

Price Determinants and Investment Characteristics of Contemporary Paintings

Master Thesis

Supervisor: Prof. Dr. Claudio Loderer

Author: Dmitrij Gawrisch
Kiev, Ukraine
01-118-363
Caecilienstrasse 7
3007 Bern
dmitrij.gawrisch@students.unibe.ch

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The opinions stated in this thesis are my own. They do not necessarily correspond with the opinions of the Institut für Finanzmanagement. The Institut für Finanzmanagement does not take responsibility for mistakes that this thesis may contain.

I. Executive Summary

Media reports suggest that art investments show a better financial performance than traditional stock investments. This claim is investigated by looking at a unique sample of paintings by 32 recognized Western contemporary artists auctioned between 1992 and 2007.

First we explore the price determinants of contemporary paintings that are identified by means of hedonic regression. We find that the price-optimal size of a contemporary painting amounts to 7 square meters. The highest premium is paid for works on canvas executed in mixed media, oil and acrylic. Similarly to other studies, Sotheby's New York seems to fetch the highest prices, followed by Christie's New York, Sotheby's London and Christie's London. Contrary to earlier findings, signature has a significantly negative influence which indicates that contemporary artists are expected to execute their works in easily recognizable individual styles. The presence of the date mark has a positive effect on prices. A standardized painting by the most-expensive artist in our sample, the British Lucian Freud, is around 172 times more expensive than an identical painting if created by the least-expensive artist, the German Walter Dahn. The age of the artist as well as the age and subject of the painting do not significantly influence prices.

In order to derive the basic investment characteristics of contemporary paintings, we then construct a hedonic price index. By comparing Sharpe ratios, we find that contemporary art shows a worse overall financial performance than S&P500, FTSE100 and DAX30 stock indices, thus suggesting that media usually report on positive outliers whose superb performance should not be generalized.

Our conclusions are relevant for collectors, art investors, auctioneers as well as artists if they are interested in the financial performance of their works.

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VI. Abbreviations

ACBO	Acrylic on Board	GBP	British Pound
ACCA	Acrylic on Canvas	HIR	Hirst, Damien
ACOT	Acrylic on Other Support	i.e.	id est (that is)
ACPR	Acrylic on Paper	ILL	Illustration
ALI	Alive	IMM	Immendorf, Jörg
ANT	Antes, Horst	IND	Indiana, Robert
BAS	Baselitz, Georg	JOH	Johns, Jasper
CAI	Contemporary Art Index	KIE	Kiefer, Anselm
CAPM	Capital Asset Pricing Model	KIP	Kippenberger, Martin
CHLO	Christie's London	KIR	Kirkeby, Per
CHNY	Christie's NY	KOO	Koons, Jeff
CHOT	Christie's Other Cities	LEW	Lewitt, Sol
CPI	Consumer Price Index	LNLOT	Natural Logarithm of Lot
CUC	Cucchi, Enzo	LUE	Lüpertz, Markus
DAH	Dahn, Walter	MAR	Marden, Brice
DAT	Dated	Max	Maximum
DAX	Deutscher Aktienindex	MER	Merz, Mario
DDM	Dividend Discount Model	MIBO	Mixed Media on Board
DIN	Dine, Jim	MICA	Mixed Media on Canvas
DOI	Doig, Peter	Min	Minimum
DUM	Dumas, Marlene	MIOT	Mixed Media on Other Support
e.g.	exempli gratia (for example)	MIPR	Mixed Media on Paper
et al.	et alii	MSE	Mean Squared Error
et seq.	and the following (page)	NAT	Natkin, Robert
et seqq.	and the following (pages)	Obs.	Observations
etc.	et cetera	OIBO	Oil on Board
EUR	Euro	OICA	Oil on Canvas
exp	Euler's number, 2.71828...	OIOT	Oil in Other Support
FOE	Förg, Günther	OIPR	Oil on Paper
FRE	Freud, Lucian	OLD	Oldenburg, Claes
FTSE	Financial Times Stock Exchange	OLI	Olitski, Jules

OTBE	Other Auction House Berlin	RAI	Rainer, Arnulf
OTBO	Other Medium on Board	RAU	Rauch, Neo
OTCA	Other Medium on Canvas	ROS	Rosenquist, James
OTLO	Other Auction House London	S&P	Standard and Poor's
OTNY	Other Auction House New York	SIG	Signed
OTOT	Other Auction House Other City	SIZ	Size
OTPA	Other Auction House Paris	SIZS	Size Squared
OTPR	Other Medium on Paper	SOLO	Sotheby's London
OTTS	Other Medium on Other Support	SONY	Sotheby's New York
OTVI	Other Auction House Vienna	SOOT	Sotheby's Other Cities
p.	page	StDev.	Standard Deviation
PAO	Paolini, Giulio	UK	United Kingdom
PIE	Piene, Otto	US	United States of America
PIS	Pistoletto, Michelangelo	USD	United States Dollar
POL	Polke, Sigmar	VAT	Value Added Tax
RAG	Rauschenberg, Robert		

Art prices are determined by the meeting of real or induced scarcity with pure, irrational desire, and nothing is more manipulable than desire.

Robert Hughes, art critic

All art is quite useless.

Oscar Wilde, Irish playwright and novelist

1. Introduction

On November 2, 2006, the New York Times announced that the abstract expressionist drip painting “No. 5, 1948” by the American artist Jackson Pollock changed owner for USD 140 million. This is the highest price ever paid for a work of art.¹ As a comparison, Pollock’s piece of fiberboard of roughly three square meters with mostly yellow and brown painting drizzled on its surface costs exactly twice as much as Manhattan’s most expensive penthouse apartment.² Two weeks later, Willem de Kooning’s “Woman III” was sold for USD 137.5 million.³ Just a few months earlier, in June, Gustav Klimt’s “Portrait of Adele Bloch-Bauer I” was acquired for the then-record-breaking amount of USD 135 million.⁴ Living artists command high prices as well: recently, in May 2008, Lucian Freud’s “Benefits Supervisor Sleeping”, depicting a corpulent naked lady dozing on a sofa, was sold by Christie’s New York for USD 30 million.⁵

Art returns appear impressive as well: Pablo Picasso’s “Boy with a Pipe”, auctioned for USD 104 million in 2004, generated an average annual nominal return of 64% over 54 years [Robertson (2005), p. 1].⁶ In comparison, the nominal average rate of return per year of S&P500 common stocks equals just 13% over the period 1926 – 2000. Over the same period, the returns of US treasury bills and bonds averaged at 3.9% and around 6%, respectively [Brealey and Myers (2003), p.155].

Newspaper reports seem to suggest that art shows a better performance than traditional securities like stocks. In this research we test this claim by analyzing the yet unexplored field of contemporary paintings by 32 leading Western artists who reached their creative peak after 1960. Contrary to most newspapers, we do not neglect risk that may be higher than the standard deviation of 20.2% in the stock market between 1926 and 2000 [Brealey et al. (2003), p.164] and thus justify the potentially higher return of art.

Referring to a growing literature on cultural economics and the relation of arts and investment theory, we first explore the price determinants of auctioned contemporary paintings over the period 1992 – 2007 using an econometric approach known as hedonic regressions and draw

¹ For details of the transaction, see Vogel (2006b).

² See Clemence (2006).

³ See Vogel (2006a)

⁴ See Vogel (2006c)

⁵ Christie’s (2008), deducting buyer’s premium.

⁶ See Higgs and Worthington (2005), p. 113 or Buelens and Ginsburgh (1993), p. 1352 for further examples.

conclusions that are potentially helpful for collectors, investors, auctioneers and artists who are at least vaguely interested in the monetary value of their works. Based on these results we then approach the question how contemporary paintings perform in terms of risk and return in contrast to traditional stock markets.

The paper is organized as follows. Chapter 2 discusses the properties of paintings as economic goods, the organization of the art market and particularities of art pricing in general. Chapter 3 provides an overview of earlier literature. After a brief presentation of techniques that are employed in art research, Chapter 4 introduces the hedonic regression methodology that is used in this study as well as the regression variables and related hypotheses. Chapter 5 presents descriptive statistics of the sample. It is followed by the discussion of price determinants of contemporary paintings in Chapter 6. Chapter 7 describes the contemporary art index, calculates its returns and volatilities and approaches the question whether contemporary art is a good investment. Chapter 8, finally, summarizes the results, draws conclusions and offers ideas for further research.

2. The Economic Nature of Art

Disputes over the nature of art go as far back as ancient Greece and the appearance of Plato's "The Republic".⁷ Philosophers, art historians, critics and, of course, artists have proposed many (sometimes contradicting) definitions of art, its purpose and importance for mankind.⁸ None of them, however, have regarded art from an economic point of view, a perspective highly relevant for art investment. How do *economists* define art (Section 2.1)? What are the characteristics of the art market (Section 2.2)? And what pricing mechanisms are at work there (Section 2.3)?

2.1 A Consumable Investment

Is it reasonable to analyze art from an economic perspective? After all, the general public regards spontaneity, imagination and pleasure as the main features of the arts, "something which will always defy any rational explanation. [...] [A]rt objects are not reducible to craftsmanship, nor to technique, certainly not to commodities; they are created by genius [...]" [Gérard-Varet (1995), p. 509].

Art works, however, have been traded since the 15th century [De Marchi and Van Miengroet (2006)]. Artists produce, among other forms, paintings. Art collectors, investors, museums and others demand them. Supply and demand meet in a more or less organized environment and negotiate the prices of these "works of genius". Is there really so much difference between paintings and commodities like oil, wheat or used cars?

Art is an extraordinary economic good [Stein (1977), p. 1021]. According to Bryan (1985), it possesses a dual personality: it is a consumption commodity that is characterized by a number of attributes *and* an investment object, much like real estate. In other words, it promises pleasure and profit at the same time [Higgs et al. (2005), p. 113]. Paintings are a consumable investment.

They provide psychic consumption services – various forms of pleasure and satisfaction – through their aesthetic and social attributes [Gérard-Varet (1995), p. 511]. The meaning of aesthetic attributes is two-fold. First, the owner of a painting may "like" it because she considers it "beautiful" or is intellectually appealed by and personally involved in the artistic "idea" or "concept" the painting is based on. The second side of aesthetic attributes could be

⁷ See Platon (2000), p. 104 et seqq.

⁸ Most of these varying views on the nature of art are discussed in Gombrich (1995).

called decorativeness: paintings are used as decoration of houses, apartments or offices. There are cheap paintings, prints and sculptures that are bought for decorative purposes only. As unique works with a high personal involvement are put on walls, too, a part of their aesthetic consumption also consists of decorativeness.

The social consumption service of a painting results from the prestige the possession of a famous work of art bestows upon its owner. An expensive painting by a famous artist has a similar signaling effect of wealth and taste as sport cars, yachts or luxury labels. It is a complementary good whose private value is enhanced by other assets [Gérard-Varet (1995), p. 516].

Commodities like oil or wheat are quite homogenous. Paintings, however, are singular [Gérard-Varet (1995), p. 510], no two paintings are identical or interchangeable. Thus paintings represent an extreme example of heterogeneous commodities (differentiated products). As their unique set of attributes generates a stream of pleasure, some authors call paintings “hedonic goods” [Chanel, Gérard-Varet and Ginsburgh (1994), p. 9].⁹

In contrast to most other commodities, paintings are further characterized by their durability: they do not disappear when they are consumed [Hodgson and Vorkink (2004), p. 630]. This feature qualifies them for their second personality as investment objects.

As financial assets paintings represent alternative investments to stocks, bonds or real estate. When an investor buys art, she, in principle, makes a bet on future taste: she hopes that a currently “hot” artist will remain “hot” in the future or that the public will learn to appreciate the works of a young artist whom it considers too “avant-garde” at the moment.¹⁰ Of course, neither can happen resulting in a complete loss of value. Due to these uncertainties and risks art is as much a speculative asset as any other [Chanel (1995), p. 520] and is sometimes acquired mainly for speculative purposes. At the same time the monetary value of paintings by established masters appears relatively stable over short time periods. Therefore paintings store value and are frequently accepted as collateral for bank loans [Chanel et al. (1994), p. 7]. Tax savings are another motive for investing in art: art works are exempt from property tax in some countries as long as they are exhibited in private (as soon as they are lent, they become subject to personal property tax and the stream of received rental fees is taxed as income); in other countries the tax burden is lower. In some countries, lower VAT rates apply to art as a result of cultural policies designed to make the acquisition of artworks more attractive (e.g.

⁹ Automobiles, real estate or wine are other examples of hedonic goods.

¹⁰ Investments in equity involve similar expectations about the future: will an established company and its products remain competitive? Will a start-up company be able to market its break-through innovations?

the standard VAT rate and the rate applying to art in the UK, France and Switzerland are 17.5% and 5%, 19.6% and 5.5%, 7.6% and 0%, respectively).¹¹

We are discussing art as an investment with consumption attributes or a consumption good with investment attributes. The fundamental question remains: is it really the correct approach to analyzing art? It is important to realize that the economic approach offers just *another* description of this complex phenomenon and does not replace creativity, aesthetics, criticism or art history [Grampp (1989), p. 3]. It rather complements them and proves useful when art is subject to supply and demand in the art market.

2.2 The Art Market

The contemporary art market is much more than a simple exchange of art works: market prices signal the status attributed to an artist by contemporary aesthetic judgment [Gérard-Varet (1995), p. 510 et seq., Throsby (1994), p. 4]. In the following we cast a look on the size, participants, structure and other economic characteristics of the art market.

The estimated size of the international art market amounts to USD 28 billion in 2007.¹² This figure is consistent with Robertson's USD 20 billion in 1999 [Robertson (2005), p. 30] if we consider that the art market has been in another boom phase since 2004. 48% of the turnover is generated in the US, 28% in the UK, 9% in France, 3.6% in Italy, 1.5% in Switzerland.

The participants in the international art market are sometimes considered to behave irrationally. Frey and Eichenberger (1995), p. 531 list the main participants and their behavioral anomalies:

- *Private collectors* earn an above-average income [Pommerehne and Feld (1997), p. 251] and buy art mainly for its consumption services. They are prone to behavioral anomalies like the ownership effect (an owned object is valued higher than one not owned), the opportunity cost effect (alternative investments are not considered), the sunk cost effect (past efforts for building a collection remain relevant for further decisions) and the bequest effect (items that shall be left to children are valued higher as they are held for monuments, signs of "immortality"). Pure collectors, if they exist, completely ignore the financial attributes of art and are willing to pay high prices for their favorite works.
- *Corporate collectors* behave much like private collectors because art is acquired for

¹¹ For more detailed information on taxation as well as regulations on import and export of art works in the EU, US and Switzerland, see Pfister (2005) and the Swiss VAT Legislation (1999).

¹² The figure was mentioned by Mr. Justin Williams from The Art Trading Fund during an interview for Bloomberg on October 12, 2007.

consumption (decoration) rather than for profit purposes.

- *Speculators* buy art mostly for financial reasons. As mentioned in Section 2.1, they make bets on the evolution of taste. In analogy to pure collectors, pure speculators are speculators who do not experience the slightest pleasure in owning and looking at art. They store or lend paintings and sell them as soon as they have sufficiently appreciated in value. As this value appreciation is ultimately due to an increase in psychic consumption (psychic dividends; see Section 2.3) of art, we can conclude that art prices depend on the willingness to pay of buyers such as private and corporate collectors who can be regarded as art market “makers” [Frey et al. (1995), p. 533 et seq., Bryan (1985), p. 3, Worthington and Higgs (2003), p. 653]. Speculators can only be successful at auction if they base their valuations on consumption values of future buyers, the collectors.
- *Public museums* are the predominant type of museums in Europe.¹³ Due to their fundraising techniques and constraints, public museums are likely to buy only specific high-quality works that fit into their collection. As there are rarely close substitutes¹⁴ for unique masterpieces, the demand of museums is inelastic.¹⁵ As a consequence, museums are likely to pay “any price” in order to acquire the desired work. Paintings that are bought by a public museum usually disappear from the market [Stein (1977), p. 1023] as museums aim at collecting, preserving and exhibiting these pieces of cultural heritage of a country.¹⁶ As public museum directors and curators are led by different, supposedly “nobler” motives than collectors or speculators, their judgment is interpreted as a signal for quality: museum exhibitions and acquisitions provide cultural validation of the works of an artist.¹⁷
- *Private museums*, mainly in the US, collect their funds from wealthy individuals and companies (particularly in times of economic upturns) instead of the government. In contrast to public museums, they are not responsible for preserving the cultural heritage

¹³ If exhibited in a museum, a painting acquires public-good attributes [Gérard-Varet (1995), p. 516].

¹⁴ As (imperfect) substitutes are regarded paintings by the same artist, illustrating similar subjects, executed in the same technique, in similar colors, etc. For example, Klimt’s portrait of Adele Bloch-Bauer II (USD 87.5 million) could be regarded as a substitute for Adele Bloch-Bauer I (USD 135 million). Paintings by other artists from the same school are sometimes regarded as substitutes as well [Worthington et al. (2003), p. 651].

¹⁵ Another reason for the inelastic demand lies in the confinement of museums to buying art: in contrast to speculators they cannot consider alternative investments [Pommerehne et al. (1997), p. 252].

¹⁶ Experts estimate that only three major Rembrandts are left in private hands; all others are owned by museums [mentioned in Robertson (2005), p. 5].

¹⁷ For more information on museum policies and their (validation) impact on painting prices, see Pommerehne et al. (1997) as well as Throsby (1994) and Frey and Meier (2006).

and are allowed to sell parts of their collection. As funds are usually accompanied by “aesthetic judgments” of the sponsors, private museums show similar patterns of behavior as private and corporate collectors [Frey et al. (1995), p. 532].

- *Galleries, art dealers and brokers* are “as much collectors as traders, [...] their motivation lies somewhere between altruistic mission and revenue maximization” [Robertson (2005), p. 24 et seq.]. Whereas dealers buy works and sell them later on, brokers work on commission (which sometimes amounts to 50% of the selling price due to high risk [Chong (2005), p. 94]). Most galleries represent mixes of dealership and brokerages. Through their understanding of the market many art dealers have acquired a good reputation and are sometimes regarded as taste leaders who might be able to command higher prices for artists they represent. However, according to Robertson (2005), p. 24, there are just too many players in the market so that single dealers like Charles Saatchi, Richard Green or Larry Gagosian cannot dictate prices.
- *Auction houses* operate on a larger scale than art brokerages: highly professional and educated staff prepares publicly available catalogs that display the objects offered for sale, including physical characteristics (size, material, technique, etc.) as well as background information on the works and the artists, the exhibition history, provenance (previous owners) and price estimates. Auction houses charge around 10-17.5% “buyer’s premium” and around 10% “seller’s commission” of the hammer price for their services [Ashenfelter and Graddy (2002), p. 6 et seq.].
- *Critics* serve as taste makers in the art world. As they are supposed to have similar non-monetary “validating” motives as museums, critics are regarded as credible sources of information and “normative aesthetic judgments” [Robertson (2005), p. 26 et seq.]. The bias through reverse causality must be considered when judging critics’ opinions: they often discuss works that have attracted extraordinary prices.¹⁸
- *Artists* are the primary suppliers of works of art. As this paper deals with established artists whose works are sold at auctions without their participation, we do not discuss their labor markets and creativity patterns, but refer to a number of interesting essays on these topics in Ginsburgh’s and Throsby’s Handbook of the Economics of Art and Culture (2006).

The art market is comprised of linked, hierarchical submarkets [Gérard-Varet (1995), p. 511].

¹⁸ For information on art critics and a model of their opinion formation process and credibility, refer to Bonus and Ronte (1997).

The lowest level of this structure is usually referred to as the primary market [Throsby (1994), p. 5]. It deals with works of artists who have not acquired a reputation yet. Artists either sell their works directly to private buyers or supply them to small dealers, galleries, exhibitions and local art fairs. The market is highly decentralized. As there are more artists on the supply side than potential buyers on the demand side, prices tend to be low.

In the secondary market, “established artists, dealers, and public and private collectors circulate works by live artists who have managed to make the transition from the primary market (for example, by succeeding in having their work taken up by a recognized commercial gallery or dealer, or purchased by a respectable public art museum), and works by dead artists whose names are still recognized” [Throsby (1994), p. 5]. The works traded on the secondary market are more significant, the number of supplying artists is lower, and therefore the prices are much higher than in the primary market. With 50% of the turnover, the secondary market accounts for the lion’s share of the art market.

The tertiary level, finally, comprises of auction houses. The two most prominent and leading auction houses are Sotheby’s and Christie’s. Both have international subsidiaries in all major art centers and trade with the most renowned and therefore most expensive living and deceased artists. However, most auction houses operate nationally [De La Barre, Docclo and Ginsburgh (1994), p. 164 et seq.]. According to Ginsburgh, Mei and Moses (2006), auction houses account for 10-20% of the art market turnover.

Leading auction houses are claimed to command the highest prices. This opinion may be biased. First, auction houses are obliged to publicly disclose their sales; galleries, art dealers or collectors are not. Therefore it is possible that top transactions are not disclosed in order to avoid envy and the risk of theft (the social prestige, a consumption attribute, resulting from the possession of a famous painting counters this “modesty”; therefore it is not surprising that the buyers and the exact prices of the three most expensive paintings mentioned in Chapter 1 are known even though the paintings were sold in private transactions).

Second, in dealer, gallery and private sales we frequently have a bilateral monopoly situation on the seller’s as well as on the buyer’s side. At auction sales, however, several auction houses compete for the right to sell a painting to a pool of potential buyers. The effect of this competition on prices is unclear: on the one hand, competition generally results in lower prices; on the other hand, auction houses have higher overhead costs and, as in case of Sotheby’s and Christie’s, can exercise their market and marketing power to attract new bidders that will enhance liquidity and ultimately drive prices up [Higgs et al. (2005), p. 115, Goetzmann and Spiegel (1995)]. Sometimes paintings are bought at auction by an art dealer

and resold to a collector with a significant mark-up¹⁹ a few months later which indicates that at least certain works achieve higher prices when they are sold in private rather than at auction.²⁰

Due to data availability and quality this research concentrates on transactions of contemporary paintings in the auction market.²¹ Before looking at the price setting mechanisms, we have to approach the question whether the auction market for art is an efficient market so that prices incorporate all publicly available information about the quality and availability of the traded asset [Chanel et al. (1994), p. 16].

Information asymmetries between sellers and buyers seem to be an essential feature of the art market. As Chanel et al. (1994), p. 16 point out, “[...] dealers or market makers can be thought of making high profits since they have information about willingness to pay of collectors interested by a specific painting. Another possible explanation is based on the valuation mechanism itself: the value of art is primarily driven by changing tastes, and some of these changes are shocks resulting in swings of relative prices. Dealers may then be seen as aesthetic risk [arbitrageurs].” Chanel et al. (1994) test the art market for weak-form efficiency and cannot reject the hypothesis that painting prices behave like a random walk for Impressionist painters. Singer and Lynch (1997) for modern paintings and Louargand and McDaniel (1991) for Americana (American art objects, not only paintings) confirm these results. This is potentially due to a better distribution of essential information through media coverage, catalogs and scientific art market research [Louargand et al. (1991), p. 55] as well as “globalization of aesthetic values” [Goetzmann (1993), p. 1375]. Unfortunately Chanel et al. (1994) lack data to test for the semi- and the strong-form efficiencies.

Despite increased information efficiency the art market is still very far from being “perfect”. But the situation has been steadily improving over the past years:

- The transaction costs (commissions) in the auction market were lowered, but they are still as high as 10% and 15% for the seller and the buyer, respectively. As a comparison, transactions of the same magnitude in the stock market cost less than 1%.²² Therefore trading occurs infrequently²³ as short-run speculations are unprofitable which negatively influences the market liquidity [Renneboog and Van Houtte (2002), p. 334].

¹⁹ This mark-up is supposed to compensate the information costs of the art dealership.

²⁰ Douglas (2008).

²¹ More information on (English) art auctions can be found in the survey of Ashenfelter et al. (2002).

²² UBS (2008).

²³ As mentioned in Frey and Pommerehne (1989), p. 398, Sotheby’s recommends that works of art are held for at least 7-10 years.

- Art buyers are usually wealthy individuals. As a consequence, the number of bidders at an auction is limited which also has a depressing effect on market liquidity. In order to increase it and thus increase the probability to achieve higher prices, auction houses themselves have devised financing plans for buyers [Louargand et al. (1991), p. 55].
- Although art auctions still work in traditional ways, globalization and new technologies have led to a wider dissemination of information and thus a wider pool of buyers and sellers [Louargand et al. (1991), p. 55], many of them from the emerging countries like Russia and China. These structural changes positively influence market liquidity.

Some problems of the art market remain unsolved due to the uniqueness of the traded asset. First, a painting cannot be split and sold in shares.²⁴ Therefore small investors will continue having difficulties to participate in the auction market.²⁵ Second, no short-selling driven by real or perceived arbitrage opportunities is feasible in the art market [Frey et al. (1995), p. 532]; this mechanism would prevent long-term mispricing of securities. Lengthy delays in the selling process are another hurdle art investors face: due to the time-consuming search of a counterparty or an intermediary such as a gallery or an auction house and extensive authenticity verifications, it may take up to six months between the decision to sell and the actual selling of a painting whereas in the financial markets this time span lasts no longer than a few seconds [Worthington et al. (2003), p. 651]. And last but not least, there are significant barriers to international trade of art that is considered to represent the cultural heritage of a country. These constraints particularly arise in Italy [Candela and Scorcu (1997), p. 187] and France [De La Barre et al. (1994), p. 168].

Art markets are still far from being “perfect”. As most pricing theories were developed for perfectly competitive markets, the following pricing approaches and equations can only be interpreted as approximations [Gérard-Varet (1995), p. 512].

2.3 Art Pricing

Before we can assess the investment characteristics of contemporary paintings, we must address the complex and controversial issue of price formation in the art market.

In his highly-debated article on art investment as floating crap game, Baumol (1986) gives a scathing judgment: “[...] it seems implausible that art markets possess anything like long-run equilibrium prices, let alone that there exist reliable forces that drive market prices toward

²⁴ In theory, art can be split as well, but it is doubtful that scraps of painted canvas will be worth much.

²⁵ In recent years, a small number of art funds emerged trying to circumvent the problem of indivisibility of art works, e.g. the Fine Art Fund or the Art Trading Fund.

them” [Baumol (1986), p. 11].²⁶ Candela et al. (1997) interpret Baumol’s statements as a complete lack of any fundamental values in paintings. Demand is highly volatile, and thus prices behave in an unpredictable manner, “following collectors’ fads and manias” [Candela et al. (1997), p. 176].

If Baumol’s views are correct, how can we explain the existence of professional art appraisers? Bauwens and Ginsburgh (2000) show that appraisals, although systematically biased for auction-strategic reasons, can predict art prices quite well on average. These findings indicate that art prices are not as random as it may seem at first glance.

Most markets, the art market being no exception, are balanced by the price of traded assets. As the supply in the art market is fairly inelastic [Candela et al. (1997), p. 176] because artists are unlikely to increase their output quickly if prices are high, prices reflect the demand for a more or less given supply of works.²⁷ How is the demand determined in the art market? And how is this demand translated into prices?

In the equity market, the price of a share equals the present value of all future cash inflows (dividends, share repurchases, par value reductions, liquidation proceeds, etc.) resulting from owning the share. Thus a stock can be valued by forecasting future dividends (and other cash inflows) and discounting them to the present using an adequate risk-adjusted discount rate. This valuation approach is known as the Dividend Discount Model (DDM). It is consistent with the popular Discounted Cash Flow model which is assumed to provide correct valuations [Loderer, Joerg, Pichler, Roth and Zgraggen (2007), p. 737 et seqq.].

Can we apply the same methodology and reasoning to paintings? In Section 2.1, we have seen that paintings possess a dual nature: they are commodities and investments at the same time. Thus we can say that a painting pays two kinds of dividends: psychic dividends and monetary dividends.

In accordance with Section 2.1, psychic dividends (we could also call them consumption dividends) consist of a stream of positive aesthetic and social dividends [Worthington et al. (2003), p. 652]. The amount of psychic dividends a painting “pays” to its holder is driven by taste. If an artist is “in”, i.e. if his works are exhibited in renowned galleries, if they have been

²⁶ Baumol’s contribution turned out to be the real starting point of a debate on the efficiency of art markets, price setting mechanisms and investment characteristics of art. Arguably all subsequent research aims at questioning Baumol’s interpretations and findings.

²⁷ One may argue that collectors are also suppliers of art and could sell a part of their collection if prices are high. As seen in Section 2.2, collectors are unlikely to sell because they are primarily interested in consumption benefits of art; speculators probably behave differently. Therefore the supply and demand effects are difficult to separate in the art market [Hodgson et al. (2004), p. 632].

validated by museum purchases, if he receives attention from influential critics in the leading art magazines, we may assume that the social prestige component of owning his paintings is high which in turn leads to higher prices. On the other hand, an artist sometimes falls from fashion which has a depressing effect on social dividends his paintings “pay”. For instance, Buelens et al. (1993) report the case of British portrait and landscape painters who were quite popular in the 19th century, but completely fell from fashion in the 20th century: their price index dropped from 100 to 7. Taste for specific artists changes slowly [Buelens et al. (1993), p. 1352, Candela et al. (1997), p. 177]. According to Gérard-Varet (1995), p. 517, this is due to “habit formation”. Taste, a form of social (cultural) capital, is “created” through education, advertising and some “process of socialization” that are not costless.²⁸

Paradoxically, the psychic dividend stream is also influenced by wealth. We have seen in Section 2.1 that art is a complementary good (even a luxury good) whose value is enhanced by other assets. Greater wealth in times of economic upturns thus leads to higher art prices whereas economic downturns have a depressing effect on them. This notion of art contradicts the common misconception that art behaves counter-cyclically and thus could be a safe store of value during economic downturns.²⁹

Whereas psychic dividends of paintings are positive, monetary dividends are partly negative. They consist of an insurance premium against fire and theft that varies between 0.2% and 1% of the appraised value, storage, maintenance and restoration costs [Frey et al. (1989), p. 398 et seq.]. Rental fees³⁰, reproduction fees [Hodgson et al. (2004), p. 633], and tax savings in some countries, on the other hand, are largely positive and may even be able to compensate the negative holding costs of paintings [Worthington et al. (2003), p. 652].

If we assume that the DDM is correct, we can argue that the price of a painting equals the present value of all psychic and monetary dividends a painting “pays” during its lifetime. Analogous to the investor in stocks who forecasts all future cash dividends, an art investor must forecast all future psychic and monetary dividends in order to establish the current price of the painting.³¹ Prices of art change due to changes in the expectations about the future dividends that are determined by taste or to changes in the risk-adjusted discount rate that is applied to the expected future dividends.

²⁸ For a detailed argumentation on the slowness of changing taste, see Rohner, Winstein and Frey (2006).

²⁹ Empirical support for cyclicity of art is provided by de la Barre et al. (1994), Chanel (1995) or Ginsburgh and Jeanfils (1995) who find a significant influence of financial markets on the art market.

³⁰ See below for a more detailed discussion of rental fees.

³¹ Production costs (time, paint, support, etc.), in most cases less than USD 2,000, are classical sunk costs and are thus irrelevant for subsequent valuation [Candela et al. (1997), p. 176].

Like in financial markets, the risk-adjusted discount rate is calculated by adding an adequate risk premium to the risk-free interest rate [Loderer et al. (2007), p. 365]. According to Agnello and Pierce (1996), p. 361, painting holders face the following *specific* risks (apart from the common risk factors like interest and exchange rates, inflation, etc.):

- *Reattribution* applies when an art-historical analysis reveals that a painting was created by a different artist than originally assumed. Reattribution risks are mostly present in the Old Master submarket. They are directly related to the amount of social esteem for an artist and thus psychic dividends associated with his works.
- *Fakes and forgeries*, when discovered, can be regarded as extreme cases of reattribution and lead to a complete loss of value. Interestingly, the aesthetic qualities of fakes and originals are identical. Therefore the loss must be due to declining social dividends (the owner cannot maintain anymore that she owns an original Picasso) which indicates the huge importance of social aspects in the arts.
- Paintings can also be *damaged, destroyed* (e.g. in a fire) or *stolen*. These events represent losses of parts or all psychic dividends, but may have no direct monetary consequences as paintings are usually insured.
- Changes in *taxation* influence monetary dividends of art and consequently the valuations of potential buyers who are at least vaguely interested in the financial services of paintings (as opposed to “pure collectors” who only care for psychic returns).

In order to apply the DDM to paintings, we need to be able to quantify and translate all relevant factors into monetary terms. Is there a way to observe, measure and forecast psychic dividends?

Frey et al. (1995), p. 534 et seqq. propose to consider the rental market of paintings. If a painting is lent e.g. to a museum, a gallery or an individual³², the owner foregoes its psychic dividends and must be compensated in monetary terms. The amount she is willing to accept equals her value of psychic dividends she receives from owning the painting.

However, rental markets of paintings seem to be almost nonexistent. According to Frey et al. (1995), this is due to the bid-ask spread that results from the ownership behavior anomaly (see Section 2.2): “An art object yields *additional* benefits if it is owned (not just rented) because the art object’s ‘aura’ [...] is herewith appropriated. Consequently, neither are potential hirers willing to pay ‘market rents’ (covering capital costs, insurance, etc.), nor can present owners be sufficiently compensated by such rents for foregoing the art object when it is rented out”

³² In this case the transaction is similar to e.g. car or house rentals.

[Frey et al. (1995), p. 535]. Purely commercial galleries and speculators, on the other hand, should easily be willing to lend their paintings as there are no psychic returns that must be compensated. When lending their art, this group would receive the monetary equivalent of psychic returns of art consumers minus the value of the psychic ownership effect. Commercial galleries and speculators may not be willing to lend their works for reasons of taxation: rented art becomes subject to property tax, and the monetary dividend stream is taxed as income [Pfister (2005)].

As psychic dividends are difficult to observe and to measure, it is impossible yet to value paintings using the DDM. But its ideas can be incorporated into a feasible alternative method. A painting, a hedonic good, pays its psychic dividends through a number of attributes. The name of the artist, for example, may be considered the main determinant of social dividends; a bigger painting is better than a smaller (however, there is an optimal size as otherwise the painting becomes too big for most walls [Agnello et al. (1996), p. 369]); the medium of execution (oil, acrylic, mixed media, etc.) and support (canvas, board, paper, etc.) are proxies for quality (oil is more difficult to handle than other media) and durability (oil and acrylic paints are more likely to keep their distinct colors than gouache) [Hodgson et al. (2004), p. 631].

The econometric method known as hedonic regressions allows distributing the selling price of a painting on variables that are sources of psychic dividends. It reveals how the auction market prices the various hedonic attributes of a painting. Hedonic regressions are discussed in detail in Chapter 4.

Authors following Baumol's line claim that there is no fundamental value in art. For instance, Goetzmann et al. (1995), p. 550 write: "Since paintings have no intrinsic value and no measurable dividends, prices depend only on what investors will pay."

Candela et al. (1997), p. 176 formulate an alternative view: "[It] recognizes that the market price of an art object depends on conventional social valuations [...] [and] assumes that these social beliefs and cultural habits are firmly held by the public, so that 'fundamentals' can be identified. Market prices could offer suitable information about 'equilibrium' values [...]. Fads are sometimes present in the art market, but in the long run, or on *ex-post* basis, they are supposed to be clearly distinguishable from 'fundamental' values. [...] A positive correlation between the returns on paintings and on alternative assets suggests therefore some form of substitutability and implicitly corroborates the [second] approach: If art prices were driven by persistent fads (or if fads were major components in determining them), art prices should be largely unrelated to the prices of other assets, like stock or real estate, which are supposedly

driven by sound economic fundamentals.”

Do sound economic fundamentals exist in the stock market? The dividends or cash flows required for valuation purposes may be easily measurable, but they are just indicators of (un)successful product and marketing strategies. Whether products like mobile phones or notebooks become stars and cash cows also depends on psychic returns and tastes that change much faster than in the art market. The true value of art may be unobservable [Mei and Moses (2002), p. 1667], but it is not alone in this quality.

In the next chapter we review the most important results of earlier empirical studies on art.

3. Past Research

Many economists, including Adam Smith and John Maynard Keynes, were interested in visual arts and considered them as a big puzzle [Gérard-Varet (1995), p. 510]. Starting in the 1970s, a number of researchers began joining the scattered pieces into one solid picture of art from the economic perspective.

In the following, we review the results and conclusions of the most important studies from three major fields of economic art research³³: investment characteristics of paintings (Section 3.1); comovements of painting and financial markets (Section 3.2); inclusion of paintings into diversified portfolios (Section 3.3).

3.1 Investment Characteristics of Paintings

A vast majority of studies deal with the question how paintings perform on average compared to other assets. Although Anderson (1974) and Stein (1977) provided important and still valid contributions, it was Baumol (1986) with his polemic statements who started the discussion whether art should be acquired for financial purposes or just for aesthetic and social pleasure.

- In his pioneering research³⁴, Anderson (1974) analyzes auctioned paintings³⁵ over the period 1780 – 1970. Applying hedonic regressions, he calculates an average nominal rate of return of 3.3% (3.7% if regressions are used that are based on repeat-sales of the same painting) and concludes that “the consumption value of art must be the primary motivation behind its purchase” [Anderson (1974), p. 25].
- By using CAPM, Stein (1977) quantifies the financial performance of paintings (by artists who died before 1946) sold in the US and UK over the period 1946 – 1968. Assuming a uniform distribution of the quality of transacted paintings (i.e. a similar set of paintings are auctioned every year), he finds annual nominal rates of returns between 10.5% and 13.1% (depending on the country of origin and sale). Compared to nominal stock returns of 14.3% over the same period, Stein concludes that paintings are “a fairly ordinary asset” [Stein (1977), p. 1034].

³³ Alternative, rather methodological, but no longer most actual reviews are offered by Gérard-Varet (1995) and Throsby (1994).

³⁴ Anderson seems to be the first researcher applying hedonic as well as repeat-sales regressions, subsequently the dominant methodologies, to paintings. Among other things, he mentions the portfolio diversification potential of art.

³⁵ Until mid-1990s, most studies relied on yearly Mayer’s International Auction Records and Reitlinger’s *The Economics of Taste* (several volumes) as their primary data and artist selection sources.

- Baumol (1986) explores the performance of paintings during 1652 – 1961. In order to calculate returns, he only considers works that have been sold at least twice either in the US or UK over a period longer than 20 years in order to exclude supposedly speculative sales. He finds that paintings achieved a mean real rate of return of just 0.55% over 300 years, around 2% less than the risk-free rate over the same period. Like his predecessors Baumol recommends to buy art only for its consumption services.
- Relying on Baumol (1986), Frey et al. (1989) deliver the first European study on the financial performance of paintings. They cover the period 1635 – 1987, include sales that took place in Continental Europe (not just in the US and UK) and check whether the investment characteristics of art changed after World War II. Including transaction costs (but disregarding costs for insurance, maintenance and restoration), they find a mean real rate of return of 1.5% per year with a standard deviation of 5%. As in Baumol's case, risky paintings are dominated by risk-free assets over 350 years. During the period 1950 – 1987 the nominal rates of return of art seem to rise sharply, but there is almost no real gain due to higher inflation. Also here the authors conclude that investments in paintings should only be made if psychic dividends are present or if significant tax savings can be realized.
- Buelens et al. (1993) replicate (“revisit”) Baumol's study and argue that his as well as results by Frey et al. (1989) should not be generalized for all periods and artistic schools. They show that the returns Baumol finds are too low because his sample is biased: 1) British (landscape) painters from the 18th century who went out of fashion in the 20th century are overrepresented in his sample; at the same time, Impressionists whose paintings achieved real rates of return over 10% are underrepresented; both effects have a negative impact on realized returns. 2) 50% of Baumol's resales fall into the time period 1914 – 1949 which, due to both World Wars and the Great Depression, may not be representative, either. Using hedonic regressions with all transactions (and not just repeat sales), the authors construct an art index and find real returns of 9.6% for all painters and 23.8% for Impressionists during the (relatively short) period 1950 – 1961. They show that paintings may be competitive investments after all. The study innovates the research field by looking at different schools³⁶ and investment horizons separately. Additionally it provides empirical evidence for changes in taste by comparing hedonic indices from different periods.

³⁶ This is a sound approach as every school is associated with taste and thus the level of psychic dividends.

- Goetzmann (1993) produces similar results as Buelens et al. (1993) applying repeat-sales regressions on an extended sample. As the painting market turns out to be quite volatile in the 20th century (he finds a standard deviation of returns of almost 53%), he concludes that “[art] is only potentially attractive to an agent who would otherwise choose a relatively volatile portfolio” [Goetzmann (1993), p. 1375]. Additionally, he is the first scientist to conduct a Granger causality test in order to explore the hypothesized influence of financial markets as generators of wealth on art. His results indicate a strong influence of the financial markets on returns in the art market. Therefore Goetzmann (1993) can be seen as the starting point of research on market comovements (see Section 3.2).
- In the most thorough paper until then, de la Barre et al. (1994) analyze returns of Impressionist, Modern and Contemporary paintings by artists somehow associated with Paris that were sold over the period 1962 – 1991. They use hedonic regressions that have become the dominant method. In order to control for the selection bias that is often mentioned as a weakness of art research, they construct two indices: one consisting of “Great Masters”, the other of “Other Painters” (followers of the Great Masters) who were selected randomly. They find that Great Masters achieve a nominal annual rate return of 12%, 4% more than Other Painters. The indices they constructed show that both groups behave quite similarly and reach tops and bottoms more or less simultaneously which indicates that the art markets are co-integrated. Additionally, the authors construct price indices of artists as well as different sales rooms and show that Christie’s and Sotheby’s in New York fetch higher prices than all other auction houses. They draw similar conclusions as Buelens et al. (1993) and Goetzmann (1993).
- Agnello et al. (1996) construct a monthly³⁷ price index of works by 66 American artists born before World War II auctioned between 1971 and 1992. Their study employs a large number of hedonic variables, going as far as whether the painting is signed and dated, auction lot number or whether the auction catalog contains an illustration of the painting. For instance, the authors find that, all other things being equal, signed paintings fetch a premium of 45% over unsigned, on the one hand due to perceived authenticity of the painting (we have seen above that fakes are a major risk in painting markets), on the other hand due to the “personal” touch a signed painting has compared to an unsigned. The premium for oil as a proxy for quality is about three times as high. Furthermore they find that the price-optimal size of a painting is around 6.5 square meters. Similarly to de la

³⁷ Due to the limited number of transactions, art indices can be yearly, half-yearly, quarterly and monthly.

Barre et al. (1994), the more expensive paintings (masterpieces) show higher returns than the less expensive works. The highest yearly returns of about 13% are achieved by American avant-garde artists, among them, not surprisingly, Jackson Pollock and Willem de Kooning. According to their analysis, American paintings have fetched an average nominal rate of return of 9.3%. Unfortunately the authors neglect risk considerations.

- Agnello et al. (1996) turned out to be the starting point of research efforts on art from single nations. In the following, Candela et al. (1997) conducted a study on Italian modern and contemporary oil paintings; Renneboog et al. (2002) examined Belgian paintings, Mei et al. (2002) once more American paintings (reviving repeat-sales regressions), Hodgson et al. (2004) Canadian paintings, Worthington and Higgs (2006) Australian paintings. All use samples consisting of paintings of rather traditional and established “stars” in the respective markets whose works were traded mostly³⁸ between 1970s and the end of 1990s. The results of all studies are similar: They show that the painting market slightly underperforms the financial markets (if looking at e.g. Sharpe ratios). They explain this discrepancy by the neglected consumption returns of art.

By now there seems to be a general consensus that the painting market underwent a structural change after World War II that resulted in higher art prices as well as returns than in earlier periods. However, art still shows a financial underperformance compared to stock markets. This fact is explained by the omission of consumption returns in the calculations. Several studies indicate that works by less known artists slightly underperform compared to art created by great masters. The minor variations in the results are mainly due to different countries, different painting portfolios and not always congruent time periods.

The major shortcoming of all profitability studies is the omission of return-relevant components like psychic dividends, transaction costs [except Frey et al. (1989)] and tax implications. As we have seen in Section 2.3, psychic dividends are difficult to assess due to the lack of rental markets for paintings; transaction costs vary between countries, auction houses and individual buyers³⁹; tax implications, finally, are also difficult to include in general estimations because they depend on the individual situation of every buyer and seller whose identities are rarely disclosed after the auction.

³⁸ Except Mei et al. (2002) who look at repeat-sales between 1875 and 2000.

³⁹ In the past, some auction houses were known to give regular customers (seller and buyers) discounts on the auction fees [Ashenfelter et al. (2002), p. 21 et seqq.].

3.2 Comovements of Painting and Financial Markets

Painting prices are influenced by wealth (see discussion in Section 2.3). Wealth, on the other hand, is an outcome of financial markets. Therefore one may conclude that the art market is influenced by the financial markets. Basically two studies test this proposition:

- Using Granger and Geweke-Meese-Dent causality tests, Chanel (1995) compares an art index (obtained in the hedonic fashion) to four important financial indices (S&P500, FTSE100, Nikkei, and I.N.S.E.E., Paris). He shows that the art market is significantly caused by the English, Japanese and American markets with time lags between one and four quarters (one year). Using Vector Autoregressive models (V.A.R.) it seems possible to predict art prices in the very short-run, but without systematic profit opportunities.
- Following the research by de la Barre et al. (1994), Ginsburgh et al. (1995) analyze price comovements between Great Masters (mainly Impressionists and Modern Painters), Other Painters and Contemporary American Painters and stock markets in the US, UK and France. They find that Other Painters in London and Paris as well as Contemporary American Painters in New York follow the prices of Great Masters. Like Chanel (1995), they find a short-term dependence of the art market on the main stock markets. However, stock markets seem to have no long-term impact on painting prices indicating that the consumption of art is not significantly changed by the state of the economy.

3.3 Inclusion of Paintings into Diversified Portfolios

After studying the risk-return characteristics of paintings and their comovements with each other and financial markets, the next logical step is to test whether paintings should be included in diversified portfolios according to Markowitz (1952). In the following, we present three studies:

- Based on the dataset used for research on market comovements by Ginsburgh et al. (1995), Flôres, Ginsburgh and Jeanfils (1999) analyze short- and long-term portfolios of paintings. They find that the variance of the long-term portfolio is minimized by including up to 92% Great Master paintings whose returns have the lowest volatility. Short-term portfolios (frequently rebalanced due to changes in returns and volatilities of the various art indices) are still dominated by Great Masters, followed by modern American Painters.
- Renneboog et al. (2002), in their inspiring analysis of Belgian paintings, consider the question whether (Belgian) paintings should be included in Markowitz mean-variance portfolios alongside equity. They find that art should *not* be included as it does not

provide any diversification gains. Consistent with Goetzmann (1993), art seems only to be an interesting portfolio investment for risk-loving investors (art shifts only the upper part of the efficient frontier upwards).

- Worthington and Higgs (2004) conduct the most sophisticated research on art portfolios by combining the two approaches presented above. They analyze indices of Contemporary Masters, Impressionists, Modern European and 19th Century European Painters, Old Masters, Surrealists, 20th Century English and Modern American Painters. They find correlations between 0.41 and 0.86 between the various art indices, but, surprisingly, some negative correlations with financial markets (namely small company stocks and long-term corporate bonds) which suggest some portfolio diversification potential of art. They find that only a small number of schools (Contemporary Painters and Old Masters, among others) are included in efficient art portfolios over the research period 1976 – 2001. Being the riskiest, contemporary paintings dominate the more risky portfolios. Surprisingly, Impressionists whose works achieve the highest returns should not be part of any efficient art portfolio. Similarly to Renneboog et al. (2002), Worthington et al. (2004) find that paintings, despite some negative correlations, should never be included in mixed portfolios as “their risk-return characteristics are so inferior to equity and debt markets” [Worthington et al. (2004), p. 269]. The authors caution, however, that once again the psychic returns of paintings are omitted in the calculations which may be the reason for the seemingly weak performance of art.

The next chapter deals with some of the methods applied in the studies summarized above. Its focus is the currently dominant econometric technique known as hedonic regression that is also employed in this paper.

4. Methodology

Our research aims at analyzing the auction price determinants and investment characteristics of contemporary paintings. First, a large number of explanatory variables that are assumed to be related to psychic dividends of paintings are regressed on the price of each painting in the sample. The regression coefficients we receive can be interpreted as implicit prices of the various utility-bearing characteristics. Second, we use the results of the regression to construct a semiannual index for contemporary art. Finally, we calculate the risk-return characteristics of contemporary paintings and compare them to alternative assets.

Section 4.1 gives a brief overview of methods applied in art research. Section 4.2 introduces hedonic regressions that are required for our analysis and describes how their coefficients can be used to construct an art index. Finally, three sets of variables that are used as regressors are discussed in Section 4.3.

4.1 Overview

A number of different approaches have been proposed to capture price variations, returns and volatilities of paintings over time:

- The most obvious way to estimate returns is the *double-sale method*: the average rate of price appreciation is calculated over the holding period for paintings that were auctioned at least twice [Locatelli Biey and Zanola (1999), p. 212]. The method was used e.g. by Baumol (1986). Obviously, it provides returns and return volatility, but cannot be used to display the general price development in the painting market due to heterogeneity issues. Additionally aggregation problems arise when the double-sale method is applied: due to limited knowledge of the auction market volumes, it is unclear how the returns should be weighted, by price or by the length of the holding period [Candela et al. (1997), p. 177; Holub, Hutter and Tappeiner (1993), p. 52].
- *Repeat-sale regressions* overcome the aggregation problem [Candela et al. (1997), p. 177]: a price index is estimated by regressing the change in the log of price of each painting that has – again – been sold at least twice on a set of dummy variables, one dummy for each period [Locatelli Biey et al. (1999), p. 212]. The dummies are -1 at first sale, +1 at the second and 0 in between [Ginsburgh et al. (2006), p. 954 et seq.]. Both methods, the double-sale method as well as repeat-sale regressions, suffer from data problems: resales are sometimes difficult to identify (e.g. Picasso's "Boy with a Pipe" could very well be re-auctioned as "Garçon à la Pipe" and thus be missed in a sample

consisting of 25,000 paintings; many artists leave their works untitled); additionally, the number of repeat-sales may be too small to construct a meaningful index. Due to holding periods of usually more than 10 years, the latter problem is particularly severe for contemporary paintings [Buelens et al. (1993), p. 1358] so that repeat-sale regressions cannot be applied to this period. Furthermore, resale techniques introduce implicit selection biases: only successful paintings (or only “lemons”) may be traded more than once [Chanel, Gérard-Varet and Ginsburgh (1996), p. 2 et seq.].

- In order to overcome these issues art market practitioners (auctioneers) proposed art indices based on the full sample of transacted paintings. They construct indices by simply calculating average or median prices for every year. Although the whole sample (not only resales) can be used, the method suffers from heterogeneity problems: if the set of auctioned paintings varies from year to year, the index reflects changes in quality of paintings rather than changes in prices. As a consequence, these art indices are called naïve [Renneboog et al. (2002), p. 335].
- The *average painting method* and its refinement, the *representative painting method*, have been proposed to overcome the heterogeneity issue of naïve indices [Locatelli Biey (1999), p. 211 et seq.; Candela et al. (1997)]. In the first case, a basket of “average” paintings is selected and valued by art experts every year. In the second case a (fictitious) representative painting is constructed that always represents the invariant price structure of the auction market. Both methods seem to solve the heterogeneity issue to some degree, but they introduce subjectivity (average painting method) and arbitrariness of selection criteria (representative painting method) so that both methods are not considered to produce reliable art indices.

Hedonic regressions seem to be able to overcome the sample biases of the resale methods by using the entire sample as well as heterogeneity and subjectivity issues raised by naïve and average painting indices. This method and its (dis)advantages are discussed in the next section.

4.2 Hedonic Regressions and Art Indices

As we argue in Chapter 2, paintings are hedonic goods that pay their psychic dividends through a number of attributes like name of the artist, size, medium, presence of signature, etc. More generally: “[Hedonic] goods are valued for their utility-bearing attributes or characteristics. [...] [I]mplicit prices of attributes [...] are revealed [...] from observed prices of differentiated products [i.e. hedonic goods] and the specific amounts of characteristics

associated with them” [Rosen (1974), p. 34]. These implicit prices of hedonic attributes of goods are calculated by means of a regression that is known as hedonic. According to Renneboog et al. (2002), p. 335, hedonic regressions have been in use since the 1930s and gained popularity with the publication of papers by Griliches (1961), Lancaster (1966) and Rosen (1974).

In our hedonic regression, we regress the (natural logarithm of the) auction price on a number of characteristics (attributes; see Section 4.3) of the painting. In accordance to most research, Ginsburgh et al. (2006)⁴⁰ propose the hedonic regression with the following additive functional form:

$$\log p_{it} = \sum_{k=1}^m \alpha_k v_{ik} + \sum_{t=0}^T \delta_t c_{it} + \varepsilon_{it} \quad (1)$$

where:

p_{it} : the price of painting i ($i = 1, 2, \dots, N$) in year t ($t = 1, 2, \dots, T$).

v_{ik} : characteristic k ($k = 1, 2, \dots, m$) of painting i .

c_{it} : year (time) dummy that is equal to 1 if a transaction occurred in year t and 0 otherwise.

α_k : estimates of implicit prices of characteristic k .

ε_{it} : random disturbance.

δ_t : price of a “stripped”, i.e. characteristic-free painting in year t .

As we are dealing with a pooled sample of independent cross-sectional data over time, we estimate our hedonic regression by using a heteroscedasticity-robust form of OLS [Wooldridge (2003), p. 426 et seqq].

Hedonic regressions help disaggregate the price of a painting into two factors: the part that is attributable to the unique set of characteristics of a painting that cause psychic dividends and the part attributable to time. If we subtract the implicit values of characteristics, sum up over all paintings included in the sample for year t and compute an average by dividing by the number of observations in the same year (n_t), we receive the implicit price of an artificial characteristic-free (“stripped”) and thus standardized painting in year t ($t = 1, 2, \dots, T$):

$$\delta_t = \frac{1}{n_t} \sum \left(\log p_{it} - \sum_{k=1}^m \alpha_k v_{ik} \right) \quad (2)$$

The path of these implicit prices represents general price changes due to external economic factors like interest rates or inflation as well as changes in the general level of interest (i.e.

⁴⁰ If not stated otherwise, the formula is taken from Ginsburgh et al. (2005).

general level of psychic dividends) in contemporary art.⁴¹

After linearizing the logarithmic coefficient δ_t and standardizing by setting the base value to 100, we receive an art index for every period according to the formula:

$$CAI_t = \exp(\delta_t) / \exp(\delta_0) \cdot 100\% \quad (3)$$

where CAI_t stands for the level of the semiannual Contemporary Art Index in period t .

Returns (r) and volatilities (standard deviation, s) can be calculated from the index using the usual formulas [Gérard-Varet (1995), p. 513; Newbold, Carlson and Thorne (2007), p. 53]:

$$r_{CAI,t} = \log(CAI_t / CAI_{t-1}) \quad (4)$$

$$s = \sqrt{\frac{1}{T-1} \sum (r_{CAI,t} - \bar{r})^2} \quad (5)$$

where \bar{r} is the computed⁴² mean return of the Contemporary Art Index.

Investment characteristics are compared using the Sharpe ratio that measures whether returns above the risk-free rate are justified by risks incurred in order to achieve these returns:

$$Sharpe = \frac{r_i - r_f}{s_i} \quad (6)$$

where r_i is the total return of CAI or a stock index, r_f the risk-free rate in the respective currency and s_i the standard deviation of the index.

Hedonic regressions (and their indices) offer several advantages over the previously introduced methods. Contrary to techniques based on resales (double-sales method and repeat-sales regression), the entire sample of sales (single sales as well as resales) can be used. The larger sample raises the accurateness of results: the variation of hedonic coefficients is significantly lower than the variation of coefficients based on resales [Chanel et al. (1996), p. 14]. The heterogeneity issue that arises in naïve indices is explicitly addressed as well by including hedonic variables. Furthermore hedonic regressions reveal price determinants of auctioned paintings, something neither of the previous methods even attempts to do. Therefore, as de la Barre et al. (1994), p. 168 note, the results of the hedonic regression can be used to forecast prices: if we value each characteristic of a to-be-auctioned painting at its implicit price and sum over all characteristics, we, on average, should end up at the price the painting fetches at auction.

However, there are also several problems associated with hedonic regressions. First, the additive functional form of the hedonic regression may be flawed [Locatelli Biey et al.

⁴¹ It is difficult to disentangle economic and psychic effects as the latter are difficult to observe.

⁴² It is treated like the observed return in financial markets [Hodgson et al. (2004), p. 631].

(1999), p. 211], but the literature seems not to consider any alternatives. Second, the selection of the correct and particularly comprehensive set of variables is crucial for the interpretation of the results [Gérard-Varet (1995), p. 514]. Candela et al. (1997), p. 178 write: “In absence of an agreement upon the theoretical model [displaying all complex influences driving art market prices], the approximation of the market dynamics with a series of time dummies is not warranted. If relevant variables are omitted, the fixed effect per period cannot be chained into a single time series representing the art market price index.”

Another assumption of the model that may not hold in the long run is the stability of implicit prices. However, as Renneboog et al. (2002) argue, they remain relatively stable over short periods of time as tastes change slowly [Buelens et al. (1993), p. 1352; Section 2.3]. In principle, we can control for changing implicit prices by either introducing interactions between the time dummies and the variables whose coefficients have supposedly changed or by calculating an individual regression for every period instead of an overall regression. However, the results may be poor if the subsamples consist of few observations. Agnello et al. (1996) argue that implicit prices of characteristics may also vary across artists. They propose to run single regressions for every artist in order to account for the issue. Their proposition leads to poor results as well if the number of observations for individual artists is limited. Furthermore, the differences in the implicit valuations are usually due to some characteristics of the artist (e.g. an oil painting by an artist known for his watercolors is probably regarded differently than an oil painting by an “oil painter”) and are thus reflected in the artist dummy. The final remark comes from Rosen (1974). He argues that hedonic coefficients can only be interpreted in reasonable ways when a (perfectly) competitive market is in (full) equilibrium. It is doubtful whether there exist many markets that meet these requirements. As painting markets are characterized by an inelastic supply, hedonic coefficients contain taste factors as well as supply characteristics (rarity) [de la Barre et al. (1994), p. 148]. Ginsburgh et al. (2006) argue that Rosen’s objection is only valid if we try to derive consumer welfare from the hedonic analysis, which is not the case here.

4.3 Variables

The dependent variable in our hedonic regression is the (log of the) auction price. Similarly to Worthington et al. (2005), the independent variables (hedonic attributes) are divided into three sets: 1) characteristics of the artist; 2) characteristics of the painting; 3) characteristics of the sales environment. An overview of the used characteristics is depicted in Table 4-1.

Characteristics	
Artist	<ul style="list-style-type: none"> ▪ Name of the artist (dummy) ▪ Alive at the time of the auction (1 if alive, 0 otherwise) ▪ Age of the artist at auction
Painting	<ul style="list-style-type: none"> ▪ Size (in square meters) ▪ Medium (oil, acrylic, mixed media, other medium) ▪ Support (canvas, paper, board, other support) ▪ Signature (1 if signed, 0 otherwise) ▪ Date (1 if dated, 0 otherwise) ▪ Subject (abstract, animal, figure, form, landscape, nude, pop art, portrait, still life, other subject) ▪ Age of the painting at auction
Sale Environment	<ul style="list-style-type: none"> ▪ Auction house (Sotheby's, Christie's and other auction houses) ▪ Location of the auction house (New York, London, Paris, Berlin, Vienna and other cities) ▪ Illustration in auction catalog (1 if illustrated, 0 otherwise) ▪ Lot number ▪ Period of sale (time dummy)

Table 4-1: Hedonic Characteristics Used as Independent Variables

In the following, we review the reasons for including these variables:

- Due to its relevance for social dividends, the name of the artist is supposed to be the principle value driver of auctioned paintings⁴³ [Agnello et al. (1996), p. 365]. The public assigns higher values to some artists than to others. It is difficult to make *ex ante* assumptions on premiums and discounts of single artists.
- Most artists in our sample are alive at the time of the sale. Nevertheless we check with a dummy variable what effect the death of a contemporary artist has on the auction price. The effect of death is unclear: on the one hand, “the fixed supply of paintings of a deceased artist may put upward pressure on prices” [Agnello et al. (1996), p. 366]. On the other hand, dead artists cannot adjust to the newest taste and may quickly fall from fashion.
- We include two variables for age: the age of the artist at the time of the auction and the

⁴³ This may not be the case for paintings bought on the street in which case purely aesthetic qualities are decisive.

age of the painting at the time of the auction.⁴⁴ Older paintings, for instance, may no longer meet the *zeitgeist*; on the other hand, the probability that the public knows and “understands” an older painting is higher. Therefore the effect of age is unclear. We also consider the squares of the age variables to check for nonlinear effects.

- The level of psychic dividends is assumed to be influenced by the size of a painting: the bigger the painting, the better so that we expect a positive regression coefficient. On the other hand, a painting can also become too big so that it cannot be easily displayed (which is a source of social as well as aesthetic dividends). Therefore size squared, accounting for the marginal effect of the size change, is hypothesized to have a negative influence on price. If so, contemporary paintings would have an “optimal” size from the financial point of view [Agnello et al. (1996), p. 369].
- Medium and support are proxies for quality and durability of a painting. We expect that oil as a medium and canvas as a support will fetch the highest premiums as they are durable and difficult to work with [Higgs et al. (2005), p. 118].
- The signature is a proxy for authenticity and the personal relation of the artist with his painting. Therefore we expect that buyers are willing to pay a premium for “branded” paintings [Renneboog et al. (2002), p. 339]. The same arguments apply to dated paintings.
- Buyers may prefer certain subjects (e.g. portraits) to others (e.g. landscapes). The subject categories are discussed in detail in Section 5.2. It is difficult to make a priori statements about the sign of the coefficients [Agnello et al. (1996), p. 366].
- We include the auction house and its location in order to account for possible violations of the “law of one price” (e.g. by Sotheby’s and Christie’s). Pesando (1993) in his analysis of prints finds that identical items fetch 14% higher prices at New York auctions of Sotheby’s than Christie’s. He concludes that the law of one price is violated. There is also evidence⁴⁵ from the painting market that the leading auction houses command higher prices than others. The interpretation, however, is less straightforward in case of paintings: it is possible that Sotheby’s and Christie’s attract paintings of higher quality that is not captured by our hedonic characteristics. In this case, the auction house variables that reflect the general price level at Sotheby’s and Christie’s will be biased upwards [de la Barre et al. (1994), p. 165].

⁴⁴ If we deduct the age of the painting at auction from the age of the painter at auction, we receive the age of the painter when he created the painting.

⁴⁵ For instance de la Barre et al. (1994), Renneboog et (2002), Higgs et al. (2005).

- Auctioneers use to include illustrations of some works that are offered for sale in the auction catalogs. These professionally photographed illustrations may attract new bidders and thus raise the auction price.
- Based on Ashenfelter's (1989) findings at wine auctions, Agnello et al. (1996), p. 363 et seq. argue that the lot number of a painting has a significant influence on its price: the higher the lot number, the lower the price due to the declining price ("afternoon") effect. If we assume that nearly identical items are traded, the bidders with the highest private valuations will buy as early as possible (in the morning) and leave the auction so that prices in the afternoon will be lower due to a diminished pool of bidders and exhausted budgets.
- The coefficients of the period of sale dummies, finally, account for changes in the general price level of contemporary paintings. They are required for the construction of the Contemporary Art Index.

As problems of these three sets of variables we should mention their subjectivity, omitted variables (e.g. provenance, the history of the previous ownership that influences social dividends, is not included due to lack of data; also data on characteristics of – often unknown – buyers and sellers is missing so that it is difficult to account for private value components of contemporary paintings⁴⁶) as well as statistical issues of simultaneity (mutual causality between the dependent and at least one of the independent variables; e.g. high prices may lead to an appreciation of the name of the artist) as well as collinearity (independent variables are correlated with each other; e.g. the name of the artist may be associated with certain subjects). The next chapter discusses the properties of our data sample.

⁴⁶ See Goetzmann et al. (1995) for further information on private value components in the painting market.

5. Data Description

Our analysis is dedicated to Western contemporary paintings. It is impossible to find a standard definition for the term “contemporary” in the arts: many art historians define contemporary art as all art created after World War II [see e.g. Gombrich (1995)] whereas others prefer the more literal definition: art created within a few years of the present day.

This paper makes a compromise and defines paintings as contemporary if they were created by artists whose creative peak lies after 1960. This way e.g. Picasso is excluded as he produced his major works before the defined period. However, our sample contains paintings by contemporary giants like Lucian Freud, Robert Rauschenberg, Jasper Johns, Damien Hirst or Jeff Koons that were auctioned between 1992 and 2007.

As it is impossible to include all contemporary artists whose paintings were traded in sufficient quantities over the studied period, Section 5.1 briefly summarizes the general considerations and challenges related to data selection. Statistical properties of the data are discussed in Section 5.2.

5.1 Data Selection

Artprice.com, an internet database for auctioned art, lists about 405,000 artists. Even if only 1% of them met our definition of contemporary art, we would still end up with a four-digit number of artists. For obvious reasons, it goes far beyond the scope and resources of this paper to analyze all of them. Therefore we must refer to a representative sample.

By concentrating our research on auctioned paintings, which is necessary in order to obtain reliable data and to consider prices that are outcomes of a competitive process [de la Barre et al. (1994), p. 150], we are implicitly forced to concentrate on top art: as mentioned in Section 2.2, only top works by top artists are traded in the tertiary market which Ginsburgh et al. (1995), p. 548 compare to a quality filter for artists. Another drawback of relying on auction data is the exclusion of the primary and secondary markets which account for the majority of sales and may exhibit different pricing patterns than paintings sold at auction [Frey et al. (1995), p. 529]. On the other hand, “auction prices play an important role in the art markets because collectors and professional art dealers take these prices as guideposts” [Frey et al. (1989), p. 397].

The artist names were selected randomly from “Kunstkompass”, a yearly ranking based on single and group exhibitions as well as publications in renowned art magazines published by Capital, a German business periodical, since 1970. The source is considered influential and

reliable, although it might be slightly biased in favor of German artists. Our choice of source introduces a selection bias, an issue art research has always been concerned with [Renneboog et al. (2002), p. 334].

Our original sample (a random portfolio of auctioned contemporary art) included 40 artists⁴⁷ all of whom are at least partly specialized in and known for painting (in contrast to e.g. sculptures or installations). In the following, 8 artists were dropped due to insufficient sales (less than 20) or restricted availability of data which is particularly tragic in case of Andy Warhol, Roy Lichtenstein and Gerhard Richter, three figures shining far beyond the borders of contemporary art in the last decades. Thus our final sample consists of 32 painters who are shown in Table 5-1.

As we are interested in the performance of Western contemporary paintings, our sample contains only artists from the United States, United Kingdom and Western Continental Europe.⁴⁸ Established or aspiring artists from Eastern Europe and China (like the Ukrainian Ilya Kabakov or the Chinese Zhang Xiaogang) are not included due to potentially different price determinants. Art from emerging regions deserves a research of its own.

All auction data was extracted from the Art Sales Index, created by Mr. Richard Hislop in 1968, hosted by ARTINFO since 2007.⁴⁹ All entries were verified by the Artprice.com database. Mistakes were corrected where possible; otherwise the transaction was dropped.

5.2 Descriptive Statistics

Our unique sample consists of 3,291 observations (paintings) by 32 artists. All of these paintings were actually sold, i.e. works that did not meet the reservation price of the seller and had to be “bought in” by the auction house, were excluded. According to the information of the databases all prices are hammer prices net of commissions (e.g. buyer’s premium). The reason for not including these fees is their high variation between countries, auction houses, painting prices and even individuals [Frey et al. (1989), p. 397]. Table 5-1 presents the relevant descriptive statistics in nominal US dollars.^{50, 51}

⁴⁷ Chanel et al. (1994) show that the overall results of the hedonic regression do not become significantly worse if the number of observed artists is reduced from 80 to around 30.

⁴⁸ Marlene Dumas, a South African, is also part of our sample as she has been living and working in Amsterdam, Holland.

⁴⁹ We would like to thank Daniel Soules from Gordon’s Art for his support in obtaining the required data.

⁵⁰ Transactions in other currencies (mostly GBP, EUR, DEM, ITL and FRF) were converted into USD using the closing exchange rate on the day of sale. For conversions of national currencies into EUR, respectively ECU before January 1, 1999, the official rates of the central banks were used.

15 artists originate in the Anglo-Saxon area: 11 Americans, 3 British and Marlene Dumas from South Africa, the only woman in our sample. 17 artists come from Continental Europe⁵², mainly Germany (11 artists), but also Italy (4), Denmark (1) and Austria (1). Interestingly, no French artists are represented in the sample which may reflect the decline of Paris as art capital of the world (see market turnovers in Section 2.2). The average age of the sampled artists is 68 years in 2007, the oldest being Lucian Freud and Jules Olitski (both born in 1922), the youngest being Damien Hirst (born in 1965). Of the 32 artists, 27 were still alive at the end of 2007.

The most expensive painting in the sample is Lucian Freud's "IB and Her Husband" from 1992. The oil painting was sold at Christie's New York for USD 17.3 million in November 2007. The least expensive painting is Robert Natkin's "Abstract" from 1974, sold for just USD 35 in 2006. The average price across all paintings is USD 186,417, the median USD 25,000 which indicates a positively skewed (right-tailed) distribution. Not surprisingly, the standard deviation of USD 759,570 is quite high.

Lucian Freud, Jasper Johns and Brice Marden seem to be the most expensive artists whereas Otto Pienne, Walter Dahn and Robert Natkin appear as the cheapest on average. However, these results should not be considered as final word as paintings are heterogeneous commodities sold in different environments that have to be homogenized by means of hedonic regression before definitive statements can be made.

⁵¹ As shown in Wooldridge (2003), p.430 it does not matter whether we base our art index on deflated prices or on nominal prices and deflate the constructed index. We choose to deflate the index.

⁵² For simplicity we will speak about Europe, meaning all Western European countries without UK.

Description	Variable	Country	Birth	Death	Obs.	Mean	StDev	Min	Max	Rank
Antes, Horst	ANT	GER	1936		133	\$28,323	\$27,725	\$191	\$145,481	23
Baselitz, Georg	BAS	GER	1938		149	\$244,713	\$241,460	\$176	\$1,922,140	8
<i>Cucchi, Enzo</i>	<i>CUC</i>	IT	1949		74	\$88,695	\$146,511	\$1,319	\$922,250	16
Dahn, Walter	DAH	GER	1954		94	\$6,369	\$6,762	\$114	\$53,789	31
Dine, Jim	DIN	US	1935		83	\$73,106	\$74,985	\$752	\$350,000	18
Doig, Peter	DOI	UK	1959		81	\$507,896	\$1,257,088	\$3,968	\$10,000,000	6
Dumas, Marlene	DUM	SA	1953		44	\$518,971	\$610,896	\$1,115	\$2,967,840	5
Förg, Günther	FOE	GER	1952		93	\$14,572	\$15,873	\$169	\$102,267	29
Freud, Lucian	FRE	UK	1922		49	\$2,319,392	\$3,485,238	\$47,500	\$17,300,000	1
Hirst, Damien	HIR	UK	1965		224	\$331,816	\$682,429	\$1,050	\$8,533,140	7
Immendorf, Jörg	IMM	GER	1945	2007	119	\$32,705	\$69,082	\$332	\$471,432	21
Indiana, Robert	IND	US	1928		85	\$154,188	\$233,851	\$3,000	\$1,400,000	12
Johns, Jasper	JOH	US	1930		45	\$1,686,702	\$2,938,668	\$259	\$15,500,000	2
Kiefer, Anselm	KIE	GER	1945		137	\$211,572	\$342,195	\$704	\$3,152,960	10
Kippenberger, Martin	KIP	GER	1953	1997	148	\$104,877	\$171,605	\$661	\$1,117,435	15
Kirkeby, Per	KIR	DK	1938		150	\$24,388	\$23,797	\$185	\$153,475	24
Koons, Jeff	KOO	US	1955		30	\$563,601	\$859,994	\$687	\$3,400,000	4
Lewitt, Sol	LEW	US	1928	2007	22	\$15,726	\$28,381	\$407	\$100,000	28
Lüpertz, Markus	LUE	GER	1941		146	\$29,363	\$25,209	\$1,289	\$112,013	22
Marden, Brice	MAR	US	1938		26	\$744,153	\$760,997	\$19,000	\$2,650,000	3
Merz, Mario	MER	IT	1925	2003	52	\$38,121	\$35,986	\$3,076	\$140,000	20
Natkin, Robert	NAT	US	1930		138	\$4,103	\$4,146	\$35	\$29,000	32
Oldenburg, Claes	OLD	US	1929		38	\$18,022	\$35,079	\$428	\$150,000	26
Olitski, Jules	OLI	US	1922	2007	94	\$22,804	\$33,372	\$1,000	\$190,000	25
Paolini, Giulio	PAO	IT	1940		37	\$41,532	\$65,317	\$717	\$364,878	19
Piène, Otto	PIE	GER	1928		126	\$11,207	\$16,182	\$525	\$119,436	30
Pistoletto, Michelangelo	PIS	IT	1933		56	\$79,143	\$138,599	\$1,800	\$590,614	17
Polke, Sigmar	POL	GER	1941		196	\$161,154	\$406,455	\$200	\$4,729,440	11
Rainer, Arnulf	PAI	AT	1929		233	\$17,608	\$22,084	\$241	\$146,620	27
Rauch, Neo	RAU	GER	1960		57	\$125,373	\$185,896	\$2,267	\$736,760	14
Rauschenberg, Robert	RAG	US	1925		237	\$234,191	\$864,773	\$125	\$9,500,000	9
Rosenquist, James	ROS	US	1933		95	\$144,035	\$203,226	\$350	\$1,300,000	13

Table 5-1: Sampled Contemporary Artists

Table 5-2 lists other variables that are used to explain the auction price of paintings. The variables SIZ, SIZS, ACCA – OTTS, SIG and DAT stand for the characteristics of the painting whereas SONY – OTOT as well as the variables 1992_1 until 2007_2 in Table 5-3 represent the environment of the sale.

The average size of a painting in our sample is 1.7 square meters and lies in the range between 0.0004 square meters (4 square centimeters) and 14.5 square meters. The most popular support is canvas which accounts for 54% of the sampled paintings. Other popular supports are paper and board. 30% of the sampled contemporary paintings are executed on a different support: photo paper, panel, metals, vellum and others. Most paintings were executed in oil, followed by mixed media (i.e. the painting was executed in more than one medium, e.g. oil and charcoal or acrylic and butterflies), acrylic and other medium.

In 29% of the paintings, the main subject is one or several figures (not shown in the tables), followed by abstract paintings (27%), geometric or architectural forms (23%) and other subjects like landscapes, nudes, portraits, classic pop arts, still lives, wild life and others. Of course, this kind of categorizing the paintings' subjects is highly subjective. Contrary to other studies⁵³ it is impossible to distinguish between currents (e.g. Impressionism or Surrealism) in the contemporary art world as there are either more art currents nowadays or just more terms classifying them. As a consequence, only pop art was able to unite a number of artists whereas many other artists represented a current of their own.

As many as 80% of the works are signed, either on the front or on the backside, 59% are dated. The oldest painting, "Girl on a Quay", was painted by Lucian Freud in 1941.⁵⁴ The newest works by Damien Hirst and others were created in 2007. Ranging between 0 and 65 years, auctioned paintings have an average age of 20 years with a standard deviation of 12 years. The mean age of the painter when the works were executed was 41 with a standard deviation of 11, ranging from 19 to 80. Accordingly, the youngest artist was 31 years old when one of his paintings was sold at auction, the oldest 85, on average 61 with a standard deviation of 12 (not shown).

31% of the paintings were sold by Christie's, 27% by Sotheby's, the rest by countless other auction houses. Most works were sold in New York, followed by London, Berlin, Vienna and Paris. 95% of the included works are illustrated in the respective auction catalog (not shown). The lot numbers vary between 1 and 9335 with a mean of 314 (not shown).

⁵³ For instance Renneboog et al. (2002) or Agnello et al. (1996).

⁵⁴ If the execution of a work lasted longer than one year (e.g. 1982-1986), we only consider the year of completion (in this example the year 1986).

Description	Variable	Obs.	Mean	StDev	Min	Max
Size	SIZ	3272	1.666	1.968	0.000	14.554
Acrylic on Canvas	ACCA	312	\$38,505	\$74,675	\$202	\$611,010
Acrylic on Board	ACBO	30	\$21,804	\$37,232	\$383	\$161,304
Acrylic on Paper	ACPR	67	\$16,646	\$21,538	\$800	\$101,835
Acrylic on Other Support	ACOT	91	\$52,759	\$111,358	\$511	\$874,704
Mixed Media on Canvas	MICA	529	\$336,102	\$1,013,207	\$600	\$15,500,000
Mixed Media on Board	MIBO	122	\$24,823	\$52,257	\$329	\$400,000
Mixed Media on Paper	MIPR	170	\$49,183	\$114,715	\$114	\$1,150,000
<i>Mixed Media on Other Support</i>	<i>MIOT</i>	525	\$111,519	\$393,468	\$169	\$5,800,000
Oil on Canvas	OICA	912	\$345,588	\$1,123,069	\$100	\$17,300,000
Oil on Board	OIBO	60	\$31,453	\$38,722	\$598	\$149,600
Oil on Paper	OIPR	49	\$42,011	\$77,916	\$950	\$460,000
Oil in Other Support	OIOT	341	\$31,804	\$96,450	\$35	\$1,000,000
Other Medium on Canvas	OTCA	20	\$784,096	\$1,483,641	\$4,320	\$4,729,440
Other Medium on Board	OTBO	11	\$6,118	\$4,618	\$1,608	\$16,590
Other Medium on Paper	OTPR	11	\$8,883	\$14,937	\$1,005	\$50,000
Other Medium on Other Support	OTTS	28	\$46,647	\$83,962	\$190	\$380,000
Signed	SIG	2626				
Dated	DAT	1932				
Sotheby's New York	SONY	413	\$316,484	\$779,878	\$1,500	\$9,500,000
Sotheby's London	SOLO	428	\$247,928	\$728,802	\$1,250	\$10,000,000
Sotheby's Other Cities	SOOT	51	\$45,546	\$78,628	\$1,319	\$487,397
Christie's NY	CHNY	549	\$338,344	\$1,264,666	\$400	\$17,300,000
Christie's London	CHLO	417	\$282,339	\$975,098	\$727	\$13,900,000
Christie's Other Cities	CHOT	55	\$40,475	\$80,035	\$376	\$400,000
Other Auction House New York	OTNY	168	\$169,081	\$289,194	\$400	\$2,000,000
Other Auction House London	OTLO	32	\$461,998	\$1,499,597	\$259	\$8,533,140
Other Auction House Paris	OTPA	95	\$48,729	\$133,412	\$382	\$1,201,700
Other Auction House Berlin	OTBE	144	\$35,121	\$47,186	\$269	\$369,775
Other Auction House Vienna	OTVI	126	\$17,520	\$22,555	\$241	\$146,620
<i>Other Auction House in Other City</i>	<i>OTOT</i>	813	\$16,678	\$24,409	\$35	\$194,427

Table 5-2: Descriptive Statistics Other Price Determinants

Description	Variable	Obs.	Mean	StDev	Min	Max
1992, January - July	1992_1	77	\$67,143	\$114,152	\$248	\$580,000
1992, August - December	1992_2	72	\$92,033	\$282,183	\$800	\$2,100,000
1993, January - July	1993_1	70	\$54,183	\$115,588	\$680	\$650,000
1993, August - December	1993_2	40	\$36,545	\$56,395	\$100	\$250,000
1994, January - July	1994_1	68	\$66,276	\$120,234	\$538	\$707,000
1994, August - December	1994_2	51	\$48,734	\$108,931	\$1,000	\$600,000
1995, January - July	1995_1	65	\$51,375	\$124,787	\$1,133	\$728,000
1995, August - December	1995_2	67	\$118,089	\$354,469	\$600	\$2,800,000
1996, January - July	1996_1	54	\$52,401	\$73,495	\$407	\$323,400
1996, August - December	1996_2	52	\$67,607	\$112,767	\$801	\$700,000
1997, January - July	1997_1	71	\$61,524	\$178,500	\$600	\$1,339,335
1997, August - December	1997_2	81	\$297,364	\$1,106,410	\$721	\$7,200,000
1998, January - July	1998_1	83	\$166,396	\$598,492	\$212	\$5,300,000
1998, August - December	1998_2	87	\$141,297	\$501,843	\$200	\$4,226,880
1999, January - July	1999_1	95	\$109,825	\$374,798	\$374	\$3,000,000
1999, August - December	1999_2	88	\$115,254	\$281,862	\$329	\$2,200,000
2000, January - July	2000_1	99	\$76,832	\$214,046	\$114	\$1,500,000
2000, August - December	2000_2	86	\$76,684	\$207,414	\$400	\$1,700,000
2001, January - July	2001_1	121	\$160,171	\$455,880	\$478	\$3,400,000
2001, August - December	2001_2	68	\$160,171	\$455,880	\$478	\$3,400,000
2002, January - July	2002_1	90	\$76,826	\$129,640	\$511	\$633,822
2002, August - December	2002_2	57	\$284,386	\$1,212,665	\$202	\$9,000,000
2003, January - July	2003_1	101	\$93,784	\$132,272	\$209	\$703,164
2003, August - December	2003_2	93	\$138,698	\$544,985	\$400	\$4,700,000
2004, January - July	2004_1	150	\$164,292	\$447,031	\$136	\$3,399,745
2004, August - December	2004_2	133	\$213,243	\$567,873	\$269	\$4,000,000
2005, January - July	2005_1	196	\$317,127	\$961,981	\$185	\$6,863,130
2005, August - December	2005_2	157	\$128,681	\$441,305	\$294	\$5,100,000
2006, January - July	2006_1	214	\$242,890	\$683,366	\$125	\$6,465,380
2006, August - December	2006_2	175	\$119,552	\$260,663	\$35	\$1,700,000
2007, January - July	2007_1	232	\$523,908	\$1,724,946	\$191	\$15,500,000
2007, August - December	2007_2	198	\$422,120	\$1,450,937	\$416	\$17,300,000

Table 5-3: Descriptive Statistics Time Dummies

Over the entire sample, more than half of the paintings (53%) were sold in the home country of the artist, indicating that there is some preference towards local art and contradicting the assumption that contemporary paintings are globalized commodities. This “nationalization of art” may of course also be a consequence of the tax legislation that makes the export of paintings for the purpose of sale less attractive. 37% of the works were sold in the United States (mostly New York), 36% in Europe and 27% in the United Kingdom (mostly London). It may be surprising that only 9 transactions took place outside of these regions (in Canada). This statistic impressively demonstrates where the centers for contemporary Western art are located.

If we consider subsamples (not shown), we see that 40% of works by German artists are sold in Germany. The rest appears at auction in the UK (27%), US (25%) and other European Countries (8%). Italian artists show similar patterns, even if a larger share of their works is sold in the UK (37%) compared to the US (15%). Looking at British artists, we see that 66% are sold in the UK, 31% in the US and only 3% in Europe. Finally, 78% of the works of American artists are sold in the US, 12% in Europe and 10% in the UK. It seems that owners of European paintings are somewhat more eager to sell them outside of their home country than collectors of US and UK paintings. They probably speculate that their paintings will fetch higher prices at major auctions due to the larger pool of potential buyers (see Section 2.2). Interestingly, the preferred exchange location for European art outside of the home country is London and not New York. It is unclear whether this is merely an anomaly of the sample, proximity in taste between Great Britain and Europe or the reluctance of European collectors to ship their paintings over the Atlantic Ocean, possibly due to higher shipping costs.

Most paintings were sold in November, followed by May and June, the main auction months. Least active trading took place during the summer months August and July as well as January. 54% of the sales took place in the first half of the calendar year (spring auction season lasting 7 months from January to July), 46% in the second half (fall auctions from August to December). As shown in Table 5-3, the period with most transactions is the first semester of 2006 whereas the period with least observations is the second semester 1993. The highest average prices were commanded in both semesters 2007. Again we have to correct these values for differences in quality of the auctioned paintings as it is possible that exceptionally many highest-quality works by top artists were sold then. This is done by means of hedonic regression.

6. Price Determinants

In the following we present the evidence obtained by regressing the (log of) auction price on a number of hedonic variables of the painting. We show overall regression results (Section 6.1) and then discuss the issues of painting size (Section 6.2), material and support (Section 6.3), the influence of signature and date marks (Section 6.4), auction houses (Section 6.5) and the relevance of the painter's name for pricing a painting (Section 6.6).

6.1 Empirical Results

Overall heteroscedasticity-robust OLS regression results are presented in Table 6-1. This is the model with the highest adjusted R^2 and the lowest root mean squared error of all specifications tested. It regresses the natural logarithm of the USD price on 96 regressors (exactly 100 if we add the dropped reference categories as well as the constant which equals the coefficient of the base period, first half-year of 1992, see Wooldridge (2003), p. 430). We control for currency effects by running the same regression on the log of the GBP and EUR prices (see Appendix 9-1 and 9-2). Comparing the coefficients, we see that the only sizable differences materialize in case of the year dummies which account for different inflation and interest rates not reflected by the exchange rate [Wooldridge (2003), p. 430]. Therefore all further calculations are done in USD, and we only return to GBP and EUR when we discuss the performance of paintings in local currencies (see Section 7.2).

In the process, several categories of variables that turned out to be insignificant were dropped from the equation. First, the effect of all age variables collectively turned out to be statistically indistinguishable from zero. We must conclude that either the age of an artist at auction is not a good proxy for his status (comparatively high valuations for young artists like Damien Hirst, Neo Rauch or Peter Doig seem to confirm this assumption) or the age is already incorporated, among many other variables, in the artist's name. This result is quite interesting if we consider that the dummy for ALI is highly significant: the rising probability of death as a result of higher age seems not to be incorporated in the expectations of art investors; otherwise there would not be such a sharp jump in prices after the announcement of an artist's death (see Section 6.6).

The irrelevance of the variable representing the age of paintings at the time of the auction is even more surprising. As we argue above, the age of the artist may be incorporated in his name; the age of the painting is certainly not as most artists remain "productive" during their entire lifetime. As a consequence, Marlene Dumas' painting that she finished yesterday seems

to be equally priced as a painting she created 20 years ago. In other words, it is no bargain to acquire recent works of an otherwise successful artist.

Second, variables representing the subject of a painting were dropped from the equation due to collective insignificance. This result is not surprising as most artists are known for their specialization in a small number of subjects. Damien Hirst, for instance, is famous for his spins, colored dots and butterflies. Subjects become part of the name of the artist and are priced through the artist dummy.⁵⁵ If a collector prefers a certain subject, she would just buy a painting by a different artist with the preferred specialization.⁵⁶

The same regression is also run on four sizable subsamples: US and UK painters⁵⁷ (15 artists, Appendix 9-3), US painters (11 artists, Appendix 9-4), European painters (17 artists, Appendix 9-5) and German painters (11 artists, Appendix 9-6). A Chow test conducted on the full sample versus subsamples US and UK painters and European painters shows that there seem to be significant structural differences between the subsamples: our Chow statistic of 3.34 is much higher than the critical $F_{97, 3065}$ of 1.4 at the 1% significance level [Wooldridge (2003), p. 431 et seq.]. However, as we regard contemporary art as a portfolio of different Western cultures and styles, we will continue working with full-sample results. As in the case of currencies, we will return to subsamples when discussing risk and return of contemporary paintings. We will see that they are able to shed some light on the overall performance of art. In the following, we discuss some of the hedonic regression coefficients more profoundly.

⁵⁵ Thus the inclusion of subjects only produces (partial) collinearity between explanatory variables.

⁵⁶ The pricing of different subjects remains a potentially interesting exercise when looking at sales of individual artists who are known for heterogeneous styles. Czujack (1997) researches Picasso's paintings at auction, but unfortunately lacks data to test for the effect of the subject on prices. However, she tests for the influence of Picasso's famous creative periods and finds at least some indication (these results are not significant due to too few observations for each period) that an influence exists.

⁵⁷ This subsample also includes the South African Marlene Dumas.

LNP(USD)	Variable	Coefficient		Std. Error	t-Statistic	p-Value
Size	SIZ	0.596 ***		0.026	23.250	0.000
Size Squared	SIZS	-0.042 ***		0.003	-14.460	0.000
Acrylic on Canvas	ACCA	0.456 ***		0.084	5.430	0.000
Acrylic on Board	ACBO	-0.065		0.144	-0.450	0.652
Acrylic on Paper	ACPR	-0.403 ***		0.138	-2.920	0.004
Acrylic on Other Support	ACOT	-0.051		0.112	-0.450	0.651
Mixed Media on Canvas	MICA	0.652 ***		0.076	8.600	0.000
Mixed Media on Board	MIBO	-0.117		0.097	-1.200	0.230
Mixed Media on Paper	MIPR	-0.332 ***		0.097	-3.430	0.001
<i>Mixed Media on Other Support</i>	<i>MIOT</i>	0.000				
Oil on Canvas	OICA	0.555 ***		0.069	8.000	0.000
Oil in Board	OIBO	0.004		0.142	0.030	0.978
Oil on Paper	OIPR	-0.573 ***		0.135	-4.230	0.000
Oil on Other Support	OIOT	-1.203 ***		0.106	-11.330	0.000
Other Medium on Canvas	OTCA	1.293 ***		0.201	6.430	0.000
Other Medium on Board	OTBO	-0.605 ***		0.216	-2.800	0.005
Other Medium on Paper	OTPR	-0.276		0.343	-0.810	0.420
Other Medium on Other Support	OTTS	-0.190		0.193	-0.980	0.326
Signed (1 if yes, 0 otherwise)	SIG	-0.392 ***		0.069	-5.690	0.000
Dated (1 if yes, 0 otherwise)	DAT	0.297 ***		0.063	4.690	0.000
Sotheby's New York	SONY	0.768 ***		0.078	9.820	0.000
Sotheby's London	SOLO	0.586 ***		0.070	8.380	0.000
Sotheby's Other City	SOOT	0.322 **		0.139	2.320	0.021
Christie's New York	CHNY	0.636 ***		0.079	8.010	0.000
Christie's London	CHLO	0.472 ***		0.071	6.670	0.000
Christie's Other City	CHOT	0.077		0.155	0.490	0.621
Other Auction House New York	OTNY	0.198 **		0.104	1.910	0.057
Other Auction House London	OTLO	0.219		0.295	0.740	0.458
Other Auction House Paris	OTPA	0.082		0.114	0.720	0.472
Other Auction House Berlin	OTBE	0.344 ***		0.089	3.870	0.000
Other Auction House Vienna	OTVI	-0.096		0.123	-0.780	0.437
<i>Other Auction House Other City</i>	<i>OTOT</i>	0.000				
Illustrated (1 if yes, 0 otherwise)	ILL	0.786 ***		0.114	6.890	0.000
LN Auction Lot Number	LNLOT	-0.284 ***		0.071	-4.010	0.000
LN Auction Lot Number Squared	LNLOTS	0.003		0.008	0.340	0.732
Antes, Horst	ANT	0.159		0.150	1.060	0.291
Baselitz, Georg	BAS	0.708 ***		0.140	5.070	0.000
<i>Cucchi, Enzo</i>	<i>CUC</i>	0.000				
Dahn, Walter	DAH	-2.114 ***		0.133	-15.920	0.000
Dine, Jim	DIN	0.089		0.152	0.580	0.559
Doig, Peter	DOI	0.942 ***		0.158	5.940	0.000
Dumas, Marlene	DUM	1.395 ***		0.205	6.790	0.000
Förg, Günther	FOE	-0.844 ***		0.146	-5.780	0.000
Freud, Lucian	FRE	3.037 ***		0.190	15.960	0.000
Hirst, Damien	HIR	0.529 ***		0.142	3.740	0.000
Immendorf, Jörg	IMM	-0.419 ***		0.145	-2.900	0.004
Indiana, Robert	IND	0.610 ***		0.154	3.950	0.000
Johns, Jasper	JOH	1.904 ***		0.312	6.100	0.000
Kiefer, Anselm	KIE	0.802 ***		0.128	6.250	0.000
Kippenberger, Martin	KIP	-0.184		0.234	-0.790	0.431
Kirkeby, Per	KIR	-0.105		0.138	-0.760	0.446
Koons, Jeff	KOO	0.447 *		0.247	1.810	0.070
Lewitt, Sol	LEW	-0.685 ***		0.265	-2.590	0.010
Lüpertz, Markus	LUE	-0.152		0.139	-1.090	0.274

LNP(USD)	Variable	Coefficient		Std. Error	t-Statistic	p-Value
Marden, Brice	MAR	2.035 ***		0.205	9.910	0.000
Merz, Mario	MER	-0.235		0.190	-1.240	0.215
Natkin, Robert	NAT	-1.968 ***		0.150	-13.090	0.000
Oldenburg, Claes	OLD	-0.542 **		0.243	-2.230	0.026
Olitski, Jules	OLI	-1.497 ***		0.144	-10.380	0.000
Paolini, Giulio	PAO	0.083		0.175	0.470	0.637
Piene, Otto	PIE	-0.786 ***		0.136	-5.760	0.000
Pistoletto, Michelangelo	PIS	-0.112		0.179	-0.620	0.533
Polke, Sigmar	POL	0.634 ***		0.138	4.610	0.000
Rainer, Arnulf	RAI	0.514 ***		0.144	3.570	0.000
Rauch, Neo	RAU	0.682 ***		0.157	4.340	0.000
Rauschenberg, Robert	RAG	0.215		0.146	1.460	0.143
Rosenquist, James	ROS	0.621 ***		0.160	3.880	0.000
Alive (1 if yes, 0 otherwise)	ALI	-0.365 **		0.183	-1.990	0.047
Constant	1992_1	9.526 ***		0.323	29.470	0.000
	1992_2	9.797 ***		0.335	29.270	0.000
	1993_1	9.621 ***		0.323	29.770	0.000
	1993_2	9.365 ***		0.353	26.550	0.000
	1994_1	9.378 ***		0.334	28.090	0.000
	1994_2	9.323 ***		0.331	28.180	0.000
	1995_1	9.795 ***		0.341	28.700	0.000
	1995_2	9.732 ***		0.337	28.910	0.000
	1996_1	9.743 ***		0.343	28.430	0.000
	1996_2	9.692 ***		0.327	29.620	0.000
	1997_1	9.649 ***		0.346	27.910	0.000
	1997_2	9.805 ***		0.336	29.200	0.000
	1998_1	9.682 ***		0.326	29.700	0.000
	1998_2	9.419 ***		0.328	28.750	0.000
	1999_1	9.606 ***		0.316	30.360	0.000
	1999_2	9.675 ***		0.338	28.640	0.000
	2000_1	9.629 ***		0.321	30.030	0.000
	2000_2	9.552 ***		0.328	29.120	0.000
	2001_1	9.515 ***		0.322	29.540	0.000
	2001_2	9.758 ***		0.328	29.760	0.000
	2002_1	9.881 ***		0.327	30.170	0.000
	2002_2	9.935 ***		0.339	29.300	0.000
	2003_1	9.862 ***		0.325	30.360	0.000
	2003_2	9.945 ***		0.327	30.410	0.000
	2004_1	9.955 ***		0.323	30.840	0.000
	2004_2	10.261 ***		0.322	31.890	0.000
	2005_1	10.114 ***		0.324	31.260	0.000
	2005_2	10.120 ***		0.322	31.450	0.000
	2006_1	10.417 ***		0.316	32.970	0.000
	2006_2	10.499 ***		0.320	32.800	0.000
	2007_1	10.901 ***		0.311	35.090	0.000
	2007_2	10.890 ***		0.311	35.010	0.000
Number of Observations		3,259			***	1% significance level
F(96, 3162)		116.90			**	5% significance level
Prob > F		0.000			*	10% significance level
R-squared		0.740				
Root MSE		1.019				<i>Reference categories in italics</i>

Table 6-1: Overall Hedonic Regression Results (USD)

6.2 Evidence on Size

The coefficient for size is positive, the one for size squared is negative, both statistically significant at the 1% level. These results confirm our assumption (see Section 4.3) that the price of a painting is a concave function of its size, i.e. that there exists a price-maximizing size. In order to calculate the latter, we simply apply the first-order condition to the function:

$$f = 0.596 \cdot SIZ - 0.042 \cdot SIZ^2$$

The optimal size of a contemporary painting in our sample turns out to be 7.04 square meters. In case of American paintings, Agnello et al. (1996) find an optimal size of 6.53 square meters which is only marginally below 6.96 square meters which we obtain for our subsample of US painters. Our results are also consistent with Higgs et al. (2005) who estimate the optimal size of Australian paintings at 6.70 square meters. In Section 4.3 we argue that paintings cannot be exhibited in private homes when they become too big. A painting by the size of roughly 7 square meters (height by width of e.g. 2 by 3.5 meters) may seem quite large at first glance, but it should still be possible for a wealthy collector to find an appropriate place for it on her wall in order to collect the painting's aesthetic and social dividends.

As the average painting size in our sample lies at only 1.7 square meters, we can conclude that most artists, when executing their works, fail to exploit the full price potential of size. This is understandable as artists have no incentive to create large-sized works for their substantial additional cost (in terms of time as well as material) that is not compensated by the market: it is important to keep in mind that artists do not receive a share of the spectacular prices their works achieve at auction. The controversial *droit de suite* legislation in some European countries that entitles artists to receive a percentage share of the resale price of their works may be such an incentive for creating larger, financially more successful paintings.

6.3 Evidence on Media and Support

We consider combinations of four media (acrylic, mixed, oil, other medium) with four supports (board, canvas, paper, other support). Table 6-1 shows that 9 out of 15 combinations are significantly different from the reference category, mixed media on other support (MIOT), which means that, other factors being equal, a painting executed in oil on canvas will fetch a premium over MIOT whereas a work in oil on paper will be priced at a discount.

To further explore the hierarchy of material, we construct an index by calculating $\exp(\text{coefficient}) \cdot 100$: positive regression coefficients lead to values above 100, negative to values below 100, and, not surprisingly, the reference category receives exactly the value

	MICA	OICA	ACCA	OIBO	M/OT	ACOT	MIBO	MIPR	ACPR	OIPR	OIOT
	192	174	158	100	100	95	89	72	67	56	30
MICA	192	0	0	+++	+++	+++	+++	+++	+++	+++	+++
OICA	174		0	+++	+++	+++	+++	+++	+++	+++	+++
ACCA	158			+++	+++	+++	+++	+++	+++	+++	+++
OIBO	100				0	0	0	++	++	+++	+++
M/OT	100					0	0	+++	+++	+++	+++
ACOT	95						0	++	++	+++	+++
MIBO	89							+	+	+++	+++
MIPR	72								0	+	+++
ACPR	67									0	+++
OIPR	56										+++
OIOT	30										

Reading example: The coefficient for MICA is statistically undistinguishable from OICA. MICA is statistically different from ACCA at 1% significance level.

+++ = 1% significance level

++ = 5% significance level

+ = 10% significance level

Table 6-2: Material Ranking

100.⁵⁸ After conducting F tests on equality of regression coefficients⁵⁹, we receive the material ranking depicted in Table 6-2 (variables with 30 or less observations are dropped).

We see that paintings on canvas fetch significant premiums whereas works on paper are sold at a discount. For one thing this is due to the limited durability of paper. At the same time paper fetches quality differences not accounted for by our hedonic model: works on paper are often merely studies for later works on canvas or other more robust supports. Unfortunately we lack data to disentangle these effects. Board and other supports, being more robust than paper, but less flexible than canvas, are in between. By far the cheapest material combination is oil on other support. We consider this result as another durability issue as the other support category also contains photo paper and tissue.

The most expensive medium on canvas is mixed media, followed by oil and acrylic (whereas the difference between oil and acrylic paintings is not significant). This result is not surprising: masterpieces have always been executed in oil, a medium known for its durability; acrylic is a modern alternative with similar qualities. Mixed media often combines oil or acrylic with other media (collage, photography, braches, books, even saws and other objects). A possible explanation for the premium paid for mixed media could be that it is a rather modern technique and collectors are willing to pay more for a painting they regard as

⁵⁸ $\exp(0.000) \cdot 100 = 100$

⁵⁹ Stata command : test e.g. MICA = OICA [Princeton (2005)].

particularly “innovative”, “contemporary” or “avant-garde”.

These findings hold also for works on paper: MIPR has a significantly higher coefficient than ACPR and OIPR, the latter coefficients being statistically indistinguishable.

In contrast to subjects, artists seem not to stick too closely to single material combinations. Although collinearity may still be present, it seems not to be as severe as in other cases.

6.4 Signature and Date

The signature of the artist is comparable to the brand symbol on a pair of sneakers or a shirt. In the latter case Lacoste’s crocodile adds value to the shirt. In the case of paintings, however, the signature coefficient is significantly negative at the 1% level: a signed painting sells for 32%⁶⁰ less than an identical painting without a signature (our data does not allow to distinguish signatures on the front side from those on the backside of the painting). This finding holds for all subsamples and thus contradicts all earlier empirical results on price determinants of paintings. It seems that collectors of contemporary art prefer works that are recognizable merely by style, technique and subject (which forces artists to seek a narrow and quickly recognizable specialization). At the same time this notion requires that fellow collectors are sufficiently educated or expert in contemporary art in order to distinguish a nude by Peter Doig from one by Marlene Dumas.

As in earlier studies, the coefficient for the presence of the date mark is positive: a dated painting yields a premium of 35%. The date is a sign of authenticity and personal involvement of the painter [Agnello et al. (1996), p. 368]. Additionally it provides the owner as well as other viewers with hints on the standing of the painting in the chronology of the artist’s otherwise recognizable oeuvre.

We can draw interesting conclusions: in order to be successful in the art market, contemporary artists must make sure that their style is easily recognizable. The collectors seem only to be interested in the date of completion of a painting. They pay a significant premium for the satisfaction of their art- or rather painter-historic interest; the date itself is irrelevant as we have seen when discussing the insignificant age variables.

6.5 A Note on Auction Houses

Paintings in our sample are sold through Sotheby’s, Christie’s and other auction houses in New York, London, Berlin, Paris, Vienna and other cities mostly in Europe. The coefficients

⁶⁰ $100\% \cdot (\exp(-0.392) - 1)$

	SONY	CHNY	SOLO	CHLO	OTBE	SOOT	OTNY	OTPA	CHOT	OTOT	OTVI
	216	189	180	160	141	138	122	109	108	100	91
SONY	216	0	++	+++	+++	+++	+++	+++	+++	+++	+++
CHNY	189	0	0	++	+++	++	+++	+++	+++	+++	+++
SOLO	180		0	+	+++	+	+++	+++	+++	+++	+++
CHLO	160			0	0	0	+++	+++	+++	+++	+++
OTBE	141				0	0	0	++	0	+++	+++
SOOT	138					0	0	0	0	++	++
OTNY	122						0	0	0	++	++
OTPA	109							0	0	0	0
CHOT	108								0	0	0
OTOT	100									0	0
OTVI	91										0

Reading example: The coefficient for CHNY is statistically undistinguishable from SOLO. CHNY is statistically different from CHLO at 5% significance level.

+++ = 1% significance level

++ = 5% significance level

+ = 10% significance level

Table 6-3: Auction House Ranking

of the auction house dummies are shown in Table 6-1. The reference category is other auction houses (OTOT).

The auction houses are ranked by similar means as the material of execution of paintings, see Section 6.3. This ranking is shown in Table 6-3. We drop the variable representing sales by other auction houses in London due to a limited number of observations.

The results clearly show that after controlling for other hedonic variables the highest bids for contemporary paintings are submitted in Sotheby's New York auctions, followed by Christie's New York and Sotheby's London. Christie's London lags behind and is not statistically distinguishable from sales by less important auction houses in Berlin that follow on the fifth position.

In case of the auction houses our findings are in complete accord with findings of other studies: summarized over all locations, Sotheby's commands the highest prices for contemporary art, followed by Christie's whose subsidiaries in cities like Zurich, Paris or Milan fail to achieve superior prices compared to smaller auction houses. (This is interesting as most record prices, in New York as well as in London, are set by Christie's, see Table 5-2.) New York remains the main art center in the world (which is further confirmed by the significantly positive coefficient of other auction houses located there), followed by London. Our results indicate that Berlin is challenging London's position. They might be "home biased", though, as Berlin mostly sells works by German artists; as we have seen in Section 5.2, American and British paintings rarely appear at auction in Europe.

Another interesting finding is that auction houses in Paris, the world's art capital at the beginning of the 20th century, command the same price levels as auction houses in other European cities like Vienna, Stockholm, Copenhagen or Munich. This is another indication of the movement of the art world from Europe to the US and UK.

Shall an art investor try to sell her paintings by Sotheby's New York? Not necessarily: our results may be biased by quality differences not reflected by our hedonic variables. In other words, Sotheby's New York may attract better paintings than other auction houses [de la Barre et al. (1994), p.165]. New York prices could also partly result from the lower sales tax burden on art in the US as well as no *droit de suite* legislation: art investors consider the total cost of an acquisition which consists of the hammer price, auction house commissions and higher tax e.g. in London than in New York. Assuming equal commissions in London and New York, we would end up with a higher hammer price (which is the reference price in this study) in New York than in London if the law of one price holds.

On the other hand, Sotheby's New York is commanding higher prices than other New York auction houses. If this price difference is due to a bigger or wealthier pool of bidders at Sotheby's New York auctions rather than simply better paintings, it could make sense for an investor to try selling her paintings there. This kind of arbitrage is not entirely free of cost: a collector moving his paintings across borders should not forget transportation and insurance costs as well as customs fees and, in some cases, import VAT [Pfister (2005)].

Other important auction variables are illustrations in the sales catalog and the lot number. The illustration seems to more than double (119% premium) the auction price of a painting compared to the same painting that is not reproduced in the catalog. This result should be interpreted with caution: as in the above case of Sotheby's, it is possible (actually quite probable in this case) that high-quality paintings are reproduced whereas low-quality ones are not. The high premium might suggest that our model does not sufficiently account for quality (it is done by proxies like material or size). It requires profound expertise and experience in the arts in order to estimate the quality of a painting within the oeuvre of an artist.

The coefficient of LNLOT is significantly negative. It says that for every 1% increase of the lot number above 1 (first item on sale in an auction), the auction price diminishes by 0.28%. The squared variable LNLOTS, accounting for the marginal effect of the lot number, is insignificant. This result seems to confirm the presence of the declining (afternoon) price anomaly that becomes neither weaker nor stronger in the process of the auction. Also in this case we must be aware that some endogeneity issues may be present: high quality works eagerly expected by the bidders may be scheduled for sale earlier than "shelf warmers".

6.6 The Relevance of the Artist

It is unquestionable that the artist is the main determinant of the price his or her painting achieves at auction. Our research observes 32 contemporary artists and compares their “value” with the Italian painter Enzo Cucchi (CUC). Tables 6-4 and 6-5 show the ranking of our contemporary artists derived by usual means from the regression coefficients.

It is interesting to compare the hedonic artist ranking with the simple ranking based on average prices in Table 5-2. We see that Lucian Freud is by far the most expensive artist in both cases. Jasper Johns, on the other hand, has been “overtaken” by Brice Marden after controlling for hedonic characteristics. Jeff Koons dropped even further: from 4 to 14. Koons’ paintings were “cleared” of exceptionally large formats, expensive materials like mixed media and canvas as well as sales by the leading auction houses in New York; furthermore Koons uses to sign his works which leads to a further price deduction. As a result, a “standardized” Koons is worth less than many other painters whose works achieve lower prices on average.

Other painters who significantly dropped in ranking after adjusting for hedonic characteristics are Martin Kippenberger, Robert Rauschenberg, Damien Hirst and others. The “winners” of the adjustments are, among others, Arnulf Rainer, Horst Antes and Neo Rauch. Interestingly, European painters gained ranking positions at the expense of the American and British. This is probably due to the environment of the sale: as we have seen in Section 5.2, most paintings by Americans and British are sold in their home countries by the premium auction houses Sotheby’s and Christie’s.

The least expensive painter in our sample is Walter Dahn. His “standardized” painting is 172 times less expensive than an identical work by Lucian Freud. This result impressively demonstrates the impact of the name of the artist on prices. As we have seen in Section 2.2, the artist is the primary driver of social dividends of a painting.

Unfortunately, the potential of generalization of this ranking to other artists is limited. Although e.g. Worthington et al. (2003), p. 651 suggest the opposite, it is difficult to find “comparables” as most painters develop their own unique style. And as we see, price spreads between these styles can be sizable.

Finally, the coefficient testing for the effect of the artist being alive or dead at the time of the auction shows that living artists trade at a significant discount of 31%. It seems that the fixed-supply effects of dead artists outweigh their inability to adjust to newest trends and styles. This result is not surprising if we consider that contemporary artists are rewarded for distinct stylistic specializations. Therefore the option to acquire new styles, only exercisable if the artist is alive, is close to worthless.

	FRE	MAR	JOH	DUM	DOI	KIE	BAS	RAU	POL	ROS	IND	HIR	RAI	KOO	RAG	ANT
	2084	765	671	404	257	223	203	198	189	186	184	170	167	156	124	117
FRE	2084	0	+++	+++	+++	+++	+++	+++	+++	+++	+++	+++	+++	+++	+++	+++
MAR	765	0	0	+++	+++	+++	+++	+++	+++	+++	+++	+++	+++	+++	+++	+++
JOH	671		0	0	+++	+++	+++	+++	+++	+++	+++	+++	+++	+++	+++	+++
DUM	404			0	++	+++	+++	+++	+++	+++	+++	+++	+++	+++	+++	+++
DOI	257				0	0	0	+	++	++	++	+++	+++	++	+++	+++
KIE	223					0	0	0	0	0	0	+++	+++	0	+++	+++
BAS	203						0	0	0	0	0	0	0	0	+++	+++
RAU	198							0	0	0	0	0	0	0	+++	+++
POL	189								0	0	0	0	0	0	+++	+++
ROS	186									0	0	0	0	0	+++	+++
IND	184										0	0	0	0	+++	+++
HIR	170											0	0	0	++	+++
RAI	167												0	0	++	+++
KOO	156													0	0	0
RAG	124														0	0
ANT	117															0

Reading example: The coefficient for MAR is statistically undistinguishable from JOH. DOI is statistically different from RAU at 10% significance level.

+++ = 1% significance level

++ = 5% significance level

+ = 10% significance level

Table 6-4: Artist Ranking 1 – 16

	DIN	PAO	CUC	KIR	PIS	LUE	KIP	MER	IMM	OLD	LEW	PIE	FOE	OLI	NAT	DAH
	109	109	100	90	89	86	83	79	66	58	50	46	43	22	14	12
DIN	109	0	0	0	0	+	0	+	+++	+++	+++	+++	+++	+++	+++	+++
PAO	109		0	0	0	0	0	0	+++	+++	+++	+++	+++	+++	+++	+++
CUC	100			0	0	0	0	0	+++	+++	+++	+++	+++	+++	+++	+++
KIR	90				0	0	0	0	+++	++	++	+++	+++	+++	+++	+++
PIS	89					0	0	0	+	+	++	+++	+++	+++	+++	+++
LUE	86						0	0	++	+	++	+++	+++	+++	+++	+++
KIP	83							0	0	0	+	+++	+++	+++	+++	+++
MER	79								0	0	+	+++	+++	+++	+++	+++
IMM	66									0	0	+++	+++	+++	+++	+++
OLD	58										0	0	0	+++	+++	+++
LEW	50											0	0	+++	+++	+++
PIE	46												0	+++	+++	+++
FOE	43													0	+++	+++
OLI	22														0	+++
NAT	14															0
DAH	12															

Reading example: The coefficient for KIP is not statistically distinguishable from IMM. MER is statistically different from LEW at 10% significance level.

+++ = 1% significance level

++ = 5% significance level

+ = 10% significance level

Table 6-5: Artist Ranking 17 – 32

7. Contemporary Paintings as an Investment

We now turn to our final question: how do contemporary paintings perform if they are regarded as investment? Can contemporary paintings be considered as alternatives to traditional investment in the stock market? Section 7.1 presents our Contemporary Art Index whereas Section 7.2 compares its performance to various investments in stocks.

7.1 Contemporary Art Index

Our semiannual Contemporary Art Index (CAI) represents the price movements of a standardized painting stripped of its hedonic characteristics. In accordance with Section 2.3, these price movements are due, on the one hand, to economic factors (inflation, interest rates, taxation, etc.); on the other hand, to changes in psychic dividends for contemporary art in general due to interest and curiosity, wealth and other external factors. The index is constructed from the regression coefficients depicted in Table 6-1 by using formula (3) in Section 4.2. As base year, we set the first half-year of 1992. CAI is depicted in Table 7-1.

Over the entire period, CAI shows a mean annual nominal return of 8.8% if denominated in USD, more than 1% less in case of GBP and EUR. Painting returns appear quite volatile; semiannual returns vary between -26.3% and 47.2%. The yearly standard deviation for painting prices denominated in USD amounts to 25.3%. In real terms (valued at prices of 1992 taken from statistical offices of the US, UK and Germany) the USD mean return equals 6.2%. Further investment characteristics of paintings are shown in Table 7-2.

We can see that CAI stays close to 100 until the end of 2001 and then sharply rises reaching its peak of 395 in the first half of 2007. This is further illustrated by analyzing subperiods: between 1992 and 1999, the average return amounts to merely 2% with a standard deviation of around 28% whereas between 2000 and 2007 the average yearly growth rate is 15.2% with a standard deviation of 22%.

Considering subsamples (see Section 6.1 as well as investment characteristics in the Appendixes 9-3 to 9-6), we realize that the return of art is particularly due to American and British painters whose performance is more than 8% higher than their European colleagues'. The volatilities are high in all cases (they reach 50.3% in case of American painters) so that we observe a strong diversification effect on our art portfolio consisting of American, British, German and other European painters: half of the risk is diversified away (50.3% down to 25.3%) which is quite high considering that our artists were selected randomly and thus our art portfolio is "naïve". In terms of the risk-return trade-off, the complete portfolio also

Year	Index	Return	Year	Index	Return
1992_1	100		2000_1	111	-5%
1992_2	131	27%	2000_2	103	-8%
1993_1	110	-18%	2001_1	99	-4%
1993_2	85	-26%	2001_2	126	24%
1994_1	86	1%	2002_1	143	12%
1994_2	82	-6%	2002_2	150	5%
1995_1	131	47%	2003_1	140	-7%
1995_2	123	-6%	2003_2	152	8%
1996_1	124	1%	2004_1	154	1%
1996_2	118	-5%	2004_2	209	31%
1997_1	113	-4%	2005_1	180	-15%
1997_2	132	16%	2005_2	181	1%
1998_1	117	-12%	2006_1	244	30%
1998_2	90	-26%	2006_2	265	8%
1999_1	108	19%	2007_1	395	40%
1999_2	116	7%	2007_2	391	-1%

Table 7-1: Contemporary Art Index (CAI)

appears superior to most subsample portfolios: the Sharpe ratio, defined as the ratio of return above risk-free rate⁶¹ to risk, of the entire portfolio (0.19) is higher than the Sharpe ratios of the subportfolios (0.18, 0.05 and 0.02 of US, European and German painters, respectively) except for the subportfolio consisting of US and UK artists (0.23). We see that it is difficult for single artists or groups of artists to beat the overall art market: higher returns come at the expense of higher volatilities.

7.2 Investment Alternatives

Should an investor buy contemporary paintings purely for the sake of financial gain? In order to approach this question, we compare pure investment in CAI, representing price movements of works by leading contemporary artists, to investment in leading stock indices: the American S&P500, the British FTSE100 and the German DAX30 obtained from Yahoo! Finance. We compare these four investment alternatives in nominal as well as real terms on the basis of Sharpe ratios over the horizon 1992 – 2007. Results are shown in Table 7-2.

Independent of the currency, the real rate of return of paintings amounts to approximately 6%, which is lower than the total return of the stock indices. As contemporary art also shows higher risk than stocks, the Sharpe ratios of our art portfolio turn out to be *sizably lower* than the ratios of stock indices we use as benchmarks (e.g. 0.20, the Sharpe ratio of CAI if denominated in USD, is much lower than 0.52 of S&P500).

⁶¹ As risk-free rate we consider the rate of return of 3-month treasury bills of the US and UK governments and the 3-month EURIBOR rate taken from the Bank of England (2008).

USD				
	nominal		real	
	CAI	S&P500	CAI	S&P500
Mean (annual)	8.80%	10.10%	6.18%	7.48%
Standard Deviation (annual)	25.35%	11.98%	25.34%	12.07%
Minimum (semiannual)	-26.26%	-21.49%	-27.07%	-22.35%
Maximum (semiannual)	47.23%	20.58%	45.76%	19.19%
Inflation Rate	2.62%			
Risk-free Rate (T-Bills)	3.86%		1.24%	
Sharpe Ratio	0.19	0.52	0.20	0.52
GBP				
	nominal		real	
	CAI	FTSE100	CAI	FTSE100
Mean (annual)	7.79%	12.05%	6.00%	10.25%
Standard Deviation (annual)	25.04%	15.37%	24.95%	15.23%
Minimum (semiannual)	-28.19%	-19.58%	-29.12%	-20.08%
Maximum (semiannual)	47.02%	17.66%	45.28%	16.44%
Inflation Rate	1.79%			
Risk-free Rate (T-Bills)	5.43%		3.64%	
Sharpe Ratio	0.09	0.43	0.09	0.43
EUR				
	nominal		real	
	CAI	DAX30	CAI	DAX30
Mean (annual)	7.48%	9.32%	5.70%	7.54%
Standard Deviation (annual)	24.24%	23.05%	24.23%	23.01%
Minimum (semiannual)	-33.60%	-32.24%	-33.69%	-33.32%
Maximum (semiannual)	41.13%	37.26%	40.00%	35.92%
Inflation Rate	1.78%			
Risk-free Rate (Euribor)	3.27%		1.49%	
Sharpe Ratio	0.17	0.26	0.17	0.26

Table 7-2: Comparison of Investment Alternatives

At the same time, we must be aware of the fact that the returns of paintings are biased by ignoring sizable transaction, insurance, storage and other costs, but also tax savings: stock dividends are subject to capital income tax, psychic dividends are not. As long as the magnitude of these tax savings is unknown, we are cautious to draw final conclusions like

Baumol (1986), p. 13 and others who claim that art returns are overestimated.

Nevertheless we must conclude that, contrary to media reports, contemporary paintings, on average, seem to perform *worse* than financial markets. As art investors are unable to collect psychic dividends that are included in the prices, but not in the monetary returns (unless they can lend their paintings which is unlikely, see Section 2.3), they use to overpay: they pay for psychic dividends and the (expected) price appreciation upon resale, but only receive the latter. Therefore investors should beware of buying art for purely financial motivation. Collectors, on the other hand, receive psychic dividends that could very well compensate them for foregoing higher returns in the financial markets.

We cannot decide how contemporary paintings perform in comparison to paintings from other periods as we do not find studies with a comparable investment horizon. However, as we also conclude that art underperforms the stock markets, we can venture to say that our results are consistent (see our summary of earlier results in Section 3.1).

Figures 7-1 to 7-3 compare the performance of CAI in different currencies with inflation and the stock indices. Again we see that art performs quite poorly before 2001, fluctuating around the Consumer Price Index (CPI) of the respective country. After 2001 art prices rise quite sharply and move more in line with financial markets. Further research is necessary to determine what factors led to the recent price appreciation of art and to decide whether the current record prices are results of a market bubble that is likely to burst.

Regarding Figures 7-1 to 7-3, we notice similarities in the charts of the painting and the stock indices. Therefore we calculate (lagged⁶²) correlations between the returns of art and the returns of stocks. The results are presented in Table 7-3. As expected, the stock indices in the well-integrated financial market show high positive correlations among themselves (up to 0.82). Art, on the other hand, seems to be either negatively correlated with financial markets or not correlated at all (correlation coefficients close to 0). Thus we cannot confirm the finding of Chanel (1995) that the art market lags behind financial markets by about one year; see Section 3.2. This finding may suggest that interest in and, as a consequence, prices of art have become somewhat more immune to macroeconomic conditions.

The negative or low correlations between art and stocks in the United States, United Kingdom and Germany suggest that there may be positive diversification effects when adding contemporary paintings to financial portfolios. Further analysis is necessary to answer this question as well as to reach the final conclusion on the profitability of contemporary art.

⁶² Art markets are supposed to lag behind stock markets, see Section 3.2.

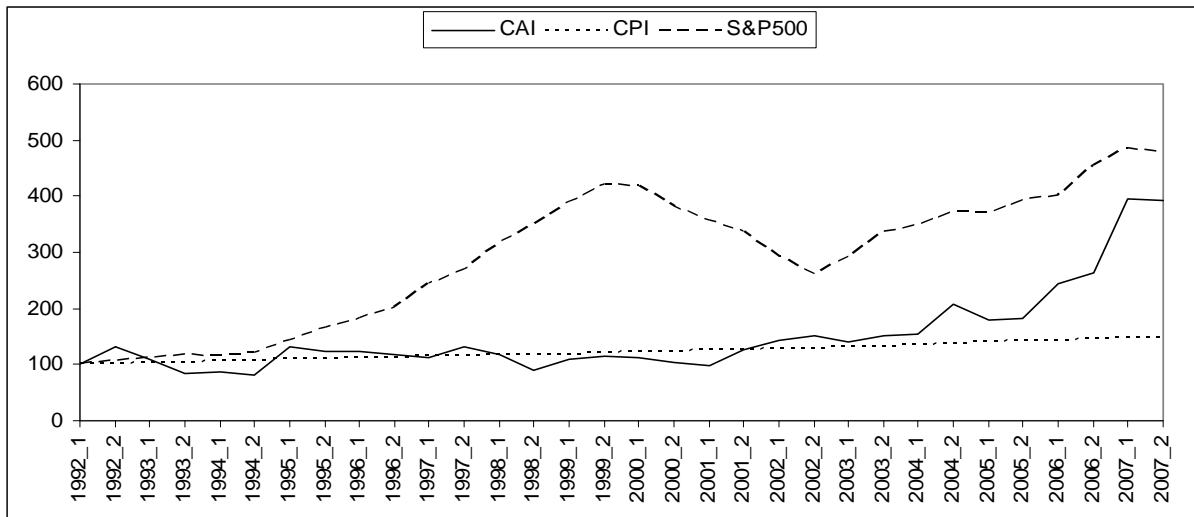


Figure 7-1: CAI (USD), CPI (US) and S&P500

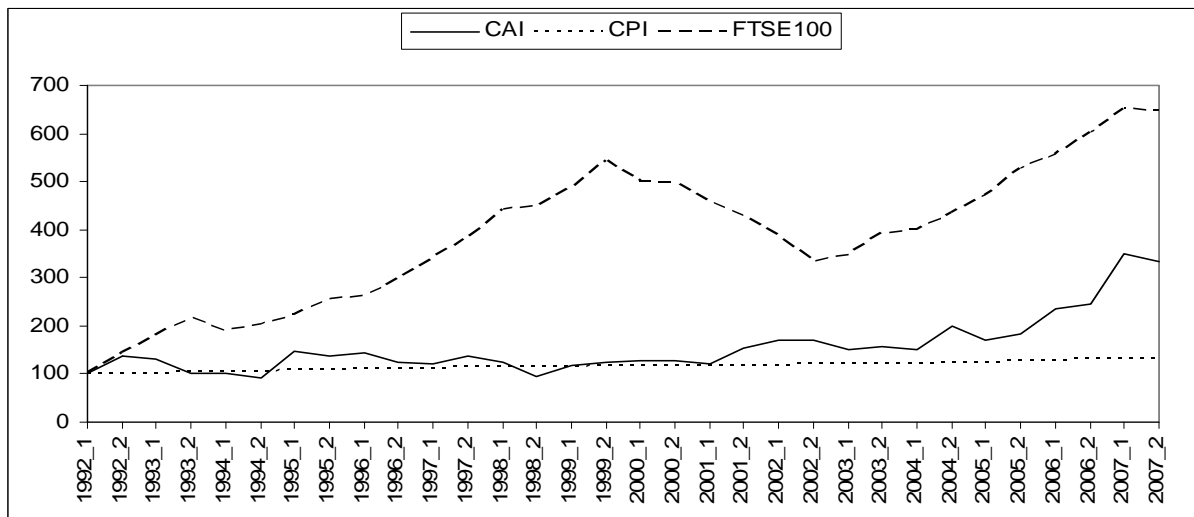


Figure 7-2: CAI (GBP), CPI (UK) and FTSE100

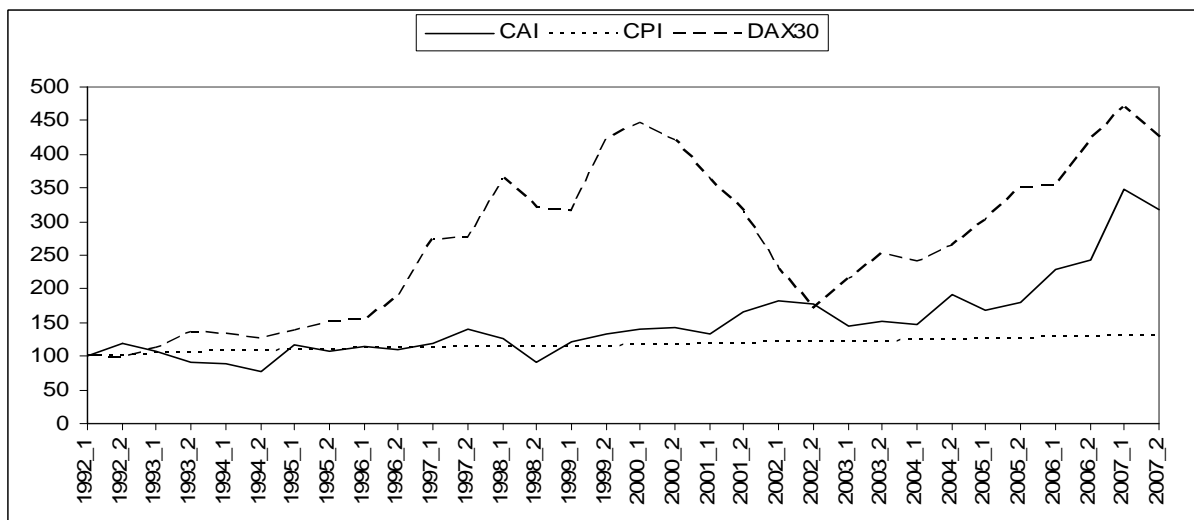


Figure 7-3: CAI (EUR), CPI (GER), DAX30

Correlation CAI_t with Indices_t					Correlation CAI_t with Indices_{t-0.5}				
	CAI	SP500	FTSE100	DAX30		CAI	SP500	FTSE100	DAX30
CAI	1.00				CAI	1.00			
SP500	-0.11	1.00			SP500	-0.07	1.00		
FTSE100	0.01	0.81	1.00		FTSE100	-0.18	0.81	1.00	
DAX30	-0.15	0.78	0.76	1.00	DAX30	-0.14	0.77	0.75	1.00
Correlation CAI_t with Indices_{t-1}					Correlation CAI_t with Indices_{t-1.5}				
	CAI	SP500	FTSE100	DAX30		CAI	SP500	FTSE100	DAX30
CAI	1.00				CAI	1.00			
SP500	-0.05	1.00			SP500	-0.15	1.00		
FTSE100	-0.25	0.81	1.00		FTSE100	0.18	0.81	1.00	
DAX30	0.00	0.78	0.75	1.00	DAX30	0.03	0.77	0.76	1.00
Correlation CAI_t with Indices_{t-2}					Correlation CAI_t with Indices_{t-2.5}				
	CAI	SP500	FTSE100	DAX30		CAI	SP500	FTSE100	DAX30
CAI	1.00				CAI	1.00			
SP500	-0.22	1.00			SP500	0.04	1.00		
FTSE100	-0.17	0.81	1.00		FTSE100	0.22	0.82	1.00	
DAX30	0.01	0.77	0.76	1.00	DAX30	0.02	0.78	0.75	1.00

Table 7-3: Lagged Correlations between CAI and Stock Indices

8. Conclusions

Media keep reporting spectacular sales in the art market: paintings by 20th century artists are transferred for over USD 100 million and even works by still living painters sell for up to USD 30 million. Other reports suggest that the returns in the art market could well beat those of traditional investments in company stocks. In our empirical study we test this claim for 3,291 paintings of 32 Western contemporary artists over the period 1992 – 2007.

Paintings, being a source of pleasure and an investment asset at the same time, are said to pay psychic (in contrast to monetary) dividends. By regressing the price of auctioned paintings on a number of hedonic characteristics that account for the psychic dividend stream, we are able to quantify the impact of various hedonic determinants on the price of paintings.

We find that the price-optimal size of contemporary paintings lies at 7 square meters. Paintings on canvas fetch the highest premium, as well as paintings executed in mixed media, oil and acrylic paint. Contrary to other findings the presence of a signature on a painting diminishes its value. We interpret this result as a preference of collectors for recognizable individual styles of their favorite artists. Dated paintings, however, are rewarded with a premium. The age and subject of the painting do not have a significant influence on prices.

The location of sale may not result in higher psychic dividends, but still affect the price due to a lower sales tax rate and the size of the bidder pool. Sotheby's New York seems to command the highest prices, followed by Christie's New York, Sotheby's London and Christie's London. Due to declining price effects an earlier sale (a smaller lot number) is preferred to a later sale (large lot number).

Grampp (1989) says that "the name of the painter is part of the aesthetic object, no less than the painting itself". This statement is confirmed by our artist ranking. According to our findings, it is no surprise that Lucian Freud holds the record price for contemporary paintings: after controlling for other hedonic characteristics we find that his name adds more than 170 times as much value to a painting as the name of Walter Dahn, the least expensive artist in our sample. Works by deceased artists are transferred with a premium. The age of the artist does not significantly influence prices.

Based on the Contemporary Art Index which reflects the price movements of a standardized painting over time we find that contemporary paintings underperform the stock market in the United States, United Kingdom and Germany. US and UK artists show the highest overall return, but even they are unable to beat stocks due to high risks. We should be aware that the calculated art returns are somewhat biased as our analysis disregards substantial transaction

and holding costs, but also tax savings on psychic compared to monetary dividends.

The underperformance of art is best explained by overpayment: pure investors pay for psychic dividends (that fundamentally drive art prices according to the Dividend Discount Model), a return component they are unable to collect (unless they lend their paintings). Collectors, on the other hand, do receive these psychic dividends that compensate them for foregoing profitable investment opportunities in the financial markets. Therefore we can conclude that art is only a good investment for those who are able to enjoy its consumption attributes.

Further research could refine our hedonic model by including other interactions (e.g. between size and material) or calculating indices for individual artists like Czujack (1997) in case of Picasso or artistic schools (e.g. pop artists) like Renneboog et al. (2002).

Already our “naïve” art portfolio consisting of roughly an equal number of Anglo-Saxon and European painters seems to be reasonably diversified. What are the specifications of an *optimal* contemporary art portfolio? Low or even negative correlations with financial markets indicate that contemporary paintings may possess some diversification potential, even if earlier findings suggest that art should not be included in financial mean-variance portfolios.

We also see interesting practical applications of our hedonic model. Can it be used for forecasting purposes? And if yes, how does the quality of these forecasts compare to expert appraisals of paintings? Is the model applicable to other than auction sales (e.g. gallery or Art Basel sales)?

In this research we had to approximate psychic dividends by hedonic characteristics. How can we measure (changes in) psychic dividends directly? How can we translate them into monetary terms in order to conduct total return calculations *including* these consumption benefits? And, consequently, is there a way to “price” an artist *ex ante* in the same fashion as we price company stocks?

Many questions are waiting for answers. Some of these answers may also be applicable to other hedonic items that Oscar Wilde would call useless. Needless to say he is not only celebrated for open cynicism, but also for his subtle irony.

9. Appendix

LNP(GBP)	Coefficient	Std. Error	t-Statistic	p-Value	Index	Return
SIZ	0.597 ***	0.026	23.240	0.000		
SIZS	-0.042 ***	0.003	-14.440	0.000		
ACCA	0.454 ***	0.084	5.400	0.000		
ACBO	-0.076	0.144	-0.530	0.599		
ACPR	-0.402 ***	0.138	-2.920	0.004		
ACOT	-0.052	0.113	-0.460	0.647		
MICA	0.649 ***	0.076	8.560	0.000		
MIBO	-0.113	0.097	-1.170	0.242		
MIPR	-0.334 ***	0.097	-3.450	0.001		
MIOT	0.000					
OICA	0.551 ***	0.070	7.920	0.000		
OIBO	-0.003	0.142	-0.020	0.986		
OIPR	-0.583 ***	0.135	-4.300	0.000		
OIOT	-1.204 ***	0.106	-11.360	0.000		
OTCA	1.292 ***	0.200	6.470	0.000		
OTBO	-0.611 ***	0.214	-2.850	0.004		
OTPR	-0.272	0.343	-0.790	0.427		
OTTS	-0.183	0.193	-0.940	0.345		
SIG	-0.393 ***	0.069	-5.700	0.000		
DAT	0.296 ***	0.063	4.680	0.000		
SONY	0.774 ***	0.078	9.910	0.000		
SOLO	0.589 ***	0.070	8.430	0.000		
SOOT	0.334 **	0.141	2.370	0.018		
CHNY	0.641 ***	0.079	8.090	0.000		
CHLO	0.480 ***	0.071	6.790	0.000		
CHOT	0.080	0.155	0.520	0.606		
OTNY	0.199 **	0.104	1.920	0.055		
OTLO	0.226	0.296	0.760	0.445		
OTPA	0.084	0.114	0.740	0.462		
OTBE	0.342 ***	0.089	3.860	0.000		
OTVI	-0.101	0.123	-0.820	0.413		
OTOT	0.000					
ILL	0.788 ***	0.114	6.920	0.000		
LNLOT	-0.286 ***	0.071	-4.020	0.000		
LNLOTS	0.003	0.008	0.380	0.706		
ANT	0.163	0.150	1.090	0.276		
BAS	0.714 ***	0.139	5.120	0.000		
CUC	0.000					
DAH	-2.111 ***	0.132	-16.010	0.000		
DIN	0.091	0.151	0.610	0.545		
DOI	0.948 ***	0.158	5.990	0.000		
DUM	1.401 ***	0.205	6.830	0.000		
FOE	-0.841 ***	0.146	-5.780	0.000		
FRE	3.046 ***	0.190	16.050	0.000		
HIR	0.535 ***	0.141	3.790	0.000		
IMM	-0.414 ***	0.144	-2.870	0.004		
IND	0.617 ***	0.154	4.000	0.000		
JOH	1.905 ***	0.311	6.120	0.000		
KIE	0.804 ***	0.128	6.280	0.000		
KIP	-0.178	0.234	-0.760	0.447		
KIR	-0.099	0.138	-0.720	0.474		

KOO	0.446 *	0.246	1.810	0.070		
LEW	-0.697 ***	0.264	-2.640	0.008		
LUE	-0.151	0.139	-1.090	0.276		
MAR	2.037 ***	0.205	9.930	0.000		
MER	-0.238	0.189	-1.260	0.208		
NAT	-1.968 ***	0.150	-13.120	0.000		
OLD	-0.533 **	0.244	-2.190	0.029		
OLI	-1.497 ***	0.144	-10.410	0.000		
PAO	0.095	0.175	0.540	0.589		
PIE	-0.785 ***	0.136	-5.770	0.000		
PIS	-0.118	0.180	-0.650	0.514		
POL	0.638 ***	0.137	4.650	0.000		
RAI	0.526 ***	0.144	3.670	0.000		
RAU	0.689 ***	0.157	4.390	0.000		
RAG	0.211	0.146	1.440	0.149		
ROS	0.625 ***	0.160	3.910	0.000		
ALI	-0.367 **	0.183	-2.010	0.045		
1992_1	8.960 ***	0.323	27.740	0.000	100	
1992_2	9.286 ***	0.335	27.740	0.000	138	33%
1993_1	9.220 ***	0.322	28.600	0.000	130	-7%
1993_2	8.964 ***	0.353	25.420	0.000	100	-26%
1994_1	8.972 ***	0.334	26.850	0.000	101	1%
1994_2	8.866 ***	0.331	26.780	0.000	91	-11%
1995_1	9.336 ***	0.341	27.360	0.000	146	47%
1995_2	9.289 ***	0.337	27.600	0.000	139	-5%
1996_1	9.317 ***	0.342	27.220	0.000	143	3%
1996_2	9.189 ***	0.327	28.060	0.000	126	-13%
1997_1	9.153 ***	0.346	26.480	0.000	121	-4%
1997_2	9.288 ***	0.336	27.670	0.000	139	13%
1998_1	9.179 ***	0.326	28.150	0.000	124	-11%
1998_2	8.897 ***	0.328	27.160	0.000	94	-28%
1999_1	9.125 ***	0.316	28.840	0.000	118	23%
1999_2	9.183 ***	0.338	27.180	0.000	125	6%
2000_1	9.207 ***	0.321	28.710	0.000	128	2%
2000_2	9.191 ***	0.328	28.030	0.000	126	-2%
2001_1	9.156 ***	0.322	28.430	0.000	122	-3%
2001_2	9.396 ***	0.328	28.650	0.000	155	24%
2002_1	9.498 ***	0.328	28.990	0.000	171	10%
2002_2	9.484 ***	0.339	27.990	0.000	169	-1%
2003_1	9.367 ***	0.325	28.840	0.000	150	-12%
2003_2	9.416 ***	0.327	28.800	0.000	158	5%
2004_1	9.362 ***	0.323	29.000	0.000	149	-5%
2004_2	9.643 ***	0.322	29.980	0.000	198	28%
2005_1	9.493 ***	0.324	29.320	0.000	170	-15%
2005_2	9.559 ***	0.322	29.710	0.000	182	7%
2006_1	9.815 ***	0.316	31.080	0.000	235	26%
2006_2	9.854 ***	0.320	30.790	0.000	244	4%
2007_1	10.214 ***	0.311	32.870	0.000	350	36%
2007_2	10.168 ***	0.311	32.690	0.000	335	-5%
Number of Obs.	3,259				Mean	7.8%
F(96, 3162)	114.74				StDev	25.0%
Prob > F	0.000				Min	-28.2%
R-squared	0.736				Max	47.0%
Root MSE	1.019				Sharpe	0.09

Table 9-1: Overall Hedonic Regression Results (GBP)

LNP(EUR)	Coefficient	Std. Error	t-Statistic	p-Value	Index	Return
SIZ	0.597 ***	0.026	23.260	0.000		
SIZS	-0.042 ***	0.003	-14.450	0.000		
ACCA	0.453 ***	0.084	5.390	0.000		
ACBO	-0.073	0.144	-0.510	0.613		
ACPR	-0.403 ***	0.138	-2.930	0.003		
ACOT	-0.052	0.113	-0.460	0.644		
MICA	0.648 ***	0.076	8.540	0.000		
MIBO	-0.114	0.097	-1.180	0.237		
MIPR	-0.333 ***	0.097	-3.440	0.001		
<i>MIOT</i>	0.000					
OICA	0.550 ***	0.070	7.910	0.000		
OIBO	0.003	0.142	0.020	0.983		
OIPR	-0.579 ***	0.136	-4.260	0.000		
OIOT	-1.201 ***	0.106	-11.320	0.000		
OTCA	1.293 ***	0.201	6.430	0.000		
OTBO	-0.615 ***	0.212	-2.900	0.004		
OTPR	-0.285	0.344	-0.830	0.409		
OTTS	-0.182	0.194	-0.940	0.350		
SIG	-0.390 ***	0.069	-5.660	0.000		
DAT	0.296 ***	0.063	4.670	0.000		
SONY	0.772 ***	0.078	9.880	0.000		
SOLO	0.590 ***	0.070	8.430	0.000		
SOOT	0.327 **	0.140	2.330	0.020		
CHNY	0.640 ***	0.079	8.070	0.000		
CHLO	0.485 ***	0.071	6.850	0.000		
CHOT	0.078	0.155	0.500	0.614		
OTNY	0.199 **	0.104	1.920	0.055		
OTLO	0.226	0.296	0.760	0.444		
OTPA	0.083	0.113	0.730	0.466		
OTBE	0.343 ***	0.089	3.860	0.000		
OTVI	-0.099	0.123	-0.810	0.420		
<i>OTOT</i>	0.000					
ILL	0.786 ***	0.114	6.900	0.000		
LNLOT	-0.281 ***	0.071	-3.940	0.000		
LNLOTS	0.002	0.008	0.320	0.750		
ANT	0.163	0.150	1.090	0.278		
BAS	0.715 ***	0.140	5.120	0.000		
<i>CUC</i>	0.000					
DAH	-2.112 ***	0.132	-15.980	0.000		
DIN	0.098	0.151	0.650	0.516		
DOI	0.953 ***	0.158	6.020	0.000		
DUM	1.408 ***	0.205	6.870	0.000		
FOE	-0.841 ***	0.146	-5.770	0.000		
FRE	3.014 ***	0.194	15.520	0.000		
HIR	0.540 ***	0.142	3.820	0.000		
IMM	-0.412 ***	0.145	-2.850	0.004		
IND	0.618 ***	0.154	4.000	0.000		
JOH	1.908 ***	0.311	6.130	0.000		
KIE	0.807 ***	0.128	6.280	0.000		
KIP	-0.177	0.234	-0.760	0.450		
KIR	-0.101	0.138	-0.730	0.465		
KOO	0.451 *	0.247	1.830	0.068		
LEW	-0.693 ***	0.263	-2.640	0.008		
LUE	-0.151	0.139	-1.090	0.278		

LNP(EUR)	Coefficient	Std. Error	t-Statistic	p-Value	Index	Return
MAR	2.048 ***	0.206	9.940	0.000		
MER	-0.235	0.189	-1.240	0.214		
NAT	-1.966 ***	0.150	-13.080	0.000		
OLD	-0.535 **	0.243	-2.200	0.028		
OLI	-1.496 ***	0.144	-10.370	0.000		
PAO	0.102	0.175	0.580	0.560		
PIE	-0.783 ***	0.136	-5.740	0.000		
PIS	-0.112	0.181	-0.620	0.537		
POL	0.641 ***	0.137	4.660	0.000		
RAI	0.522 ***	0.144	3.630	0.000		
RAU	0.690 ***	0.157	4.380	0.000		
RAG	0.214	0.146	1.460	0.144		
ROS	0.630 ***	0.160	3.930	0.000		
ALI	-0.370 **	0.183	-2.020	0.044		
1992_1	9.346 ***	0.323	28.890	0.000	100	
1992_2	9.528 ***	0.335	28.430	0.000	120	18%
1993_1	9.427 ***	0.323	29.160	0.000	108	-10%
1993_2	9.244 ***	0.353	26.170	0.000	90	-18%
1994_1	9.221 ***	0.334	27.600	0.000	88	-2%
1994_2	9.099 ***	0.332	27.440	0.000	78	-12%
1995_1	9.510 ***	0.342	27.840	0.000	118	41%
1995_2	9.426 ***	0.337	27.960	0.000	108	-8%
1996_1	9.486 ***	0.343	27.650	0.000	115	6%
1996_2	9.434 ***	0.328	28.790	0.000	109	-5%
1997_1	9.513 ***	0.346	27.470	0.000	118	8%
1997_2	9.676 ***	0.336	28.790	0.000	139	16%
1998_1	9.583 ***	0.326	29.370	0.000	127	-9%
1998_2	9.247 ***	0.328	28.170	0.000	91	-34%
1999_1	9.534 ***	0.317	30.080	0.000	121	29%
1999_2	9.626 ***	0.338	28.450	0.000	132	9%
2000_1	9.692 ***	0.321	30.180	0.000	141	7%
2000_2	9.695 ***	0.328	29.530	0.000	142	0%
2001_1	9.630 ***	0.323	29.850	0.000	133	-6%
2001_2	9.858 ***	0.328	30.020	0.000	167	23%
2002_1	9.951 ***	0.328	30.310	0.000	183	9%
2002_2	9.926 ***	0.339	29.250	0.000	179	-3%
2003_1	9.717 ***	0.325	29.890	0.000	145	-21%
2003_2	9.766 ***	0.328	29.820	0.000	152	5%
2004_1	9.733 ***	0.324	30.030	0.000	147	-3%
2004_2	9.994 ***	0.322	31.020	0.000	191	26%
2005_1	9.868 ***	0.324	30.440	0.000	169	-13%
2005_2	9.933 ***	0.322	30.820	0.000	180	7%
2006_1	10.178 ***	0.316	32.170	0.000	230	24%
2006_2	10.235 ***	0.321	31.930	0.000	243	6%
2007_1	10.594 ***	0.311	34.040	0.000	348	36%
2007_2	10.505 ***	0.311	33.730	0.000	319	-9%
Number of Obs.	3,259				Mean	7.5%
F(96, 3162)	114.24				StDev	24.2%
Prob > F	0.000				Min	-33.6%
R-squared	0.736				Max	41.1%
Root MSE	1.020				Sharpe	0.17

Table 9-2: Overall Hedonic Regression Results (EUR)

LNP(USD)	Coefficient	Std. Error	t-Statistic	p-Value	Index	Return
SIZ	0.530 **	0.041	12.940	0.000		
SIZS	-0.036 ***	0.005	-7.360	0.000		
ACCA	0.530 ***	0.169	3.140	0.002		
ACBO	0.033	0.329	0.100	0.919		
ACPR	-0.307	0.195	-1.570	0.116		
ACOT	0.134	0.188	0.710	0.478		
MICA	1.187 ***	0.158	7.500	0.000		
MIBO	0.046	0.280	0.170	0.868		
MIPR	-0.335 **	0.170	-1.970	0.049		
MIOT	0.000					
OICA	0.534 ***	0.167	3.200	0.001		
OIBO	-0.338	0.339	-1.000	0.318		
OIPR	-0.805 **	0.388	-2.070	0.038		
OIOT	-1.792 ***	0.192	-9.360	0.000		
OTCA	1.702 ***	0.416	4.100	0.000		
OTBO	-0.101	0.306	-0.330	0.741		
OTPR	-0.531	0.411	-1.290	0.196		
OTTS	-0.198	0.355	-0.560	0.577		
SIG	-0.424 ***	0.105	-4.020	0.000		
DAT	0.317 ***	0.105	3.010	0.003		
SONY	1.060 ***	0.147	7.190	0.000		
SOLO	0.873 ***	0.164	5.340	0.000		
SOOT	0.644	0.566	1.140	0.255		
CHNY	0.867 ***	0.151	5.730	0.000		
CHLO	0.795 ***	0.159	5.010	0.000		
CHOT	-0.463	0.371	-1.250	0.212		
OTNY	0.283 *	0.173	1.640	0.102		
OTLO	0.464	0.381	1.220	0.223		
OTPA	0.186	0.219	0.850	0.395		
OTBE	0.848 **	0.420	2.020	0.043		
OTVI	-1.017 **	0.523	-1.950	0.052		
OTOT	0.000					
ILL	0.587 ***	0.177	3.310	0.001		
LNLOT	-0.215 **	0.113	-1.900	0.057		
LNLOTS	-0.010	0.013	-0.720	0.470		
DIN	0.000					
DOI	0.844 ***	0.201	4.200	0.000		
DUM	1.306 ***	0.237	5.510	0.000		
FRE	3.015 ***	0.222	13.590	0.000		
HIR	-0.012	0.156	-0.080	0.938		
IND	0.675 ***	0.173	3.900	0.000		
JOH	1.926 ***	0.286	6.730	0.000		
KOO	0.438 *	0.240	1.830	0.068		
LEW	-0.447 *	0.280	-1.600	0.110		
MAR	1.768 ***	0.213	8.310	0.000		
NAT	-1.744 ***	0.184	-9.460	0.000		
OLD	-0.233	0.248	-0.940	0.348		
OLI	-1.383 ***	0.174	-7.930	0.000		
RAG	0.332 **	0.153	2.170	0.030		
ROS	0.794 ***	0.186	4.270	0.000		
ALI	-0.130	0.227	-0.570	0.567		

LNP(USD)	Coefficient	Std. Error	t-Statistic	p-Value	Index	Return
1992_1	8.874 ***	0.482	18.400	0.000	100	
1992_2	9.141 ***	0.514	17.780	0.000	131	27%
1993_1	9.052 ***	0.487	18.610	0.000	119	-9%
1993_2	8.525 ***	0.516	16.530	0.000	71	-53%
1994_1	9.002 ***	0.474	18.980	0.000	114	48%
1994_2	8.670 ***	0.481	18.020	0.000	82	-33%
1995_1	8.822 ***	0.469	18.820	0.000	95	15%
1995_2	8.963 ***	0.499	17.970	0.000	109	14%
1996_1	8.653 ***	0.467	18.520	0.000	80	-31%
1996_2	9.113 ***	0.501	18.200	0.000	127	46%
1997_1	9.266 ***	0.528	17.560	0.000	148	15%
1997_2	9.517 ***	0.523	18.180	0.000	190	25%
1998_1	9.364 ***	0.481	19.490	0.000	163	-15%
1998_2	9.416 ***	0.476	19.790	0.000	172	5%
1999_1	9.389 ***	0.453	20.710	0.000	167	-3%
1999_2	9.587 ***	0.555	17.270	0.000	204	20%
2000_1	9.330 ***	0.454	20.530	0.000	158	-26%
2000_2	9.216 ***	0.473	19.490	0.000	141	-11%
2001_1	9.082 ***	0.472	19.240	0.000	123	-13%
2001_2	9.826 ***	0.459	21.420	0.000	259	74%
2002_1	9.615 ***	0.481	19.980	0.000	210	-21%
2002_2	9.751 ***	0.568	17.170	0.000	240	14%
2003_1	9.475 ***	0.465	20.390	0.000	182	-28%
2003_2	9.600 ***	0.483	19.890	0.000	207	13%
2004_1	9.830 ***	0.469	20.970	0.000	260	23%
2004_2	10.236 ***	0.458	22.350	0.000	390	41%
2005_1	9.938 ***	0.449	22.150	0.000	290	-30%
2005_2	9.995 ***	0.467	21.380	0.000	307	6%
2006_1	10.368 ***	0.460	22.510	0.000	445	37%
2006_2	10.408 ***	0.455	22.870	0.000	464	4%
2007_1	11.024 ***	0.438	25.190	0.000	858	62%
2007_2	11.012 ***	0.440	25.020	0.000	848	-1%
Number of Obs.	1,278				Mean	13.8%
F(78, 1198)	61.11				StDev	42.3%
Prob > F	0.000				Min	-52.7%
R-squared	0.801				Max	74.4%
Root MSE	1.067				Sharpe	0.23

Table 9-3: Hedonic Regression Results Subsample US and UK (USD)

LNP(USD)	Coefficient	Std. Error	t-Statistic	p-Value	Index	Return
SIZ	0.561 **	0.049	11.400	0.000		
SIZS	-0.040 ***	0.005	-7.770	0.000		
ACCA	0.363 **	0.180	2.020	0.043		
ACBO	-0.538	0.374	-1.440	0.151		
ACPR	-0.150	0.239	-0.630	0.529		
ACOT	0.010	0.201	0.050	0.959		
MICA	0.880 ***	0.169	5.220	0.000		
MIBO	-0.005	0.295	-0.020	0.987		
MIPR	-0.227	0.180	-1.260	0.209		
<i>MIOT</i>	0.000					
OICA	0.372 **	0.178	2.100	0.036		
OIBO	-0.656	0.734	-0.890	0.372		
OIPR	-2.190 ***	0.301	-7.270	0.000		
OIOT	-1.892 ***	0.210	-9.000	0.000		
OTCA	1.379 ***	0.380	3.630	0.000		
OTBO	-0.027	0.317	-0.080	0.933		
OTPR	-0.493	0.465	-1.060	0.290		
OTTS	-0.217	0.388	-0.560	0.576		
SIG	-0.392 ***	0.153	-2.560	0.011		
DAT	0.218 *	0.130	1.680	0.094		
SONY	1.015 ***	0.152	6.660	0.000		
SOLO	1.264 ***	0.218	5.790	0.000		
SOOT	1.235 ***	0.325	3.800	0.000		
CHNY	0.834 ***	0.160	5.230	0.000		
CHLO	0.485 **	0.204	2.380	0.018		
CHOT	-0.741	0.471	-1.570	0.116		
OTNY	0.028	0.199	0.140	0.886		
OTLO	0.199	0.593	0.340	0.737		
OTPA	0.103	0.232	0.450	0.656		
OTBE	0.545	0.537	1.020	0.310		
OTVI	-1.017 **	0.497	-2.050	0.041		
<i>OTOT</i>	0.000					
ILL	0.594 ***	0.183	3.260	0.001		
LNLOT	-1.058 ***	0.224	-4.710	0.000		
LNLOTS	0.065 ***	0.022	3.030	0.003		
<i>DIN</i>	0.000					
IND	0.760 ***	0.188	4.050	0.000		
JOH	1.843 ***	0.287	6.420	0.000		
KOO	0.573 **	0.256	2.240	0.026		
LEW	-0.597 **	0.286	-2.090	0.037		
MAR	1.645 ***	0.214	7.670	0.000		
NAT	-1.762 ***	0.200	-8.820	0.000		
OLD	-0.167	0.250	-0.670	0.503		
OLI	-1.361 ***	0.183	-7.430	0.000		
RAG	0.323 **	0.153	2.110	0.036		
ROS	0.798 ***	0.189	4.230	0.000		
ALI	-0.381	0.258	-1.480	0.140		

LNP(USD)	Coefficient	Std. Error	t-Statistic	p-Value	Index	Return
1992_1	11.591 ***	0.792	14.630	0.000	100	
1992_2	11.827 ***	0.777	15.210	0.000	127	24%
1993_1	11.920 ***	0.757	15.740	0.000	139	9%
1993_2	11.181 ***	0.766	14.590	0.000	66	-74%
1994_1	11.712 ***	0.735	15.940	0.000	113	53%
1994_2	11.500 ***	0.758	15.170	0.000	91	-21%
1995_1	11.520 ***	0.734	15.690	0.000	93	2%
1995_2	11.777 ***	0.775	15.200	0.000	120	26%
1996_1	11.354 ***	0.742	15.300	0.000	79	-42%
1996_2	11.792 ***	0.766	15.390	0.000	122	44%
1997_1	12.203 ***	0.783	15.590	0.000	184	41%
1997_2	12.330 ***	0.795	15.510	0.000	209	13%
1998_1	11.947 ***	0.748	15.980	0.000	143	-38%
1998_2	12.370 ***	0.756	16.370	0.000	218	42%
1999_1	12.116 ***	0.765	15.840	0.000	169	-25%
1999_2	12.798 ***	0.894	14.320	0.000	334	68%
2000_1	12.217 ***	0.754	16.210	0.000	187	-58%
2000_2	11.903 ***	0.770	15.450	0.000	137	-31%
2001_1	11.898 ***	0.761	15.640	0.000	136	-1%
2001_2	12.341 ***	0.723	17.070	0.000	212	44%
2002_1	12.666 ***	0.747	16.950	0.000	293	32%
2002_2	12.611 ***	0.874	14.440	0.000	277	-5%
2003_1	12.310 ***	0.775	15.880	0.000	205	-30%
2003_2	12.219 ***	0.768	15.910	0.000	187	-9%
2004_1	12.344 ***	0.781	15.810	0.000	212	13%
2004_2	12.638 ***	0.749	16.880	0.000	285	29%
2005_1	12.370 ***	0.752	16.450	0.000	218	-27%
2005_2	12.518 ***	0.764	16.370	0.000	253	15%
2006_1	12.950 ***	0.769	16.840	0.000	389	43%
2006_2	13.008 ***	0.760	17.120	0.000	412	6%
2007_1	13.540 ***	0.723	18.720	0.000	702	53%
2007_2	13.606 ***	0.737	18.470	0.000	750	7%
Number of Obs.	882				Mean	13.0%
F(73, 806)	39.10				StDev	50.3%
Prob > F	0.000				Min	-73.9%
R-squared	0.784				Max	68.2%
Root MSE	1.092				Sharpe	0.18

Table 9-4: Hedonic Regression Results Subsample US (USD)

LNP(USD)	Coefficient	Std. Error	t-Statistic	p-Value	Index	Return
SIZ	0.647 ***	0.034	19.220	0.000		
SIZS	-0.046 ***	0.004	-11.820	0.000		
ACCA	0.424 ***	0.099	4.260	0.000		
ACBO	-0.175	0.154	-1.140	0.255		
ACPR	-0.411 **	0.202	-2.030	0.042		
ACOT	-0.214	0.136	-1.570	0.116		
MICA	0.304 ***	0.073	4.150	0.000		
MIBO	-0.222 **	0.098	-2.280	0.023		
MIPR	-0.356 ***	0.107	-3.330	0.001		
<i>MIOT</i>	0.000					
OICA	0.528 ***	0.070	7.580	0.000		
OIBO	-0.019	0.142	-0.130	0.893		
OIPR	-0.482 ***	0.134	-3.600	0.000		
OIOT	-0.837 ***	0.125	-6.690	0.000		
OTCA	1.027 ***	0.247	4.150	0.000		
OTBO	-0.745 ***	0.220	-3.380	0.001		
OTPR	0.247	0.172	1.430	0.153		
OTTS	-0.294	0.219	-1.340	0.179		
SIG	-0.307 ***	0.084	-3.640	0.000		
DAT	0.216 ***	0.078	2.770	0.006		
SONY	0.418 ***	0.099	4.240	0.000		
SOLO	0.516 ***	0.075	6.900	0.000		
SOOT	0.238 *	0.128	1.850	0.064		
CHNY	0.470 ***	0.096	4.870	0.000		
CHLO	0.410 ***	0.078	5.260	0.000		
CHOT	0.295 **	0.143	2.070	0.039		
OTNY	0.380 ***	0.138	2.750	0.006		
OTLO	0.348	0.368	0.940	0.345		
OTPA	0.100	0.128	0.780	0.434		
OTBE	0.309 ***	0.091	3.390	0.001		
OTVI	-0.029	0.119	-0.250	0.806		
<i>OTOT</i>	0.000					
ILL	0.812 ***	0.148	5.480	0.000		
LNLOT	-0.204 **	0.101	-2.030	0.042		
LNLOTS	0.001	0.011	0.100	0.922		
ANT	0.102	0.153	0.660	0.508		
BAS	0.663 ***	0.141	4.710	0.000		
<i>CUC</i>	0.000					
DAH	-2.198 ***	0.134	-16.400	0.000		
FOE	-0.974 ***	0.144	-6.770	0.000		
IMM	-0.542 ***	0.145	-3.750	0.000		
KIE	0.831 ***	0.132	6.280	0.000		
KIP	-0.319	0.255	-1.250	0.211		
KIR	-0.375 ***	0.137	-2.750	0.006		
LUE	-0.303 **	0.143	-2.120	0.034		
MER	-0.331 *	0.193	-1.710	0.087		
PAO	0.048	0.170	0.280	0.778		
PIE	-0.805 ***	0.136	-5.910	0.000		
PIS	-0.136	0.180	-0.760	0.449		
POL	0.567 ***	0.142	3.980	0.000		
RAI	0.241 *	0.144	1.670	0.095		
RAU	0.587 ***	0.162	3.620	0.000		
ALI	-0.557 ***	0.211	-2.640	0.008		

LNP(USD)	Coefficient	Std. Error	t-Statistic	p-Value	Index	Return
1992_1	9.658 ***	0.374	25.820	0.000	100	
1992_2	9.868 ***	0.387	25.510	0.000	123	21%
1993_1	9.622 ***	0.380	25.340	0.000	96	-25%
1993_2	9.557 ***	0.411	23.280	0.000	90	-6%
1994_1	9.285 ***	0.399	23.270	0.000	69	-27%
1994_2	9.484 ***	0.392	24.200	0.000	84	20%
1995_1	9.996 ***	0.404	24.760	0.000	140	51%
1995_2	9.824 ***	0.393	25.020	0.000	118	-17%
1996_1	10.163 ***	0.399	25.500	0.000	166	34%
1996_2	9.618 ***	0.386	24.940	0.000	96	-55%
1997_1	9.655 ***	0.399	24.180	0.000	100	4%
1997_2	9.698 ***	0.387	25.090	0.000	104	4%
1998_1	9.626 ***	0.377	25.560	0.000	97	-7%
1998_2	9.199 ***	0.386	23.830	0.000	63	-43%
1999_1	9.533 ***	0.380	25.100	0.000	88	33%
1999_2	9.556 ***	0.382	25.000	0.000	90	2%
2000_1	9.515 ***	0.381	24.950	0.000	87	-4%
2000_2	9.468 ***	0.394	24.010	0.000	83	-5%
2001_1	9.543 ***	0.381	25.040	0.000	89	8%
2001_2	9.554 ***	0.386	24.750	0.000	90	1%
2002_1	9.761 ***	0.385	25.380	0.000	111	21%
2002_2	9.793 ***	0.377	25.970	0.000	115	3%
2003_1	9.915 ***	0.383	25.910	0.000	129	12%
2003_2	9.975 ***	0.385	25.930	0.000	137	6%
2004_1	9.747 ***	0.381	25.580	0.000	109	-23%
2004_2	9.938 ***	0.384	25.850	0.000	132	19%
2005_1	10.021 ***	0.392	25.530	0.000	144	8%
2005_2	9.949 ***	0.383	25.980	0.000	134	-7%
2006_1	10.247 ***	0.369	27.760	0.000	180	30%
2006_2	10.360 ***	0.378	27.370	0.000	202	11%
2007_1	10.483 ***	0.369	28.420	0.000	228	12%
2007_2	10.509 ***	0.373	28.190	0.000	234	3%
Number of Obs.	1,981				Mean	5.5%
F(81, 1899)	71.54				StDev	31.6%
Prob > F	0.000				Min	-54.5%
R-squared	0.709				Max	51.2%
Root MSE	0.920				Sharpe	0.05

Table 9-5: Hedonic Regression Results Subsample Europe (USD)

LNP(USD)	Coefficient	Std. Error	t-Statistic	p-Value	Index	Return
SIZ	0.562 ***	0.035	16.020	0.000		
SIZS	-0.039 ***	0.004	-9.380	0.000		
ACCA	0.406 ***	0.106	3.840	0.000		
ACBO	-0.268 *	0.162	-1.650	0.098		
ACPR	-0.546 ***	0.191	-2.860	0.004		
ACOT	-0.157	0.169	-0.930	0.352		
MICA	0.244 ***	0.085	2.880	0.004		
MIBO	-0.256 **	0.114	-2.240	0.025		
MIPR	-0.501 ***	0.120	-4.180	0.000		
<i>MIOT</i>	0.000					
OICA	0.501 ***	0.089	5.630	0.000		
OIBO	-0.251	0.201	-1.250	0.211		
OIPR	-0.444 ***	0.183	-2.430	0.015		
OIOT	-1.809 ***	0.193	-9.350	0.000		
OTCA	0.954 ***	0.265	3.600	0.000		
OTBO	0.137	0.181	0.750	0.451		
OTPR	0.157	0.216	0.730	0.466		
OTTS	-0.057	0.252	-0.230	0.819		
SIG	-0.293 ***	0.103	-2.850	0.004		
DAT	0.015	0.093	0.170	0.867		
SONY	0.532 ***	0.114	4.680	0.000		
SOLO	0.689 ***	0.093	7.400	0.000		
SOOT	0.153	0.224	0.690	0.493		
CHNY	0.651 ***	0.107	6.110	0.000		
CHLO	0.559 ***	0.093	6.000	0.000		
CHOT	0.042	0.157	0.270	0.787		
OTNY	0.557 ***	0.148	3.770	0.000		
OTLO	0.483	0.403	1.200	0.230		
OTPA	0.461 ***	0.154	3.000	0.003		
OTBE	0.406 ***	0.090	4.500	0.000		
OTVI	-0.126	0.153	-0.830	0.409		
<i>OTOT</i>	0.000					
ILL	0.771 ***	0.167	4.620	0.000		
LNLOT	-0.253 ***	0.098	-2.590	0.010		
LNLOTS	0.006	0.010	0.540	0.586		
ANT	0.744 ***	0.296	2.510	0.012		
BAS	1.367 ***	0.306	4.460	0.000		
DAH	-1.475 ***	0.293	-5.030	0.000		
FOE	-0.180	0.304	-0.590	0.553		
IMM	0.147	0.268	0.550	0.584		
KIE	1.337 ***	0.295	4.530	0.000		
<i>KIP</i>	0.000					
LUE	0.261	0.307	0.850	0.394		
PIE	-0.073	0.293	-0.250	0.803		
POL	1.296 ***	0.293	4.420	0.000		
RAU	1.262 ***	0.308	4.100	0.000		
ALI	-0.850 ***	0.276	-3.080	0.002		

LNP(USD)	Coefficient	Std. Error	t-Statistic	p-Value	Index	Return
1992_1	9.497 ***	0.411	23.100	0.000	100	
1992_2	9.791 ***	0.441	22.210	0.000	134	29%
1993_1	9.538 ***	0.431	22.110	0.000	104	-25%
1993_2	9.435 ***	0.472	20.010	0.000	94	-10%
1994_1	9.271 ***	0.455	20.380	0.000	80	-16%
1994_2	9.595 ***	0.440	21.780	0.000	110	32%
1995_1	10.172 ***	0.447	22.760	0.000	196	58%
1995_2	9.738 ***	0.431	22.590	0.000	127	-43%
1996_1	10.201 ***	0.464	22.010	0.000	202	46%
1996_2	9.292 ***	0.427	21.780	0.000	81	-91%
1997_1	9.645 ***	0.455	21.190	0.000	116	35%
1997_2	9.655 ***	0.421	22.940	0.000	117	1%
1998_1	9.630 ***	0.412	23.360	0.000	114	-3%
1998_2	9.221 ***	0.432	21.360	0.000	76	-41%
1999_1	9.419 ***	0.418	22.550	0.000	93	20%
1999_2	9.592 ***	0.431	22.270	0.000	110	17%
2000_1	9.503 ***	0.428	22.220	0.000	101	-9%
2000_2	9.403 ***	0.431	21.800	0.000	91	-10%
2001_1	9.393 ***	0.420	22.370	0.000	90	-1%
2001_2	9.535 ***	0.421	22.630	0.000	104	14%
2002_1	9.624 ***	0.426	22.610	0.000	114	9%
2002_2	9.672 ***	0.437	22.120	0.000	119	5%
2003_1	9.689 ***	0.420	23.080	0.000	121	2%
2003_2	10.092 ***	0.428	23.590	0.000	181	40%
2004_1	9.661 ***	0.426	22.700	0.000	118	-43%
2004_2	9.878 ***	0.426	23.210	0.000	146	22%
2005_1	9.985 ***	0.435	22.950	0.000	163	11%
2005_2	9.954 ***	0.433	23.000	0.000	158	-3%
2006_1	10.162 ***	0.408	24.940	0.000	194	21%
2006_2	10.322 ***	0.424	24.320	0.000	228	16%
2007_1	10.437 ***	0.405	25.780	0.000	256	12%
2007_2	10.227 ***	0.408	25.050	0.000	208	-21%
Number of Obs.	1,385				Mean	4.7%
F(74, 1309)	57.40				StDev	43.1%
Prob > F	0.000				Min	-90.9%
R-squared	0.767				Max	57.7%
Root MSE	0.888				Sharpe	0.02

Table 9-6: Hedonic Regression Results Subsample Germany (USD)

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Bern, 02.09.2008

Dmitrij Gawrisch