CESifo WORKING PAPERS

8181
2020

March 2020

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Heinrich W. Ursprung, Katarina Zigova

CESifo

Impressum:

CESifo Working Papers
ISSN 2364-1428 (electronic version)
Publisher and distributor: Munich Society for the Promotion of Economic Research - CESifo GmbH
The international platform of Ludwigs-Maximilians University's Center for Economic Studies and the ifo Institute
Poschingerstr. 5, 81679 Munich, Germany
Telephone +49 (0)89 2180-2740, Telefax +49 (0)89 2180-17845, email office@cesifo.de
Editor: Clemens Fuest
https://www.cesifo.org/en/wp
An electronic version of the paper may be downloaded
· from the SSRN website: www.SSRN.com
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CESifo *Working Paper No. 8181*

Diff-in-Diff in Death: Estimating and Explaining Artist-Specific Death Effects

Abstract

We investigate how an artist's death impacts on the price of her artwork by estimating individual death effects of a sample of famous visual artists who died between 1985 and 2010. Using data from art auctions that took place in a narrow window around the artists' death, we apply various econometric methods, including regression discontinuity and differences-in-differences strategies. The heterogeneity in death effects across artists turns out to be substantial and can, in large part, be explained by age and reputation at death. This result is robust to various specifications and measures of reputation. We present as an exacting test the case of Keith Haring, whose terminal illness was communicated by him well in advance.

JEL-Codes: I200, J240, J310.

Keywords: art auction prices, death effect, reputation, differences in differences, regression discontinuity.

Heinrich W. Ursprung
University of Konstanz / Germany
heinrich.ursprung@uni-konstanz.de

Katarina Zigova
University of Konstanz / Germany
katarina.zigova@uni-konstanz.de

March 30, 2020
We thank Kathryn Graddy, Arye Hillman, Tommy Krieger, Stefan Maurer, Jörn-Steffen Pischke, Guido Schwerdt and Tom Stanley for valued comments. We also thank Luc Renneboog for letting us discuss our project with him on the occasion of a visit to Tilburg University in December 2018. Helpful feedback was received from conference participants at the 20th International ACEI Conference on Cultural Economics in Melbourne 2018, the Ninth European Workshop on Applied Cultural Economics in Copenhagen 2019, and seminar participants at the University of Konstanz and Jadavpur University (Kolkata).

(B)y way of a preamble I want you to note that a great artist has never been acknowledged until after he was starved and dead. This has happened so often that I make bold to found a law upon it."

Mark Twain: Is he living or is he dead?

1. Introduction

We define the death effect as the causal influence of an artist's death on the price of her works of art. Given rational art market participants, the death effect works on impact, is discontinuous and need not be persistent. Economic theory can explain the death effect by pointing out that art works are durable goods produced under monopolistic competition. In such markets, the celebrated Coase conjecture (Coase 1972) predicts that the price will permanently settle at the competitive price level if the producer is unable to credibly commit to limiting total production. Since artists have no way to commit to a severely curtailed total oeuvre, supply-side induced changes in the price of their artwork will not occur as long as their creative powers and ambitions remain unimpaired. Only when an artist dies, the final size of her oeuvre is irrevocably determined and, because the grim reaper usually arrives more or less unsuspected, at a lower level than expected. It is this unexpected death-induced curtailment of an artist's oeuvre, i.e. the difference between the expected and the actual final size of the oeuvre that causes a sudden increase in the price of her artwork.

In this study we estimate individual death effects of visual artists and explain why these artist-specific death effects differ across artists. In explaining the size of the death effects, we focus on two determinants: the artist's age at death and her reputation in the art scene when she dies. The death effect is expected to vary negatively with the age at death because the older an artist is when she dies, the smaller is the unexpected death-induced decrease in the expected size of her oeuvre and thus the death effect.[1] This asset pricing argument applies to all artists, be they eminent or not. Eminence plays, however, a role when a young artist dies. Expected future reputation may not materialize if a young artist's career is curtailed by death and this frustrated

[1] A potential demand side effect may amplify this supply side effect because an older artist has already satisfied a larger fraction of the stock demand than a younger artist has. For a theoretical study producing this result, even though in a somewhat more abstract setting, see Itaya and Ursprung (2016).

expectation will induce a fall in the price of her artwork. In this case, the net effect can be positive or negative. To test our hypotheses, we focus on a sample of famous visual artists whose artwork was sold at auctions sufficiently often to allow estimating individual death effects without resorting to data of an entire group of artists. Ready availability of auction data further restricted us to focus on artists who died between 1985 and 2010. Since art prices are, in the medium run, subject to non-observable changes in fads and tastes, we only use auction price data from a relatively narrow time widow around the respective artist's year of death and use regression discontinuity (RD) and differences-in-differences (DD) strategies to estimate the individual death effects. In a second step, we then go on to test to what extent age at death and reputation (preferably also at death) determine the estimated artist-specific death effects. We conduct these test by regressing the individual death effects on those two explanatory variables and also by integrating those variables directly into the models that estimate the individual death effects.

We obtain results that are in agreement with our theoretical predictions: death effects of artists who enjoyed a full life are mostly positive and decrease with increasing age at death. For artists who died before their time, we find that the death effect can be negative if these artists did not already enjoy a firmly established reputation when they died. Moreover, we find for short-lived artists that the death effect increases with increasing reputation. We show that these results are robust to the applied estimation method and the employed measures of reputation.

Our baseline estimates presuppose that the death of an artist comes as a surprise for the art market. Technically speaking, we assume that an artist's death changes the information set of the market participants – and this is, of course, exactly the kind of change that causes asset price to jump in a rational expectations environment. Death, however, does not always come as a surprise. If, for example, it is publicly known that an artist is terminally ill, her death can often be timed with great accuracy. These exceptional cases give rise to an additional test of our asset pricing approach to explaining the death effect. We therefore examine in some detail the case of Keith Haring who was diagnosed with AIDS in 1988 and whose death in early 1990 was therefore generally anticipated. Our results show that Haring's publicizing his illness gave rise to a preponed death effect in 1989, thereby lending additional credibility to the Coase conjecture as applied to the art market.

Our study fits into the sizable literature on art price formation that is nicely surveyed in Ashenfelter and Graddy (2006). Ekelund et al. (2017) survey the empirical literature on the death effect. Our study is most closely related to the study by Ursprung and Wiermann (2011) whose dataset comprises, for the period 1980-2005, all auction sales of oil paintings, drawings, and prints reported in Hislop's Art Sale Index, a dataset amounting to over 400,000 observations. The identification strategy employed by Ursprung and Wiermann is based on hedonic regressions that include artist and time fixed effects, a set of explanatory variables that are commonly used in hedonic art price regressions, and, for recently deceased artists, dummy variables that are interacted with the age at death. This specification allows estimating death effects that are contingent on the age at death. The results indeed reveal death effects in the sense of our definition, i.e. price jumps immediately after the death of the artists, and the estimated death effects are, moreover, shown to vary for older artists negatively with the age at death and for younger artists positively, i.e. the death effect curve is hump-shaped across age at death. Etro and Stepanova (2015) reproduced this result by exploiting a marvelous self-collected historic dataset of almost 90,000 Paris auction sales of paintings sold in the 75 years straddling the periods of Rococo (1720-1780), Neoclassicism (1770-1840), and Romanticism (1800-1850). Because of the long observation period, this study allows identifying sufficiently many repeat sales (about 1.5% of all recorded transactions) to conduct, apart from the usual hedonic regressions, also repeat sale regressions.

The inverted U-shaped pattern of the death effect can be explained if one assumes that an artist's reputation increases with the size of her oeuvre and thus with (career) age. If an artist dies young, her reputation will never reach the level that the art market participants had good reason to expect. These frustrated expectations will have a negative price effect that may or may not be compensated by the positive effect associated with the death-induced reduction in the size of the oeuvre. The trouble with this argument put forward by Ursprung and Wiermann (2011) is that reputation is far from being perfectly correlated with age. Some artists enjoy already substantial reputation at an early age. Many of those artists are conceptual innovators (Galenson and Jensen 2001), i.e. artists who work deductively by applying methods that are suitable to immediately transform a given innovative idea into the preconceived artistic output. Since this method of operation does not require accumulating expertise by incremental experimentation, technical prowess is replaced by conceptual innovation with the consequence that artistic reputation can be achieved even by very young masters. The empirical studies by Galenson and Weinberg (2000 and 2001) indeed show that successful conceptual innovators produced their most valuable and important work much earlier than aesthetically-motivated experimentalists. These insights clearly show that career age is not an ideal measure for reputation. We therefore estimate in our study death effects without associating "age at death" with two potentially very different concepts, namely with an unrealized period of creative work and with unfulfilled reputation. This approach requires of course measures of artistic reputation that are independent of career age.

The remainder of the paper unfolds as follows. Section 2 describes the criteria for selecting the artists in our sample, presents the art auction data, and elaborates on our measures of artistic reputation. The empirical strategies are detailed in section 3 and the results are presented and discussed in section 4. Section 5 concludes.

2. Data

Artists and Art Auction Data

We rely on art auction data reported by *Hislop's Art Sales Index* and its successor, the *Blouin Art Sales Index*.[2] These auction records are electronically available from 1980.

Our sample of deceased artists satisfies the following restrictions. First, we need a time window around each sampled artist's year of death. A time window of eleven years, i.e. the artist's year of death and the five years before and after her death, fits the requirements imposed by the employed econometric methods. We therefore restricted the sample to artists who died between 1985 and 2011. Our empirical methods furthermore require for each artist a sufficient number of observations. Of the artists who died between 1985 and 2011, we found 245 whose artwork (oil paintings, works on paper or prints) was auctioned at least 40 times. To estimate the death effect, we need however also sufficiently many auctions before and after the artist's death. We therefore required in addition at least fifty sales in the 11-year window and at least twenty sales before and after the artists' death.[3] This last constraint reduced the sample size to 106 artists with a total

[2] *Hislop's Art Sales Index*, CD-ROM, 2005, edited by Duncan Hislop. Art Sales Index, Ltd., Egham, Surrey, England www.artbusiness.com/revs1205asi.html. *Blouin Art Sales Index*: www.blouinartsalesindex.com/search.action

[3] In a few cases, we deviated from that rule to arrive at a larger number of artist who died before their time.

number of 22,447 auction sales between 1980-2016.[4] Table 1 (to be found at the end of the paper) lists these 106 artists and provides some relevant descriptive statistics.

Table 1 provides a first impression of the death effect on art prices. The average auction prices do indeed increase after death; for 78 of the 106 artists in our sample the difference in the 5-year averages before and after death is positive. The size of this average price difference varies between 9 and 833622 US dollars, indicating already sizable differences across artists. To be sure, art prices are determined by a multitude of factors; before drawing conclusions we therefore need to account for these effects that include properties of the artwork, the auction house handling the sale, the year of sale, and, most importantly, the unobserved artistic quality of the artist.

The distribution of the 106 sampled artist's years of death (left panel) and their age at death (right panel) is shown in Figure 1. In the 24 years of our observation period 1985-2011, the number of cases of death varies between 0 and 8. The distribution of the age at death is more concentrated: the mean age at death is 80 and the median is 80.5.[5]

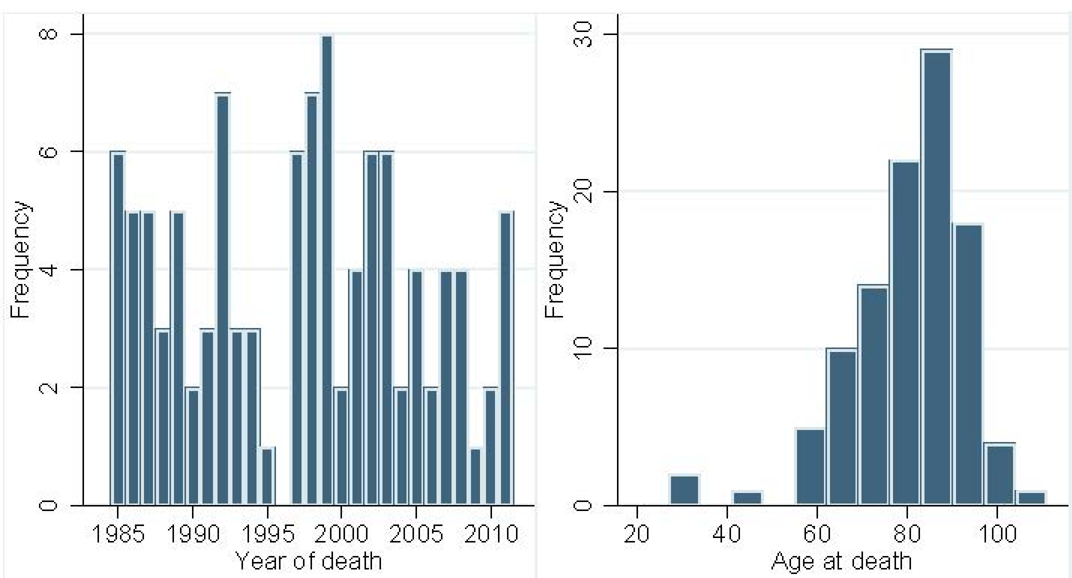

Figure 1: Distribution of death years and age at death for the 106 artists

[4] We excluded 61 auction houses outside Europe and the US because they handled only very few sales of our sample artists' work.

[5] In Sweden in 2000, the mean age at death was 80 and the meian 83 (Canudas-Romo 2010).

The left panel of Figure 2 shows that in our sample the number of auction sales increases after the artist's death. This is the case for 75 of the 106 artists. The question therefore arises whether the artwork sold before and after the artists' death differ.

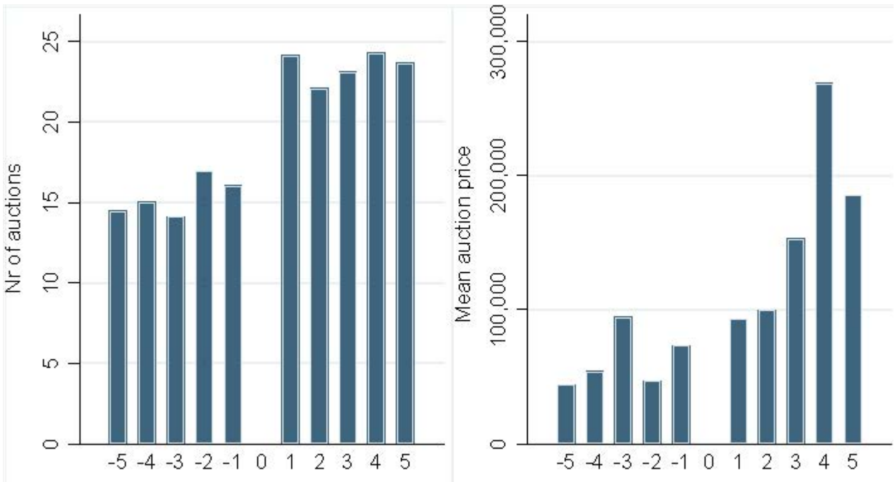

Figure 2: Average number of artworks and mean auction price (corrected by the art index) around the year of death

Table 2 provides the descriptive statistics of the physical properties of the auctioned artwork, the auction houses handling the transactions, and the prices.

Table 1 Descriptive statistics of the 22,674 artworks of the 106 deceased artists

	Mean	Std. dev.	Mean before	Mean after	Difference
Height (cm)	69.28	51.90	70.55	68.43	-2.12**
Width (cm)	70.38	57.40	71.76	69.46	-2.30**
Oil painting	0.45		0.47	0.44	-0.031***
Work on paper	0.42		0.43	0.42	-0.015**
Print	0.13		0.10	0.14	0.048***
Signature	0.82		0.84	0.80	-0.03***
Christie's	0.28		0.28	0.28	0.002
Sotheby's	0.27		0.30	0.26	-0.04***
USA	0.48		0.50	0.47	-0.03***
Price (US $)	122,342	1,141,831	76,571	152,676	76,105***

In terms of dimension, the artwork is quite heterogeneous. The mean height and width amounting to about 70 cm are well in line with what most people are used to, but the standard deviation of more than 50 cm indicates a large variety of formats. 45% of the artwork in our sample are oil paintings, 42% are (unique) works on paper, the remaining 13% are prints. 82% of the artwork is signed. The renowned auction houses Christie's and Sotheby's account for more than one half of all sales in our sample and almost one half of all auction sales were conducted in the United States, the other half in Europe. The differences in the reported means before and after the artists' death are in eight of the nine reported characteristics statistically significant, but very small substantively. There is therefore no reason to suspect that the common trend assumption in differences-in-differences estimates is violated. The only before-and-after death difference that is statistically and substantively significant are the mean prices in US-dollars. They have doubled. The right panel of Figure 2 provides a more detailed picture of the price development around the year of death.

Measures of Artistic Reputation

We use the term *artistic reputation* in the sense of a quantitative measure of an artist's acknowledged presence and notability in the art community. Measuring artistic reputation is not an easy task to begin with, but measuring artistic reputation at a specific point of time, in our case at the time immediately after the artist's death, turns out to be a real challenge. Given these difficulties, we settled for employing a variety of measures based on different types of information, such as online sources, print media, and encyclopedias.

Online encyclopedias offer a readily available online source. We therefore collected from Wikipedia for each artist the number of languages in which they have entries. A second online-based measure of reputation we counted the number of books offered by amazon.com in the subcategories art history and biographies relating to the artists' lives and artwork. Given that amazon is selling both new and used books, this measure includes books in stock as well as many out of print books.

The main problem with all online resources is that they do not lend themselves, at least not easily so, to measuring reputation at any given time in the past. Moreover, artists who died in the 1980s and 1990s may be less present in online fora and, since English is the predominant language of this medium, the online-based reputation measures of artists who have closer relations to the Anglo-Saxon world may be inflated. We therefore collected obituaries in general interest newspapers in different countries and base our preferred reputation measure on the number of words in those obituaries.[6] This measure is, in principle, well suited to measure the reputation of an artist at the time of death. We nevertheless acknowledge that this measure relies, for practical reasons, on a rather limited number of newspapers.

The standard measure of reputation used in the literature ranks the reputation of eminent persons by using word counts in entries of well-recognized, high-quality encyclopedias; Galenson (2006), for example, uses this method to rank artists, and Murray (2003) to rank extraordinary human accomplishments, in general. Those measures are highly objective because they reflect the so-called test of time; they do, however, not provide information about the reputation at the time of the persons' death. In any event, we use for this purposes the Oxford Dictionary of Art and Artists (Chilvers 2017).[7]

Table 3 reports some descriptive statistics for the nine reputation measures that we collected. The average number of amazon art books and biographies is 22 and the maximum number (Andy Warhol leads the pack) is almost 500 available books. For the average artist, Wikipedia provides information in about 17 different languages; in this contest Salvador Dalí wins with 162 different languages. Salvador Dalí also leads the field in the length of the English Wikipedia entry in all three languages that we considered. The longest obituaries commemorate Salvador Dalí, Marc Chagall, Willem de Kooning. The length of obituaries of the artists differ, mainly due to the preference for the "local" artists of the different newspapers.

Table 2: Descriptive statistics of our reputation measures

	Mean	Std. Dev.	Min	Max
Amazon: nr. of books	22.27	58.58	0	498
Wiki: nr. of languages	16.82	22.71	0	162
Wiki: length of English entry	2017.33	2393.61	0	13413
Oxford dict.: length of entry	136.24	172.38	0	724
Obituary: NYT	688.05	784.13	0	3251
Obituary: El País	254.43	328.67	0	1606
Obituary: Der Spiegel	112.93	211.70	0	1122
Obituary: Le Monde	407.38	571.15	0	3273
Obituary: The Independent	476.57	690.88	0	2524

[6] The obituary measure is an arithmetic average of number of words in obituaries published in *The New York Times*, the German *Der Spiegel*, the Spanish *El País*, the French *Le Monde*, and the British *The Independent*.
[7] We used the electronic version of this dictionary.
www.oxfordreference.com/view/10.1093/acref/9780191782763.001.0001/acref-9780191782763

In most cases the correlation between our eight reputation measures is reasonably high (between 0.4 and 0.6, see Table 4). Exceptions are the measure based on the length obituaries in *The Independent* and the length of the English Wikipedia entry in some cases does not correlate well with the other measures. Nevertheless, the measure of inter-item similarity, Cronbach's α, is quite high at 0.59. Similar correlations between different reputation measure have been found in Simonton (1984) for scientists. Simonton finds a reliability index of 0.78 based on 23 distinct measures of scientific reputation in a sample of over 2000 scientists spanning several centuries. This result should not be surprising given the study by Graddy (2013) who uses de famous Roger de Piles ranking to show that artists ranked by de Piles enjoy today a largely unchanged reputation – and that after three centuries.

Table 3: Correlations among the reputation measures

		Wikipedia				Obituaries		
	Amazon	Nr. of languages	English entry	Oxford dict.	NYT	El País	Der Spiegel	Le Monde
Wiki: nr. of languages	0.529	1						
Wiki: length of English entry	0.370	0.508	1					
Oxford dict.: length of entry	0.313	0.638	0.405	1				
Obituary: NYT	0.551	0.605	0.350	0.501	1			
Obituary: El País	0.277	0.609	0.269	0.451	0.349	1		
Obituary: Der Spiegel	0.515	0.659	0.287	0.380	0.485	0.359	1	
Obituary: Le Monde	0.405	0.660	0.212	0.467	0.507	0.466	0.478	1
Obituary: The Independent	0.156	0.330	0.180	0.386	0.415	0.373	0.311	0.337

Note: Cronbach's alpha is 0.59.

3. Estimating the death effect

Empirical strategy

To estimate the causal effect of an artist's death on the price of her artwork, we introduce the treatment variable

$$DE_{im} = \begin{cases} 0 & \text{if age}_m < \text{death age}_m \\ 1 & \text{if age}_m \geq \text{death age}_m \end{cases} \tag{1}$$

that indicates whether the creator m of an artwork i sold at auction was alive ($DE_{im} = 0$) or dead ($DE_{im} = 1$) when the transaction took place. The treatment status, i.e. whether an artist is dead or alive (DE), is thus a deterministic function of the artist's age.

We consider two specifications for estimating the death effects. The first specification applies the regression discontinuity design (Angrist and Pischke 2014, ch. 4) and estimates the death effect for each artist individually:

$$\ln \hat{p}_i = \alpha_0 + \gamma DE_i + f(a_i) + \varepsilon_i, \quad \text{where } \ i = 1, \dots, n_m \tag{2}$$

In this specification, $\ln \hat{p}_i$ is the log auction price (corrected for changes in an art price index and for hedonic characteristics of the sold artwork) of each of the pictures $i = 1, \dots, n_m$ created by artist m. In order to identify the parameter γ, we control for the artist's age with the help of function $f(a_i)$, where a is the difference between the "running age" and the artist's death age; a is therefore negative as long as the artist is alive. We work with linear and quadratic functions $f(a_i)$ and also allow different $f(a_i)$-coefficients on the both sides of the death threshold using an interaction term $DE \times f(a)$.

The second specification for estimating the death effect applies the difference-in-difference (DD) design (Angrist and Pischke 2014, ch. 5). In our DD approach we estimate the death effects using the entire panel of artists in our sample:

$$\ln p_{imt} = \alpha_0 + \sum_{m=2}^{68} \mu_m + \sum_{m=2}^{68} \gamma_m DE_{imt} + \sum_{j=1}^{K} \beta X_{ijmt} + \sum_{t=1980}^{2011} \delta_t Y_t + \varepsilon_{imt} \tag{3}$$

In this specification, the dependent variable $\ln p_{imt}$ is the log hammer price of lot i (sold in year t) of an artwork created by artist m. We regress these prices on K hedonic characteristics included in matrix X. We also control for changes in general art market prices using the year dummies Y_t and include artist-specific linear time trends and artist fixed effects.

Estimation Results: Regression Discontinuity Design

In our regression discontinuity regressions, we use on the left hand side of equation (2) prices that are corrected for the hedonic characteristics of each item sold and for the general movements of the art market. To arrive at these corrected or normalized prices, we estimated for each artist m the following auxiliary regression:

$$\ln \tilde{p}_i = \beta_0 + \boldsymbol{\beta X}_i + \varepsilon_i \quad where\ i = 1, \dots, n_m \tag{4}$$

where $\tilde{p}_i$ is already the hammer price corrected for general price movements in the art market. To correct for these general price movements, we constructed a price index that is based on our entire price dataset of 20th century artists. Many studies of art price formation correct the art prices only for inflation. We do not favor this approach because it clearly ignores the specific price development of the art market. The dependent variable ($\ln \tilde{p}_i$) in equation (4) is thus the auction hammer price divided by our own art price index.

The constant β_0 is the artist-specific base price level and $\boldsymbol{\beta}$ is a $k \times 1$ vector of parameters measuring the influence of the hedonic characteristics on the hammer price of artwork i. The $k \times n_m$ matrix $\boldsymbol{X}$ comprises the following variables: the log of the painting's size (height width), a signature dummy, medium dummies (oil, work on paper, print), dummies for the auction houses Sotheby's and Christie's (i.e. proxies for the quality of the artwork), and a dummy for European auction houses (the reference group being US based auction houses).

The corrected prices $\hat{p}_i$ that we use in equation (2) are thus the residuals of the hedonic regressions (4). In Figure 3, we plot for our sample of 106 artists an average of the corrected prices against the normalized year of sale (defined as years before and after the respective artists' death, i.e. the artist died in the normalized year of sale 0). The average that we use for this figure is the mean across all 106 artists of the mean corrected price for each individual artist. Figure 3 reveals an economically significant discontinuity in auction prices in the death year; the price increase amounts to more than 15%. This kind of averaging blurs, of course, individual heterogeneity in death effects. We depict therefore the individual corrected prices for twelve artists in Figure 4 (to be found at the end of the paper). The selection is meant to demonstrate the heterogeneity in death effects. A visual inspection of the twelve panels reveals that the corrected prices jump in the death year for some artists and remain constant for others.[8] Economically

[8]The trend lines are not influenced by the observations in the death year (i.e. year zero), as for most of the artists we do not have enough observations before and after death in the death year. The observations in the death year are, however, used in the regressions.

significant price increases appear to be associated with artists who died at a relatively young age. This is of course in line with our hypothesis derived from the Coase conjecture.

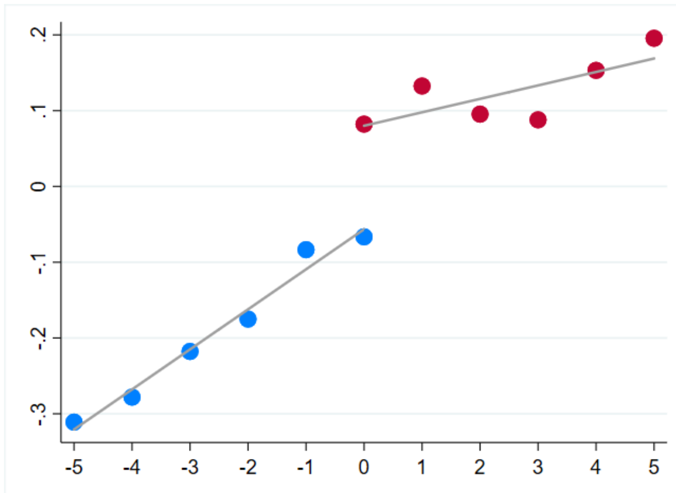

Figure 3: Average corrected auction prices across all artists against relative years of sale

One important lesson to be learned from Figures 3 and 4 is that the price trend over the normalized year of sale (i.e. our "running age" in equation 2) can be different on the two sides of the threshold. We thus consider in addition to specification (2) a specification that can accommodate different time trends before and after the artist's death, i.e. a specification with an appropriate interaction term (Angrist and Pischke 2014):

$$\ln \hat{p}_i = \alpha_0 + \gamma DE_i + f(a_i) + \delta[f(a_i)DE_i] + \varepsilon_i, \quad \text{where } i = 1, \dots, n_m \qquad (5)$$

The results of the regression discontinuity regressions of specification (2) and (5) are reported for the twelve showcased artists in Table 5. We show results for three different bandwidths. The estimated death effects γ, of specification (2), range from -0.64 to 1.54, indicating that the downward jump in auction prices can be about 64%, while the upward jump could reach more than 150%. However, for a large portion of the artists (31) we estimate statistically insignificant death effects in all specifications. Among the artist whose death has not induced a marked price change we find also superstars such as Salvador Dali and Roy Lichtenstein. We discuss the potential determinants of these differences in death effects in Section 4.

Table 4: Regression discontinuity estimations of the death effect for 15 selected artists

Artist	Bandwidth: 5 years DE, a		Bandwidth: 5 years DE, a, DE × a		Bandwidth: 4 years DE, a		Bandwidth: 4 years DE, a, DE × a		Bandwidth: 3 years DE, a		Bandwidth: 3 years DE, a, DE × a	
APPEL	0.283	***	0.187	*	0.215	**	0.163		0.171		0.124	
BASQUIAT	1.543	***	1.577	***	1.655	***	1.637	***	1.652	***	1.667	***
BUFFET	0.137	**	0.137	**	0.164	***	0.163	***	0.159	**	0.159	**
CHAGALL	0.110		0.132		0.176		0.271		0.183		0.311	
DALI	0.246		-0.013		0.215		-0.029		0.224		-0.122	
GISSON	-0.143		-0.190		-0.125		-0.208		-0.150		-0.197	
HARING	1.237	***	1.308	***	1.333	***	1.265	***	1.263	***	0.749	***
LEWITT	0.324	***	0.243	**	0.419	***	0.345	***	0.412	***	0.443	***
LORJOU	-0.638	**	-0.389		-0.726	***	-0.277		-0.376		0.310	
NESBITT	-0.509		-0.502		-0.458		-0.405		-0.164		-0.396	
POLKE	0.421	**	0.401	**	0.443	***	0.406	**	0.530	***	0.528	***
RIZZI	-0.432		-0.443		-0.861		-1.406	*	-0.948		-2.059	
TWOMBLY	0.611	***	0.614	***	0.471	**	0.484	**	0.485	**	0.467	*
WARHOL	0.834	***	0.853	***	0.997	***	0.995	***	1.099	***	0.927	***
WYETH	0.142		-0.017		0.283		-0.014		0.127		-0.075	

The (DE, a) columns report estimates the DE from specification (2) and the (DE, a, DE × a) columns from specification (5) that includes an interaction term of running age and death dummy. Full list of results is available on request. * p<0.10, ** p<0.05, *** p<0.01

Estimation Results: Difference-in-Difference Design

The second method that we employ to estimate individual death effects is the difference-in-difference (DD) estimator. Unlike RD, DD estimates the treatment effect not by directly exploiting the exogenous discontinuity caused by the artists' death but by comparing the prices of the artwork of treated, i.e. deceased, artists with the prices of artwork created by artists who are still alive and thus can serve as a control group. This approach does not give rise to any objections if the assignment to the treatment and control groups is random because in this case the prices move in parallel, at least for sufficiently large treatment and control groups. Death is, of course, to a large extent a random event, but because expected mortality varies positively with age we need to establish that the pre-treatment price paths, i.e. the price paths of the artwork of living and deceased artists, do indeed move in parallel. Only if the pre-treatment time paths move in parallel can we remove doubts about whether post-treatment differences in the two time paths indicate the treatment or death effect.

We estimate the death effect in the pseudo panel setting in which the control group consists of all auction sales of artwork created by the sample artists who are still alive. Since all of our sample artists die in the observation period and we only consider sales in the eleven-years of the time window around each artist's death, the control group observations are taken from an ever changing and shrinking selection of living artist. In one of our robustness tests we therefore run the DD regression with other artists who were alive throughout the considered period.

The dependent variable in regression equation (3) is the raw log hammer prices of artist m's artwork i sold at auction in year t, $\ln p_{imt}$. We use in this regression the raw prices because we control on the right hand side for art market idiosyncracies with time the fixed effects Y_t, hedonic characteristics X_{jimt} of the auctioned artwork, and with artist-specific fixed effects μ_m. The variables of interest are the artist-specific death dummies DE_{imt}. In line with Angrist and Pischke (2014), we refer to this setting as our multi-artist DD regression setup. Apart from using a different control group of artists, we can test the robustness of the estimated death effects by allowing for nonparallel trends in auction prices across artists. To do so, we amend equation (3) with artist specific linear time trends $\theta_m t$:

$$\ln p_{imt} = \alpha_0 + \sum_{m=2}^{106} \mu_m + \sum_{m=1}^{106} \gamma_m DE_{imt} + \sum_{j=1}^{K} \beta X_{ijmt} + \sum_{t=1980}^{2016} \delta_t Y_t + \sum_{m=2}^{106} \theta_m t + \varepsilon_{imt} \qquad (6)$$

Using specification (6) also allows us to compare the DD with the RD estimates, as the RD specification (2) contains by construction a running variable.

The results of our DD regressions are reported in Table 6. Comparing the first two columns, one can see that the estimates resulting from specifications (3) and (6) differ significantly for many artists. Moreover, many estimates in the first column imply sizable death effects which vanish when including artist-specific linear time trends (column 2). Our preferred specification is specification (6). In columns 4 and 6 we report the estimates of specification (6) for smaller bandwidths. Those estimates are largely in line with our preferred specification with a bandwidth of 5 years (column 2). The estimates of our preferred specification (column 2) indicate statistically significant death effects γ_m ranging from -0.5 to 1.1, indicating price changes on impact between -50% and +110%. We conclude that the death effect is statistically significant for only about one half of our sample artists when considering specifications that include artist-specific linear time trends. This result is in line with our RD results. The death effects estimated with the RD method are also similar to those estimated with the DD method, however somewhat larger. The measure of similarity of all RD and DD estimates, Cronbach's α, amounts to 0.94.

Table 5: Diff-in-diff estimations of the death effect for 15 selected artists

	Bandwidth: 5 years						4 years		3 years	
Artist	DE		DE, ASLTT		RDD: DE, a		DE, ASLTT		DE, ASLTT	
APPEL	0.188		0.054		0.283	***	0.039		0.050	
BASQUIAT	0.988	***	0.998	***	1.543	***	0.964	***	1.060	***
BUFFET	-0.271	***	0.129	**	0.137	**	0.135	*	0.158	*
CHAGALL	0.085		0.115		0.110		0.374		0.312	
DALI	-0.185	**	-0.009		0.246		-0.065		-0.123	
GISSON	-0.577	***	-0.175	**	-0.143		-0.074		-0.064	
HARING	1.068	***	1.095	***	1.237	***	1.071	***	0.957	***
LEWITT	0.432	***	0.273	***	0.324	***	0.288	**	0.380	*
LORJOU	-0.112		-0.500	*	-0.638	**	-0.493	*	-0.042	
NESBITT	0.372	***	-0.467	*	-0.509		-0.546	***	-0.684	
POLKE	0.376	***	0.595	***	0.421	**	0.447	***	0.675	***
RIZZI	1.823	***	0.677		-0.432		1.174		0.915	
TWOMBLY	0.657	***	0.763	***	0.611	***	0.751	***	0.755	***
WARHOL	0.374	***	0.553	***	0.834	***	0.881	***	0.815	***
WYETH	-0.528	***	-0.164	**	0.142		0.031		-0.072	

The DE column reports estimates of the DE from specification (3) and the DE, ASLTT columns from specification (6) that includes artist specific linear time trends (ASLTT). The RDD column duplicates the regression discontinuity results with bandwidth 5 years from Table 5. Full list of results is available on request. * p<0.10, ** p<0.05, *** p<0.01

Before testing in the next section whether the estimated artist-specific death effects follow the pattern predicted by microeconomic theory, we first turn to the interesting case of Keith Haring and acknowledge here that we did, so far, not reveal all pertinent facts when presenting the data and regression results relating to this famous artist who sadly died at a very young age.

Placebo estimates: The case of Keith Haring

Regression discontinuity and difference-in-differences designs go a long way towards establishing causal effects; in our case a causal effect of an artist's death on the price change in her artwork. An even more exacting test of the underlying economic theory would be to show that when a case of death is "announced" for the near future, the market reacts in advance, i.e. at the time of the announcement and not after the fact. Given informed and rational market participants, this is what one would expect to happen because expected changes in fundamentals of asset pricing are priced in at once.

It does not happen very often that a case of death is "announced" for the near future. But in the case of Keith Haring this is exactly what happened. Haring rose to fame in the 1980s when he was in his twenties. He was diagnosed with AIDS in 1988, announced his affliction, and established his foundation to provide financial support for AIDS-related education, prevention, and care. He also used his art in the fight against AIDS. Since in the late 1980s no effective medical treatment against the immune deficiency was available, it was clear that Haring did not have long to live. With Haring's announcement of his HIV-positive status, all actors in the art market knew that his life's work would be smaller than hitherto expected. From a theoretical perspective, one would therefore expect that the announcement of his health status would have led to an immediate increase in the prices of his artwork. Given his reputation and his young age, Haring was not yet 32 years old when he died, one would furthermore expect this death effect to be extraordinarily large. This is exactly what happened: the prices of Haring's pictures did not rise after his death in 1990, but already after the announcement of his incurable illness two years before. The death or in this case rather announcement effect illustrated in Figure 5 amounts to about 130% (see Table 5, column 2). Notice that in Haring's case, the normalized year 0 in Figure 5 does not indicate his year of death (1990) but the year in which he made the announcement of his health status (1988).

To corroborate this finding, we employ the border-falsification strategy proposed by Becker et al. (2016) which, in turn, is derived from the regression discontinuity design (Imbens and Lemieux 2008). The basic idea of this strategy is not to consider time windows (or in the original context: geographical bands) that include the border line (in our case the border-line year) that is claimed to give rise to the discontinuity, because otherwise the placebo estimates would be flawed by the effects deriving from the border-line (in our case the announcement of Haring's terminal illness).

Our time windows include 3 years before the announcement and 3 years after the announcement, i.e. we take our shortest time windows to test as close as possible to the true announcement year. In order not to cross the true announcement year, we test for the existence of the death effect in three consecutive years, namely 1993, 1994, and 1995. We could not test for the artificial death effect before the announcement year, because assuming a time window of three years, we would have to assume fictitious time windows that include the year 1985 and earlier years, i.e. years in which only very few pictures by Haring were sold at auctions (in 1985 Haring was, after all, only 27 years old).

Figure 5 plots four death effects for Keith Haring. The first effect is the effect following the actual announcement in 1988, the three other effects assume, counterfactually, that the announcement had been made in 1993, 1994, and 1995. The true announcement effect indicates a statistically significant price increase of about 75% (see Table 5, column 6), the placebo death effects are very small and statistically not significant.

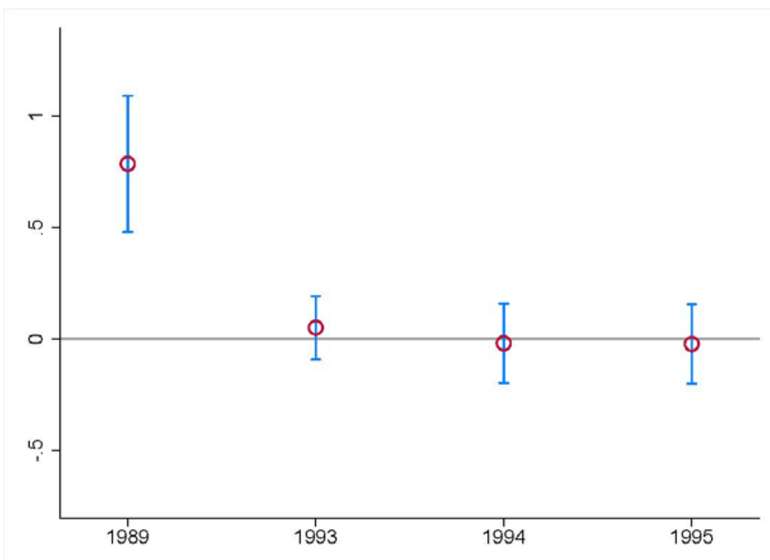

Figure 5: Estimates of Placebo Death Effects for Keith Haring

4. Explaining the Death Effect: Reputation and Age at Death

The Coase conjecture and general asset pricing considerations give rise to two hypotheses that guided our attempts to explain the estimated heterogeneity in death effects across artists. The first hypothesis maintains that that the death effect varies, ceteris paribus, negatively with the artist's age at death and disappears for artists who die at a very high age. The ceteris paribus clause is important because the death of an aspiring young or middle-aged artist who is still little known by the general public, but who some insiders believe to be likely to make it big, may have a significant negative effect on the prices of her artwork because her death nips those hopes of becoming eminent in the bud and thus frustrates the expectations of the early collectors. For young and middle-aged artists who do not yet enjoy a generally acknowledged reputation in the art world, the positive death effect associated with the death-induced curtailment of their oeuvre is diminished by a negative effect associated with frustrated expectations of reputation. We thus hypothesize that the death effect of artists who die before their time is smaller, perhaps even negative, for less reputed artists than for truly eminent ones.

As an initial test of the first hypothesis we regress the estimated death effects of our sample artist on a polynomial of the respective artist's age at death. We have two dependent variables: the death effects estimated with the regression discontinuity (RD) method and those estimated with the difference-in-difference (DD) method. In both cases we use the estimates obtained from the regressions based on the bandwidth of five years. Table 7 reports the results.

Table 6: The death effect as a function of age at death

	RD (1)	DD (2)	RD (3)	DD (4)	RD (5)	DD (6)
Dependent variable: death effect (RD or DD based, 5 year bandwidth)						
age at death	-0.01	-0.006	-0.080***	-0.077***	-0.269***	-0.177**
	(0.006)	(0.006)	(0.012)	(0.018)	(0.070)	(0.087)
age at death^2/100			0.051***	0.050***	0.363***	0.208
			(0.010)	(0.014)	(0.119)	(0.138)
age at death^3/1000					-0.016**	-0.008
					(0.006)	(0.007)
Cons.	0.944*	0.645	3.218***	2.941	6.563***	4.820**
	(0.506)	(0.515)	(0.38)	(0.554)	(1.187)	(1.598)
Observations	106	106	106	106	106	106
R^2-squared	0.122	0.042	0.321	0.220	0.382	0.239

All rows are based on the weighted least squares regression, with the underlying squared precisions as analytical weights. The RD columns use as dependent variable the death effects estimated from the Regression Discontinuity specification (2) with a 5-year bandwidth, i.e. Table 5, column 2. The DD columns use as dependent variable the death effects estimated from the Difference-in-Difference specification (6) with a 5-year bandwidth, i.e. Table 6, column 2. Robust standard errors in the parentheses.
* p<0.10, ** p<0.05, *** p<0.01

The model fit is much better when using the death effects estimated with the RD method than when using the DD estimates. Given the significance of the all three powers of age at death in the regression reported in column (5), and also because the cubic functional form is less restricting that the quadratic specification, we proceed with this specification. The relationship between age at death and the death effect is illustrated in Figure 7 that plots the graphs of the preferred specification (cubic RD) and the cubic DD specification reported in Table 7. Both graphs have the shape predicted by our first hypothesis: the death effect is largest for artists who die at a young age and decreases with increasing age at death. The death effect remains positive for all artists who died before 60 and then disappears for artists who died after the age of 60.

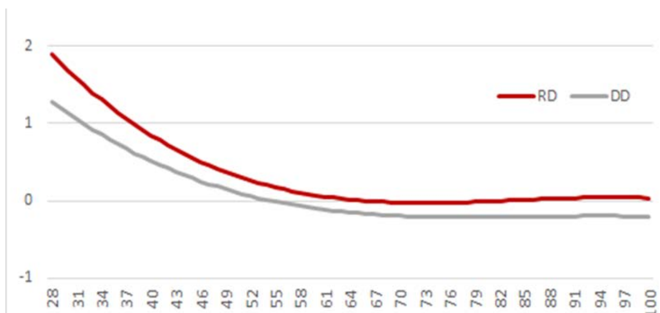

Figure 7: Death effect as a cubic function of age at death
Note: RD, Table 7, column 5; DD, Table 7, column 6

The storyline that relates the price jump following the death of young artists to the surprising and large curtailment of their oeuvre now needs to be enriched by the role of reputation. After all, the regression results reported in Table 7 lump together artists who enjoyed at the time of death different levels of reputation.[9] To do so, we amend specification (5) in Table 7 with the measures of reputation discussed in Section 2. To capture the moderating effect of reputation predicted by our second hypothesis, we interact the variables REPUTATION and AGE-AT-DEATH. We report the results in Table 8. The effect of reputation is for all reputation measures positive,

[9] The reason why we obtain in our estimates reported in Table 7 and plotted in Figure 7 a death effect that decreases with age at death whereas Ursprung and Wiermann (2011) and Etro and Stepanova (2015) obtained a hump-shaped curve can be attributed to the differences in the employed samples. Both Ursprung and Wiermann (2011) and Etro and Stepanova (2015) worked with very large samples which included a large number of artists with little or no reputation to speak of. Our sample, however, only includes artist whose work has been sold many times in a relatively short period which implies that all of our sample artists enjoy a substantial reputation.

however not significant for all measures. More importantly, because this lends empirical support to our second hypothesis, the estimated coefficient of the interaction term is negative, i.e. the effect of reputation decreases with age at death.

Table 7: The death effect as a function of age at death and reputation

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Dependent variable: death effect (RD based, 5 year bandwidth)							
age at death	-0.240***	-0.249***	-0.239***	-0.211***	-0.311***	-0.276***	-0.271***
	(0.061)	(0.068)	(0.078)	(0.067)	(0.062)	(0.067)	(0.068)
age at death^2/100	0.341***	0.363***	0.318**	0.298***	0.434***	0.372***	0.365***
	(0.105)	(0.111)	(0.125)	(0.11)	(0.105)	(0.113)	(0.115)
age at death^3/1000	-0.015***	-0.017***	-0.014**	-0.013**	-0.019***	-0.016***	-0.016***
	(0.005)	(0.006)	(0.006)	(0.006)	(0.005)	(0.006)	(0.006)
reputation	0.020***	0.319*	0.048	0.205**	3.049***	0.673	0.159**
	(0.005)	(0.171)	(0.08)	(0.079)	(0.792)	(0.628)	(0.071)
reputation × age	-0.000***	-0.003	-0.0001	-0.002**	-0.032***	-0.006	
	(0)	(0.002)	(0.001)	(0.001)	(0.01)	(0.008)	
Const.	5.328***	5.211***	5.794***	4.502***	6.919***	6.704***	6.598***
	(1.011)	(1.337)	(1.576)	(1.286)	(1.057)	(1.129)	(1.145)
Reputation measure	Nr. of wiki lang.	ln nr. of amazon books	ln length oxford entry	ln length obituary NYT	additive obituary measure	dummy high reput.	dummy high reput.
Observations	106	106	106	106	106	106	106
R^2	0.438	0.431	0.424	0.486	0.470	0.419	0.414

All rows are based on the weighted least squares regression. The dependent variable is the death effects estimated from the Regression Discontinuity specification (2) with a 5-year bandwidth (see Table 5, column 2). The underlying squared precisions are used as analytical weights. The additive obituary measure is calculated as sum of relative obituaries lengths across all five magazines. The high reputation dummy is one if the obituaries were of exceptional lengths. * p<0.10, ** p<0.05, *** p<0.01

Using, for example, the reputation measure based on the number of books available on the amazon website (column 3), a 1% increase in the number of books dealing with the respective artist’s life or work, increases the death effect by 60%. If, however, such an eminent artist dies at the age of 85, this effect is reduced by about 62%. We illustrate the relationship between age at death and reputation in Figure 8, where we plot the graph of the function estimated in column (7) of Table 8. The reputation measure in this specification is a dummy variable derived from the number of words in our obituaries measure. We indicated 25 artists who had exceptionally long obituaries (longer than 450 words) as highly eminent at the time of their death, i.e. the dummy equals one for these 25 artists. For the remaining artists the high reputation dummy equals zero. In Figure 8, the age at death curve for highly eminent artist is above the curve for the less eminent artists. Moreover, the death effect for the highly eminent artists becomes zero about 15 years later than for the less eminent artists.

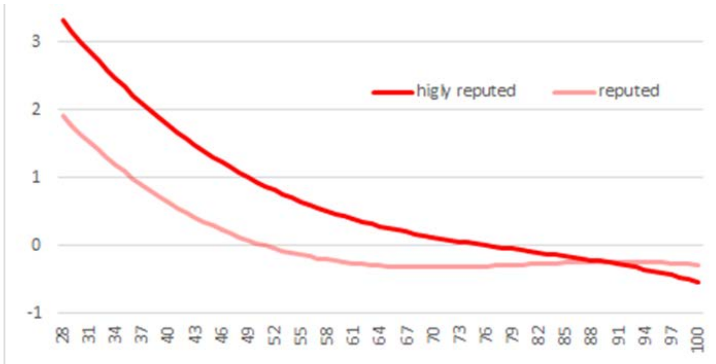

Figure 8: Relationship between the death effect and age at death for highly reputed and reputed artists

5. Conclusion

Empirical studies measuring and explaining death effects in the visual art market have hitherto used panel data to estimate average death effects, i.e. death effects that could not be associated with specific individual artists. In this study we estimate individual death effects for a sample of artists whose work has been sold at auctions sufficiently often to allow estimating artist-specific death effects with the help of regression discontinuity and difference-in-differences techniques. In our sample of 106 artists we find artists with statistically positive and negative death effects, as well as artists whose death caused no statistically significant death effect.

We explain this heterogeneity in death effects by applying the famous Coase (1972) conjecture to the art market. In the art market context, the Coase conjecture gives rise to two hypotheses that we test with our data. The first hypothesis maintains that death effects are negatively related to the deceased artists' age at death and disappear when an artist dies at a high age. The second hypothesis predicts that for artists who die before their time, the death effects varies positively with the deceased artist's reputation at the time of death.

Our results support all of these predictions. To test our hypotheses, we collected a variety of potential measures of artistic reputation. Our results turn out to be quite robust with respect to the reputation measures used in explaining the variance in the observed individual death effects. The main conclusion that we draw from our results is that the basic predictions of asset pricing theory can be used to interpret art price formation; in other words, pieces of visual art exhibit fundamental characteristics of financial assets.

As compared to previous studies on the death effect, we disentangling for the first time the two of the main determinants of the death effect, to wit, age and artistic reputation at death. So far, empirical estimates of the relationship between the death effect and age and death has been confounded with influences arising from artistic reputation which, of course, to some extent correlated with age: young artists are less likely to be eminent than older ones. Since dying young, with little reputation but perhaps well-deserved hopes of eventually becoming an eminent artist, sets the stage for a negative death effects, the estimated relationship between the death effect and age at death turns out to be hump-shaped if one does not explicitly correct for reputation. When taking reputation into account, as we do in this study, the hump-shaped relationship between the death effect and age and death gives way to a negative relationship for young and middle-aged artists and vanishing death effects for older artist.

Notice, finally, that dying young increases, at impact, the market value of the deceased artist's work only if the deceased young artist already enjoyed a great deal of reputation. If nobody has noticed her qualities, perhaps because there were none to be found, the price of her artwork does not change at all, and if some early collectors made a perhaps well-informed wager and bought some of her artwork at increasing prices, they will have a lot to regret. What this shows is that you cannot trust wordsmiths with economic matters. In short, Mark Twain in his story that prompted the preamble of this working paper, got it all wrong. Making money from an artist's death is not easy. It may even involve murder, at least if you want to believe economist-turned-mystery-writer Marshall Jevons (2014).

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Table 8: Descriptive statistics of auctions by artist

Artist	Death date	Age at death	Nr. of auctions before	after	diff	Average hammer price (US $) before	after	diff
APPEL, Karel	5/3/2006	85	347	662	315	37338	65067	27729
ARMAN, Fernandez	10/22/2005	77	134	318	184	12994	26259	13265
BACON, Francis	4/28/1992	82	11	30	19	2300000	640601	-1615245
BASQUIAT, Jean Michel	8/12/1988	27	67	241	174	13314	70586	57272
BERMUDEZ, Cundo	10/30/2008	94	34	33	-1	21301	53901	32600
BERNSTEIN, Theresa F	2/12/2002	111	22	50	28	3734	3946	212
BEUYS, Joseph	1/23/1986	64	11	46	35	5392	22710	17319
BOHROD, Aaron	4/3/1992	84	37	32	-5	2486	3000	514
BRATBY, John	7/20/1992	64	28	23	-5	1528	2297	768
BUFFET, Bernard	10/4/1999	71	386	352	-34	33978	26663	-7315
BURRI, Alberto	2/13/1995	79	21	44	23	76764	182489	105725
CADMUS, Paul	12/12/1999	94	56	52	-4	6685	15339	8655
CARRENO, Mario	12/20/1999	86	98	32	-66	55713	35329	-20384
CASCELLA, Michele	8/31/1989	96	57	62	5	3865	8210	4345
CESAR, Baldaccini	12/6/1998	77	33	53	20	2947	3035	87
CHAGALL, Marc	3/28/1985	97	144	346	202	91973	450482	358509
CHILLIDA, Eduardo	8/19/2002	78	31	124	93	14974	21115	6141
CLAVE, Antoni	9/1/2005	92	175	160	-15	28876	35852	6975
DALI, Salvador	1/23/1989	84	84	114	30	52566	75450	22883
DORAZIO, Piero	5/17/2005	77	234	408	174	9295	32964	23669
DUBUFFET, Jean	5/12/1985	83	166	423	257	29048	224160	195112
DYF, Marcel	9/15/1985	85	26	74	48	1704	5743	4039
DZUBAS, Friedel	12/10/1994	79	35	27	-8	12553	5143	-7410
EGGENHOFER, Nick	3/1/1985	87	53	13	-40	3747	7008	3261
EISENDIECK, Suzanne	6/15/1998	90	45	20	-25	2189	2355	166
ELLINGER, David	3/24/2003	90	44	60	16	1544	2689	1145
ERTE, Romain de Tirtoff	4/21/1990	98	68	66	-2	5167	4332	-835
FRANCIS, Sam	11/4/1994	71	240	293	53	102061	51142	-50919
FRANKENTHALER, Helen	12/27/2011	83	164	325	161	107644	132084	24440
FREUD, Lucian	7/20/2011	88	162	244	82	1000000	849150	-193375
FRINK, Elizabeth	4/18/1993	62	60	81	21	3229	3433	204
FROST, Terry	9/1/2003	87	107	293	186	5756	23564	17808
GALL, Francois	12/9/1987	75	70	144	74	2124	5285	3160
GISSON, Andre	7/28/2003	75	127	175	48	2216	2471	255
GRAVES, Morris	5/5/2001	90	35	28	-7	10934	22552	11618
GUAYASAMIN, Oswaldo	3/10/1999	79	38	31	-7	21746	26691	4944
GUTTUSO, Renato	1/18/1987	75	90	135	45	9559	18293	8734
HAMBOURG, Andre	12/4/1999	90	143	124	-19	6883	8097	1214
HAMILTON, Richard	9/13/2011	89	149	181	32	32885	28941	-3944
HARING, Keith	2/16/1990	32	56	200	144	4528	20248	15720
HARTUNG, Hans	12/8/1989	85	242	210	-32	38074	60436	22362
HAYTER, Stanley William	5/4/1988	86	27	40	13	3479	9048	5570
HELD, Al	7/27/2005	77	16	28	12	12350	39776	27426
HERON, Patrick	3/20/1999	79	18	52	34	5550	43807	38258
HIRSCHFELD, Al	1/20/2003	99	17	99	82	4356	6849	2493
IMMENDORF, Jorg	5/28/2007	61	97	129	32	19780	49179	29399
JERZY, Richard	2001	58	91	27	-64	1436	1009	-427

KINGMAN, Dong	5/12/2000	89	46	21	-25	2276	4093	1817
KIPPENBERGER, Martin	3/7/1997	43	5	67	62	3370	36737	33367
KITAJ, R. B.	10/21/2007	74	20	34	14	93738	65817	-27921
KLUGE, Constantine	1/9/2003	91	40	61	21	5201	4694	-508
KOONING, Willem de	3/19/1997	92	79	156	77	373222	350655	-22567
LE PHO	12/12/2001	94	78	94	16	7275	19980	12704
LEVIER, Charles	9/3/2003	83	64	52	-12	1231	1350	119
LEWITT, Sol	4/8/2007	79	205	399	194	13567	26281	12714
LICHTENSTEIN, Roy	9/29/1997	73	151	556	405	171558	95532	-76026
LORJOU, Bernard	1/26/1986	77	23	72	49	1547	5913	4365
LOVELL, Tom	6/29/1997	88	17	89	72	4500	13339	8839
LUCEBERT	5/10/1994	69	130	163	33	9200	6200	-3000
MANESSIER, Alfred	8/1/1993	81	79	53	-26	34798	9948	-24850
MARCA-RELLI, Conrad	8/29/2000	87	26	36	10	9378	19436	10057
MARTIN, Agnes	12/16/2004	92	48	37	-11	317036	1200000	833622
MASSON, Andre	10/28/1987	91	113	135	22	14737	58683	43947
MATTA, Roberto	11/23/2002	91	213	290	77	53287	73669	20382
MENKES, Zygmunt	8/20/1986	90	14	29	15	3679	3688	9
MITCHELL, Joan	10/30/1992	67	48	52	4	118490	102658	-15832
MOORE, Henry O M	8/31/1986	88	98	110	12	25750	34864	9114
MOTHERWELL, Robert	7/16/1991	76	99	80	-19	78949	42362	-36587
MUHL, Roger	4/4/2008	79	63	112	49	3983	4629	646
NESBITT, Lowell	7/8/1993	59	51	35	-16	2635	2123	-512
NOLAN, Sidney	11/28/1992	75	14	15	1	2603	47951	45348
NOLAND, Kenneth	1/5/2010	85	86	166	80	82795	156951	74156
OLITSKI, Jules	2/4/2007	85	23	84	61	33849	48596	14747
PAIK, Nam June	1/29/2006	73	12	34	22	10845	7362	-3483
PASMORE, Victor	1/23/1998	89	12	23	11	56256	19647	-36610
PIPER, John	6/28/1992	88	50	108	58	8945	6249	-2696
POLKE, Sigmar	6/10/2010	69	299	417	118	122813	474742	351929
PORTOCARRERO, Rene	4/27/1985	73	49	50	1	2460	5408	2948
RAUSCHENBERG, Robert	5/12/2008	83	174	143	-31	254506	556251	301745
RIOPELLE, Jean-Paul	3/12/2002	78	89	178	89	42304	136515	94211
RIVERS, Larry	8/14/2002	78	64	75	11	14473	40516	26042
RIZZI, James	12/26/2011	61	16	82	66	1571	1800	229
ROTH, Dieter	6/5/1998	68	37	90	53	3464	5001	1537
SAINT PHALLE, Niki de	5/21/2002	71	26	49	23	7421	7404	-17
SAURA, Antonio	7/22/1998	67	107	151	44	26266	34672	8406
SCANAVINO, Emilio	11/28/1986	64	11	81	70	1253	6659	5406
SCOTT, William	12/28/1989	76	31	22	-9	7142	15851	8709
SEBIRE, Gaston	12/13/2001	81	35	22	-13	2115	2327	212
SHEETS, Millard	3/31/1989	81	16	43	27	4294	6329	2035
SLOANE, Eric	3/5/1985	80	33	61	28	2294	4109	1815
SOYER, Raphael	11/4/1987	87	112	122	10	6103	6240	136
STAMOS, Theodoros	2/2/1997	74	74	62	-12	7439	7281	-158
STEINBERG, Saul	5/12/1999	84	67	49	-18	10736	12273	1537
TAMAYO, Rufino	6/24/1991	91	127	128	1	112195	226798	114603
TINGUELY, Jean	8/30/1991	66	42	86	44	10749	8637	-2112
TWOMBLY, Cy	7/5/2011	83	192	322	130	481648	1800000	1347472
VASARELY, Victor	3/15/1997	90	188	243	55	9707	9805	98

VENARD, Claude	1999	86	95	58	-37	1804	2675	871
VOSTELL, Wolf	4/3/1998	65	13	26	13	3394	3008	-386
WARHOL, Andy	2/22/1987	58	98	535	437	26686	117579	90893
WESSELMANN, Tom	12/17/2004	73	408	342	-66	33222	282873	249650
WIEGHORST, Olaf	4/27/1988	88	24	44	20	7341	13656	6315
WOLVECAMP, Theo	10/11/1992	67	17	67	50	6970	4653	-2317
WYETH, Andrew	1/16/2009	92	69	133	64	401728	222784	-178943
ZORNES, Milford	2/24/2008	100	92	50	-42	3317	2018	-1299
ZUNIGA, Francisco	8/9/1998	86	113	55	-58	6365	6700	335

Figure 4: Corrected auction prices against relative years of sale for 15 selected artists