001	0.4944	<.0001	0.5574	<.0001	0.6416	<.0001	0.8593	<.0001	0.7948	<.0001	0.6834	<.0001
CHR_NY	0.4547	<.0001	0.4543	<.0001	0.5598	<.0001	0.7963	<.0001	0.7681	<.0001	0.7816	<.0001	0.7062	<.0001
CHR_OTHER	-0.0125	0.6199	0.0609	<.0001	0.0522	0.0502	0.1150	0.0071	0.1865	<.0001	0.0338	0.1471	0.1527	<.0001
BON_LONDON	-0.2234	0.0002	-0.2775	<.0001	-0.2157	0.0002	-0.1904	0.0959	0.1129	0.0487	0.2267	<.0001	0.0717	0.2234
BON_OTHER	-0.2981	0.0388	-0.2301	<.0001	-0.7515	<.0001	-0.4641	0.0131	-0.0175	0.7995	-0.1012	0.0550	-0.0096	0.8691
PHIL_LONDON	-0.0181	0.6347	-0.0043	0.8054	-0.0181	0.6847	0.2193	0.0045	0.2366	<.0001	0.3280	<.0001	0.1824	<.0001
PHIL_OTHER	-0.5016	<.0001	-0.3018	<.0001	-0.2652	<.0001	-0.1572	0.2001	0.3516	<.0001	0.1450	0.0010	0.2984	<.0001
AUCTION_EUROPEAN	0.1987	<.0001	0.2242	<.0001	0.2844	<.0001	0.2067	<.0001	0.2513	<.0001	0.1549	<.0001	0.1117	<.0001
AUCTION_AMERICAN	-0.3865	<.0001	-0.2360	<.0001	-0.1996	<.0001	-0.1841	0.0120	0.0646	0.0155	-0.0032	0.8898	-0.0159	0.4119
Number of observations	33,276		129,629		31,625		12,832		42,761		64,277		101,249	
Adjusted R-square	0.51		0.51		0.50		0.52		0.57		0.64		0.71	
F-value	34.95		113.09		115.89		49.61		158.99		318.43		574.72	

Table 9: Movement-specific regressions (cont.)

Model	Model (7h)		Model (7i)		Model (7j)		Model (7k)		Model (7l)		Model (7m)	
Type of data considered	Fauvism & Expr.		Cub., Fut. & Constr.		Dada & Surr.		Abstract Expr.		Pop		Minimalism & Cont.	
	Coeff.	p-value	Coeff.	p-value	Coeff.	p-value	Coeff.	p-value	Coeff.	p-value	Coeff.	p-value
Year dummies	[incl.]		[incl.]		[incl.]		[incl.]		[incl.]		[incl.]	
Artist characteristics												
Artist dummies	[incl.]		[incl.]		[incl.]		[incl.]		[incl.]		[incl.]	
ART_HISTORY_BOOK	0.0592	<.0001	-0.0005	0.9727	0.0333	0.1262	0.0729	0.0300	0.3252	<.0001	-0.4880	<.0001
EXHIBITION	-0.0780	0.2853	-0.1520	0.8283	0.3021	0.0172	0.7124	<.0001	0.1301	0.7677	0.4843	0.0099
DECEASED	-0.0795	0.0020	-0.2404	<.0001	-0.1775	<.0001	0.0243	0.1882	-0.0637	0.0242	0.3531	<.0001
Work characteristics												
Attribution dummies												
ATTRIBUTED	[not incl.]		[not incl.]		[not incl.]		[not incl.]		[not incl.]		[not incl.]	
STUDIO	[not incl.]		[not incl.]		[not incl.]		[not incl.]		[not incl.]		[not incl.]	
CIRCLE	[not incl.]		[not incl.]		[not incl.]		[not incl.]		[not incl.]		[not incl.]	
SCHOOL	[not incl.]		[not incl.]		[not incl.]		[not incl.]		[not incl.]		[not incl.]	
AFTER	[not incl.]		[not incl.]		[not incl.]		[not incl.]		[not incl.]		[not incl.]	
STYLE	[not incl.]		[not incl.]		[not incl.]		[not incl.]		[not incl.]		[not incl.]	
Authenticity dummies												
SIGNED	0.3589	<.0001	0.2195	<.0001	0.2660	<.0001	0.2004	<.0001	0.0385	0.0338	-0.0423	0.0262
DATED	0.1087	<.0001	0.1451	<.0001	0.2076	<.0001	0.0060	0.5990	0.1875	<.0001	0.1108	<.0001
INSCRIBED	0.0222	0.0240	-0.0634	<.0001	-0.0190	0.0917	0.0202	0.0973	0.0109	0.4659	0.0362	0.0229
Medium dummies												
OIL	[left out]		[left out]		[left out]		[left out]		[left out]		[left out]	
PRINT	-2.0849	<.0001	-2.8009	<.0001	-2.9133	<.0001	-2.3736	<.0001	-2.1744	<.0001	-1.8746	<.0001
PAPER	-1.2809	<.0001	-1.0488	<.0001	-1.1469	<.0001	-0.6158	<.0001	-0.6971	<.0001	-0.6509	<.0001
Size variables												
HEIGHT	0.0401	<.0001	0.0427	<.0001	0.0252	<.0001	0.0306	<.0001	0.0216	<.0001	0.0250	<.0001
WIDTH	0.0428	<.0001	0.0251	<.0001	0.0286	<.0001	0.0277	<.0001	0.0250	<.0001	0.0226	<.0001
HEIGHT_2	-2.00E-04	<.0001	-2.05E-04	<.0001	-4.53E-05	<.0001	-1.26E-04	<.0001	-7.18E-05	<.0001	-1.06E-04	<.0001
WIDTH_2	-2.22E-04	<.0001	-9.24E-05	<.0001	-9.86E-05	<.0001	-1.06E-04	<.0001	-8.16E-05	<.0001	-7.01E-05	<.0001
Topic dummies												
STUDY	-0.2534	<.0001	-0.2036	<.0001	-0.2384	<.0001	-0.1391	0.0120	0.1044	0.0192	-0.2196	<.0001
ABSTRACT	-0.1407	<.0001	0.0642	0.0002	-0.1485	<.0001	-0.1275	<.0001	-0.2057	0.0002	-0.1066	0.0218
ANIMALS	-0.1505	0.0002	-0.2386	<.0001	-0.1963	<.0001	-0.0524	0.3183	-0.3951	<.0001	[not incl.]	
LANDSCAPE	-0.0881	<.0001	-0.1066	<.0001	-0.1571	<.0001	-0.1043	0.0392	-0.0756	0.1227	-0.0760	0.3529

49

Table 9: Movement-specific regressions (cont.)

Model	Model (7h)		Model (7i)		Model (7j)		Model (7k)		Model (7l)		Model (7m)	
Type of data considered	Fauvism & Expr.		Cub., Fut. & Constr.		Dada & Surr.		Abstract Expr.		Pop		Minimalism & Cont.	
	Coeff.	**p-value**	**Coeff.**	**p-value**	**Coeff.**	**p-value**	**Coeff.**	**p-value**	**Coeff.**	**p-value**	**Coeff.**	**p-value**
NUDE	-0.2029	<.0001	-0.1252	<.0001	-0.1108	0.0010	-0.3738	<.0001	0.1111	0.1394	[not incl.]	
PEOPLE	-0.0148	0.3065	0.0402	0.0145	0.1369	<.0001	-0.0737	0.0130	-0.0541	0.2347	-0.0131	0.7864
PORTRAIT	-0.2755	<.0001	-0.2013	<.0001	-0.0312	0.1757	-0.4676	<.0001	-0.0765	0.1232	-0.0658	0.3132
RELIGION	-0.0704	0.1527	-0.2622	0.0004	-0.1282	0.1349	[not incl.]		[not incl.]		[not incl.]	
SELF-PORTRAIT	0.4062	<.0001	-0.0548	0.4555	0.0413	0.5822	[not incl.]		0.6616	<.0001	0.2583	0.0022
STILL_LIFE	0.0076	0.6515	0.1975	<.0001	0.0159	0.6046	-0.1959	0.0034	-0.1274	0.0372	[not incl.]	
UNTITLED	-0.1505	0.0008	-0.2791	<.0001	-0.1280	<.0001	-0.1718	<.0001	-0.3044	<.0001	-0.0964	<.0001
URBAN	0.0550	0.0159	0.0275	0.4401	-0.0480	0.3389	-0.1059	0.1820	[not incl.]		-0.0959	0.2562
Sale characteristics												
SEMESTER2	0.2147	<.0001	0.3712	<.0001	0.1810	<.0001	0.2638	<.0001	0.2569	0.0041	0.1650	0.0462
Month dummies												
JANUARY	[left out]		[left out]		[left out]		[left out]		[left out]		[left out]	
FEBRUARY	0.2809	<.0001	0.2359	<.0001	0.2230	<.0001	0.2040	0.0003	0.2388	0.0052	0.1437	0.0459
MARCH	0.3392	<.0001	0.3701	<.0001	0.2114	<.0001	0.2856	<.0001	0.2014	0.0182	0.1599	0.0290
APRIL	0.2599	<.0001	0.4480	<.0001	0.2477	<.0001	0.3387	<.0001	0.3792	<.0001	0.2378	0.0010
MAY	0.4894	<.0001	0.5694	<.0001	0.3973	<.0001	0.4649	<.0001	0.5869	<.0001	0.4680	<.0001
JUNE	0.5377	<.0001	0.6207	<.0001	0.3860	<.0001	0.4251	<.0001	0.4588	<.0001	0.3649	<.0001
JULY	[left out]		[left out]		[left out]		[left out]		[left out]		[left out]	
AUGUST	0.3119	<.0001	-0.0014	0.9846	-0.0088	0.9020	-0.4877	0.0002	-0.1377	0.3765	-0.6801	<.0001
SEPTEMBER	-0.1328	<.0001	-0.2002	<.0001	-0.2047	<.0001	-0.1372	0.0005	-0.2083	<.0001	-0.2038	0.0009
OCTOBER	0.0485	0.0409	-0.0520	0.0421	-0.0479	0.0633	0.0041	0.8964	0.0866	0.0309	0.0607	0.2361
NOVEMBER	0.3505	<.0001	0.2463	<.0001	0.2709	<.0001	0.2490	<.0001	0.4340	<.0001	0.3364	<.0001
DECEMBER	0.1831	<.0001	0.1660	<.0001	0.1610	<.0001	0.1315	<.0001	0.2034	<.0001	0.1849	0.0004
Auction house dummies												
SOTH_LONDON	0.6736	<.0001	0.6090	<.0001	0.6436	<.0001	0.5620	<.0001	0.8409	<.0001	0.9056	<.0001
SOTH_NY	0.5726	<.0001	0.6826	<.0001	0.6789	<.0001	0.4487	<.0001	0.6943	<.0001	0.7128	<.0001
SOTH_OTHER	0.1768	<.0001	0.1634	<.0001	0.2066	<.0001	0.1416	<.0001	0.1074	0.0206	0.1501	<.0001
CHR_LONDON	0.6600	<.0001	0.5770	<.0001	0.6552	<.0001	0.5471	<.0001	0.8069	<.0001	0.8381	<.0001
CHR_NY	0.4670	<.0001	0.5776	<.0001	0.6352	<.0001	0.4423	<.0001	0.6332	<.0001	0.6391	<.0001
CHR_OTHER	0.0241	0.2413	0.0400	0.0727	-0.0010	0.9681	0.0168	0.4435	0.1981	<.0001	0.2117	<.0001
BON_LONDON	0.0317	0.6731	0.4002	<.0001	0.3288	<.0001	0.5145	<.0001	0.3788	0.0003	0.1391	0.1588
BON_OTHER	-0.3095	<.0001	-0.1362	0.0467	-0.1481	0.0296	-0.1382	0.0654	-0.1086	0.1045	-0.2533	0.0002
PHIL_LONDON	0.1071	0.0847	0.1392	0.0229	0.1658	0.0110	0.1157	0.0754	0.2515	0.0361	0.5646	<.0001
PHIL_OTHER	0.3994	<.0001	0.0557	0.4500	0.2862	0.0001	0.0402	0.5837	0.6630	<.0001	0.6058	<.0001
AUCTION_EUROPEAN	0.0177	0.1025	0.0645	<.0001	0.0338	0.0095	-0.0277	0.0742	0.0542	0.0179	0.1308	<.0001
AUCTION_AMERICAN	-0.2011	<.0001	0.0032	0.8884	0.0261	0.2923	-0.1548	<.0001	-0.0517	0.2056	-0.0860	0.1440
Number of observations	82,468		62,499		61,355		38,368		27,809		22,232	
Adjusted R-square	0.69		0.68		0.68		0.69		0.65		0.70	
F-value	841.32		641.44		595.29		431.25		329.37		183.44	

Table 9: Movement-specific regressions (cont.)

<u>Panel B: Model (8)</u>

Model	Model (8b)		Model (8c)		Model (8d)		Model (8e)		Model (8f)		Model (8g)	
Type of data considered	Baroque		Rococo		Neoclassicism		Romanticism		Realism		Impress. & Symb.	
	Coeff.	**p-value**	**Coeff.**	**p-value**	**Coeff.**	**p-value**	**Coeff.**	**p-value**	**Coeff.**	**p-value**	**Coeff.**	**p-value**
Artist nationality dummies												
AMERICAN	[not incl.]		[not incl.]		[not incl.]		0.1976	<.0001	0.3428	<.0001	0.1346	<.0001
BRITISH	[not incl.]		[not incl.]		[not incl.]		-0.7473	<.0001	-0.3779	<.0001	[not incl.]	
DUTCH	0.0805	<.0001	[not incl.]		[not incl.]		[not incl.]		[not incl.]		[not incl.]	
FRENCH	-0.0026	0.8297	0.4425	<.0001	0.4282	<.0001	-0.2241	<.0001	0.4077	<.0001	0.2077	<.0001
GERMAN	[not incl.]		0.1286	0.0064	0.1932	<.0001	[not incl.]		[not incl.]		-0.5410	<.0001
ITALIAN	-0.1282	<.0001	0.6602	<.0001	0.2310	<.0001	[not incl.]		[not incl.]		[not incl.]	
Number of observations	129,626		31,625		11,844		42,761		64,277		101,249	
Adjusted R-square	0.42		0.44		0.44		0.44		0.51		0.57	
F-value	722.16		199.02		81.32		264.86		535.47		1,111.07	

Model	Model (8h)		Model (8i)		Model (8j)		Model (8k)		Model (8l)		Model (8m)	
Type of data considered	Fauvism & Expr.		Cub., Fut. & Constr.		Dada & Surr.		Abstract Expr.		Pop		Minimalism & Cont.	
	Coeff.	**p-value**	**Coeff.**	**p-value**	**Coeff.**	**p-value**	**Coeff.**	**p-value**	**Coeff.**	**p-value**	**Coeff.**	**p-value**
Artist nationality dummies												
AMERICAN	-0.2884	<.0001	0.1644	0.0003	-0.2522	<.0001	-0.3068	<.0001	-0.0488	0.0132	-0.0296	0.1669
BRITISH	[not incl.]		[not incl.]		[not incl.]		-1.0001	<.0001	-0.5976	<.0001	-0.3897	<.0001
DUTCH	[not incl.]		[not incl.]		[not incl.]		[not incl.]		[not incl.]		[not incl.]	
FRENCH	-0.2566	<.0001	0.0359	0.0036	-0.0290	0.0236	-0.0342	0.0325	[not incl.]		[not incl.]	
GERMAN	0.1407	<.0001	[not incl.]		-0.4589	<.0001	[not incl.]		0.2258	<.0001	-0.4538	<.0001
ITALIAN	[not incl.]		0.1630	<.0001	[not incl.]		[not incl.]		[not incl.]		[not incl.]	
Number of observations	82,468		62,499		61,355		38,368		27,809		22,232	
Adjusted R-square	0.55		0.58		0.58		0.55		0.59		0.55	
F-value	938.69		811.51		783.81		465.53		415.45		290.51	

Table 10: Top-10 artists per art movement

This table presents the ten artists (that have at least 100 recorded sales) with the highest coefficients in each movement-specific model. The table also displays the number of sales in our dataset for each artist.

Model (7a) Medieval & Renaissance		Model (7b) Baroque		Model (7c) Rococo		Model (7d) Neoclassicism	
Artist	**Sales**	**Artist**	**Sales**	**Artist**	**Sales**	**Artist**	**Sales**
Brueghel, Pieter, II	583	Rubens, Peter Paul	364	Goya, Francisco de	390	Ingres, Jean-Auguste-Dominique	307
Bruegel, Pieter, I	170	Avercamp, Hendrick	110	Bellotto, Bernardo	278	Piranesi, Giovanni Battista	203
Bosch, Hieronymus	106	Beert, Osias, I	135	Guardi, Francesco	1,345	Prud'hon, Pierre-Paul	244
Weyden, Rogier van der	119	Brueghel, Jan, I	709	Canaletto	1,702	Panini, Giovanni Paolo	998
Patinir, Joachim	103	Ast, Balthasar van der	198	La Tour, Maurice-Quentin de	126	Gerome, Jean-Leon	515
Bartolommeo, Fra	157	Hals, Frans	172	Tiepolo, Giambattista	867	David, Jacques-Louis	290
Cranach, Lucas, I	406	Brueghel, Jan, II	750	Carriera, Rosalba	223	Gandolfi, Gaetano	295
El Greco	192	Hooch, Pieter de	112	Tiepolo, Giandomenico	911	Vincent, Francois-Andre	141
Valckenborch, Lucas van, I	124	Tiepolo, Giambattista	867	Watteau, Antoine	452	Vigee Le Brun, Elisabeth-Louise	356
Bellini, Giovanni	139	Ruysdael, Salomon van	498	Chardin, Jean-Simeon	116	Drouais, Francois-Hubert	246

Model (7e) Romanticism		Model (7f) Realism		Model (7g) Impressionism & Symbolism		Model (7h) Fauvism & Expressionism	
Artist	**Sales**	**Artist**	**Sales**	**Artist**	**Sales**	**Artist**	**Sales**
Ingres, Jean-Auguste-Dominique	307	Degas, Edgar	1,773	Gogh, Vincent van	411	Kandinsky, Vasily	976
Cozens, John Robert	101	Homer, Winslow	304	Cezanne, Paul	790	Schiele, Egon	987
Heade, Martin Johnson	245	Manet, Edouard	338	Seurat, Georges	179	Klee, Paul	1,798
Goya, Francisco de	390	Prendergast, Maurice	296	Monet, Claude	1,038	Marc, Franz	207
Gericault, Theodore	430	Daumier, Honore	467	Degas, Edgar	1,773	Modigliani, Amedeo	893
Blake, William	131	Larsson, Carl	564	Manet, Edouard	338	Nolde, Emil	2,035
Turner, J. M. W.	1,049	Menzel, Adolph	542	Renoir, Auguste	3,827	Matisse, Henri	3,321
Stubbs, George	243	Rossetti, Dante Gabriel	279	Sisley, Alfred	582	Schlemmer, Oskar	212
Palmer, Samuel	203	Hopper, Edward	250	Moreau, Gustave	180	Munch, Edvard	1,153
Corot, Camille	1,640	Zorn, Anders	709	Gauguin, Paul	868	Macke, August	460

Table 10: Top-10 artists per art movement (cont.)

Model (7i) Cubism, Futurism & Constructivism		Model (7j) Dada & Surrealism		Model (7k) Abstract Expressionism		Model (7l) Pop	
Artist	**Sales**	**Artist**	**Sales**	**Artist**	**Sales**	**Artist**	**Sales**
Morandi, Giorgio	1,088	Picasso, Pablo	13,389	Pollock, Jackson	164	Klein, Yves	315
Picasso, Pablo	13,389	Duchamp, Marcel	151	Rothko, Mark	233	Thiebaud, Wayne	328
Gris, Juan	459	Magritte, Rene	1,350	Johns, Jasper	914	Johns, Jasper	914
Chagall, Marc	6,973	Tanguy, Yves	420	Twombly, Cy	567	Dubuffet, Jean	2,153
Duchamp, Marcel	151	Savinio, Alberto	152	Stael, Nicolas de	498	Warhol, Andy	6,443
Braque, Georges	1,539	Wols	355	Burri, Alberto	245	Richter, Gerhard	1,065
Leger, Fernand	3,057	Miro, Joan	4,735	De Kooning, Willem	878	Polke, Sigmar	523
Schwitters, Kurt	532	Ernst, Max	1,411	Atlan, Jean-Michel	753	Lichtenstein, Roy	2,016
Mondrian, Piet	371	Schwitters, Kurt	532	Kline, Franz	451	Hamilton, Richard	162
Delaunay, Robert	224	Giacometti, Alberto	1,128	Avery, Milton	955	Hockney, David	1,592

Model (7m) Minimalism & Contemporary	
Artist	**Sales**
Wu Guanzhong	392
Freud, Lucian	313
Balthus	369
Klein, Yves	315
Martin, Agnes	179
Marden, Brice	197
Kiefer, Anselm	184
Close, Chuck	110
Ofili, Chris	104
Hirst, Damien	404

Table 11: Returns on art and art movements

Table 11 displays the geometric mean returns on art in general and on each individual art movement since 1951 (whenever possible) and since 1982. Panel A reports real returns, while Panel B shows nominal returns. The average real returns are calculated using the relevant hedonic price indices (based on model (3) for the general art index and on model (7) for the movement-specific indices). The nominal returns are obtained by correcting the indices for the year-to-year changes in the US CPI series. The table also includes data on the volatility of the returns since 1982 (as measured by the standard deviation).

Panel A: Real returns

	Art	Medieval & Ren.	Baroque	Rococo	Neoclassicism	Romanticism	Realism
Average return 1951-2007	4.03%	5.31%	4.28%	2.10%	4.65%	2.63%	5.83%
Average return 1982-2007	4.49%	5.58%	4.66%	4.14%	5.12%	3.89%	3.50%
Volatility 1982-2007	14.40%	16.83%	11.56%	11.54%	16.97%	12.52%	13.74%

	Impress. & Symb.	Fauvism & Expr.	Cub., Fut. & Constr.	Dada & Surr.	Abstract Expr.	Pop	Minimalism & Cont.
Average return 1982-2007	3.94%	3.64%	5.14%	4.86%	6.83%	8.33%	6.52%
Volatility 1982-2007	15.77%	17.51%	19.56%	18.71%	21.51%	25.50%	23.50%

Panel B: Nominal returns

	Art	Medieval & Ren.	Baroque	Rococo	Neoclassicism	Romanticism	Realism
Average return 1951-2007	7.97%	9.32%	8.22%	6.12%	8.71%	6.55%	9.86%
Average return 1982-2007	7.65%	8.76%	7.80%	7.26%	8.28%	7.05%	6.65%
Volatility 1982-2007	14.39%	16.53%	11.50%	11.62%	16.92%	12.40%	13.72%

	Impress. & Symb.	Fauvism & Expr.	Cub., Fut. & Constr.	Dada & Surr.	Abstract Expr.	Pop	Minimalism & Cont.
Average return 1982-2007	7.11%	6.83%	8.33%	8.03%	10.04%	11.60%	9.70%
Volatility 1982-2007	15.72%	17.45%	19.65%	18.82%	21.65%	25.50%	23.65%

Table 12: Comparison of art index with financial indices

Table 12 compares the geometric mean return and volatility of our art index with the return and volatility of some financial indices since 1951 and since 1982. The data of the financial assets (US treasury bills, 10-year US government bonds, Dow Jones corporate bonds, a global index for government bonds, S&P 500 stocks, and a global index for equity) come from Global Financial Data. Panel A and Panel B report real returns, while Panel C and Panel D show nominal returns. The table also includes ex-post Sharpe ratios, using the T-bill index as a measure of the risk-free return.

Panel A: Calculations based on real returns 1951-2007

	Art	T-bills	Government bonds	Corporate bonds	World bonds	S&P 500	World stocks
Average return	4.03%	1.29%	2.30%	3.56%	2.67%	8.90%	7.23%
Volatility	16.50%	2.03%	10.52%	9.82%	8.62%	17.25%	16.55%
Sharpe ratio	0.1639	-	0.0987	0.2337	0.1622	0.4436	0.3602

Panel B: Calculations based on real returns 1982-2007

	Art	T-bills	Government bonds	Corporate bonds	World bonds	S&P 500	World stocks
Average return	4.49%	2.09%	6.75%	7.74%	6.64%	13.64%	9.92%
Volatility	14.40%	1.95%	12.69%	10.99%	9.94%	16.69%	17.53%
Sharpe ratio	0.1656	-	0.3707	0.5178	0.4594	0.6951	0.4485

Panel C: Calculations based on nominal returns 1951-2007

	Art	T-bills	Government bonds	Corporate bonds	World bonds	S&P 500	World stocks
Average return	7.97%	5.10%	6.21%	7.47%	6.58%	12.92%	11.24%
Volatility	16.09%	2.86%	9.83%	9.12%	7.90%	16.29%	15.60%
Sharpe ratio	0.1682	-	0.1056	0.2517	0.1769	0.4699	0.3819

Panel D: Calculations based on nominal returns 1982-2007

	Art	T-bills	Government bonds	Corporate bonds	World bonds	S&P 500	World stocks
Average return	7.65%	5.19%	9.90%	10.87%	9.78%	16.78%	13.08%
Volatility	14.39%	2.26%	12.45%	10.84%	9.66%	16.60%	17.36%
Sharpe ratio	0.1656	-	0.3780	0.5250	0.4725	0.6988	0.4530

Figure 1: Average real prices and number of sales 1922-2007

Figure 1 illustrates the average transaction price (in 2007 USD) and number of sales in our dataset for all years since 1922.
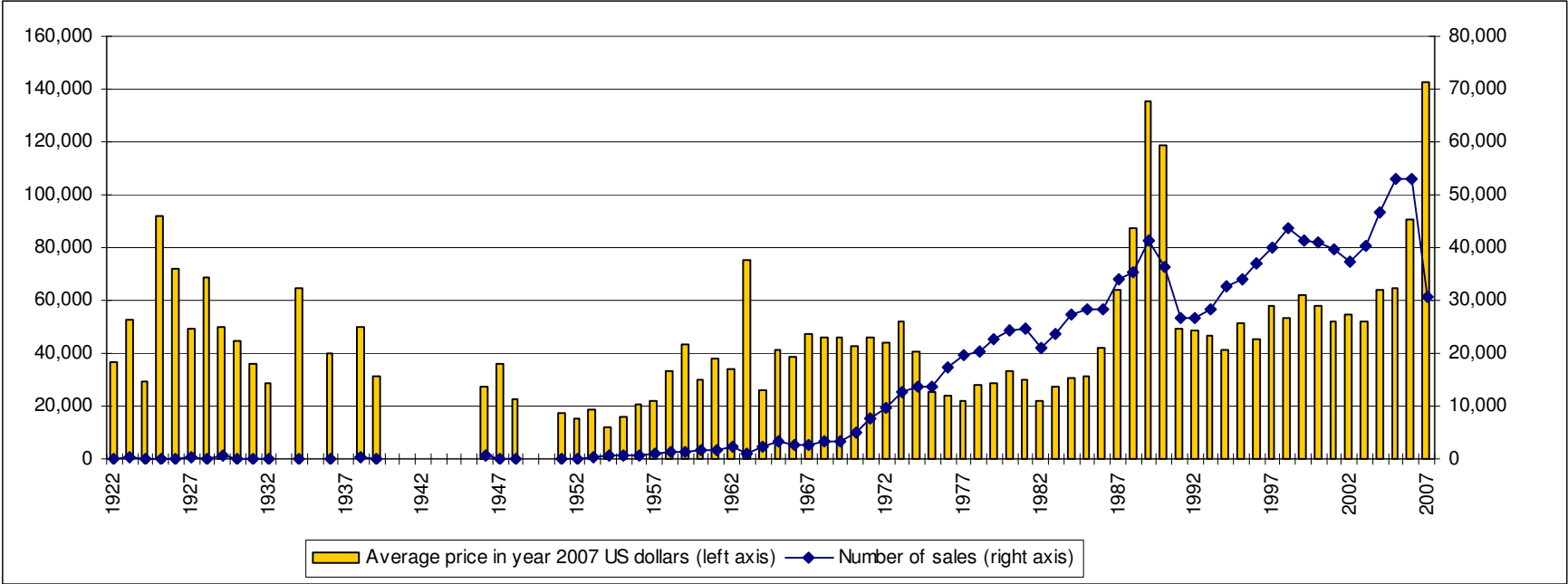
Figure 2: Hedonic price index 1951-2007 for benchmark models

Figure 2 presents our general hedonic price indices since 1951, based on the results of models (3) and (4). The index values in 1978 are set equal to 100.
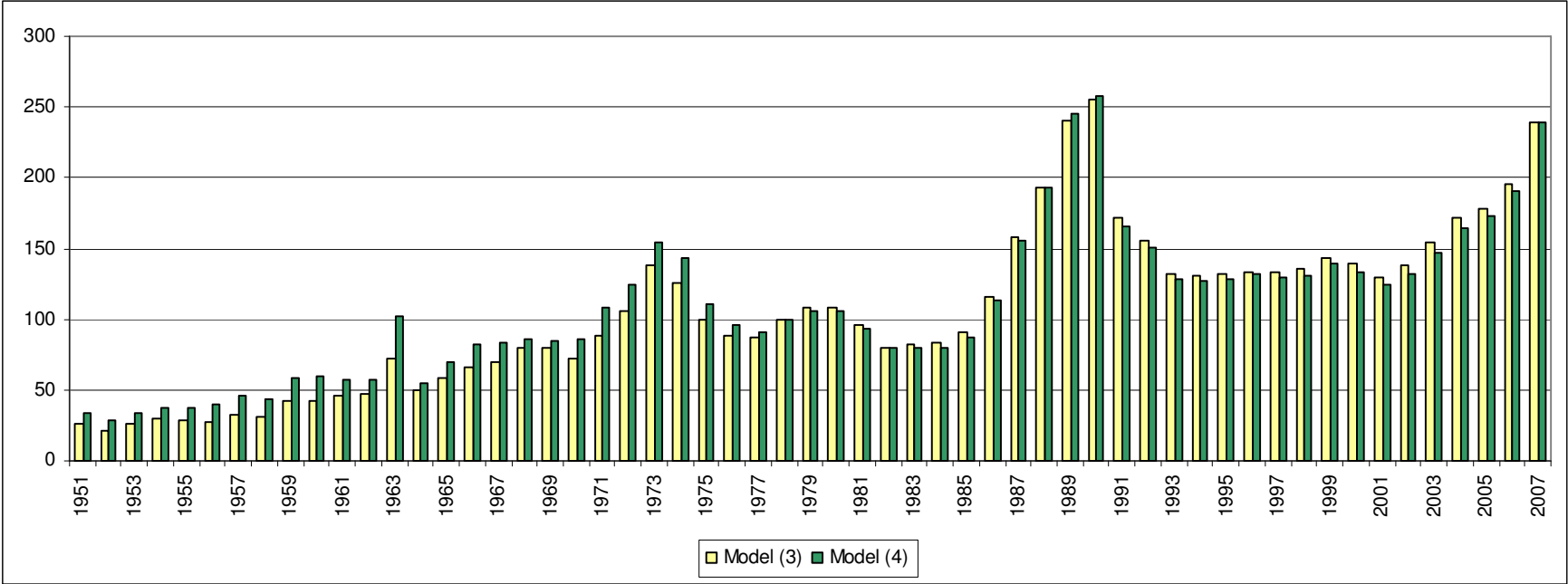
Figure 3: Hedonic price index 1951-2007 for medium-specific models

Figure 3 presents our medium-specific hedonic price indices since 1951, based on the results of model (5), for oil paintings, works on paper, and prints (since 1996). The index values in 1978 are set equal to 100.
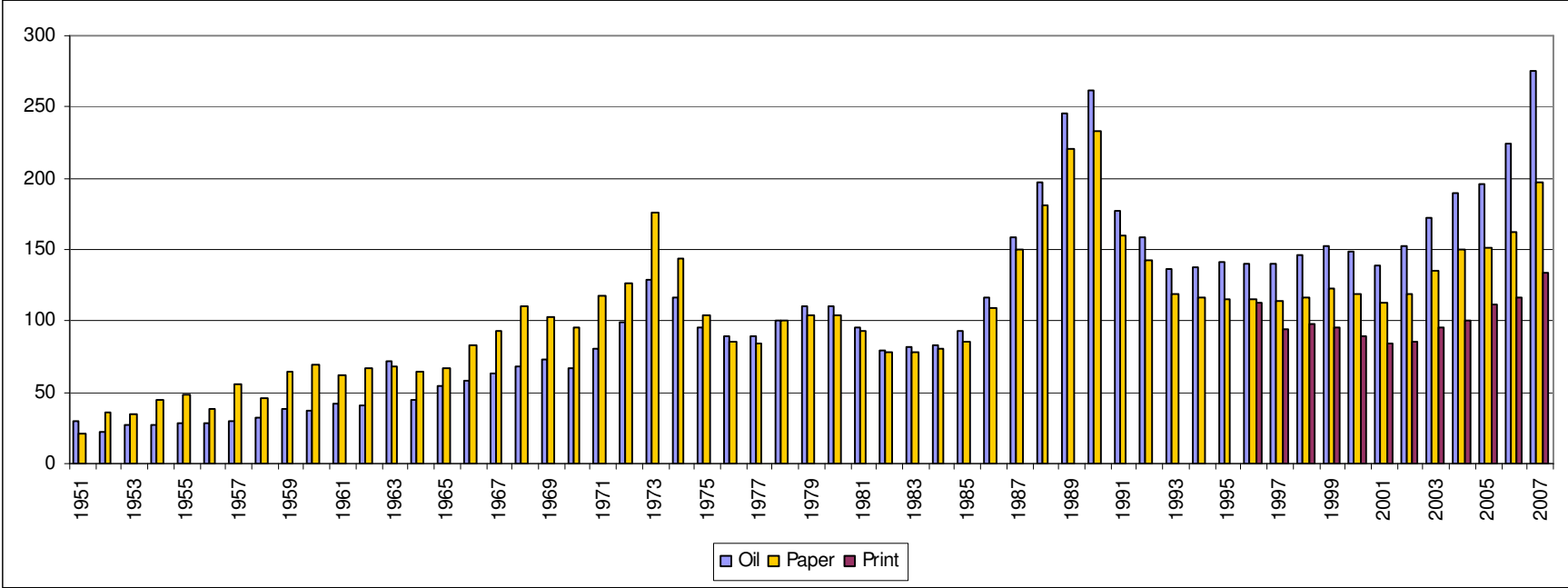
Figure 4: Hedonic price index 1971-2007 for movement-specific models

Figure 4 presents our movement-specific hedonic price indices since 1971, based on the results of model (7), for Medieval & Renaissance, Baroque, Rococo, Neoclassicism, and Romanticism in Panel A, for Realism, Impressionism & Symbolism, Fauvism & Expressionism, and Cubism, Futurism & Constructivism in Panel B, and for Dada & Sur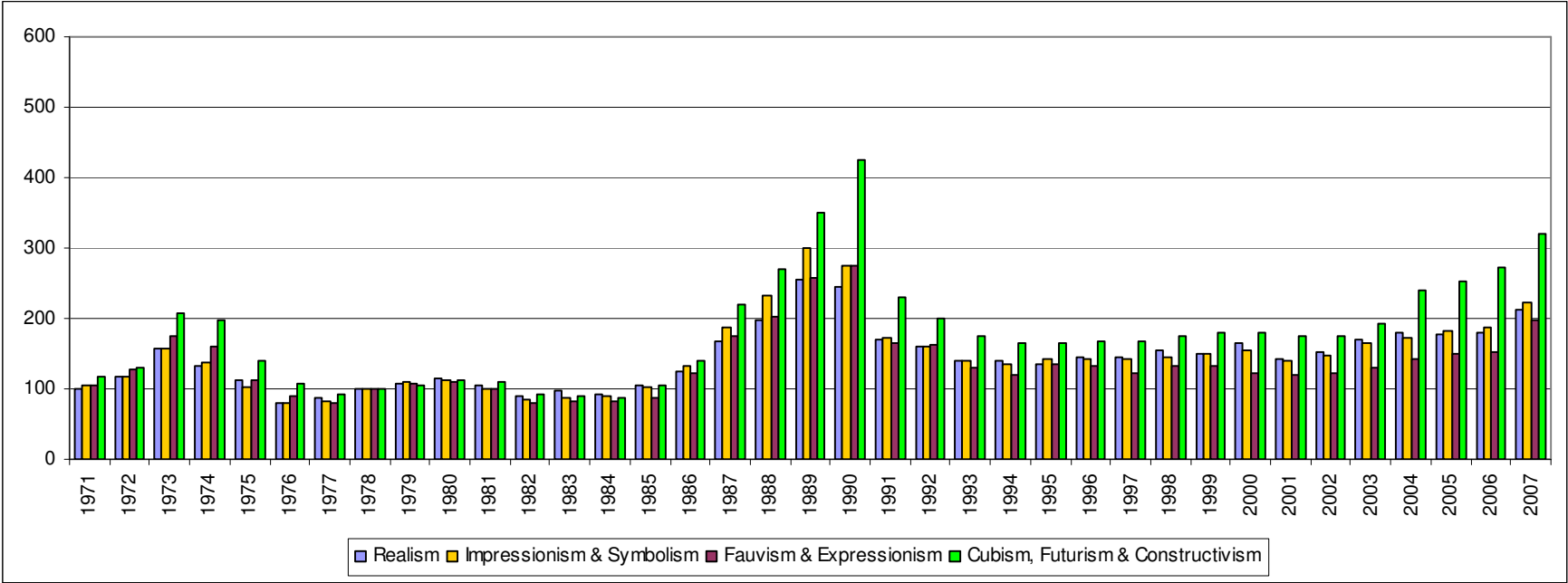realism, Abstract Expressionism, Pop, and Minimalism & Contemporary in Panel C. The index values in 1978 are set equal to 100.

Panel A: Price indices for Medieval & Renaissance, Baroque, Rococo, Neoclassicism, and Romanticism
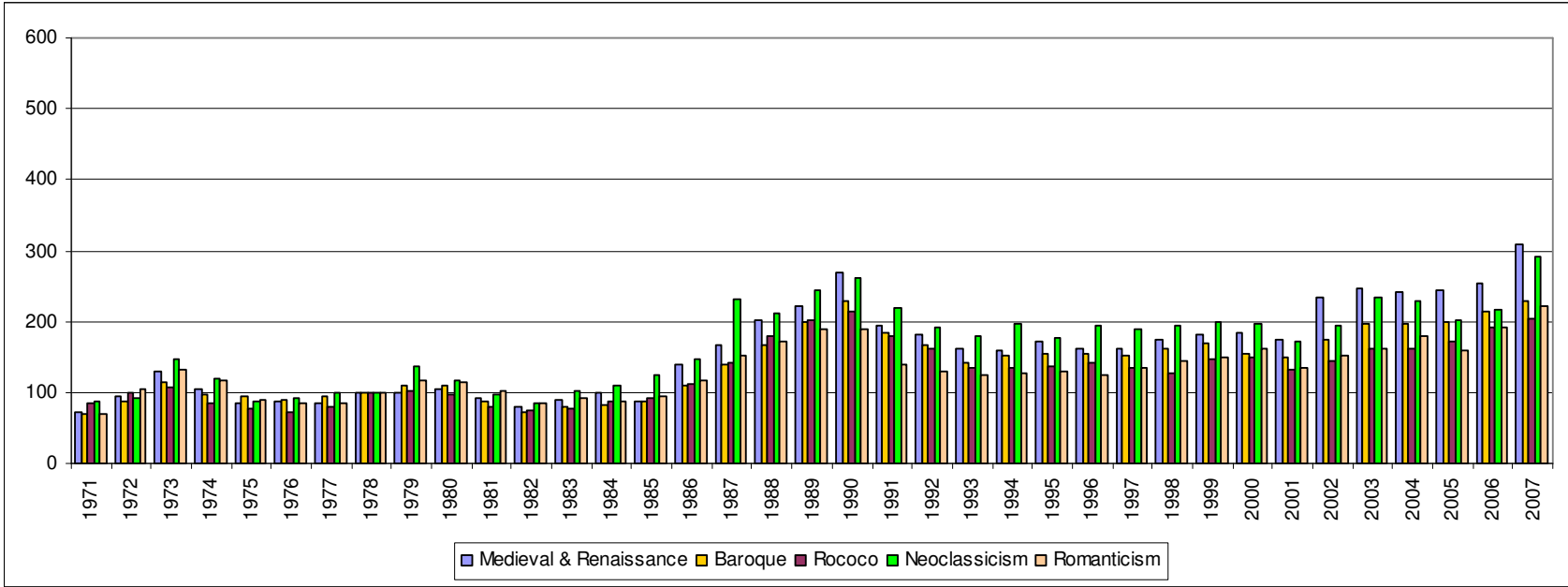
Figure 4: Hedonic price index 1971-2007 for movement-specific models (cont.)

Panel B: Price indices for Realism, Impressionism & Symbolism, Fauvism & Expressionism, and Cubism, Futurism & Constructivism

Figure 4: Hedonic price index 1971-2007 for movement-specific models (cont.)

Panel C: Price indices for Dada & Surrealism, Abstract Expressionism, Pop, and Minimalism & Contemporary
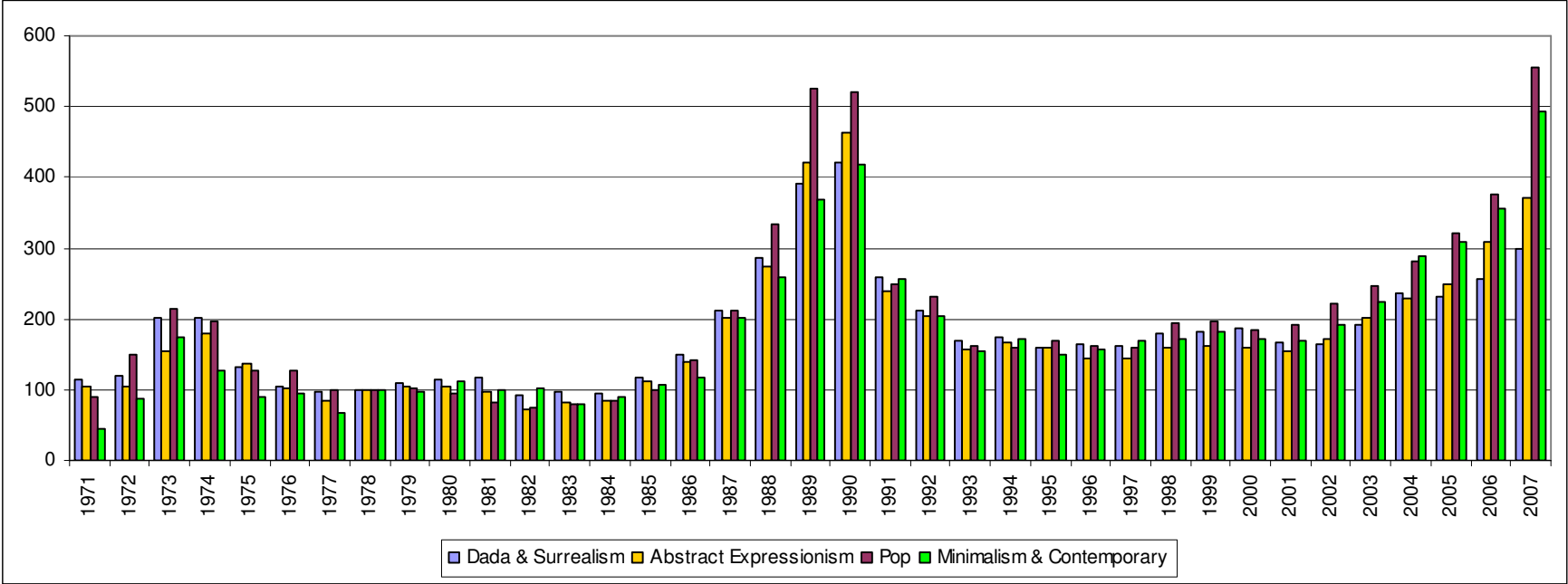
Figure 5: Hedonic price index 1951-2007 for benchmark model (4) and an adjacent year model

Figure 5 compares our general hedonic price index since 1951, based on the results of model (4), to a hedonic price index based on an adjacent year model. The index values in 1978 are set equal to 100.
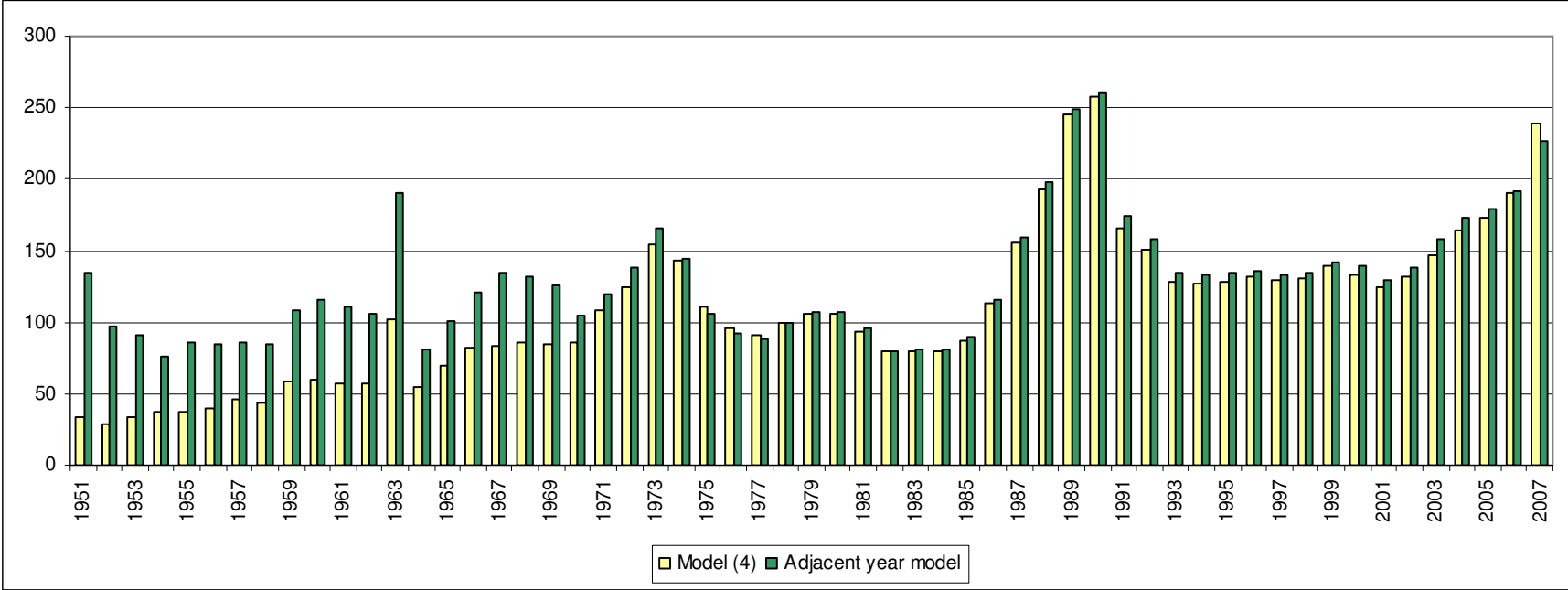
Figure 6: Robustness of general art index

Figure 6 compares our general hedonic price index since 1951, based on the results of model (3), to a hedonic price index based on all sales for which the artist was mentioned in the previous edition of the art history textbook Gardner's Art through the Ages ('Previous Gardner'), and to a hedonic price index based on all works by artists who were included in the 1926, 1959 or 1980 edition of Gardner's Art through the Ages, but not in the 1996 or 2004 edition ('Fallen from fashion'). The index values in 1978 are set equal to 100.
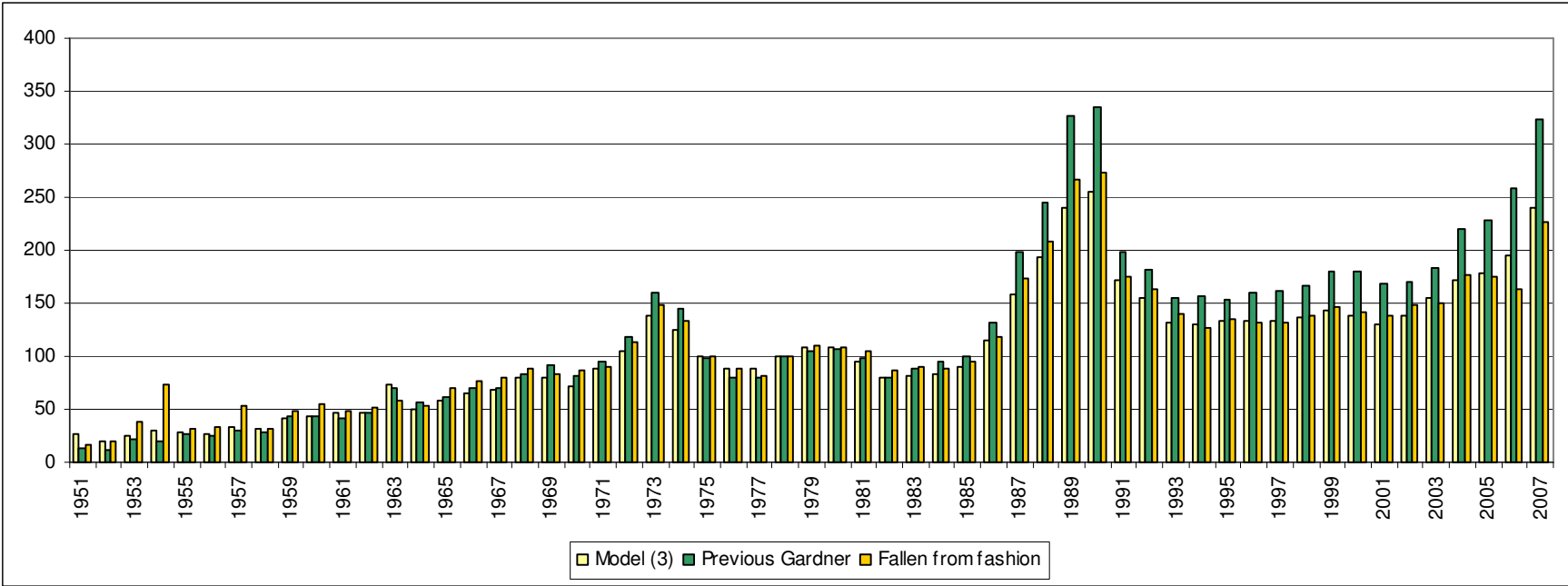
Figure 7: The "masterpiece effect"

Figure 7 compares our general hedonic price index since 1951, based on the results of model (3), to a hedonic price index based on all works by artists with a very high (top 5%) word count in the Grove Art Online database ('Top 5% word count'), one based on all works by artists mentioned in all five considered Gardner textbooks ('Blue chip'), and an index based on sales by the latter artists at Sotheby's or Christie's in London or New York ('Blue chip (top sales room)'). The index values in 1978 are set equal to 100.
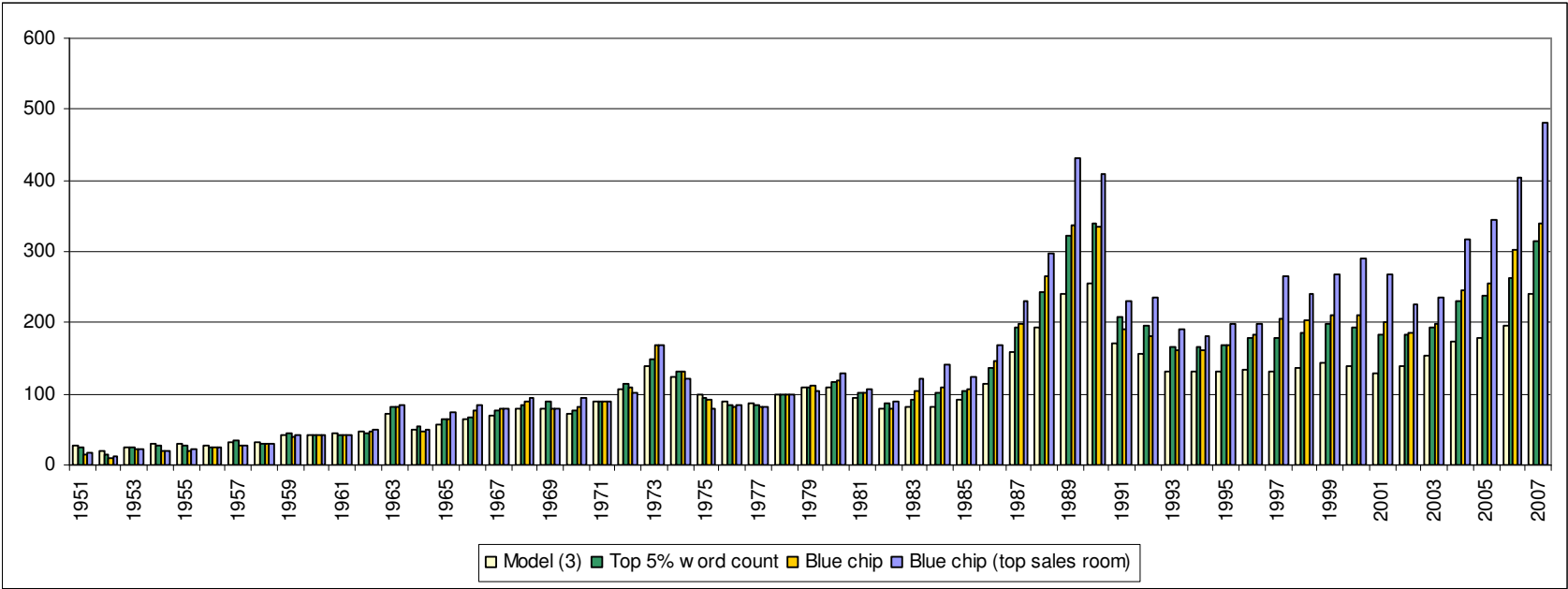
Figure 8: Hedonic price index 1951-2007 for benchmark model (3) in USD and GBP

Figure 8 compares our general hedonic price index since 1951, based on the results of model (3), to a hedonic price index based on the same model, but starting from transaction prices in (real) GBP. The index values in 1978 are set equal to 100.