Returns and Fundamentals in International Art Markets

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Abstract

This paper documents that international market segmentation affects the price formation of luxury assets. Using data from more than one million auction sales, I construct art price indices spanning from the early 1970s to 2007 for 13 different countries. The variation across countries in annualized returns is substantial. I find that art prices are impacted by global economic growth and stock market trends, as well as by country-specific factors. This paper also provides international evidence that the prices of luxury goods in fixed supply reveal information about the equity premium, in support of Aït-Sahalia et al. (2004).

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1 Introduction

Works of art are neither easily tradable across borders, nor evaluated according to globally identical standards. Yet, prior research has not investigated the impact of geographical segmentation on the price formation of art. This paper therefore has two purposes. First, I study the risks and returns in international art markets since the early 1970s. Second, I assess the relative importance of worldwide and country-specific economic fundamentals in determining art prices.

Examining the price dynamics of art is relevant, because collectible goods are gaining importance as alternative investment classes. A number of specialized funds, such as the Fine Art Fund and the Artist Rare Instrument Fund, cater to high-net-worth individuals that want to diversify their portfolios. The Wall Street Journal (2010) recently reported that almost 8% of total wealth is held in so-called "passion investments": art, musical instruments, wine, jewelry, antiques, cars, racehorses, etc. Of all luxury assets, art is the most likely to be acquired for its potential appreciation in value (Capgemini, 2010).

In general, however, non-monetary motives dominate financial considerations among buyers of art and other collectibles.[1] The performance of art as an *investment* may thus largely depend on wealthy households' demand for luxury *consumption*. Accordingly, Hiraki et al. (2009) and Goetzmann et al. (2010) show how art prices are impacted by changes in equity wealth and in top incomes.

I take an international perspective because art markets are segmented geographically in two different but mutually reinforcing ways. First, practical and legal barriers hinder international art transactions. Most countries impose certain restrictions on the export of art, which can negatively affect foreign demand.[2] If not outlawed, international art trade may still be discouraged by import tariffs and transport costs that also induce a home bias in the consumption of other goods (Obstfeld and Rogoff, 2001). Mere distance

[1]Surveys indicate that investment is not a motive for most collectors (Burton and Jacobsen, 1999). In a recent paper, Mandel (2010) studies the impact of shocks in GDP on international art flows, and finds that art behaves much more like a consumption good than like an investment asset.

[2]Onofri (2009) shows that export vetos negatively affect prices of Old Master paintings in Italy. The degree to which trade in cultural goods is limited by legal provisions varies across countries. Fisman and Wei (2009) analyze illicit trafficking in art and antiques.

from the sale may matter as well, since it can be hard for a potential buyer to adequately assess a work without physically inspecting it. Collectors worldwide have historically indeed been more likely to buy art close at home (Goodwin, 2008).

Second, art is a heterogeneous good, and its market is also partially segmented because of differences in taste. Most importantly, collectors generally prefer art from compatriots. In recent years, this has been particularly obvious in emerging markets such as China, India, and Russia, where the new rich are buying back their heritage (Renneboog and Spaenjers, 2010). However, survey evidence indicates that a home bias in taste is also relevant in developed economies.[3] For many artists' output, the demand will thus be the highest in their country of origin.

To study the effects of art market segmentation on the international structure of returns, I use novel data from more than one million transactions of paintings and works on paper at auctions worldwide. The data set reveals substantial differences between the 13 sample countries in the kind of art sold. I then apply a hedonic regression model, which controls for variation in price-determining characteristics across individual sales, to the data. I find that annualized real U.S. dollar (USD) returns between the early 1970s and 2007 range from –0.90% (Belgium) to 4.60% (U.K.). The investment performance of art is clearly inferior to that of equities, despite similar return volatilities. In most countries, the annualized returns on art are even below the average GDP growth rates over the same periods. The average correlation in art returns between countries is comparable to that in stock returns.

The results of comovement regressions provide evidence that international art markets share considerable exposure to worldwide equity market trends and aggregate economic growth. This finding can explain why many art markets suffered after the global economic downturns in the mid-1970s and in the early 1980s, 1990s, and 2000s. Yet, art prices are also partially set locally. Augmenting the baseline model with orthogonal local factors yields an increase in explanatory power of almost 50%.

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[3]For example, 47% of the Finns interviewed by the Dia Center for the Arts (1997) indicated that they prefer Finnish art over art from other countries. Only 2% of the Dutch respondents, but 49% of the U.S. ones, chose American art over art from other regions. Schulze (1999) argues that the culture specificity of art consumption can be explained by international differences in "consumption capital" (i.e., accumulated past consumption).

My main results are robust to a wide range of different methodologies and model specifications. For example, using repeat sales regressions (on a subsample of my data) instead of hedonic regressions, or changing the currency perspective, does not lead to different conclusions. However, I find that local fundamentals do not significantly impact the prices of works by the most highly reputable artists.

One of my key findings is that of a strong and consistent relation between stock returns and the demand for art, an important luxury consumption good. As an additional exercise, I therefore use the estimated art price indices to evaluate the equity premium, using the methodology proposed by Aït-Sahalia et al. (2004). Because of the high volatility of art returns and their substantial correlation with equity returns, art prices imply a more plausible equity premium for the U.S. than does a standard aggregate consumption measure. I also extend the procedure to an international setting, and find that art prices can partly rationalize the high equity premia observed in international data. For example, high-quality art prices imply domestic-currency equity premia of 4.25% for France and 6.25% for the U.K. over the 1971–2007 period.

This paper contributes to the literature in at least three respects. First, this is the first study to estimate long-term art returns for multiple countries, and to link variation in performance to segmentation in the modern art market.[4] Most existing research constructs a single universal art price index, often largely based on auction sales in London or New York—see, for example, Goetzmann (1993) and Mei and Moses (2002). The paper closest in spirit to this work is Ginsburgh and Jeanfils (1995), which examines long-term price comovement between three important locations. Also related is the evidence of violations of the law of one price provided by Pesando (1993). However, these studies do not directly investigate differences in returns and the reasons for these differences. In contrast, taking an international point of view has already furthered our understanding of the housing market. For example, Case et al. (1999), Ling and Naranjo (2002), and Bond et al. (2003) examine the international correlation of real estate returns, and the determinants of cross-country variation in investment performance.

Second, my findings significantly deepen our knowledge of the return drivers of

[4] Historically, art market segmentation may have been even more important than it is today. For example, De Marchi (2004) shows evidence of segmentation in terms of quality, audience, and location in the London art market of the 17th century, leading to a general lack of resale possibilities.

collectibles. They point to a role for aggregate economic growth, a factor that has been largely ignored, although Schulze (1999) and Mandel (2010) find that variation in GDP correlates with international art trade. My results also highlight the importance of local fundamentals in the determination of prices of durable luxury assets.

Third, in contrast to most previous work on art investments, I explicitly acknowledge the fact that art is primarily a consumption good. Hiraki et al. (2009) adopt a similar approach, but focus solely on the cross-border effects of stock market wealth on art consumption. Relatedly, I extend the evidence of Aït-Sahalia et al. (2004) that the prices of luxury goods in fixed supply can be used as a measure of the marginal utility of wealthy households' consumption. By examining the correlation between stock returns and art prices in an international context, this paper adds to the consumption-based asset pricing literature.

I proceed as follows. The next section describes the art transaction data and the other data series of interest. Section 3 introduces the hedonic regression model, and presents the resulting distribution of returns for each sample country. Section 4 shows the results of the comovement regressions that relate art returns to global and local fundamentals. Section 5 checks the robustness of the results to alternative specifications and methodologies. Section 6 uses art prices to explain the equity premium. Section 7 concludes and suggests avenues for further research.

2 Data

2.1 Art sales

I start from the database constructed in Renneboog and Spaenjers (2009). The authors first rely on different authoritative art history resources to compile an exhaustive list of 10,211 artists. They then look up all auction sales of paintings, watercolors, and drawings by these artists in the Art Sales Index, an online resource [http://www.artinfo.com/artsalesindex]. Next to prices (exclusive of transaction costs), the Art Sales Index also provides some details on the work (e.g., medium, size) and the sale (e.g., location, date) for each transaction. The final data set contains 1,088,709 observations from 1957 until 2007. As in most databases, buy-ins (i.e., items that do not reach the reserve price) are not included.

Only London sales are included until 1969, but the coverage of the data set is very broad since 1970. A majority of all sales took place outside the London or New York offices of Sotheby's and Christie's. Over the last 25 years of the studied time frame, the average number of observations per year is around 35,000. About 60% of all transactions concern oil paintings. The artist with the highest number of sales (5,405) in the data set is Pablo Picasso. In real USD terms, the most expensive transaction is 'Portrait du Dr. Gachet' by Vincent van Gogh, which sold for 75 million USD in May 1990 at Christie's New York. (In nominal prices, it is 'Garçon à la Pipe' by Pablo Picasso, which was auctioned off for 93 million USD in May 2004 at Sotheby's New York.) Despite the attention that goes to such high-profile sales, the average price level is much lower. The mean sales price over all observations for 2007 is 159,354 USD, while the median transaction price for the same year equals 14,775 USD.

A comparison of the total annual value of these sales to the turnover of the fine art auction market suggests that the database represents around 70% of the market in recent years. For example, a review by Artprice (2008) reports a total fine art auction turnover of 6.4 billion USD for 2006, while the total sales value for the same year in the data set used here equals 4.6 billion USD. It is important to note that art is not only sold at auction, but also privately, for example through dealers. Total turnover in the art and antiques market is roughly split equally between the two transaction types (McAndrew, 2010). However, it is generally accepted that auction prices set a benchmark also used in the private market.

I categorize all sales by country, based on the currency of the sale and the location of the auction house. For 13 different countries, I record more than 10,000 sales: Australia, Austria, Belgium, Canada, Denmark, France, Germany, Italy, the Netherlands, Sweden, Switzerland, the U.K., and the U.S. I focus on these countries as from now. The first columns of Table 1 show the number of observations for each sample country. Not surprisingly, most sales information is available for the U.K. (333,973 observations), and for the U.S. (216,896).

[Insert Table 1 about here]

Even in public sales, the identity and location of the buyer and the seller are typically kept secret by the auction house. Nevertheless, the data indirectly hint at a degree of segmentation in two different but related ways. First, more than 40% of all artists for whom I record at least two transactions have three quarters or more of their sales in just one country. Striking examples include Edward Hopper and Georgia O'Keeffe who account for about 200 observations each, all in the U.S. However, there are also many artists whose sales cluster outside the U.K. or the U.S. For example, 605 of the 618 sales of art by Max Ackermann took place in Germany, and 86% of the more than 2,000 transactions of Sidney Nolan works occurred in Australia.

Second, I have information on the nationality of all post-Renaissance artists classified in one or more art movements by Renneboog and Spaenjers (2009). Based on this information, about 40% of all sales in my sample can be classified as works by a Belgian, French, German, Italian, Dutch, Spanish, U.K., or U.S. artist. (These are the eight largest nationality groups in the data set. When an artist has a double nationality, I use the country of residence during his adult life.) The largest nationality subsample is that of French art (168,476 sales). Table 1 shows the distribution of sales over nationalities for each country. In Belgium, France, Germany, Italy, and the Netherlands, the number of sales of domestic works far outnumbers that of other nationalities. For example, the data set includes 68,518 sales of French works at French auction houses, but only 544 sales of British art in France. The relative importance of domestic art is substantially lower in the U.K. and the U.S., the largest art markets. Yet, Table 1 also shows that more than 80% of British and American art is sold domestically. The data thus indicate a close connection between the location of the sale and the type of art sold.

2.2 GDP growth rates and equity returns

I focus on two potentially important fundamentals of art prices for which data are widely available: GDP growth rates and equity returns. First, GDP plays an important role in determining the returns in international real estate markets (Case et al., 1999). Housing is a durable asset category that, like art, has both investment and consumption characteristics. Furthermore, both cross-country and time-series variation in economic growth have been shown to affect art imports (Schulze, 1999; Mandel, 2010). I therefore construct a series of logged and deflated USD-denominated GDP growth rates, using data from Global Financial Data. I also take a series of global GDP growth rates from the World Bank.

Second, as explained before, there is evidence of stock market wealth effects on the consumption of art. I consult Global Financial Data to collect yearly total equity returns (i.e., including dividends) for each country in my sample. As a proxy for worldwide movements in stock prices, I use the same database's capitalization-weighted World Return Index. Again, all log return series are expressed in deflated USD.

3 The returns in international art markets

To construct a (universal) price index for art, most prior research has applied either a repeat sales estimator (Pesando, 1993; Goetzmann, 1993; Mei and Moses, 2002) or a hedonic regression (Buelens and Ginsburgh, 1993; Chanel et al., 1996; Renneboog and Spaenjers, 2009) to a data set of auction sales. Repeat sales regressions estimate returns based on purchase-and-sale price pairs of objects that trade more than once. The method provides a near-perfect control for quality, but often implies the use of small and selective data sets. In contrast, a hedonic regression can use all available sales information. It regresses transaction prices on a range of price-determining hedonic characteristics and a set of time dummies. The changes in the coefficients on the time dummies then measure returns, under the assumption that the time-invariant quality (or appeal) of each individual work is captured by the hedonic characteristics (Ashenfelter and Graddy, 2003).

My data set includes detailed information on a very large number of auction sales, but does not identify multiple transactions of the same item. I therefore use hedonic regressions to estimate a separate art price index for each country. My basic hedonic regression model is given by Equation (1):

$$\ln P_{kt} = \alpha + \sum_{m=1}^{M} \beta_m X_{mkt} + \sum_{t=1}^{T} \delta_t D_{kt} + \varepsilon_{kt}, \tag{1}$$

where P_{kt} represents the price of good k at time t, X_{mkt} is the value of hedonic characteristic m of object k at time t, and D_{kt} is a time dummy variable which takes a value of one if good k is sold in year t (and zero otherwise). The coefficients β_m reflect the attribution of a shadow price to each of the m variables that control for variation in quality. The estimated log return in year t, r_t, is equal to $\delta_t - \delta_{t-1}$. (One time dummy is left out; the slope coefficient is set equal to zero for this base period.)

All auction prices are translated to deflated USD, using monthly U.S. CPI data, prior to applying the hedonic regression. In order to capture the properties of the artist, the work, and the sale, my regression model includes the following hedonic variables:

- *Textbook dummy.* To obtain an exogenous proxy for artist reputation, five different editions (1926, 1959, 1980, 1996, and 2004) of the classic art history textbook 'Gardner's Art Through the Ages' were consulted. Slightly less than 10% of all considered artists are included in this resource at some point. The variable TEXTBOOK equals one if the artist features in the last edition prior to the sale.

- *Attribution dummies.* Attribution can be an important factor that influences prices, especially of older art objects. The different types of attribution used in this study—reflecting different levels of relationships between master and pupil (or follower)—are: ATTRIBUTED (to), STUDIO (of), CIRCLE (of), SCHOOL (of), AFTER, and (in the) STYLE (of).

- *Authenticity dummies.* SIGNED and DATED works may impart a premium, because there is less uncertainty about their authenticity.

- *Medium dummies.* Average price levels vary across techniques. I therefore include the variables OIL, WATERCOLOR, and DRAWING.

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

- *Topic dummies.* Renneboog and Spaenjers (2009) create the following categories, based on the first word(s) of the title: ABSTRACT, ANIMALS, LANDSCAPE, NUDE, PEOPLE, PORTRAIT, RELIGION, SELF-PORTRAIT, STILL_LIFE, UNTITLED, and URBAN. Furthermore, the dummy STUDY equals one if the title contains either "study" or "étude".

- *Month dummies.* Important sales are often clustered in time, and therefore I include the variables JANUARY to DECEMBER.

- *Auction house dummies.* For Sotheby's and Christie's, I introduce dummy variables for their London, New York, and other sales (e.g., SOTH_LONDON, SOTH_NY, and SOTH_OTHER). For Bonhams and Phillips, two other important British auction houses, I distinguish between London and other locations. I also include two dummies that account for the sales by reputable European and American auction houses.

The descriptive statistics of these variables for the original data set are shown and discussed in Renneboog and Spaenjers (2009), but are not of key importance here. Equation (1) is estimated using ordinary least squares (OLS) for each country separately. The detailed regression output for the hedonic characteristics can be found in Online Appendix A (Spaenjers, 2010). The results are in line with previous findings: higher prices are generally paid for works by the master himself, signed and dated items, oil paintings (relative to watercolors and drawings), larger works (up to a point), and objects sold at Sotheby's and Christie's. Studies, portraits, and untitled works on average fetch lower prices.

My main interest lies in the estimated log returns, calculated as the first differences of the coefficients on the year dummies. I exclude the time dummy coefficients for country-year combinations with less than 50 observations in order to ensure that the reported returns are representative. Also, I do not consider the pre-1971 returns for the U.K., to enable a meaningful comparison across countries. The resulting real USD annual return series for each country is presented in Online Appendix B (Spaenjers, 2010). Table 2 shows the average return, the standard deviation, and the lowest and highest returns (with the corresponding years) over the longest available uninterrupted time frame for each country. The table also includes the average real GDP growth and equity return in those countries over the same periods.

[Insert Table 2 about here]

The annualized real USD returns on art, over the three to four decades leading up to 2007, range from –0.90% (Belgium) to 4.60% (U.K.). For the U.S., it equals 3.07%. In most cases, the average return on art is lower than the average GDP growth, and in all cases it remains below the average equity return. The bottom rows of Table 2 show that there is positive cross-sectional correlation between average art appreciation and economic growth; the coefficient of 0.52 is significant at the 0.10 level. In contrast, there is no such correlation between long-term art performance and equity returns. (Note that these correlation coefficients are calculated using 13 data points only.)

Table 2 indicates that there is cross-sectional variation in return volatility as well. However, there is no clear correlation between risk and return. The highest standard deviations are recorded for Australia (21.15%) and Sweden (20.18%). In contrast, the lowest volatility is observed in Germany (13.12%). The relatively small standard deviation for the U.S. (14.31%) may not be a surprise, given that we consider returns in USD. The reported volatilities for art are of the same order of magnitude as those of the equity markets in the sample.[5]

Despite the cross-country variation in long-term returns, art markets often display similar movements. Table 2 shows that 1991 was a bad year for international art markets: average art prices in France, Sweden, Switzerland, the U.K., and the U.S. dropped by between 29% and 61%. Many low returns were also recorded in 1981. Most art markets delivered their strongest returns either in 1972–1973 or in the second half of the 1980s.

Figure 1 presents the resulting price indices for the five largest art markets: France, Italy, the Netherlands, the U.K., and the U.S. In all cases, the log index value in 1970 is set equal to one. The plots confirm previous observations on both the cross-sectional variation in performance—over the full time frame, but also at any point in time—and the cyclical behavior of international art markets. On average, art prices increased in the early 1970s, the late 1980s, and in the last years of my sample period. Art markets suffered after 1973 and in the early 1980s, 1990s, and 2000s, which were recessionary periods in most developed economies.

[Insert Figure 1 about here]

To further investigate the comovement between the art price indices, I calculate pairwise return correlation coefficients. The results can be found in Table 3. All coefficients are significantly positive at the 0.05 level, except the correlation between

[5] Due to the time aggregation of sales data, the raw standard deviations still underestimate the true riskiness of art investments. I address this problem in subsection 5.1. I report on the distributions of domestic-currency returns in subsection 5.3.

Australia and Switzerland. However, also in some other cases, the correlations are remarkably low. For example, the correlations between the returns in Austria or Germany on the one hand and those in the U.S. on the other are below 0.50. In contrast, art returns in France, the U.K., and the U.S.—traditionally the countries with the largest shares of international consignors and bidders—show pairwise correlation coefficients between 0.77 and 0.87.

[Insert Table 3 about here]

The average of the cross-country correlation coefficients in Table 3 amounts to 0.59. This exceeds the mean correlation in international property markets of about 0.40 reported by Case et al. (1999) over a shorter period. Due to the immobility of houses, real estate markets are of course defined more locally than art markets. The average correlation between international art markets is, however, almost identical to that between the international equity markets in my sample (0.58).[6]

4 The fundamentals of art prices

4.1 Global fundamentals

The previous section showed that international art markets roughly exhibit similar time series patterns. I therefore examine to which degree art price changes can be explained by global economic fundamentals. The regression equation of interest for country i is the following:

$$r_{it} = \alpha_i + \sum_{f=1}^{F} \beta_i^f z_{wt}^f + \varepsilon_{it}, \tag{2}$$

[6] I perform two additional analyses to examine the degree of relatedness between different art markets. First, I check whether the price indices share a common long-term trend. The results of Johansen trace tests (not reported) show no or only weak evidence of cointegration between most countries. Second, I explore whether the art markets show evidence of an increase in integration over time. I rely on two convergence measures used in Bekaert and Wang (2009): (i) the trend in the cross-sectional dispersion of returns and (ii) a time-varying beta model that relates international art returns to U.K. or U.S. returns. The results (not reported) of these tests are mixed. An empirical issue with both analyses, however, is the low number of observations for each country.

where r_{it} is the log return on art in time period t in country i and z_{wt}^f is $w$orld factor f in year t. The total number of fundamentals considered is equal to F. The slope coefficient β_i^f measures the sensitivity of the art market in country i to global fundamental f. The adjusted R-squared of the OLS estimation of Equation (2) for country i will be represented by $R_i^2(A)$.

As explained earlier, the fundamentals of interest are GDP growth and equity returns. In line with prior research, I use lagged equity returns, because the equity returns are calculated at the end of each year, while the art index aggregates information per calendar year (just like GDP). Moreover, there may be a lag between shocks to stock market wealth and art consumption, since most auction houses only hold sales every few months.

The results of the OLS estimations of the two-factor model presented in Equation (2) can be found in Table 4. There are between 34 and 37 annual observations since 1971 per country. The table also shows the results for the pooled data set. In this case, traditional OLS standard errors may be biased, if the residuals are correlated within years. Therefore, following Petersen (2009), I cluster standard errors per year.[7]

[Insert Table 4 about here]

The results in Table 4 show that variation in worldwide economic growth impacts the price of art. For all countries in the sample, the coefficient is significantly larger than zero at the 0.10 level. I find that the sensitivity of art prices to income growth rates is higher than one for the pooled data set. This backs up previous assertions that art is a superior consumption good (Pommerehne and Feld, 1997; Mandel, 2010). Lagged global equity returns also have a substantial effect on art returns in many countries. After pooling the data, the coefficient of 0.33 is significantly higher than zero. The constant is significantly negative in nearly all cases.

The global GDP growth rates and equity returns explain between 16% and 49% of the variation in local art market returns. For the pooled data set, the adjusted R-squared is slightly higher than 30%. The explanatory power of these models lies in line

[7] Another concern in any time series analysis is the possibility of serial correlation. However, Durbin-Watson statistics (not reported) do not indicate autocorrelation in the residuals. In any case, Prais-Winsten regressions that correct for first-order serial correlation yield very similar results (not reported). The results are also robust to the inclusion of country fixed effects.

with prior research—see, for example, Goetzmann et al. (2010). Still, there is scope for identifying other factors that play a role in art pricing. Adding local factors should simultaneously allow me to explain more of the variation in art returns, and to gauge the relative importance of global versus local fundamentals.

4.2 Adding orthogonal factors

I construct a two-step model which separates the fundamentals in common global and orthogonal local components. Case et al. (1999), Ling and Naranjo (2002), and Bond et al. (2003) follow a similar strategy to analyze the determinants of international real estate performance. First, I regress the time series of each local fundamental (e.g., growth of Australian GDP) on the global factor (e.g., growth of global GDP). More formally, for country i and fundamental f, the first stage can be expressed as follows:

$$z_{it}^{f} = \gamma_i^f + \delta_i^f z_{wt}^f + \zeta_{it}^f, \tag{3}$$

where z_{it}^f is the value of fundamental f in country i in year t, and z_{wt}^f is the worldwide fundamental used before. The parameter δ_i^f estimates the sensitivity of fundamental f in country i to global changes in the same fundamental. The residuals ζ_{it}^f represent the portion of the change in each country's fundamental not explained by changes in the global fundamental. The error terms thus constitute an orthogonal, country-specific factor that can be used in a regression together with the global fundamental to explain the returns on art. Therefore, the second stage is an expanded version of Equation (2):

$$r_{it} = \alpha_i + \sum_{f=1}^{F} \beta_i^f z_{wt}^f + \sum_{f=1}^{F} \theta_i^f \zeta_{it}^f + \eta_{it}, \tag{4}$$

where ζ_{it}^f are the residuals from Equation (3). The parameter β_i^f measures the exposure to global fundamental f for country i, while θ_i^f is an estimate of art market i's sensitivity to the orthogonal counterpart of the same fundamental. Comparing the two slope coefficients will shed light on the relative magnitude of the two types of exposure across countries. I can also quantitatively evaluate the importance of the local to the global component by comparing the explanatory power of this last model to that of model (2), which did not include the orthogonal factors. If I represent the adjusted R-squared of the estimation of Equation (4) for country i by $R_i^2(B)$, then the proportional increase in explained variance, $\Delta_p R_i^2$, can be defined as:

$$\Delta_p R_i^2 \equiv \frac{[R_i^2(B) - R_i^2(A)]}{R_i^2(A)}. \tag{5}$$

The output of the OLS estimation of Equation (4) can be found in Table 5. As before, standard errors are clustered per year on the level of the pooled data. The same table also shows the proportional increases in R-squared, as calculated in Equation (5).

[Insert Table 5 about here]

The results in Table 5 indicate a lower impact of global GDP, now that I control for the orthogonal factors. Indeed, the statistical significance disappears in many country-specific models. However, for the pooled data, the coefficient is still highly significantly positive. The orthogonal GDP factor has a significant impact for a large majority of the included countries. The estimates for the pooled data set show that the orthogonal factor (coefficient of 0.62) is about as important as the global GDP growth rate (coefficient of 0.64).

Some of the largest coefficients on global equities are recorded for France, the U.K., and the U.S., the most international (and most high-end) art markets. The coefficient on global equities for the pooled data is very comparable to the one in Table 4. The coefficient on the orthogonal equity factor is positive for most countries.[8] Moreover, the coefficient is significantly positive at the 0.05 level for the pooled data. In this case, the estimation clearly benefits from the large cross-section. Still, the sensitivity of art returns to the local equity factor (coefficient of 0.13) is much smaller than that to global equities (0.32).[9] For nearly all countries, the constant is no longer significantly different from zero, although it is still significantly negative for the pooled data. One economic interpretation is that, ceteris paribus, an average work of art slowly depreciates over time. The negative sign could also be related to the winner's curse in the art market, created by the private value component of art (Goetzmann and Spiegel, 1995).

[8] The coefficient is significantly negative for the U.S. This seems due to the very high correlation between the global and the U.S. equity returns. The significance disappears when using an equal-weighted or GDP-weighted average as a proxy for worldwide equity returns.

[9] A formal test on the equality of the coefficients on the equity variables rejects the null hypothesis at a 0.12 level. For the GDP variables, equality of the coefficients on the global and the orthogonal factor cannot be rejected at any reasonable level.

The increase in R-squared varies across countries. Local deviations from global economic trends thus seem to be more important for some countries than for others. Remarkably, two of the three countries with the largest changes in explanatory power are Australia and Italy. These markets are arguably the ones most affected by distance from other countries and legal provisions, respectively.[10] The increase in R-squared is much smaller for the more internationally-oriented art markets. For Switzerland, the newly generated orthogonal variables heighten the R-squared with only 5%; for all other countries, the increase is at least 20%. Overall, local factors add about 15 percentage points to the explanatory power of the model, which is equivalent to a proportional increase of 48%. One can conclude that global economic factors explain more of the variation in art returns than do local trends. However, adding local fundamentals increases the explanatory power of the models in an economically significant way. Art prices are thus, to a substantial degree, set locally.

5 Alternative specifications and methodologies

5.1 Different methods for hedonic index construction

A first methodological issue with the baseline hedonic regression model is that the coefficients on the hedonic variables—the vector β_m in Equation (1)—are constrained to be stable over time. This is a strong assumption, as aesthetic preferences may change. An *adjacent-period model* can mitigate this problem: it enables the hedonic coefficients to fluctuate, by dividing the sample in a number of subperiods (Triplett, 2004). The chain-linked price index then controls for differences in time-invariant characteristics as well as for time-varying tastes. I therefore split the sample in the periods 1970–1990 and 1990–2007, and re-estimate the hedonic model for both time frames. The first columns of Panel A of Table 6 shows that the new return estimates are similar to those in Table 2.

[Insert Table 6 about here]

[10] Hope (2005) reports that, in Italy, many applications for export licenses are refused, even for minor works.

Second, since the hedonic methodology aggregates sales information per calendar year, the estimated returns will suffer from spurious first-order autocorrelation and have understated standard deviations (Working, 1960). A solution is to *unsmooth* the index, a technique originated in the real estate literature (Ross and Zisler, 1991), but later also applied to art (Campbell, 2008) and stamps (Dimson and Spaenjers, 2010). In line with Geltner (1993), Equation (6) expresses the uncorrected log return in period t as a weighted average of the true return in t, r_t^d, and the smoothed return in $t-1$:

$$r_t = (1-\alpha)r_t^d + \alpha r_{t-1}. \tag{6}$$

Equation (6) can be inverted to recover the unsmoothed return series from the observed returns:

$$r_t^d = \frac{(r_t - \alpha r_{t-1})}{(1-\alpha)}. \tag{7}$$

Working (1960) shows that aggregating prices over a year induces spurious first-order correlation in the log returns of about 0.25. I therefore use this value for α in Equation (7). The last columns of Panel A show that the volatilities are now indeed higher.

I then repeat the pooled comovement regression model from Table 5 using the newly developed art return series. Panel B of Table 6 shows the results. When using the adjacent-period model to estimate art returns, the coefficients are virtually identical to those reported earlier. In the case of the desmoothed indices, the results for the orthogonal factors are even stronger than before.

5.2 Repeat sales regressions

As explained earlier, an advantage of repeat sales regressions (RSR) is that they control exactly for the uniqueness of each work. Although I cannot identify multiple transactions of the same item with certainty, I am able to proxy for repeat sales. I consider two items to be identical if they are from the same artist (not from a pupil or follower), have the same dimensions, carry the same title (but not "Untitled" or "Composition"), are of the same medium, and do not differ with respect to the presence of a signature or date. For the 13 sample countries, this reduces the data set from more than one million individual transactions to 32,007 "repeat sales". The distribution of these sales over the sample countries confirms the earlier claim of segmentation; for about three quarters of all transaction pairs, the "sale" took place in the same country as the "purchase".

I now apply two types of RSR to those sales pairs for which there is no change in the country of sale. First, I estimate a standard RSR model per country. In this case, all items' log returns are regressed on a matrix of dummy variables that indicates the holding periods. Second, I also run a Bayesian variation on the standard RSR, as proposed by Goetzmann (1992). The Bayes RSR imposes some additional constraints on the estimation, but avoids spurious negative autocorrelation in returns and leads to more accurate estimates when the number of observations is small.[11] The procedure may be particularly helpful in the cases of Austria, Belgium, and Denmark, for which relatively few sales pairs are identified. The new return estimates are shown in Panel A of Table 7, for the same time frames as before.

[Insert Table 7 about here]

The standard RSR return estimates exhibit high volatility for some countries. In contrast, when using the Bayes RSR, the standard deviations are somewhat lower than before. In both cases, there are substantial differences between the new average return estimates and our baseline findings. Of course, the samples are now much smaller, and most likely also include transaction pairs that are not truly repeat sales. Nevertheless, the correlations with the baseline country-year return series are around 0.60.

Repeating the comovement regressions gives the results reported in Panel B of Table 7.[12] Even though the art return series are now estimated using a completely different methodology, the results generally confirm my main findings.

5.3 Domestic-currency returns

The baseline hedonic models use dollar-denominated transaction prices. All reported art returns can thus be considered as a combination of the return in the domestic currency

[11] More details on the repeat sales methodologies applied here, and on alternative procedures, can be found in Goetzmann (1992).

[12] Since the standard RSR is known to induce negative serial dependancy, I add an autoregressive term to the model when using those returns as the dependent variable. As expected, the coefficient on the lagged return variable is highly significantly negative (not reported). Since the Bayes RSR may induce a smoothing of the series, I also experimented with adding a lagged term for that model, but the coefficient was not significantly above zero.

and the change in the exchange rate. Therefore, it is relevant to reconstruct indices in the domestic currency. All domestic-currency art prices are deflated using end-of-month CPI data from Global Financial Data prior to rerunning Equation (1).

Panel A of Table 8 shows the recalculated returns. On average, they are slightly lower than before. At 3.60%, the U.K. still has the highest average return. Of course, for the U.S., the returns are identical to those reported in Table 2. Remarkably, minimum art returns are no longer observed for 1981—a year in which the USD appreciated strongly against many currencies. I now record most lowest returns in 1975–1976 and in 1991.[13]

[Insert Table 8 about here]

The standard deviations are below those in Table 2. I decompose the overall riskiness for a dollar investor in the risk of art investments in the domestic currency on the one hand, and exchange rate risk on the other hand, as in Liu and Mei (1998). The first fraction is indicated by V_1 and is calculated as the standard deviation in the domestic currency divided by the standard deviation in USD as shown in Table 2. V_2 is then one minus V_1. In general, a large part—about three quarters or more—of the overall riskiness can be attributed to the risks of art investments, but a small part is explained by exchange rate fluctuations.

I next check whether my main conclusions hold when using domestic-currency art returns. The global GDP growth rates and equity returns in the domestic currency are split out in the same factors in USD and the log change in the inflation-adjusted exchange rate over the year. The orthogonal factors are now constructed by regressing the deflated local GDP and equity returns in the domestic currency on the global factors in USD, which still serve as common components. The results are reported in Panel B of Table 8. I find no evidence that exchange rate fluctuations significantly affect domestic-currency art returns. Although the explanatory power of the model is lower than before, the other results confirm previous findings on the impact of global and local economic growth and equity market behavior.

[13] I also calculate the pairwise correlation coefficients between the returns in domestic currencies (not reported). The average correlation is equal to 0.47, about one fifth lower than when using USD returns.

5.4 The importance of quality

Local factors may play a smaller role in determining the price level of art by the most highly reputable artists, which is often appreciated universally (and for which fixed transportation costs should matter less). To test this hypothesis, I split my sample into three groups, based on the length of the entry for each artist in the online encyclopedia Oxford Art Online [http://www.oxfordartonline.com]. A first subsample includes the top decile of all sales, in terms of biography word count. The other two subsamples contain the remaining above-median-quality and the below-median-quality sales. The differences in the average price level across these three groups are economically significant. In 2007, the average price in the U.S. of a piece in the top-quality category was 1,453,096 USD, compared to 474,778 USD and 110,595 USD for the other two categories.

The availability of data varies over countries and over quality categories. Because no returns can be estimated for many country-category combinations during the 1970s, I report returns since 1980 in Panel A of Table 9. The results show a positive relation between quality and long-term returns: higher-quality art works appreciate in value faster. For the low-quality category, I record negative returns for four different countries.

[Insert Table 9 about here]

I now repeat the baseline comovement regression for the different subsamples, in Panel B of Table 9. I find that local deviations from global trends have no statistically significant impact on art prices for works by the most highly reputable artists. The contribution of the orthogonal factors to the explanatory power of each model is inversely related to average artist quality. Furthermore, the coefficients on the global factors are higher for higher-quality art. This larger sensitivity, especially to global stock markets, could partially explain the higher financial returns to better art in recent decades.[14]

[14] Since word count is measured near the end of my time frame, it is not entirely exogenous. However, most biographies were written in the early 1990s. Also, endogeneity with respect to auction prices should matter less in a peer-reviewed reference work than in more popular resources. Nevertheless, to test the robustness of the reported findings, I also split my sample based on the variable TEXTBOOK, and based on whether the sale took place at one of the two biggest auction houses or not. The results (not reported) broadly confirm the findings reported here.

5.5 Nationality-specific indices

Until now, I have focused on calculating returns for different countries. However, as explained earlier, because of a home bias in taste, the artist's nationality may matter in price formation as well.[15] I therefore estimate the baseline hedonic regression model for each of the eight nationality groups presented before. Panel A of Table 10 shows the distribution of the resulting returns per nationality over the longest possible time frames.[16] I now find somewhat less cross-sectional variation: the average real USD returns range from 3.24% (French) to 4.26% (German). This relative homogeneity could be explained by the fact that the nationality-specific samples are longer-term and not restricted to one country of sale.

[Insert Table 10 about here]

Panel B of Table 10 repeats the main comovement regression. Most results are in line with previous findings, although the impact of the orthogonal equity factor becomes close to zero. The weaker results could be due to the fact that I now consider sales worldwide. Moreover, the artists for whom I have information on their nationality are in general the better-known artists, whose prices may be determined less by local factors.

5.6 Control for income distribution

Goetzmann et al. (2010) find that increases in income inequality have historically pushed up art prices in the U.K. However, the lack of cross-sectional information in their research prevents generalization of that finding to other countries. Therefore I now add an income distribution variable as a control to my set-up. To measure income inequality, I borrow inverted Pareto coefficients from Atkinson and Piketty (2010). A higher value indicates higher concentration of income among the biggest income earners, and thus greater

[15] A number of previous studies have investigated specific national markets, such as those for American (Agnello and Pierce, 1996), Australian (Worthington and Higgs, 2006), Belgian (Renneboog and Van Houtte, 2002), and Russian (Renneboog and Spaenjers, 2010) art.

[16] Data for all nationalities are available since 1957, although only for sales in London until 1969. As before, I delete all nationality-year pairs with less than 50 observations. Furthermore, I remove the 1963 and 1964 returns, because the Art Sales Index has non-representative coverage in 1963.

inequality.[17] The data are available for a majority of the sample countries, but not always on an annual basis and only until 2005. Since the inequality variable is a relative measure, I do not have to dollar-denominate or deflate. I construct a proxy for trends in global income inequality by taking a GDP-weighted average of the observed innovations in every year, based on an extended set of countries. Inequality has increased sharply in the late 1980s, and during the economic booms of the late 1990s and the mid-2000s. The orthogonal factor is estimated as before. Table 11 outlines the results.[18]

[Insert Table 11 about here]

Table 11 shows a significant impact of changes in global income inequality, even when controlling for GDP and equity market trends. This suggests that an increase in top incomes worldwide may indeed be associated with higher art prices. The other main conclusions on GDP and equities do not change, even though the number of observations is substantially smaller than before.

6 Art and the equity premium

Among other things, the previous sections suggest a strong relation between equity returns and the demand for art consumption. Apart from its importance for the research on collectibles, this finding is also relevant from a more general asset pricing perspective. In the consumption capital asset pricing model (C-CAPM), the risk premium on an asset is determined by the covariance of its returns with consumption growth (Breeden, 1979). Typically, however, growth in aggregate consumption is too smooth and too weakly correlated with stock returns to justify the observed equity premium (Mehra and Prescott, 1985). At least since Mankiw and Zeldes (1991), one specific strand of the literature that deals with this puzzle has focused on the importance of the consumption

[17] The variables of Atkinson and Piketty (2010) are based on tax data. Capitals gains and losses are generally not included, although other investment income is considered. See Atkinson and Piketty (2010) for more information on data and methodology.

[18] A large proportion of high incomes (e.g., bonuses, investment income) may be realized near the end of each year. Therefore, I use lagged changes in inequality. However, the results are robust to the addition of same-year inequality variables.

of (actual or likely) stockholders. In particular, Aït-Sahalia et al. (2004) show that luxury consumption is more volatile and more correlated with equity returns than a standard consumption measure.

For luxury goods in fixed supply, even *prices* may reveal information about the equity premium. These prices should fluctuate proportionately with changes in demand—and thus with variation in the marginal utility of consumption. Aït-Sahalia et al. (2004) show that the equity premium implied by the prices of luxury goods in inelastic supply is given by:

$$E[R^e_{t+1}] = -\frac{Cov[P_t/P_{t+1}, R^e_{t+1}]}{E[P_t/P_{t+1}]}, \tag{8}$$

where R^e is the excess return on equities and P is the price level of the luxury good. The authors apply Equation (8) to two types of luxury goods, namely Manhattan pre-war apartments and fine Bordeaux wines (at U.S. auctions). The results are mixed: while the price of the most luxurious category of real estate covaries strongly with excess stock market returns, the correlation between the wine indices and equity returns is actually negative.

Compared to the luxury goods considered in Aït-Sahalia et al. (2004), the art price indices constructed in this paper have the advantages of being longer-term (albeit at lower frequency) and of covering a range of countries. I start by calculating the equity premium implied by U.S. art prices. Panel A of Table 12 shows the results.[19] The same panel also reports the standard deviation of the art returns, their correlation with excess equity returns, and the realized equity premium over the period of interest. Furthermore, I compare the art-implied equity premium to the premium implied by the standard C-CAPM, using National Income and Product Accounts (NIPA) consumption expenditures on non-durables and services, and assuming a relative risk aversion coefficient of 10.

[Insert Table 12 about here]

The results show that art prices are more informative about the equity premium than a traditional aggregate consumption measure. Art returns are both more volatile and

[19] As before, I use lagged equity returns. The risk-free yields are taken from Global Financial Data. I show corrected estimates of the implied equity premium that take into account time aggregation in the data by multiplying the raw implied premium by two (Breeden et al., 1989; Aït-Sahalia et al., 2004).

more highly correlated with excess equity returns. The implied equity premium of 1.51% is still relatively small, but more than double the equity premium implied by the standard model.

In Panel B of Table 12, I calculate the implied domestic-currency equity premiums for the other countries in my sample. In many cases, the implied premium is higher than that for the U.S., because of the higher correlations between art returns and excess equity returns. For example, the implied equity premium equals 4.79% for France and 3.62% for Italy. These premia are more plausible than those typically implied by aggregate consumption measures (and reasonable risk aversion coefficients), although still below the historical equity premia.[20]

The assumption of inelastic supply is arguably more realistic in the case of top-quality art, for which fewer close substitutes exist. I therefore repeat the estimation of Equation (8) using the previously developed price indices for high-end art in France, the U.K., and the U.S. The results are shown in Panel C of Table 12. The implied equity premia of 6.25% for the U.K. and 3.86% for the U.S. are closer to the average realized equity market performance than the earlier estimates.

Figure 2 illustrates the above findings. It shows top-quality art returns, changes in NIPA consumption, and excess equity returns for the U.S. over the period 1972-2007. All series are normalized to have zero mean. Clearly, the demand for art is more volatile and more highly correlated with equity returns than is aggregate consumption.

[Insert Figure 2 about here]

7 Conclusion and discussion

This paper studies the investment performance and the price fundamentals of art from an international perspective. I apply a hedonic regression model to art sales data spanning the period between the early 1970s and 2007 for 13 different countries. Annualized art

[20]The correlation between the implied equity premia and the realized premia across the 13 sample countries is 0.38, but not significantly different from zero. In the spirit of Jagannathan and Wang (2007), I also reconstruct art price indices based on sales information for the second half of each year only (in which sales are mainly clustered in the fourth quarter). This did not imply very different results.

returns in real USD range from –0.90% (Belgium) to +4.60% (U.K.). The average cross-country return correlation is similar to that in international equity markets. I find strong and robust evidence that global GDP growth rates and equity returns impact art prices. However, the orthogonal local counterparts of these factors explain a substantial portion of the variation in art returns as well. This indicates that, because of segmentation, art prices are partially set locally. Furthermore, I show that art prices are more volatile and more correlated with equity prices than are standard consumption measures. They therefore also imply more plausible equity premia.

My findings are relevant for investors in art, and for all collectors who hope for financial gains. Insofar as international art markets are sensitive to global GDP and equities, an investment in art is a bet on worldwide economic growth. However, since also local fundamentals affect the prices of art works, there can be benefits to diversifying across countries (or nationalities). The results of this paper may apply to other luxury goods markets that are segmented by region (or by differences in preferences). They also reinforce the importance of the consumption of wealthy households in the pricing of assets.

At the same time, the results imply a number of possible avenues for future research. I give two examples. First, the present study has mainly examined short-term effects of GDP growth and stock market returns. Cointegration models using longer-term or higher-frequency data could probably deepen our understanding of the drivers of collectibles prices. For example, what is the impact of long-run trends in demographics? Second, the research would benefit from a better theoretical understanding of the return-generating process for collectibles, especially when investment motives become more important. The consumption-based asset pricing model of Mandel (2009), which incorporates utility from conspicuous art consumption, represents a first effort in this direction.

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Table 1: Frequency of sales per country and per nationality

Table 1 shows the total number of observations per sample country and the distribution of sales over the largest nationality groups. The last column contains the sales for which the artist's nationality is either not among those shown or unknown. All art data come from the Art Sales Index.

		Nationality of artist								
Country	**Total**	**Belgian**	**French**	**German**	**Italian**	**Dutch**	**Spanish**	**U.K.**	**U.S.**	**Other / unkn.**
Australia	29,656	22	97	16	42	59	11	165	25	29,219
Austria	15,601	879	561	673	1,165	1,525	66	91	76	10,565
Belgium	15,007	6,228	969	56	150	781	45	50	120	6,608
Canada	14,685	56	352	24	66	141	23	232	133	13,658
Denmark	22,676	431	481	166	188	909	48	53	101	20,299
France	162,996	4,004	68,518	1,472	5,282	5,766	2,759	544	2,697	71,954
Germany	63,621	1,299	3,585	18,122	1,481	3,267	291	309	1,262	34,005
Italy	49,653	757	2,140	644	18,216	967	365	259	650	25,655
Netherlands	39,651	3,203	1,246	435	391	11,939	62	64	147	22,164
Sweden	31,357	609	1,339	394	641	1,674	135	210	316	26,039
Switzerland	38,247	981	6,030	2,194	1,342	2,456	369	252	737	23,886
U.K.	333,973	13,756	44,292	7,123	22,588	24,322	5,291	32,592	4,829	179,180
U.S.	216,896	3,791	36,658	4,731	8,844	8,012	4,533	4,982	53,229	92,116

Table 2: Distribution of art returns per country

Table 2 shows a number of characteristics (average, standard deviation, minimum, and maximum) of the distribution of art returns per country, measured over the longest available time frame. The art returns are estimated using Equation (1). All art data come from the Art Sales Index. The table also includes the averages of the GDP growth rates and the equity returns over the same periods. Data on world GDP are taken from the World Bank. Data on local GDP and on global and local equities come from Global Financial Data. All variables are USD-denominated, deflated, and logged. The bottom rows show the correlations of average art returns with GDP growth rates and equity returns. Coefficients that are significantly different from zero at the 0.10, 0.05, and 0.01 level are indicated by *, **, and ***, respectively.

Country	**Time frame**	**Art returns**						**Avg. GDP growth**	**Avg. equity return**
		Avg.	**S.D.**	**Min.**		**Max.**			
Australia	1971-2007	3.09%	21.15%	-40.40%	1975	66.66%	1973	3.91%	7.56%
Austria	1971-2007	2.53%	17.44%	-38.40%	1981	37.76%	2007	4.11%	5.66%
Belgium	1975-2007	-0.90%	17.41%	-44.30%	1975	38.57%	1986	2.02%	8.42%
Canada	1972-2007	2.36%	16.12%	-27.19%	1983	28.31%	2004	3.03%	5.91%
Denmark	1976-2007	1.75%	15.56%	-41.96%	1981	29.66%	1987	2.70%	9.58%
France	1971-2007	1.14%	18.94%	-61.03%	1991	39.74%	1986	3.50%	8.00%
Germany	1971-2007	1.52%	13.12%	-28.08%	1981	25.87%	1986	1.43%	5.44%
Italy	1971-2007	1.99%	17.67%	-41.80%	1976	36.66%	1986	3.68%	6.75%
Netherlands	1971-2007	2.30%	17.94%	-44.26%	1981	48.74%	1973	4.13%	8.14%
Sweden	1971-2007	2.32%	20.18%	-55.16%	1991	44.56%	1987	2.65%	10.51%
Switzerland	1972-2007	1.99%	18.50%	-38.99%	1991	75.63%	1972	3.41%	7.30%
U.K.	1971-2007	4.60%	15.79%	-38.66%	1991	30.47%	1987	3.88%	7.94%
U.S.	1971-2007	3.07%	14.31%	-28.73%	1991	33.58%	1973	2.53%	6.19%
Cross-sectional correlation of average art returns with average GDP growth rates								0.52 *	
Cross-sectional correlation of average art returns with average equity returns									-0.14

Table 3: Pairwise correlations between art returns

Table 3 shows the pairwise correlations between the art returns of different countries. All coefficients are significantly different from zero at the 0.05 level, except the correlation between Australia and Switzerland. All returns are USD-denominated, deflated, and logged. More information on the distribution of art returns per country can be found in Table 2.

Country	**Australia**	**Austria**	**Belgium**	**Canada**	**Denmark**	**France**	**Germany**	**Italy**	**Netherlands**	**Sweden**	**Switzerland**	**U.K.**	**U.S.**
Australia	-												
Austria	0.49	-											
Belgium	0.41	0.68	-										
Canada	0.66	0.43	0.34	-									
Denmark	0.43	0.65	0.60	0.41	-								
France	0.55	0.69	0.66	0.53	0.70	-							
Germany	0.34	0.75	0.69	0.48	0.67	0.77	-						
Italy	0.47	0.69	0.61	0.56	0.46	0.80	0.72	-					
Netherlands	0.46	0.61	0.72	0.41	0.74	0.64	0.54	0.49	-				
Sweden	0.52	0.50	0.47	0.56	0.76	0.75	0.70	0.59	0.64	-			
Switzerland	0.27	0.47	0.49	0.52	0.59	0.73	0.66	0.55	0.40	0.64	-		
U.K.	0.69	0.67	0.65	0.64	0.78	0.87	0.60	0.67	0.63	0.68	0.67	-	
U.S.	0.71	0.46	0.50	0.64	0.60	0.77	0.39	0.55	0.56	0.64	0.54	0.84	-

Table 4: Regressions on global fundamentals

Table 4 shows the results of the OLS estimation of the regression model outlined in Equation (2), with art returns as the dependent variable, and global GDP growth rates and lagged equity returns as independent variables. The last rows of Table 4 show the results when the data for all countries are pooled. In this case, standard errors (in parentheses) are clustered by year. More information on the distribution of art returns per country can be found in Table 2. Data on world GDP are taken from the World Bank. Data on global equities come from Global Financial Data. All variables are USD-denominated, deflated, and logged. Regression coefficients that are significantly different from zero at the 0.10, 0.05, and 0.01 level are indicated by *, **, and ***, respectively. The last column of Table 4 shows the adjusted R-squared for each model.

Country	N	α		β^{GDP}		$\beta^{Equities}$		R^2(A)
Australia	37	-0.11	**	1.41	**	0.50	***	0.28
Austria	37	-0.13	***	1.89	***	0.12		0.35
Belgium	34	-0.12	**	1.19	**	0.24		0.16
Canada	36	-0.09	**	1.22	***	0.24		0.22
Denmark	34	-0.10	**	1.52	***	0.31	*	0.34
France	37	-0.13	***	1.38	***	0.52	***	0.38
Germany	37	-0.11	***	1.56	***	0.05		0.40
Italy	37	-0.10	**	1.34	***	0.19		0.18
Netherlands	37	-0.09	*	1.12	**	0.40	**	0.24
Sweden	37	-0.12	**	1.56	***	0.40	**	0.28
Switzerland	36	-0.13	***	1.63	***	0.32	**	0.32
U.K.	37	-0.07	**	1.12	***	0.53	***	0.49
U.S.	37	-0.04		0.59	*	0.49	***	0.38
All countries	473	-0.10	***	1.35	***	0.33	**	0.31
		(0.03)		(0.23)		(0.12)		

Table 5: Regressions on global and orthogonal fundamentals

Table 5 shows the results of the OLS estimation of the regression model outlined in Equation (4), with art returns as the dependent variable, and global and orthogonal GDP growth rates and lagged equity returns as independent variables. The orthogonal factors are the residuals from the OLS estimation of Equation (3), which regresses the time series of each local factor on that of the global fundamental for each country. The bottom rows of Table 5 show the results when the data for all countries are pooled. In this case, standard errors (in parentheses) are clustered by year. More information on the distribution of art returns per country can be found in Table 2. Data on world GDP are taken from the World Bank. Data on local GDP and on global and local equities come from Global Financial Data. All variables are USD-denominated, deflated, and logged. Regression coefficients that are significantly different from zero at the 0.10, 0.05, and 0.01 level are indicated by *, **, and ***, respectively. The last columns of Table 5 show the adjusted R-squared and the proportional increase in explanatory power relative to the models in Table 4.

Country	**N**	**α**		**Global**				**Orthogonal**				**R^2(B)**	**$\Delta_p R^2$**
				β^{GDP}		**$\beta^{Equities}$**		**θ^{GDP}**		**$\theta^{Equities}$**			
Australia	37	-0.04		0.34		0.47	***	1.04	***	0.12		0.50	0.77
Austria	37	0.00		0.07		0.16		0.99	***	0.12		0.55	0.60
Belgium	34	0.00		-0.28		0.23		0.70	*	0.31		0.36	1.28
Canada	36	-0.05		0.78	*	0.21		0.86	**	0.24		0.31	0.42
Denmark	34	-0.06		0.78	*	0.32	**	0.63	***	0.07		0.51	0.47
France	37	-0.06		0.43		0.54	***	0.71	***	0.08		0.51	0.37
Germany	37	-0.06	**	1.03	***	0.04		0.48	***	0.03		0.55	0.38
Italy	37	-0.04		0.51		0.18		0.68	***	0.16		0.39	1.24
Netherlands	37	-0.04		0.44		0.39	***	0.60	***	0.13		0.38	0.54
Sweden	37	-0.07		0.79		0.36	**	0.68	***	0.27		0.43	0.52
Switzerland	36	-0.10	*	1.19	**	0.30	*	0.37		-0.02		0.34	0.05
U.K.	37	-0.05		0.68	*	0.52	***	0.48	***	0.07		0.59	0.20
U.S.	37	-0.01		0.08		0.46	***	0.99		-0.73	**	0.48	0.27
All countries	473	-0.05	**	0.64	***	0.32	***	0.62	***	0.13	**	0.46	0.48
		(0.02)		(0.21)		(0.09)		(0.10)		(0.05)			

Table 6: Different methods for hedonic index construction

Panel A of Table 6 shows the average and the standard deviation of the distribution of art returns per country, measured over the same time frames as before, based on two different alternative hedonic index construction methods. First, the hedonic regression is estimated separately on two subsamples for each country, prior to chain-linking the returns (the "adjacent-period" technique). Second, the baseline return series are desmoothed using Equation (7). All returns are USD-denominated, deflated, and logged. Panel B repeats the analysis reported at the bottom of Table 5, using the new return series.

Panel A: Distributions of returns

Country	Time frame	Art returns			
		Adjacent-period		*Desmoothed*	
		Avg.	S.D.	Avg.	S.D.
Australia	1971-2007	2.75%	20.57%	3.46%	28.20%
Austria	1971-2007	2.66%	18.02%	1.91%	22.46%
Belgium	1975-2007	-1.08%	17.24%	0.96%	20.41%
Canada	1972-2007	2.44%	16.08%	2.14%	20.71%
Denmark	1976-2007	1.49%	15.44%	1.40%	18.84%
France	1971-2007	1.24%	18.97%	1.47%	23.57%
Germany	1971-2007	1.78%	12.94%	1.75%	16.50%
Italy	1971-2007	2.03%	17.50%	1.10%	21.08%
Netherlands	1971-2007	2.69%	18.02%	2.81%	24.05%
Sweden	1971-2007	2.38%	20.06%	2.30%	25.09%
Switzerland	1972-2007	1.75%	18.31%	-0.68%	17.87%
U.K.	1971-2007	4.62%	15.69%	4.43%	19.72%
U.S.	1971-2007	3.21%	14.09%	3.71%	18.32%

Panel B: Regressions on fundamentals

Methodology	N	α	Global		Orthogonal		R^2(B)	$\Delta_p R^2$
			β^{GDP}	$\beta^{Equities}$	θ^{GDP}	$\theta^{Equities}$		
Adjacent-period	473	-0.05 **	0.65 ***	0.32 ***	0.62 ***	0.14 ***	0.47	0.49
		(0.02)	(0.21)	(0.10)	(0.09)	(0.05)		
Desmoothed	458	-0.04	0.47 *	0.39 ***	0.81 ***	0.14 **	0.40	0.66
		(0.03)	(0.25)	(0.12)	(0.12)	(0.06)		

Table 7: Repeat sales regressions

Panel A of Table 7 shows the average and the standard deviation of the distribution of art returns per country, measured over the same time frames as before (when possible), based on a standard RSR and a Bayesian RSR. I use all "repeated" transactions (within the same country) of items by the same artist, of the same size, with the same title, of the same medium, and with no differences in the presence of a signature or date. All returns are USD-denominated, deflated, and logged. Panel B repeats the analysis reported at the bottom of Table 5, using the new return series. The model that explains the standard RSR returns also includes an autoregressive term (not shown).

Panel A: Distributions of returns

Country	**Time frame**	**Art returns**			
		Standard RSR		*Bayes RSR*	
		Avg.	**S.D.**	**Avg.**	**S.D.**
Australia	1971-2007	2.00%	23.94%	1.41%	13.07%
Austria	1971-2007	-	-	-2.18%	16.85%
Belgium	1975-2007	-	-	-0.45%	18.94%
Canada	1972-2007	3.62%	25.57%	2.20%	11.88%
Denmark	1976-2007	-	-	3.54%	16.41%
France	1971-2007	1.70%	19.88%	1.12%	16.54%
Germany	1971-2007	3.74%	20.07%	1.68%	12.62%
Italy	1971-2007	6.02%	34.57%	1.39%	17.00%
Netherlands	1971-2007	3.69%	28.06%	1.03%	16.43%
Sweden	1971-2007	2.32%	36.13%	0.18%	17.95%
Switzerland	1972-2007	2.69%	23.90%	-0.29%	12.84%
U.K.	1971-2007	3.97%	17.18%	3.05%	14.98%
U.S.	1971-2007	2.91%	14.47%	2.50%	9.86%

Panel B: Regressions on fundamentals

Methodology	**N**	**α**		**Global**				**Orthogonal**				**R^2(B)**	**$\Delta_p R^2$**
				β^{GDP}		$\beta^{Equities}$		θ^{GDP}		$\theta^{Equities}$			
Standard RSR	447	-0.07	***	0.95	***	0.32	***	0.78	***	0.16	*	0.34	0.41
		(0.02)		(0.31)		(0.11)		(0.13)		(0.09)			
Bayes RSR	481	-0.03		0.19	*	0.32	***	0.56	***	0.09	**	0.32	0.89
		(0.02)		(0.07)		(0.11)		(0.08)		(0.04)			

Table 8: Domestic-currency returns

Panel A of Table 8 shows a number of characteristics (average, standard deviation, minimum, and maximum) of the distribution of domestic-currency art returns per country, measured over the longest available time frame. All returns are deflated and logged. Panel A also includes the fraction of volatility in USD returns due to real domestic currency return volatility (V_1) and the portion due to exchange rate volatility (V_2). Panel B repeats the analysis reported at the bottom of Table 5, using the new return series. The global factors are separated out in USD-denominated changes, and changes in the contemporary and lagged inflation-adjusted exchange rates (FX and L1.FX). The orthogonal factors are now the residuals from a regression of the time series of each local factor in the domestic currency on that of the global fundamental in USD.

Panel A: Distribution of returns

Country	**Time frame**	**Art returns**						**Fractions of volatility**	
		Avg.	**S.D.**	**Min.**		**Max.**		**V_1**	**V_2**
Australia	1971-2007	2.43%	17.31%	-39.64%	1975	38.20%	1973	0.82	0.18
Austria	1971-2007	1.03%	12.33%	-19.50%	1975	32.25%	2007	0.71	0.29
Belgium	1975-2007	-1.00%	13.97%	-47.26%	1975	30.67%	1988	0.80	0.20
Canada	1972-2007	2.55%	14.86%	-29.46%	1983	24.83%	1980	0.92	0.08
Denmark	1976-2007	1.26%	12.53%	-27.43%	1992	23.80%	2000	0.80	0.20
France	1971-2007	0.35%	16.42%	-56.33%	1991	32.47%	1989	0.87	0.13
Germany	1971-2007	0.68%	8.91%	-16.67%	1976	18.80%	1989	0.68	0.32
Italy	1971-2007	1.32%	13.84%	-29.92%	1976	38.35%	1989	0.78	0.22
Netherlands	1971-2007	1.00%	16.27%	-30.42%	1975	34.24%	1973	0.91	0.09
Sweden	1971-2007	2.43%	16.95%	-56.98%	1991	33.65%	1989	0.84	0.16
Switzerland	1972-2007	0.38%	14.41%	-32.90%	1991	50.34%	1972	0.78	0.22
U.K.	1971-2007	3.60%	14.21%	-40.74%	1991	29.02%	1973	0.90	0.10
U.S.	1971-2007	3.07%	14.31%	-28.73%	1991	33.58%	1973	1.00	0.00

Panel B: Regression on fundamentals

N	**α**		**Global**				**Currency effects**		**Orthogonal**				**R^2(B)**	**$\Delta_p R^2$**
			β^{GDP}		**$\beta^{Equities}$**		**β^{FX}**	**$\beta^{L1.FX}$**	**θ^{GDP}**		**$\theta^{Equities}$**			
473	-0.05	*	0.66	***	0.24	**	0.02	0.12	1.49	***	0.14	***	0.22	0.42
	(0.03)		(0.23)		(0.10)		(0.11)	(0.12)	(0.49)		(0.04)			

Table 9: The importance of quality

Panel A of Table 9 shows the average and the standard deviation of the distribution of art returns per country, measured over the time frame 1980-2007 (when possible), for three different quality categories. All sales are first ranked according to the length of the artist's biography in the online art history resource Oxford Art Online. Then three categories are created, based on the word count deciles: top quality (decile 1), medium quality (deciles 2-5), and low quality (deciles 6-10). All returns are USD-denominated, deflated, and logged. Panel B repeats the analysis reported at the bottom of Table 5, using the new return series.

Panel A: Distributions of returns

Country	**Time frame**	**Art returns**					
		Top quality		*Medium quality*		*Low quality*	
		Avg.	**S.D.**	**Avg.**	**S.D.**	**Avg.**	**S.D.**
Australia	1980-2007	-	-	4.23%	23.13%	3.98%	17.97%
Austria	1980-2007	-	-	2.37%	20.80%	0.32%	17.25%
Belgium	1980-2007	-	-	0.60%	20.80%	-0.64%	16.57%
Canada	1980-2007	-	-	-	-	2.13%	17.34%
Denmark	1980-2007	-	-	1.32%	20.27%	0.90%	16.26%
France	1980-2007	3.21%	28.94%	1.39%	19.34%	1.57%	19.01%
Germany	1980-2007	-	-	0.96%	13.71%	-0.36%	14.55%
Italy	1980-2007	-	-	2.93%	17.04%	2.83%	18.21%
Netherlands	1980-2007	-	-	2.57%	18.81%	1.28%	14.60%
Sweden	1980-2007	-	-	1.56%	25.33%	-0.05%	19.93%
Switzerland	1980-2007	-	-	-	-	-0.72%	14.82%
U.K.	1980-2007	5.95%	17.62%	4.75%	15.23%	4.03%	14.06%
U.S.	1980-2007	4.85%	20.95%	3.78%	14.49%	3.25%	11.13%

Panel B: Regressions on fundamentals

Quality category	**N**	**α**		**Global**				**Orthogonal**				**R^2(B)**	**$\Delta_p R^2$**
				β^{GDP}		**$\beta^{Equities}$**		**θ^{GDP}**		**$\theta^{Equities}$**			
Top quality	180	-0.07	*	0.74	**	0.61	***	0.23		0.07		0.25	0.02
		(0.04)		(0.36)		(0.15)		(0.14)		(0.11)			
Medium quality	445	-0.05	*	0.63	**	0.35	***	0.63	***	0.14	**	0.36	0.49
		(0.03)		(0.24)		(0.10)		(0.11)		(0.06)			
Low quality	464	-0.05	**	0.63	***	0.27	***	0.62	***	0.12	**	0.44	0.57
		(0.02)		(0.19)		(0.09)		(0.09)		(0.05)			

Table 10: Nationality-specific indices

Panel A of Table 10 shows a number of characteristics (average, standard deviation, minimum, and maximum) of the distribution of art returns per nationality, measured over the longest available time frame. All returns are USD-denominated, deflated, and logged. Panel B repeats the analysis reported at the bottom of Table 5, using the new return series.

Panel A: Distribution of returns

Nationality	**Time frame**	**Art returns**					
		Avg.	**S.D.**	**Min.**		**Max.**	
Belgian	1965-2007	4.20%	15.91%	-34.45%	1981	32.43%	1968
French	1965-2007	3.24%	18.24%	-59.88%	1991	38.74%	1987
German	1971-2007	4.26%	14.26%	-25.85%	1982	41.62%	1971
Italian	1965-2007	4.20%	15.81%	-30.35%	1991	33.81%	1969
Dutch	1965-2007	3.97%	14.25%	-29.74%	1991	36.24%	1973
Spanish	1971-2007	4.08%	23.60%	-64.08%	1975	44.34%	1987
U.K.	1965-2007	4.11%	15.70%	-37.43%	1975	38.89%	1987
U.S.	1971-2007	3.94%	16.88%	-40.02%	1991	36.49%	1989

Panel B: Regression on fundamentals

N	**α**	**Global**				**Orthogonal**				**R^2(B)**	**$\Delta_p R^2$**
		β^{GDP}		**$\beta^{Equities}$**		**θ^{GDP}**		**$\theta^{Equities}$**			
336	-0.04	0.62	**	0.45	***	0.46	***	0.03		0.41	0.21
	(0.03)	(0.24)		(0.11)		(0.11)		(0.05)			

Table 11: Control for income inequality

Table 11 repeats the analysis reported at the bottom of Table 5, but adding income distribution variables. Changes in income inequality are proxied by log changes in inverted Pareto coefficients from Atkinson and Piketty (2010).

N	**α**		**Global**						**Orthogonal**						**R^2(B)**	**Δ_p R^2**
			β^{GDP}		**$\beta^{Equities}$**		**$\beta^{Inequal.}$**		**θ^{GDP}**		**$\theta^{Equities}$**		**$\theta^{Inequal.}$**			
235	-0.08	**	0.75	***	0.36	***	1.27	**	0.72	***	0.17	***	0.00		0.50	0.60
	(0.04)		(0.27)		(0.11)		(0.61)		(0.12)		(0.05)		(0.24)			

Table 12: Art and the equity premium

Panel A of Table 12 uses Equation (8) to estimate the equity premium implied by U.S. art prices. It also shows the premium implied by a standard C-CAPM model, using NIPA data on aggregate consumption and assuming a relative risk aversion of 10. The estimates take into account time aggregation in data (Breeden et al., 1989). The table also reports the standard deviation of each series, the correlation with excess equity returns, and the realized equity premium over the same period. Panel B repeats the analysis using the art indices of the other sample countries. Panel C shows the results using the returns on top-quality art.

Panel A: Implied equity premium for U.S.

Series	**Time frame**	**Standard deviation**	**Correlation with excess equity returns**	**Implied equity premium**	**Avg. realized equity premium**
Art	1971-2007	0.191	0.277	1.51%	6.05%
NIPA	1971-2007	0.015	0.137	0.63%	6.05%

Panel B: Implied equity premia for other countries, using baseline art price indices

Country	**Time frame**	**Standard deviation**	**Correlation with excess equity returns**	**Implied equity premium**	**Avg. realized equity premium**
Australia	1971-2007	0.177	0.364	2.96%	7.17%
Austria	1971-2007	0.129	0.275	1.84%	6.06%
Belgium	1975-2007	0.140	0.314	2.27%	6.54%
Canada	1972-2007	0.151	0.388	1.85%	4.58%
Denmark	1976-2007	0.135	0.262	1.77%	7.38%
France	1971-2007	0.150	0.530	4.79%	7.49%
Germany	1971-2007	0.090	0.069	0.35%	6.12%
Italy	1971-2007	0.143	0.411	3.62%	4.79%
Netherlands	1971-2007	0.166	0.410	2.97%	8.64%
Sweden	1971-2007	0.161	0.416	4.03%	12.12%
Switzerland	1972-2007	0.160	0.246	1.78%	9.51%
U.K.	1971-2007	0.139	0.450	3.97%	8.04%

Panel C: Implied equity premia for France, U.K., and U.S., using top-quality art prices

Country	**Time frame**	**Standard deviation**	**Correlation with excess equity returns**	**Implied equity premium**	**Avg. realized equity premium**
France	1972-2007	0.295	0.219	4.25%	7.49%
U.K.	1971-2007	0.189	0.525	6.25%	8.04%
U.S.	1972-2007	0.282	0.364	3.86%	6.05%

Figure 1: Art price indices for France, Italy, the Netherlands, the U.K., and the U.S.

This figure shows the log art price index values (in real USD) for the five largest art markets. The indices are set equal to one in 1970. More information on the distribution of art returns per country can be found in Table 2.

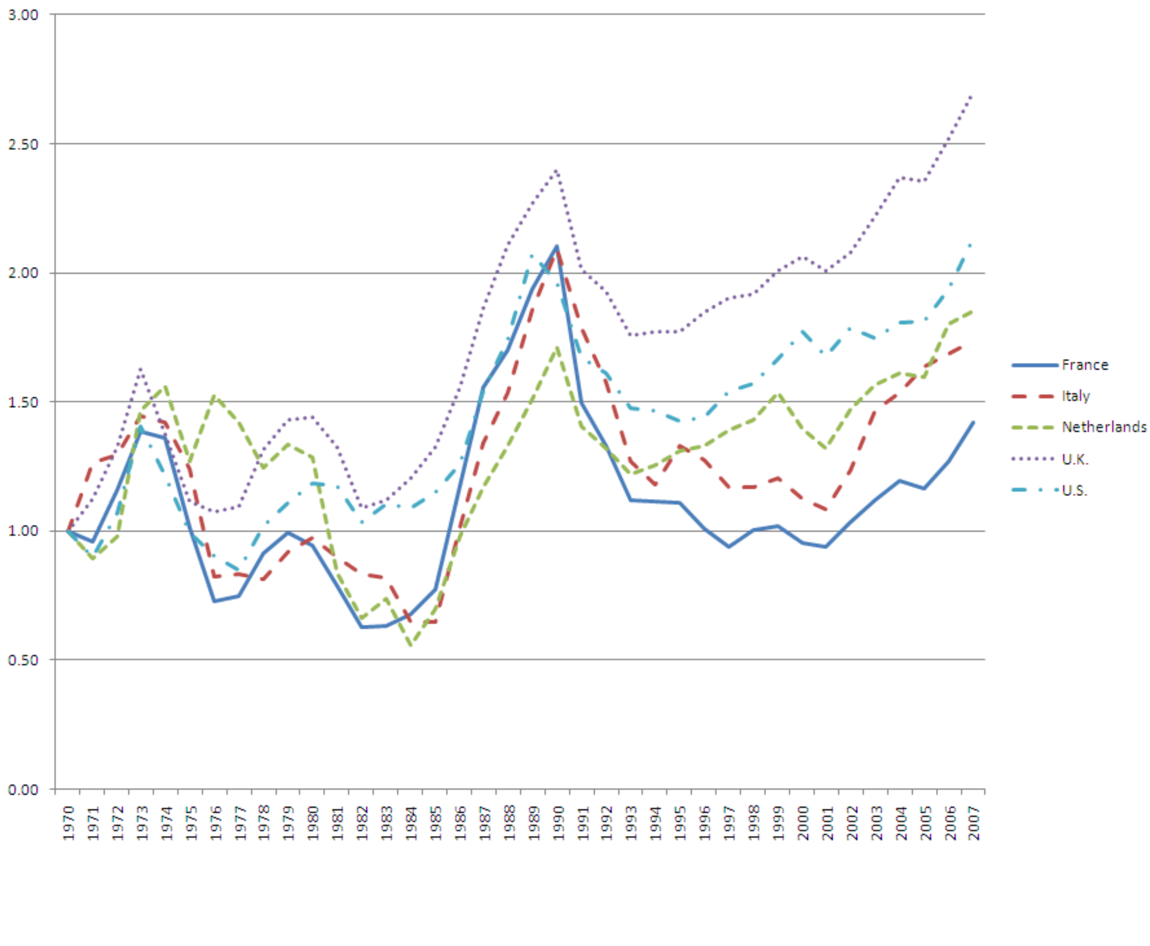

Figure 2: Response of art prices and aggregate consumption to excess equity returns

This figure shows top-quality art returns, changes in aggregate consumption, and excess equity returns for the U.S. over the period 1972-2007. More information on the distribution of top-quality art returns can be found in Table 9. Data on equities and risk-free yields come from Global Financial Data. Consumption growth is calculated using NIPA data on consumption of non-durable goods and services. All variables are USD-denominated and deflated. All series are normalized to have zero mean.