Art and Money

William Goetzmann, Luc Renneboog, and Christophe Spaenjers*

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Abstract:
This paper investigates the impact of equity markets and top incomes on art prices. Using a long-term art market index that incorporates information on repeated sales since the eighteenth century, we demonstrate that both same-year and lagged equity market returns have a significant impact on the price level in the art market. Over a shorter time frame, we also find empirical evidence that an increase in income inequality may lead to higher prices for art, in line with the results of a numerical simulation analysis. Finally, the results of Johansen cointegration tests strongly suggest the existence of a long-term relation between top incomes and art prices.

JEL classification: G1, Z11.
Keywords: Art investments; Cointegration; Comovement; Equities; Income inequality; Long-term returns.

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* William Goetzmann (william.goetzmann@yale.edu) is Edwin J. Beinecke Professor of Finance and Management, Yale School of Management, USA. Luc Renneboog (luc.renneboog@uvt.nl) is Professor of Corporate Finance, Tilburg University, the Netherlands. Christophe Spaenjers (c.spaenjers@uvt.nl) is a doctoral candidate in Finance, CentER Graduate School, Tilburg University, the Netherlands.

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1. Introduction

Unless cast in platinum and covered with diamonds, as in the case of a 2007 Damien Hirst sculpture, a work of art has little intrinsic value. Nevertheless, works of art from time to time have fetched shockingly high prices, at least from the perspective of ordinary wage earners. The highest prices have been paid for creations of deceased artists, but also living artists – Hirst being the exemplar – have commanded multi-million dollar (or pound) sums for their work. The inelastic supply in the art market makes the demand for art "the only meaningful driver of investment returns" (Mandel, 2009). Indeed, the price of an art object is only limited by how much collectors are willing and able to spend on it. When individuals' buying power rises, this can be expected to lead to higher art consumption, and thus to a higher price level in the art market.

Given the fixed and relatively limited supply of art works, how wealthy the *wealthy* are may matter more to the determination of art prices than total wealth. The Economist (2006) puts it as follows: "Trophy asset prices may be a function of the huge dispersion of incomes. What is the point of being rich if you cannot drink the finest wines while gazing at the world's most famous artworks on the walls of your penthouse flat?" This is especially relevant because many so-called "high net worth individuals" seem to be attracted to art assets, and often consider investing a considerable part of their wealth in it (Cap Gemini, 2008).

One way to measure changes in wealthy individuals' buying power, is to look at stock market returns. Equities are typically held more widely among the most affluent. Without explicitly making this point, a number of studies (cf. Section 2) have indeed looked at the relation between stock market movements and art market trends. In this study, we extend this work over a much longer time frame, starting our study in the first half of the nineteenth century. By doing this, we may benefit from the fact that, at least in the earlier periods of our time frame, the art market was much less globalized, enabling a less noisy measurement of the correlation between the equity market and the art market than has previously been possible. Additionally, we differentiate between capital growth and dividend yield.

An alternative way may be to consider the evolution of top incomes over time. Especially if top incomes also go the wealthiest individuals, they should proxy reasonably well for art collectors' buying power. Insofar as equities make up only a small percentage of the total value of these same individuals' assets (including human capital), changes in top income may be more relevant than equity market movements. The simple simulation model in Section 3 of this paper, which builds on previous work by Goetzmann and Spiegel (1995), shows how changes in total income, the income distribution, and the population of art collectors may have an impact on art prices. We also empirically investigate the link between total income and its distribution on the one hand and art prices on the other. Somewhat surprisingly, this relationship has not been analyzed before.

In our empirical analysis, we first construct an art price index that covers the period 1765-2007, using transaction data from Reitlinger (1961) and the Art Sales Index. Since the initial selection of artists conforms to British taste, and most of the art sales considered took place in Great Britain, we relate our GBP-denominated art price index to British equity market and income series. Our results show that over the period 1830-2007, there is a strong positive relation between equity market and art market movements. Both same-year and lagged equity capital changes show significant positive correlation with changes in art prices. The effect is robust to several alternative specifications. Next, we also find some evidence of a relation between income inequality and art prices over the period 1908-2005, the time frame for which the inequality data are available. The significance of this result is driven by the large variation in the British income distribution during the first half of the twentieth century. For the post-war period, we find weak evidence that art prices are influenced by U.S. income inequality. Finally we demonstrate the existence of a cointegrating relationship between top income and art prices over our time period, which suggests that top incomes are fundamental in setting the price level in the art market. This result holds even when only the post-war period is considered.

This paper contributes to the literature in a number of respects. First, it constructs an annual long-run art index, which is used to re-estimate the relationship between art and the stock market. The results strengthen previous evidence on the impact of equity markets on art prices. Second, it sheds light on the fundamentals of art prices; more specifically, it is the first study to investigate the interaction between income, inequality, and art prices. Third, it adds additional evidence to the growing literature on wealth effects and luxury consumption.

The remainder of this paper is structured as follows. Section 2 outlines the relevant literature on art prices, stock market wealth effects, and the market fundamentals of real assets. Section 3 outlines a simple model that relates total income and income inequality to art prices, and shows simulation results. Section 4 presents the data for our empirical part, while Section 5 gives an overview of our results. Section 6 concludes.

2. Related literature

Since the first studies by Anderson (1974) and Stein (1977), an expanding literature has investigated the returns to art investments. For example, using different estimation techniques and ever-larger auction sales datasets, Baumol (1986), Pesando (1993), Goetzmann (1993), Mei and Moses (2002), Campbell (2008), Pesando and Shum (2008), and Renneboog and Spaenjers (2009) have studied the price appreciation of art over time, and compared the returns to those on financial assets. In addition, researchers have focused on the price determinants of art objects, anomalies in the price formation in the art market, and the diversification potential and collateral value of art.[1] We refer to Ashenfelter and Graddy (2003) and Ginsburgh et al. (2006) for more complete reviews of the literature on art auctions, prices, and price indices. In a recent contribution to the literature, Mandel (2009) demonstrates how a utility dividend derived from conspicuous art consumption may affect art returns in a consumption-based asset pricing model.

There is relatively little work on the link between the art market and the broader economy, despite the anecdotal evidence that highlights the importance of the relationship. Goetzmann (1993) shows that art has a positive beta with respect to the stock market over the very long term. In contrast, however, Mei and Moses (2002) report a correlation coefficient of not more than 0.04 between the S&P 500 and their art index (annual real returns, 1950-1999). Pesando and Shum (2008) find a correlation of 0.21 between the same stock index and their index for modern prints (semi-annual real returns, 1977-2004). Some of these differences may be due to the use of different intervals of observation and estimation, or to drawbacks of the repeat-sales regression, the method commonly used to build art indices. The low correlations may also be caused by a focus on U.S. stocks; the art market has become a global trading place over the last few decades. Indeed, Renneboog and Spaenjers (2009), using a hedonic pricing approach, report a much higher positive correlation (0.38) between a global art price index and the returns on a global stock index, than between the same art index and the S&P 500 (0.19) (annual real returns, 1951-2007).

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[1] See Renneboog and Spaenjers (2009) for a recent example of how a hedonic regression model can shed light on the price determinants of art objects. Anomalies in the art market include biases in presale estimates (Mei and Moses, 2005), violations of the law of one price (Pesando, 1993), lower returns for items that have been bought in (Beggs and Graddy, 2008), and anchoring effects (Beggs and Graddy, 2009). Many authors have also investigated whether there is a “masterpiece effect”, in the sense that better art makes a better investment, as first put forward by Pesando (1993), but the evidence is conflicting. The collateral value of fine art is investigated by McAndrew and Thompson (2007).

Even when present, correlations may not completely capture financial market wealth effects, for different reasons. First, most art indices aggregate pricing information over a calendar year while the financial returns are normally year-to-year changes in daily (or continuously) updated indices. This leads to non-synchroneity in the measured returns. Second, it may take some time before the wealth created in financial markets finds its way to art markets. Therefore, different authors have looked at the lagged relation between investor wealth and art prices. Goetzmann (1993) finds that, at least between 1900 and 1986, art prices seemed to follow stock market trends. Also Chanel (1995) and Worthington and Higgs (2003) present evidence that stocks markets Granger-cause art prices. However "the exact strength and persistence of this causal relationship" (Worthington and Higgs, 2004) remain unclear. Moreover, the relation between wealth and art prices over the longer run is still largely a puzzle. For example, Ginsburgh and Jeanfils (1995) find no long-term impact of stock markets on art markets. Similarly, Worthington and Higgs (2003) and Chanel (1995) conclude that it is hard to make long-run forecasts of art prices. It is important to note that, up until now, the art markets literature has typically not considered proxies for changes in investors' wealth other than financial market movements.

While the issue of art as a financial asset has long been of interest to scholars interested in the role of art in the economy, a broader economic issue is the relationship between consumption and the financial markets. Standard pricing models typically assume a representative investor as the marginal investor in the economy. Recent research has relaxed that assumption and considered how the concentration of financial wealth in a small, wealthy cohort may affect asset pricing. Given the failure of the consumption CAPM to explain the relationship between aggregate consumption and equity prices, scholars have conjectured that prices might be set by the very wealthy, or at least by stock market participants only. Poterba (2000) argues that one would expect the strongest relationship between consumption and asset prices among the cohort households that own the majority of all stocks. Since a high share of the consumption of these households typically concerns luxury goods, this would imply a solid link between stock market wealth fluctuations and luxury spending. With respect to durable luxury goods in inelastic supply, such as art and wine, Poterba (2000) notes that the concentration of stock ownership and associated wealth gains in the 1990s has led to an increased demand for such goods, which in turn resulted in "significant price appreciations". Empirically, Aït-Sahalia et al. (2003) find a strong correlation between stock market returns and luxury consumption (and show that this result goes a far way in explaining the equity premium puzzle). Likewise, Hiraki et al. (2009) provide compelling evidence that such a "luxury consumption hypothesis" is valid in the art market. The authors use data on stock market returns, import/export flows, and art prices to show that wealth shocks to Japanese investors affected their art purchases in the 1980s, and that this led to higher prices for art.

A large literature also investigates the fundamentals of house prices, another important real asset class. The studies in this field have at times related house prices to per capita income, for example to investigate whether real estate can be considered overpriced (Case and Shiller, 2003). However, some recent studies have acknowledged the importance of the income *distribution* in determining price levels as well. For example, Nakajima (2005) shows that rising earnings inequality in the United States may have been an important factor in the rise of real estate prices in the second half of the twentieth century, through an increased demand for precautionary savings that made the housing asset more attractive than financial assets. More directly related to the effects we are interested in here, Gyourko et al. (2006) demonstrate that "the thickness and length of the right tail of the income distribution" can have an important effect on real estate prices. In places that are desirable, but where little new housing is constructed, high-income families will outbid lower-income families for scarce housing, effectively driving up prices. Prices will thus rise faster when population or income inequality increases. The authors claim that "in this sense, living in a superstar city is like owning a scarce luxury good". In a recent addition to the literature, Van Nieuwerburgh and Weill (2009) show how the increase in house price dispersion in the United States over the last three decades can be explained by increases in the cross-sectional productivity dispersion (which directly translates into wage dispersion in their model). The simulation model in the next section makes clear how population growth, changes in total income, and shocks in income inequality may affect prices in the art market. In contrast to the situation in the real estate market, where there are important spatial differences in supply elasticity, the supply in the art market is (almost completely) fixed.

3. A model of income (inequality) and art returns

In this section we develop a model of art prices and income. The model is then used to simulate the effects of changes in the income distribution and the induced relationship between asset and art returns. Our model is based on Goetzmann and Spiegel (1995). However, we focus on income instead of on a global risky asset portfolio: we assume that an art collector buys art out of his income in each period, as he builds up his collection. Income is assumed here to include both investment and employment income.[2] In contrast to Goetzmann and Spiegel (1995), we allow for increases in the population. In addition, in order to make our simulations exercise more realistic, we model the transactions in the art market as outcomes

[2] In our empirical part, our income variable will not include realized equity capital gains, and therefore will be combined with equity market proxies. See the description of the data in the next section for more information.

of second-price auctions. The price paid by the bidder with the highest private valuation thus equals the second highest valuation, and not his own one.

3.1. The model

The price that a collector is willing to pay for a work of art is expressed as:

$$V_{ijt} = \lambda_{ij} \gamma_i m_t \quad (1),$$

where λ_{ij} is the fraction of his income art collector *i* is willing to invest in painting *j*, γ_i is the fraction of total income earned by investor *i*, and m_t is the total global income at time *t*. When we assume that there are N_t collectors in time *t*, the highest bid for art object *j* at time *t* can be expressed as:

$$P_{jt} = \max_i [V_{ijt}, i = 1,..., N_t] \quad (2).$$

Assuming *w(b)* and *w(s)* represent the winning bidders at the date of purchase, *b*, and the date of sale, *s*, the price appreciation of object *j* between purchase and sale can be expressed as follows:

$$\frac{P_{js}}{P_{jb}} = \frac{\lambda_{w(s)j} \gamma_{w(s)} m_s}{\lambda_{w(b)j} \gamma_{w(b)} m_b} \quad (3).$$

Taking logs yields:

$$\ln\left(\frac{P_{js}}{P_{jb}}\right) = \ln\left(\frac{\lambda_{w(s)j}}{\lambda_{w(b)j}}\right) + \ln\left(\frac{\gamma_{w(s)}}{\gamma_{w(b)}}\right) + \ln\left(\frac{m_s}{m_b}\right) \quad (4).$$

In our T-period model, the growth rates in total income are random draws from a normal distribution with mean and standard deviation both equal to $\varphi > 0$. λ_{ij}, which reflects collector *i*'s personal taste of work *j*, is drawn from a normal distribution with mean and standard deviation $\psi > 0$. We consider *Z* works of art. In each period, every painting is sold with a probability equal to *p*. They are sold to the N_t art collectors at that point in time. The works are sold through an English ascending-bid auction: the collector with the highest valuation wins the auction, but the price paid is equal to the second highest valuation. The population of art buyers increases by a number *n* in each period.

We construct a repeat sales art price index from the simulated transactions in the model, via the following equation:

$$R = X\mu + \varepsilon \quad (5),$$

where *R* is a vector of log returns, *X* is a matrix of dummy variables equal to 1 for all *t* for which $b < t \leq s$ for each observation (and zero otherwise), and μ is a vector of log geometric return estimates that can be used to construct the index. We use the exponents of μ to build our indices, in line with, for example, Ginsburgh et al. (2006).[3]

3.2. Simulations

We can now simulate an art market, and see how the art price indices relate to the global changes in income. We first generate a series of average per capita income data over 20 periods, putting the first differences' mean and standard deviation (φ) equal to 0.05. We stick to this once randomly generated series throughout our simulations. The personal taste variable λ has a mean and and standard deviation (ψ) of 0.15. We put the number of art works (Z) for which we follow prices equal to 50. We assume that every artwork is auctioned off in every period, thus $p = 1$, but the seller can simply buy the item back if he still has the highest valuation. (In other words, we consider buy-ins as transactions at the second-highest valuation in the market.) In the first period, the number of collectors (N_1) is equal to 20, and this number grows with n equal to 2 in each period. In each period, total income is equal to the average per capita income times the number of collectors. In the first scenario, each investor gets a share (γ_i) of total income that is drawn from a uniform distribution between zero and twice the average per capita income. However, after $T = 10$, there is a shock in the income distribution, leaving everyone with the average per capita income from $T = 11$ until $T = 20$. Scenario 1 is thus that of a decrease in income inequality. In a second scenario, everyone starts with the average per capita income, but as from $T = 11$, the share of total income of each investor is again drawn from a uniform distribution. Scenario 2 is thus the opposite of scenario 1: inequality increases. Simulations for both scenarios are repeated ten times, starting from the same randomly generated income time series. We also repeat the analysis with n, i.e. the increase in the population of art collectors per period, equal to 5 (instead of 2).

Summing up, there are three separate forces that will drive art prices in our simple model: (i) changes in income, (ii) changes in income inequality, and (iii) changes in the art buying population. The results of our simulations are shown in Figure 1.

[Insert Figure 1 about here]

Panels A and B of Figure 1 show the randomly generated per capita income index (equal over both scenarios and all simulations), and the average art price indices for the two values of n. The index

[3] In our empirical part, we will correct our coefficients for bias introduced by the concavity of the log function, as explained in Section 4. There is less need for such a correction in our simulations thanks to the very small standard deviations in cross-sectional returns. In any case, it would not change our findings.

values in the first period are put equal to 1. We see that the art price indices move in line with the income index. However, for the first ten periods, art prices are higher in the first scenario, where the total income is distributed unequally, than in the second one, while the opposite is true for the second half of our time frame. We also see a clear drop in prices in Panel A after the introduction of an identical income for everyone, and a sharp rise in art prices in Panel B after the income distribution becomes more unequal. In short: income inequality leads to higher art prices.

We also learn from Panels A and B that we get higher index values when the inflow of collectors into the market is larger. Panels C and D show one reason for this. They show that the evolution of the average private valuation λ of the winning bidder in each period changes over time in the first ten periods (with the average valuation in the first period normalized to 1). It is clear that we will see stronger increases in the winning bidders' relative valuations when more collectors are flowing into the art market, since this creates a larger chance that someone with a very high private valuation of a piece enters the market. We find weaker increases when the income is distributed evenly (Panel D), backing up previous claims about the importance of income inequality.

However, there is also another, less straightforward mechanism driving art price trends in our simulation, stemming from the second-price set-up. Panels E and F present the average percentage of the price paid to the valuation of the winning bid. In Panel E, in the first periods, the winning bidder has to pay less than 80% of his own valuation to buy the work, but this percentage generally increases over time. Again, the increase is higher when more art buyers enter the auction market. Not suprisingly, this percentage is higher when incomes are identical for everyone (Panel F).

Our model thus predicts that art prices will rise with average income, and, when controlling for income, with income inequality. Cross-sectionally, we would also expect to see stronger price increases where the population of art collectors grows more strongly. In the next section, we will consider the first two predictions, but not the third one, due to the fact that we limit ourselves to data from one country with a rather stable growth in population over the time frame considered. The total income measures utilized will combine information both on average income and population, but the variation in changes in total income is mainly driven by fluctuation in average income.

4. Data

In this section, we first construct a long-run art price index based on repeated sales information extracted from a historical resource and on online sales database (subsection 4.1). Since our art market index is mainly built on sales in London, and is expressed in British pounds, we also collect equity market and income data for Great Britain (subsection 4.2). Insofar as it were mainly British individuals buying the considered artists at British auctions over our time frame, this seems a valid procedure. Of course, even though many of the great American collections of European art were already formed in the late 19th and early 20th centuries, the art market became much more integrated over the course of the second half of the twentieth century. Moreover, our art transaction dataset also contains somewhat more non-British sales for this period. If anything, these factors should work against finding significant results. Tests for stationarity, descriptive statistics, and correlations for our variables are discussed in subsection 4.3.

4.1. Art prices

We start by building a long-term art price index. To do so, we go back to the auction sales data collected by Gerard Reitlinger in his 1961 book ‘The Economics of Taste’, which was the first book in a series of three, and investigated the history of the British paintings and drawings market. The artists whose sales are listed in Reitlinger mostly conform to English standards of taste; Guerzoni (1995) reports that Reitlinger took into account sales of the “most important and prestigious collections”. All transaction prices in Reitlinger (1961) are expressed in British pounds. Reitlinger’s data have previously been used to calculate the returns on art by, amongst others, Anderson (1974), Baumol (1986), and Goetzmann (1993). In line with these studies, we identify all repeated sales within Reitlinger’s book. (Reitlinger adds a short note, such as “see [year]” or “£[amount] in [year]”, to many transactions, which makes it possible to correctly identify repeated sales.) This gives us a dataset of 1,094 sales pairs until 1961, excluding buy-ins. We then look up all 6,661 works listed in Reitlinger’s book in the dataset constructed in Renneboog and Spaenjers (2009), which contains more than one million transactions from the online database Art Sales Index [http://www.artinfo.com/artsalesindex] since the 1920s until 2007, and try to identify resales of those same works. We only classify a transaction as a resale when there is a unique match of a non-ambiguous title, which occurs in 387 cases.[4] About two thirds of these resales took place in Great Britain.

[4] We classify a transaction in the Art Sales Index as a match to a sale in Reitlinger’s list if we find strong evidence of the existence of only one work with the same title by the same artist. Also, we exclude objects with attribution classifications and with very general titles (or titles that point to a much-used subject of the artist), and objects that went to museums according to Reitlinger. Additionally, for the last ten years of our time frame, we can consult the provenance of the work in the online catalogue description on http://www.invaluable.com and delete a limited number of observations, for which the ownership history contradicted the original classification from our dataset.

However, also for the other transactions we have prices in British pounds. In total we thus end up with a dataset containing 1,481 repeated sales. Since the data are very sparse for the first decades covered by Reitlinger, we delete the thirteen pairs for which the purchase occurred prior to 1765. This leaves us with 1,468 repeated sales.

There are some well-documented selection issues with the data. First, Reitlinger included a disproportionate high number of sales from Christie's London. However, if the sales at Christie's were representative for the higher end of the British market, this does not have to be a major issue. Second, Reitlinger also included relatively more artists that were famous in the beginning of the 1960s. The addition of transactions since the publication of the book, which affect the estimation of the whole index, should alleviate concerns about a potential upward bias. Third, in his critical review of the Reitlinger data series, Guerzoni (1995) shows that some transactions in between sales pairs seem to be missing. However, this is also the case in other repeated sales studies, and should not be expected to impact our index strongly. A more general concern is the survivorship bias in the art market. Simulating an art investment portfolio, without requiring resale, Goetzmann (1996) shows that survivorship issues can put a significant upward bias on estimated returns. However, insofar as this bias does not change significantly over time, this is not a problem in the context of this research. (It is a more pressing issue when solely focusing on the performance of art as an investment.)

It is important to stress that, despite the caveats outlined in the previous paragraph, the Reitlinger data still constitute a unique overview of auction sales since the end of the eighteenth century. Also, the art price index is a means to an end here. Our use of the Reitlinger data and the repeat-sales methodology is a function of a desire to examine very long term trends in income and asset market behavior. For shorter time frames, return series can estimated more precisely via a hedonic approach that uses characteristics data not available in Reitlinger.

To get an estimate of the index μ over T periods based on N repeated sales observations, we follow the Bayes formulation of a repeat sales regression, which imposes some additional restrictions on the estimation, outlined in Goetzmann (1992, 1993):

$$\hat{\mu} = \left[\left(X'\Omega^{-1}X \right) + \kappa \left(I - \frac{1}{T} J \right) \right]^{-1} X'\Omega^{-1}R \qquad (6),$$

where X again is a N x T matrix of dummy variables indicating the holding period for each object, the weights in Ω are the times between sales, and R is the N-dimensional vector of logged returns. Additionally, J is a matrix of ones, and κ is a constant that divides the variance of the residual error by the variance of the index:

$$\kappa = \frac{\sigma^2}{\sigma_\mu^2} \qquad (7).$$

We approximate κ by first running a simple GLS repeat sales regression on our data, which provides us with estimates of σ and σ_μ. The Bayes formulation avoids spurious negative autocorrelation in the estimated return series, and leads to a much more accurate estimator when the number of observations is relatively small (Goetzmann, 1992).

A good approximation of the annual arithmetic returns is then given by $\exp(\hat{\mu}_t + \hat{\sigma}_t^2/2)$, where the cross-sectional variance of the return can be estimated in the second stage of the Case-Shiller repeat-sales regression under the assumption that it is constant over time (Goetzmann, 1992). This specification corrects for a downward bias of the arithmetic mean that is due to the log transformation of the art prices. The return estimates can then be used to build a price index over the period of interest.

We perform the analysis outlined in the previous paragraph using our dataset of repeated sales. All prices were deflated using the U.K. RPI (Officer, 2009b) before the log transformation. (We start from real prices because the Bayes repeated sales estimator implies the assumption that the returns conform to a prior distribution, which is more realistic in the context of real returns.) The resulting art price index, in real British pounds, is shown in Figure 2.

[Insert Figure 2 about here]

A visual inspection of the figure suggests a relationship between the real economy and art prices. For example, we see significant price drops during World War I, over the Great Depression in the 1930s, and after the oil crisis in 1973. There is no such an effect over the second World War, but the price level then was already the lowest of the whole twentieth century. Consistent with previous studies that have investigated the late twentieth century art market, we find strong price appreciations throughout the 1960s, during the art market boom at the end of the 1980s, and in the first years of the 2000s. We will henceforward refer to the natural log of our art price index as *Art*.

4.2. Equity and income data

We build a history of British stock price returns, based on the following sources: Acheson et al. (2009) for the period 1830-1870,[5] Grossman (2002) for the period 1870-1913, and Dimson et al. (2002, 2009) for the

[5] We start our analysis in 1830 instead of 1825 due to data constraints on the *GDP* variable (cf. infra).

years thereafter. We create yearly indices covering total return, capital appreciation, and dividend yield, transformed into real terms by deflating by the U.K. RPI (Officer, 2009b). The natural log series are called *Equities*, *Equities (capital)*, and *Equities (dividend)*.

A recent literature has investigated the evolution of top incomes over the course of the twentieth century. Atkinson and Piketty (2007) document that the general pattern is one of a decline of top income in the inter-war period (mainly due to a decline of top capital income), and a sudden rise in top income in the Anglo-Saxon countries since the 1970s (mainly thanks to a rise of top wages, i.e. executive compensation, in those countries). We use data from Atkinson and Piketty (2010) – who themselves rely on income tax data – to build a consistent series of the share of total income received by the top 0.1% of all income-earners in the U.K. for the period 1908-2005.[6] This series will be referred to as *Inequality*. We refer to Atkinson (2007) for more details on data sources and methodology. However, it is important to note that the data exclude most capital gains and losses, and certain remunerations in kind. Our variable will thus not simply capture stock market wealth effects, even though one can expect equity prices and top income shares to be highly positively correlated, which will make it hard to disentangle the effects of both variables.

Atkinson (2007) observes that the time trends in the distribution of income among the employed and the distribution of wealth among individuals are similar. This is important in our context for two related reasons. First, it suggests that we are measuring the share of income earned by the wealthy. Second, it indicates that, by measuring (changes in) inequality in the income distribution, we also proxy for (changes in) inequality in the distribution of wealth.

We also borrow data on the (natural log of) total personal income (in real terms) from Atkinson (2007) for the years 1908-2005.[7] This series is called *Income*. We calculate a similar series *Top income* that indicates how large a share of total income (in percent) the top 0.1% gets in every year. Yearly data

[6] The top income share data were downloaded from Emmanuel's Saez website (September 16, 2008). Over the period 1908-2007, data on the top 0.1% income share are missing for a number of years, even though, at least in some cases, data for other top groups are available. For the period 1908-1912, we estimate the share of the top 0.1% based on the coefficients of a linear probability model (without intercept) that relates the top 0.1% share to the top 0.05% and top 0.01% shares. The model was estimated based on the period 1913-1922. We estimate a similar model relating the top 0.1% share to the top 1% and top 0.5% shares using data from the periods 1982-1986 and 1993-1997 to get estimates of the top 0.01% for the 1987-1992 time frame. For the years 1961 and 1980 we linearly interpolated the income share based on the shares in the surrounding years.

[7] The updated data series was provided by Tony Atkinson.

on an alternative measure of total income, namely real GDP, come from Officer (2009a). The data are available from 1830 to 2007, and the logged series is indicated by *GDP*.

4.3. Tests for stationarity, descriptive statistics, and correlations

As is well known, relating non-stationary series to each other would lead to spurious results. Therefore, we first want to determine whether our series are stationary or not. Table 1 shows the results of our Dickey-Fuller tests, which test for the existence of a unit root in time series. Next to the test statistics for the standard Dickey-Fuller test, we also report the results for an "augmented" version with one lagged difference, which accounts for potential second-order autocorrelation. In each case, the null hypothesis is that of a unit root, or non-stationarity.

[Insert Table 1 about here]

The results in Table 1 show that we cannot reject the null hypothesis for all our original time series, implying that we cannot exclude non-stationarity. However, when considering the first differences in our time series, which measure the rate of change or indeed the return, we are able to reject non-stationarity at very high significance levels. Henceforward, we will thus mainly work with the first differences of the variables of interest.

Table 2 gives the descriptive statistics for these first differences. We see an average annual log return over the whole time frame for our art series of 2.97%, with a standard deviation of almost 11%; for equities the mean is 6.74%, with a standard deviation of more than 15%. As can be expected, we find much lower volatility in the series measuring the changes in GDP and total income. The average first difference in *Inequality* is small (-0.06%), but the standard error is 0.32%, indicating some variation in this variable. We also include the regression results of an autoregressive model with two lags in Table 2, to measure autocorrelation in the first differences. One can see that several of our first-differenced variables have highly significant first-order autocorrelation in returns. We will have to take this into account in our empirical analysis in Section 5.

[Insert Table 2 about here]

Table 3 gives an overview of the pairwise correlations between the different variables. The returns on art have a significantly positive correlation with the total equity returns and capital growth in equities, and with changes in GDP. We also witness a strong positive correlation between art returns and changes in income inequality, and a weaker positive correlation between the first differences in art prices and those in top income. Note that there is also highly significant positive correlation between *Δ Equities* (and both of its components) and *Δ Inequality*, even though the latter measure does not include capital gains. This may be due to business cycle effects.

[Insert Table 3 about here]

5. Empirical results

The results of our comovement analysis are outlined in subsection 5.1. First, we look at the relation between the equity market and the art market. Second, we consider the correlation between changes in income inequality and art returns. Third, we combine equity returns and changes at the top of the income distribution into a single analysis. Thereafter, we undertake a cointegration analysis in subsection 5.2, to investigate whether we can identify a long-run driver of art prices. Subsection 5.3 splits the time series into a period prior to 1945 and a post-war period.

5.1. Comovement

First we investigate the relationship between art prices and equity markets. The data series constructed in Section 4 enable a long-term view. Panel A of Table 4 outlines the baseline regression results; all models are estimated using ordinary least squares. Model (1) relates our market returns to yearly changes in our measure of income for which we have information since 1830, namely *GDP*. We thereafter include equity market returns in our analysis. However, since the price of an equity is a 'stock' variable measured at year-ends (and thus not a 'flow' variable like GDP or dividends), we also include the lagged first differences for both *Equities* and *Equities (capital)*. Models (2) and (3) look at overall equity returns, while models (4) and (5) differentiate between capital growth and dividend yield. We present Newey-West standard errors that account for first-order autocorrelation in the error terms, which Durbin-Watson test statistics indicate is present (not reported).

[Insert Table 4 about here]

The results for the estimation of model (1) in Panel A indicate that overall income does not explain art price changes at a meaningful statistical significance level. The coefficient on *Δ GDP* is positive, but has a p-value of 0.101. It is possible that the low variation in GDP changes makes it hard to identify the effect of changes in total income. Models (2) and (3) in Panel A of Table 4 show positive coefficients on both same-year and lagged equity market returns that are strongly significant. The results of model (4) and (5) show that it is mainly capital gains and losses that drive art returns. This is no surprise given the correlation table already showed a positive correlation of art returns with equity capital changes, but no significant correlation with the first differences of the dividend index.

The comovement of the equity prices and the art market is also nicely illustrated in Figure 3, which plots the evolution of the series *Art* and *Equities (capital*) over our time frame. Although the equity index is more volatile, we see similar trends in our art price index and the equity capital index in many periods.

[Insert Figure 3 about here]

Up to now, we have considered the relation between equity market movements and changes in the price level in the art market. We found strong evidence that capitals gains and losses drive art prices, and only very weak evidence that a proxy for overall income is helpful in explaining art price trends. However, we also want to look deeper into the link between income inequality and art prices. Panel B of Table 4 reports the results of a number of regression models that links art returns to proxies for both total income and its distribution. Data on these variables are available for the period 1908-2005, which limits our analysis to that time frame.

Again, the first models indicate that changes in overall income variables (such as GDP or total personal income) do not have a statistically significant relation to art returns. Models (3) and (4) add the first differences in *Inequality* to the regression specification, and in both cases we find positive and highly significant coefficients, indicating that art prices rise when income inequality goes up, in line with our simulation model. (The coefficient in model (4) suggests that a one percentage point increase in the share of total income held by the top 0.1% leads to a increase in art prices of about 15 percent.) Model (5) relates art price changes to the changes in *Top income*, the variable that combines the personal income variable with the proxy for income inequality. In contrast to the coefficients on *Δ Income*, we see a (weakly) significant positive relation.

We illustrate the trends of total personal income, the share held by the top 0.1%, and art prices between 1908 and 2005 in Figure 4. Figure 4 shows that art prices were below the pre-World War I level until the very end of the 1960s. If we only consider total income measures, this is very suprising. Indeed, total personal income had by then increased almost fourfold – would one not expect rises in income to lead to upwards art price trends? The results presented here suggest that the changes in the income distribution may have played an important role: the share of total income earned by the top 0.1% decreased enormously in the first half of the twentieth century.

[Insert Figure 4 about here]

In models (1) and (2) of Panel C, we check whether our inequality measure still has explanatory power when controlling for same-year and lagged equity capital growth variables. We exclude the dividend variable, because dividends are captured by the personal income inequality variable already. We still control for total income, in the different ways that were presented before. Model (3) again looks at the changes in top incomes.

The results from the three models in Panel C confirm the previous findings that equity markets strongly affect art prices. However, although the coefficient is somewhat smaller, our income inequality measure is still a significant determinant of the art price level. We find less support for the hypothesis that art returns can readily be associated with changes in top incomes. As with *Δ GDP* and *Δ Income*, this may be due to low variation in the top income variable.

In Table 2, we reported strong autocorrelation in our returns on art. To some degree, this may be explained by speculative dynamics also relevant in other asset markets (Cutler et al., 1991). However, it may also partially be attributable to a 'Working effect' (Working, 1960; Schwert, 1990): our index is smoothed and will have autocorrelated returns by construction due to the implicit averaging of art prices per period. Therefore, Table 5 repeats the analysis of Table 4, but adds the lagged art market return to each model. Durbin-Watson test statistics (not reported) indicate that the error terms do now no longer show significant autocorrelation, and therefore we report robust standard errors in Table 5 (instead of the Newey-West standard errors in Panel 4).

[Insert Table 5 about here]

Even though the lagged art returns are highly significant in all specifications, we do not see much change in the coefficients on the equity related variables (or their significance) in Panels A and C. In Panel B of Table 5, the coefficients on *Δ Inequality* are somewhat smaller than in Table 4, but still very strongly signifcant. The coefficient on *Δ Top income* keeps the expected sign, but loses statistical significance at an appropriate level. The same happens for our income inequality variables in Panel C: the coefficients are positive, and more than a standard deviation above zero, but not statistically significant (p-values around 0.15). Nevertheless, it is important to observe that including lagged art market returns does not lead to different conclusions.

5.2. Cointegration

The previous observations provide evidence of comovement between equity markets and income inequality on the one hand and art markets on the other. However, these are relatively short-term effects. Given our long-term data series, and since the time series in this research are integrated of order one, we are also able to explore the factors that drive art prices over the long run. If it is really the wealthy or high-income individuals that determine the price level in the art market, then one would expect *Top income* (but not necessarily *GDP* or *Income*) to be cointegrated with art prices.

Panel A of Table 6 shows the results of Johansen's cointegration test applied to our time series over the period since 1908, the first year for which we have income inequality data. We report both the results of a test assuming a trend in the cointegrating equation, and of a test assuming no such a trend. We include one lagged first difference in our set-up. Given that we are working with yearly data, this seems reasonable. Also, in most cases lag selection criteria (not reported) suggest the inclusion of just one lag. We find that the null hypothesis of no cointegration cannot be consistently rejected, except in the case of *Top income*. This is in line with our simulation model as well as the earlier empirical evidence above. Over the long run, the income of the wealthy seems a key factor in the price formation in the art market.

[Insert Table 6 about here]

Panel B of Table 6 shows the resulting cointegrating equations, in which the coefficients are normalized, which is a standard procedure that allows better insight in the interaction between the variables. Setting the coefficient on *Art* equal to one, we find significantly negative coefficients on *Top income*, in line with expectations. However, note that the absolute value of these coefficients are also significantly smaller than one, implying that there is no one-on-one relationship between top incomes and art prices.

5.3. Before and after World War II

Profound changes have taken place in the art market since the middle of the previous century. Without doubt, the art market has become more globalized. One may thus expect the relation between our art price index on the one hand and the British equity market and income distribution on the other to be weaker after the second World War. Another motivation to do an analysis per subperiod is that more transactions from outside Great Britain are included for the later decades of our time frame. Therefore, Table 7 repeats some crucial comovement analyses, but now differentiates between the period prior to 1945 and the post-war period. The different panels follow the structure of earlier tables, and in all cases models (1) and (2) concern the period 1908-1945, while models (3) and (4) are estimated using post-war data.

[Insert Table 7 about here]

We now briefly discuss the results presented in Table 7. (An analysis splitting the dataset in 1961 gives qualitatively similar results.) Panel A shows that British equity capital growth has a statistically significant impact on our art price index for both subperiods. This is reassuring: at least for our analysis of the impact of equity markets, our results are not driven by one particular era. Panel B, however, suggests that our findings on the role of income inequality in the determination of art prices are caused by trends in the first decades of the twentieth century. Indeed, the coefficients on *Δ Inequality* are clearly positive for the period up to 1945, despite the small sample size. In contrast, the coefficients are not significantly different from zero for the second subperiod. As before, Panel C combines the information on income and equities. Although for the first subperiod we do not find any statistical significance, all coefficients have the expected sign and order of magnitude. The low power probably originates from the limited number of yearly observations we consider. The results for the second subperiod, since World War II, confirm the points made earlier in this paragraph: equity markets have a clear impact, while we do not find evidence of a role for changes in the income distribution in settting art prices.

The lack of support for our hypothesis that income inequality impacts art prices during the post-war period should not be too surprising for the reasons mentioned above. To get an idea of whether globalization may indeed work against finding significant results using British data series for the post-war period, we do an analysis incorporating data on income and income inequality in the United States. As before, the data come from Atkinson and Piketty (2010). The results are shown in Table 8. *Δ Income* and *Δ Inequality* refer to the British data used earlier, while *Δ Income US* and *Δ Inequality US* refer to the newly introduced U.S. data.

[Insert Table 8 about here]

From models (1) through (4), we learn that U.S. income inequality did not play a role in setting British art prices prior to 1945. However, a striking conclusion one can draw from models (5) through (8) is that U.S. inequality seems to matter in the post-war period. We get significantly positive coefficients on *Δ Inequality US* for the time frame 1945-2007. This result holds even when taking British income and inequality into account, as in model (8). When also controlling for GBP-denominated U.S. equity capital returns, using NYSE data from Goetzmann et al. (2001) for the pre-1925 period and from CRSP for the period after, the coefficient on *Δ Inequality US* is of the same order of magnitude (not reported), with p-values around 0.10. We see this as evidence that income inequality trends may still be relevant to art prices, but that the relation is certainly not country-specific anymore.

As a final analysis, we repeat the Johansen's cointegration tests outlined before, which should be able to identify long-run connections, on the post-war data. We find statistically significant evidence of a long-run relationship between top incomes and art prices (not reported), both when starting from U.S. and U.K. top income data. Again, this hints that top incomes may indeed be primitive to art prices, even after World War II.

6. Conclusion

Andy Warhol once wrote: "I like money on the wall. Say you were going to buy a $200,000 painting. I think you should take that money, tie it up, and hang it on the wall. Then when someone visited you, the first thing they would see is the money on the wall"(Warhol, 1975). This article has investigated how equity wealth and income – more generally, money – determines the price of art.

Motivated by a growing literature on stock market wealth effects and the effects of income dispersion on the prices of real assets, we do a simulation exercise that investigates how changes in the income distribution may affect art prices. We find that art prices can be expected to rise not only when income (or the size of the population) goes up, but also when income inequality rises.

We then construct a new art price index that incorporates information since the beginning of the eighteenth century, and utilizes econometric noise-reduction methods. Using this index, we are able to confirm and strengthen previous evidence that equity market movements affect art prices. This result is robust to many different specifications and holds even when we split the overall 1830-2007 time frame in two subperiods.

We find weaker evidence for the impact of income inequality. Although there is evidence that changes in income inequality had an important effect in the first half of the twentieth century, and that this effect is significant for the overall time frame, we do not find the result for the post-war period. However, we do find some evidence that U.S. income inequality impacted art prices over the later period. This result is consistent with the changing relative roles of the U.S. and U.K. in the global economy in the twentieth century. Also, and arguably more important, we find a cointegrating relationship between top incomes and art prices, both for the total 1908-2005 period and since 1945.

Taken together, we believe that these results demonstrate that it is indeed the wealth of the wealthy that drives art prices. This implies that we can expect art booms whenever income inequality rises quickly. This seems exactly what we have been witnessing during the last period of strong art price appreciation, 2002-2007. Indeed, in many countries with large numbers of art buyers, income inequality rose significantly in those years, mainly due to strong increases in managerial compensation. Warhol, for one, would probably have applauded this evolution: “I don’t think everybody should have money. It shouldn’t be for everybody – you wouldn’t know who was important” (Warhol, 1975).

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Table 1: Tests for stationarity

	Period	Original series		First differences			
		DF	ADF(1)	DF		ADF(1)	
Art	1830-2007	-1.288	-1.918	-8.722	***	-7.754	***
Equities	1830-2007	-2.720	-2.885	-13.134	***	-10.124	***
Equities (capital)	1830-2007	-2.671	-2.831	-13.175	***	-10.172	***
Equities (dividends)	1830-2007	-0.317	-0.995	-6.666	***	-6.608	***
GDP	1830-2007	-1.148	-2.059	-9.294	***	-8.264	***
Income	1908-2005	-1.460	-1.557	-4.830	***	-3.982	***
Inequality	1908-2005	-1.913	-2.573	-6.089	***	-5.607	***
Top income	1908-2005	0.362	-0.141	-5.328	***	-4.063	***

Notes. This table presents the Dickey-Fuller test statistics of the original series and their first differences. In both cases, we show the results of a standard Dickey-Fuller test and of an augmented Dickey-Fuller test including one lag. For all original series, we compare with the critical values with trend. We do not assume trends for the first differences. ***, **, and * indicate significance at the 1%, 5%, and 10% level, respectively.

Table 2: Descriptive statistics

	Period	Mean	S.D.	Min	Max	L1		L2
Δ Art	1830-2007	0.0297	0.1092	-0.3541	0.3080	0.4167	***	-0.0680
						0.0993		0.0879
Δ Equities	1830-2007	0.0674	0.1557	-0.8189	0.6821	0.0055		-0.0897
						0.1671		0.1099
Δ Equities (capital)	1830-2007	0.0247	0.1573	-0.8948	0.6249	0.0023		-0.0927
						0.1665		0.1106
Δ Equities (dividends)	1830-2007	0.0205	0.0555	-0.1289	0.2745	0.6506	***	-0.1034
						0.1245		0.1113
Δ GDP	1830-2007	0.0196	0.0288	-0.1031	0.0947	0.3700	***	-0.0935
						0.1227		0.0864
Δ Income	1908-2005	0.0623	0.0581	-0.1415	0.2237	0.5655	***	0.0689
						0.1569		0.1299
Δ Inequality	1908-2005	-0.0006	0.0032	-0.0121	0.0099	0.2461		-0.1708
						0.1557		0.1845
Δ Top income	1908-2005	0.0547	0.0846	-0.1353	0.3451	0.4645	***	0.1081
						0.0888		0.1096

Notes. This table presents the descriptive statistics (mean, standard deviations, minimum, and maximum) of the first differences. L1 and L2 show the coefficients and robust standard errors of an AR(2) model that relates the first differences to the lagged first differences. ***, **, and * indicate significance at the 1%, 5%, and 10% level, respectively.

Table 3: Correlations

	Δ Art		Δ Eq.		Δ Eq. (cap.)		Δ Eq. (div.)		Δ GDP	Δ Inc.		Δ Ineq.	Δ Top
Δ Art	1.0000												
Δ Equities	0.2253	***	1.0000										
Δ Equities (cap.)	0.2342	***	0.9979	***	1.0000								
Δ Equities (div.)	0.1196		0.4419	***	0.4406	***	1.0000						
Δ GDP	0.1685	**	0.0967		0.1068		-0.0452		1.0000				
Δ Income	-0.0182		-0.1874	*	-0.1974	*	-0.8148	***	0.1466	1.0000			
Δ Inequality	0.3576	***	0.3245	***	0.3326	***	0.3357	***	0.1325	-0.2271	**	1.0000	
Δ Top income	0.1980	*	0.0413		0.0384		-0.3850	***	0.1655	0.5698	***	-0.0496	1.0000

Notes. This table presents the pairwise correlations for the first differences. All correlations except those involving the first differences in *Income*, *Inequality*, and *Top income* (1908-2005) are calculated over the time frame 1830-2007. ***, **, and * indicate significance at the 1%, 5%, and 10% level, respectively.

Table 4: Comovement analysis

Panel A

	(1) Δ Art	(2) Δ Art	(3) Δ Art	(4) Δ Art	(5) Δ Art
Δ GDP	0.6403		0.2507		0.2279
	0.3888		0.3896		0.3842
Δ Equities		0.1565 ***	0.1520 ***		
		0.0562	0.0553		
Δ(-1) Equities		0.2391 ***	0.2272 ***		
		0.0495	0.0524		
Δ Equities (capital)				0.1663 **	0.1591 **
				0.0662	0.0651
Δ(-1) Equities (capital)				0.2387 ***	0.2274 ***
				0.0522	0.0556
Δ Equities (dividends)				-0.0292	-0.0120
				0.2007	0.1982
Number of obs.	177	176	176	176	176
F-value	2.71	13.48 ***	8.94 ***	9.90 ***	7.44 ***

Notes. This table shows the results of comovement regressions. The returns on art are regressed on a changing set of independent variables, listed in the first column. Below each coefficient is the Newey-West standard error, taking into account first-order autocorrelation in the error structure. ***, **, and * indicate significance at the 1%, 5%, and 10% level, respectively.

Panel B

	(1) Δ Art	(2) Δ Art	(3) Δ Art	(4) Δ Art	(5) Δ Art
Δ GDP	0.8342		0.6551		
	0.5219		0.4582		
Δ Income		-0.0404		0.1471	
		0.2888		0.2629	
Δ Inequality			13.6039 ***	15.0969 ***	
			3.5997	4.3498	
Δ Top income					0.3013 *
					0.1741
Number of obs.	99	97	97	97	97
F-value	2.56	0.02	8.42 ***	7.43 ***	3.00 *

Notes. This table shows the results of comovement regressions. The returns on art are regressed on a changing set of independent variables, listed in the first column. Below each coefficient is the Newey-West standard error, taking into account first-order autocorrelation in the error structure. ***, **, and * indicate significance at the 1%, 5%, and 10% level, respectively.

Panel C

	(1) Δ Art		(2) Δ Art		(3) Δ Art	
Δ GDP	0.3248					
	0.4970					
Δ Income			0.2289			
			0.2480			
Δ Inequality	8.1209	**	9.0119	**		
	3.9395		4.1230			
Δ Top income					0.1932	
					0.1628	
Δ Equities (capital)	0.1423	**	0.1567	**	0.1887	***
	0.0634		0.0601		0.0636	
Δ(-1) Equities (capital)	0.2236	***	0.2371	***	0.2520	***
	0.0582		0.0606		0.0544	
Number of obs.	96		96		96	
F-value	8.48	***	10.28	***	7.99	***

Notes. This table shows the results of comovement regressions. The returns on art are regressed on a changing set of independent variables, listed in the first column. Below each coefficient is the Newey-West standard error, taking into account first-order autocorrelation in the error structure. ***, **, and * indicate significance at the 1%, 5%, and 10% level, respectively.

Table 5: Comovement analysis including lagged art returns

Panel A

	(1) Δ Art		(2) Δ Art		(3) Δ Art		(4) Δ Art		(5) Δ Art	
Δ GDP	0.3620				0.0679				0.0478	
	0.3415				0.3514				0.3482	
Δ Equities			0.1456	***	0.1444	***				
			0.0425		0.0428					
Δ(-1) Equities			0.1883	***	0.1856	***				
			0.0477		0.0484					
Δ Equities (cap.)							0.1543	***	0.1528	***
							0.0514		0.0512	
Δ(-1) Equities (cap.)							0.1875	***	0.1854	***
							0.0494		0.0499	
Δ Equities (div.)							-0.0375		-0.0339	
							0.1637		0.1597	
Δ(-1) Art	0.3727	***	0.3211	***	0.3185	***	0.3162	***	0.3144	***
	0.0836		0.0828		0.0813		0.0826		0.0811	
Number of obs.	176		176		176		176		176	
R2	0.1623		0.2643		0.2646		0.2661		0.2663	

Notes. This table shows the results of comovement regressions. The returns on art are regressed on a changing set of independent variables, listed in the first column. Below each coefficient is the robust standard error. ***, **, and * indicate significance at the 1%, 5%, and 10% level, respectively.

Panel B

	(1) Δ Art		(2) Δ Art		(3) Δ Art		(4) Δ Art		(5) Δ Art	
Δ GDP	0.4141				0.3629					
	0.4807				0.4429					
Δ Income			-0.1083				0.0352			
			0.2210				0.2300			
Δ Inequality					10.1295	***	10.5001	**		
					3.5812		4.1297			
Δ Top income									0.1288	
									0.1528	
Δ(-1) Art	0.3833	***	0.4154	***	0.3097	***	0.3305	***	0.3865	***
	0.1053		0.1058		0.1108		0.1098		0.1087	
Number of obs.	98		96		96		96		96	
R2	0.1797		0.1716		0.2356		0.2282		0.1758	

Notes. This table shows the results of comovement regressions. The returns on art are regressed on a changing set of independent variables, listed in the first column. Below each coefficient is the robust standard error. ***, **, and * indicate significance at the 1%, 5%, and 10% level, respectively.

Panel C

	(1)		(2)		(3)	
	Δ Art		**Δ Art**		**Δ Art**	
Δ GDP	0.1084					
	0.4796					
Δ Income			0.1372			
			0.2348			
Δ Inequality	5.3329		5.8686			
	3.8717		3.9805			
Δ Top income					0.0796	
					0.1494	
Δ Equities (capital)	0.1504	***	0.1576	***	0.1788	***
	0.0516		0.0511		0.0499	
Δ(-1) Equities (capital)	0.1919	***	0.1976	***	0.2053	***
	0.0563		0.0606		0.0555	
Δ(-1) Art	0.2673	**	0.2628	**	0.2914	***
	0.1079		0.1076		0.1063	
Number of obs.	96		96		96	
R2	0.3449		0.3477		0.3332	

Notes. This table shows the results of comovement regressions. The returns on art are regressed on a changing set of independent variables, listed in the first column. Below each coefficient is the robust standard error. ***, **, and * indicate significance at the 1%, 5%, and 10% level, respectively.

Table 6: Testing for cointegrating relationships

Panel A

	Intercept, no trend				Intercept, trend			
	Trace		Max. Eigenval.		Trace		Max. Eigenval.	
Equities	5.7922		5.7922		16.193		10.8464	
Equities (capital)	8.3220		8.2691		16.3305		11.4327	
GDP	7.3799		7.3131		18.2229		10.9144	
Income	10.8052		10.4074		22.5284		17.4250	*
Top income	19.9515	***	16.4240	**	24.7334	*	17.3767	*

Notes. This table shows the results of Johansen's cointegration tests. The null hypothesis is that of no cointegrating relation. The test statistics of both the trace and the maximum eigenvalue tests are reported. ***, **, and * indicate significance at the 1%, 5%, and 10% level, respectively.

Panel B

	Intercept, no trend		Intercept, trend	
	Normalized coeff.		Normalized coeff.	
Art	1.0000		1.0000	
Top income	-0.3847	***	-0.4775	***
	0.0596		0.1134	
Trend			0.0075	
			0.0066	

Notes. This table shows the normalized coefficients in the cointegrating relationship between art and top income. ***, **, and * indicate significance at the 1%, 5%, and 10% level, respectively.

Table 7: Comovement analysis for subperiods

Panel A

	(1) 1830-1945 Δ Art		(2) 1830-1945 Δ Art		(3) 1945-2007 Δ Art		(4) 1945-2007 Δ Art	
Δ GDP	0.0009		-0.1092		0.8042		0.3135	
	0.4393		0.3922		0.9810		0.7746	
Δ Equities (capital)	0.3197	**	0.3076	**	0.0844	*	0.1019	**
	0.1366		0.1282		0.0498		0.0467	
Δ(-1) Equities (capital)	0.2218	**	0.1462		0.1934	***	0.1864	***
	0.1096		0.1038		0.0527		0.0499	
Δ Equities (dividends)	-0.1304		-0.1633		0.0512		-0.0264	
	0.2629		0.2304		0.3870		0.2972	
Δ(-1) Art			0.2656	**			0.4051	***
			0.1034				0.1346	
Number of obs.	114		114		61		61	
F-value	3.48	**	4.65	***	6.77	***	6.17	***
R2			0.2328				0.4070	

Notes. This table shows the results of comovement regressions for two different subperiods (1830-1945 and 1945-2007). The returns on art are regressed on a changing set of independent variables, listed in the first column. Below each coefficient in columns (1) and (3) is the Newey-West standard error, taking into account first-order autocorrelation in the error structure. Below each coefficient in columns (2) and (4) is the robust standard error. ***, **, and * indicate significance at the 1%, 5%, and 10% level, respectively.

Panel B

	(1) 1908-1945 Δ Art		(2) 1908-1945 Δ Art		(3) 1945-2005 Δ Art		(4) 1945-2005 Δ Art	
Δ Income	0.3575		0.2997		-0.0062		-0.1245	
	0.5735		0.5251		0.3979		0.3172	
Δ Inequality	21.6651	**	18.9164	*	4.0891		-0.6958	
	9.2882		9.4392		5.8228		5.1625	
Δ(-1) Art			0.2083				0.4732	***
			0.1515				0.1393	
Number of obs.	37		36		60		59	
F-value	7.45	***	6.90	***	1.68		4.47	***
R2			0.2632				0.2192	

Notes. This table shows the results of comovement regressions for two different subperiods (1908-1945 and 1945-2005). The returns on art are regressed on a changing set of independent variables, listed in the first column. Below each coefficient in columns (1) and (3) is the Newey-West standard error, taking into account first-order autocorrelation in the error structure. Below each coefficient in columns (2) and (4) is the robust standard error. ***, **, and * indicate significance at the 1%, 5%, and 10% level, respectively.

Panel C

	(1) 1908-1945 **Δ Art**		(2) 1908-1945 **Δ Art**		(3) 1945-2005 **Δ Art**		(4) 1945-2005 **Δ Art**	
Δ Income	0.2554		0.2482		0.2152		0.1049	
	0.5429		0.5033		0.2627		0.2362	
Δ Inequality	9.7421		9.0091		-0.9192		-5.4116	
	11.4706		10.6915		6.5141		5.7457	
Δ Equities (capital)	0.3291		0.3305		0.1072	**	0.1180	***
	0.2025		0.1963		0.0448		0.0371	
Δ(-1) Equities (capital)	0.2286		0.1754		0.2362	***	0.2120	***
	0.1533		0.1733		0.0577		0.0555	
Δ(-1) Art			0.1198				0.4362	***
			0.1638				0.1337	
Number of obs.	36		36		59		59	
F-value	6.00	***	4.46		5.53	***	7.16	***
R2			0.3651				0.4221	

Notes. This table shows the results of comovement regressions for two different subperiods (1908-1945 and 1945-2005). The returns on art are regressed on a changing set of independent variables, listed in the first column. Below each coefficient in columns (1) and (3) is the Newey-West standard error, taking into account first-order autocorrelation in the error structure. Below each coefficient in columns (2) and (4) is the robust standard error. ***, **, and * indicate significance at the 1%, 5%, and 10% level, respectively.

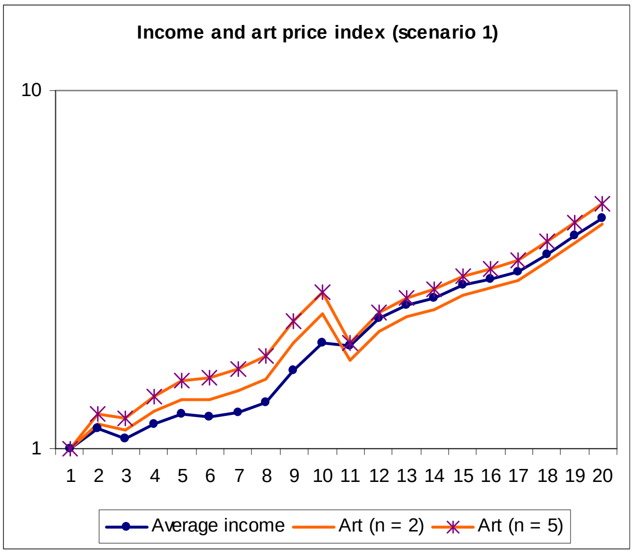
Table 8: Comovement analysis for subperiods using U.S. income (inequality) data

	(1)		(2)		(3)		(4)		(5)		(6)		(7)		(8)	
	1913-1945		1913-1945		1913-1945		1913-1945		1945-2007		1945-2007		1945-2005		1945-2005	
	Δ Art		**Δ Art**		**Δ Art**		**Δ Art**		**Δ Art**		**Δ Art**		**Δ Art**		**Δ Art**	
Δ Income					0.0880		0.0720						0.0219		-0.1432	
					0.6844		0.6559						0.4143		0.3013	
Δ Inequality					19.46531	*	16.5169						-0.7343		-6.0249	
					9.8924		10.6195						5.7485		6.0304	
Δ Income US	0.4026		0.1890		0.3063		0.1971		0.1475		0.0857		0.1490		0.0622	
	0.3333		0.3187		0.3392		0.3394		0.2521		0.2674		0.2616		0.2746	
Δ Inequality US	3.3282		3.5653		-2.5117		-1.5106		6.5171	*	5.5966	*	6.7399	*	7.2996	*
	3.7739		4.0524		3.7964		4.3116		3.4108		3.1197		3.9561		4.0424	
Δ(-1) Art			0.3038	*			0.1806				0.4427	***			0.4793	***
			0.1660				0.1725				0.1308				0.1391	
Number of obs.	32		31		32		31		62		61		60		59	
F-value	1.41		2.62	*	3.36	**	2.90	**	1.95		4.70	***	0.96		2.97	**
R2			0.1523				0.2579				0.2586				0.2752	

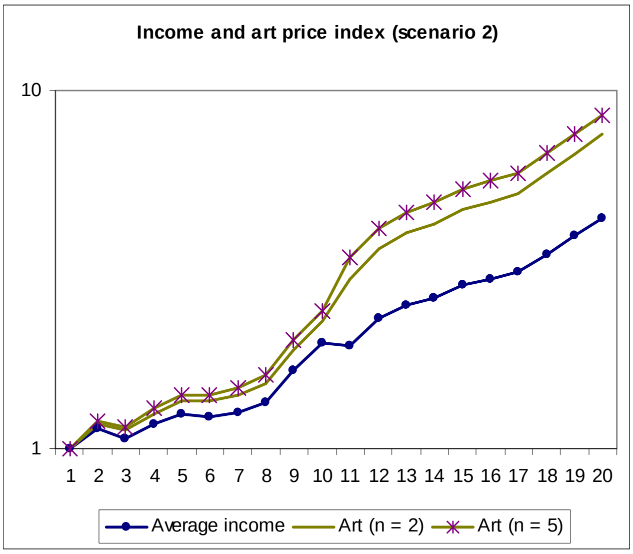
Notes. This table shows the results of comovement regressions for two different subperiods (1908-1945 and 1945-2005). The returns on art are regressed on a changing set of independent variables, listed in the first column. Below each coefficient in columns (1), (3), (5), and (7) is the Newey-West standard error, taking into account first-order autocorrelation in the error structure. Below each coefficient in columns (2), (4), (6), and (8) is the robust standard error. ***, **, and * indicate significance at the 1%, 5%, and 10% level, respectively.

Figure 1: Simulation results

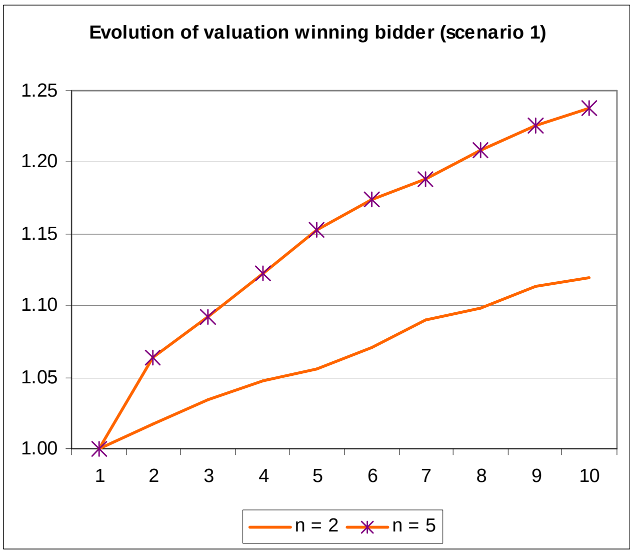
Panel A



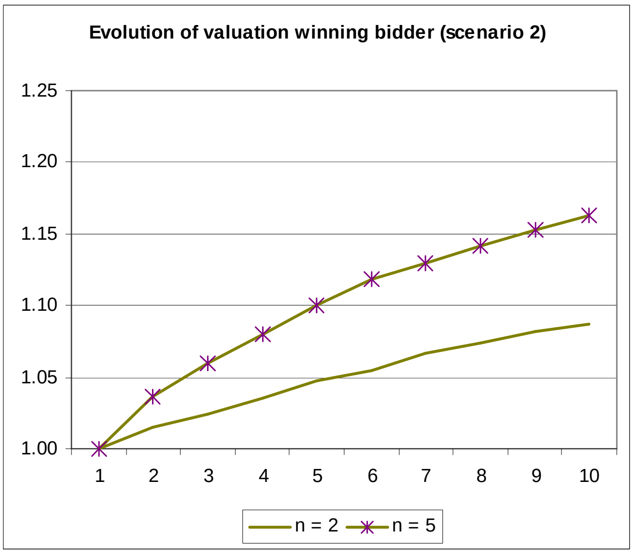
Panel B



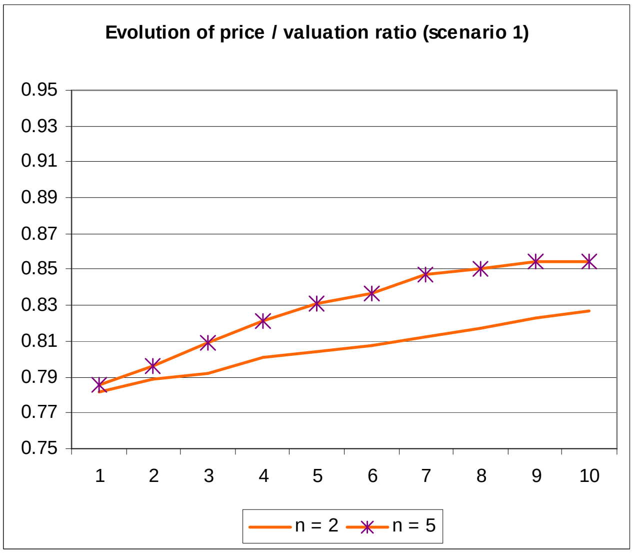
Panel C



Panel D



Panel E



Panel F

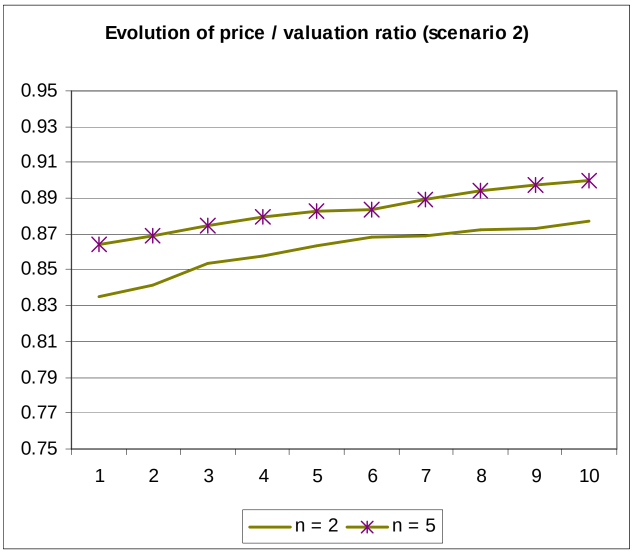


Figure 2: Yearly art price index 1765-2007

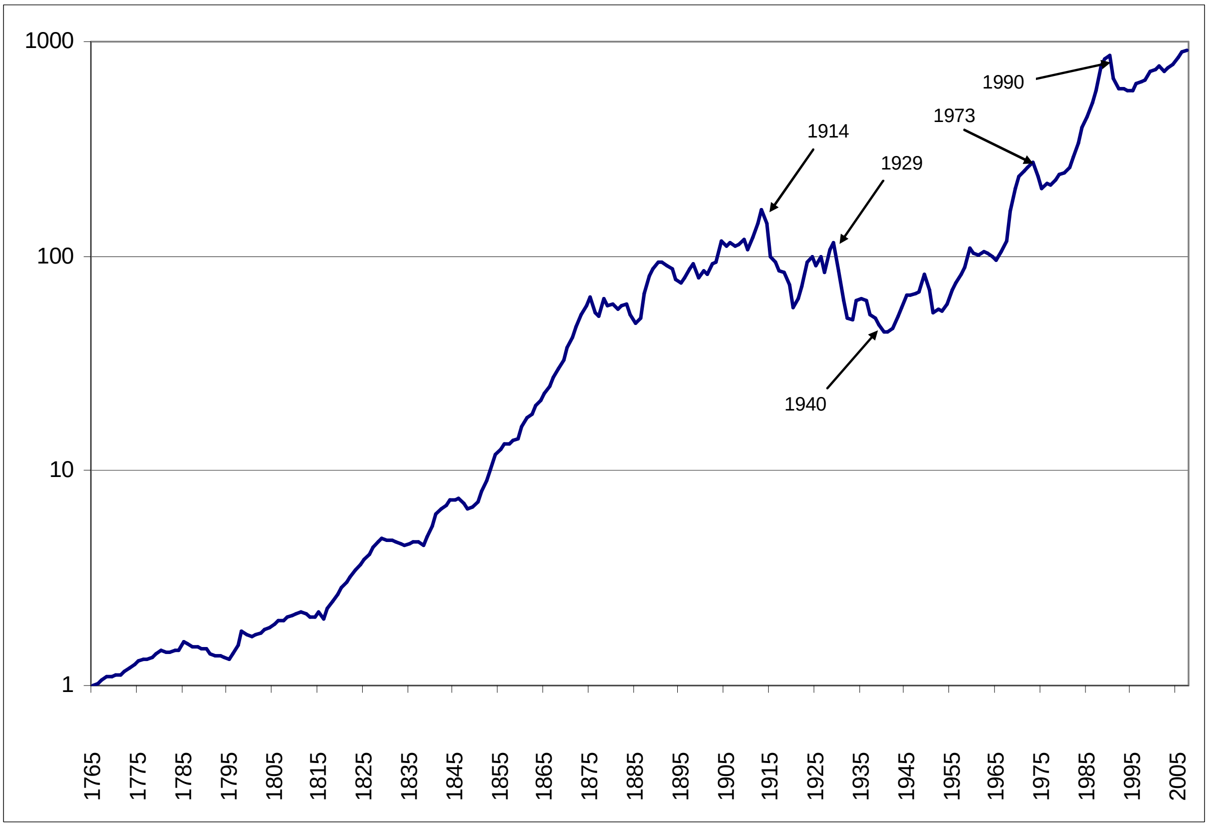


Figure 3: ***Art*** **and** ***Equities (capital)*** **1830-2007**

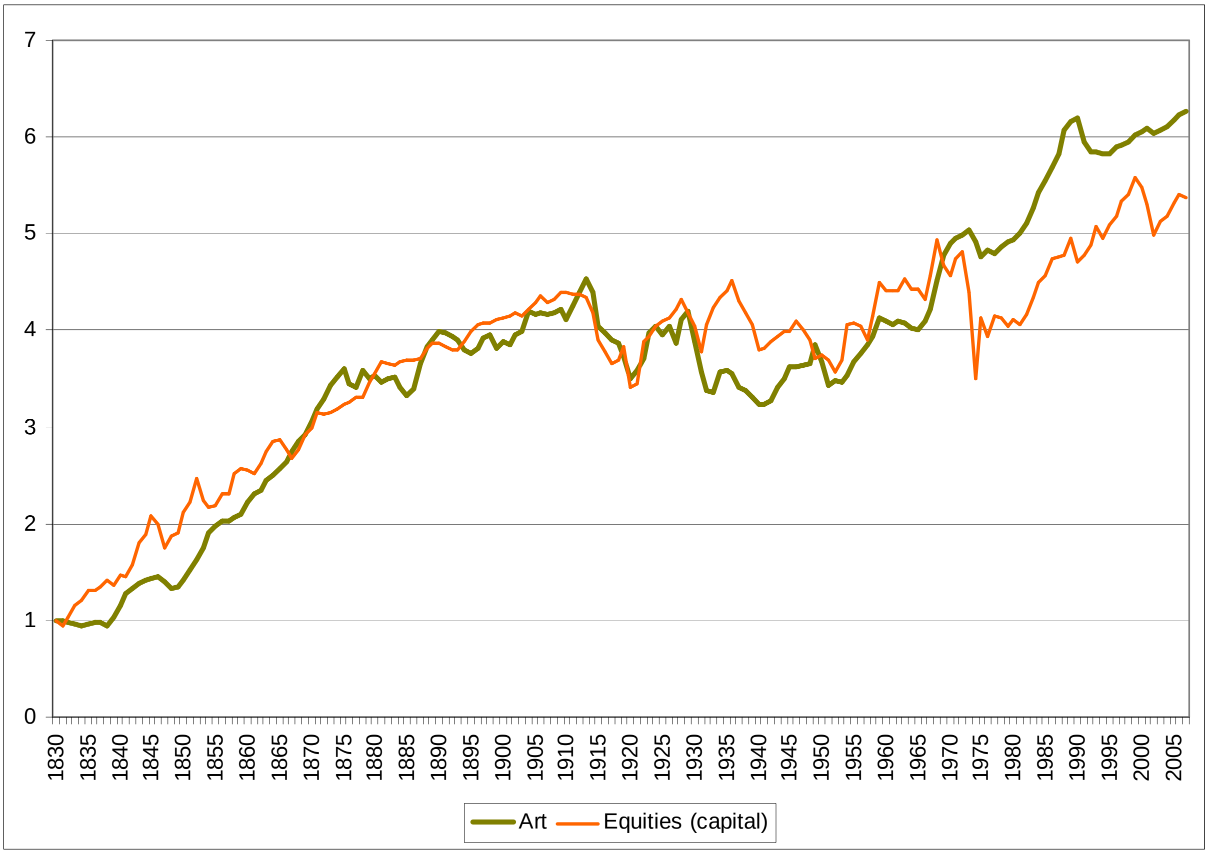


Figure 4: *Art, Income,* and *Inequality* 1908-2007