

# From digital to new media art : A market perspective

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**FROM DIGITAL TO NEW MEDIA ART:  
A MARKET PERSPECTIVE**

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## **Abstract**

*In this research, a sample of 3413 auction records from 70 artists known as digital and new media artists is used for the construction of a hedonic price index and to analyze the relative price of the artworks' attributes. While the actual share of digital and new media artworks in the sample turns out to be too small (2.1%) to yield significant hedonic estimates for digital and new media art, price indices on other subsample segments (paintings, photographs and prints) allow to draw meaningful assumptions. It is indeed suggested that the price index for the photographic market may inform on the ongoing and future development of a market trend for digital and new media art.*

*Key words: digital art – new media art – art market – hedonic regression*

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## 1 INTRODUCTION

According to the 2013 TEFAF Art Market Report, the post-war and contemporary art segment has exceptionally well sold at auction in 2012. With a global value of € 4.5 billion this particular segment makes up for 43% of the total market value in 2012 (*The European Fine Art Fair* [TEFAF], 2013). These figures show that the artistic production starting from the 1950s until recent years has been very popular within the secondary art market. For the period going from July 2012 to June 2013, 46 out of the 50 best selling artists in terms of auction turnover were alive (artprice, 2013), which proves the high state of the demand for the contemporary art segment in the secondary market. While these top selling artists make up for a major part of the post-war and contemporary art market in term of value and fuel the high end of the secondary market, they only represent a tiny share of the contemporary art production (artprice, 2013).

The aim of this research is to shed light on one specific artistic practice that first emerged in the 1960s and quickly died out before making an interesting come back in the 1990s and thereafter. Initially identified as computer art, the massive development of technology, Internet and new media during the 1990s prompted an artistic revival categorized as digital art, also known as new media art. Referring to stages of artistic experimentation taking place at different periods, both terminologies however tend to be used in the same way by experts and institutions. Unless specifically stated otherwise, this research refers to them together as digital and new media art.

The renewed interest for digital and new media art can be illustrated by a range of events and trends recently observed on the art market, which, taken together, seem to indicate a growth of attention. To begin with, the 2013 edition of the Art Basel art fair ([www.artbasel.com](http://www.artbasel.com)) presented a Morning Conversation where new media art was presented to the audience of the art fair, emphasizing on the collectible dimension of a medium ignored by the art world in general and by the market in particular. More ambitious was the first edition of the Unpainted art fair ([unpainted.net](http://unpainted.net)), which took place in Munich in January 2014 and was thought to be the first international art fair entirely dedicated to new media art.

In Autumn 2013 worldwide renowned Christie's auction house ([christies.com](http://christies.com)) and Paddle8 online auction house ([paddleson.tumblr.com](http://paddleson.tumblr.com)) both organized online sales devoted to new media and digital art. Unlike Christie's, Paddle8 sale had a charity objective supported by Phillips ([phillips.com](http://phillips.com)) – the third biggest auction house in the world and the first one specialized in contemporary art sales – and by the blog website Tumblr ([tumblr.com](http://tumblr.com)). On this occasion, 20% of the sales were donated to Rhizome ([rhizome.org](http://rhizome.org)), an online platform dedicated for over 15 years to the preservation and diffusion of digital art. Last April, a few weeks back, a second Paddle8 benefit auction ([paddle8.com](http://paddle8.com)) took place online, putting on sale digital artworks this time in favor of the Link Art Center ([linkartcenter.eu](http://linkartcenter.eu)), a non-profit Italian organization involved in the promotion of projects merging art practice and new technologies.

It is specifically the recent activity on both the primary and secondary art market<sup>1</sup> that motivates the present research. All these events should provide reasonable signs for the existence of an established, or at least growing, digital and new media art market segment. Consequently, this research aims to confirm whether a market for digital and new media art practices does actually exist or not. The well attested lack of available information on trades on the primary art market (Candela & Scorcu, 1997, Ginsburgh et al., 2006) as well as the limited time at hand have both led to focus the research on the secondary art market, using data gathered from past transactions at art auctions. The main research question has been articulated as follows:

**Have artists recognized as digital and new media artists ever sold any digital and new media artwork at auction?**

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<sup>1</sup> The art market has sometimes been divided into three segments instead of two. According to Singer and Lynch (1994) and Robertson (2005), the primary art market refers to artists dealing directly with collectors, in the secondary art market the art dealer acts as an intermediary between artists and buyers, whereas the tertiary art market is the auction market where collectors, dealers and museums trade their works of art. This research paper considers the secondary art market to be the auction market.

To answer this question a hedonic regression was run on a sample of 70 artists<sup>2</sup> known as digital and new media artists, adding up a total of 3414 observations of artworks being sold at auction between 1987 and 2013. While the sample includes types of artworks beyond digital and new media art, it is hoped that the results will contribute meaningfully to a rich body of academic literature on the art market that has so far neglected artworks characteristics of the late 20<sup>th</sup> century onwards. While prints and photographs have been given some academic attention, videos and installations are for instance generally ignored although they have become increasingly common artistic practices traded on the market. Investigating into the market for digital and new media art may help to understand the dynamics between artists and the market and therefore contribute to address this gap. At the same time the research aims to provide more information to interested parties, professionals involved in the art market and amateurs alike, on an artistic practice that – the media attention and the recent top end auction sales left aside – remains generally unknown to the broader audience.

The thesis is structured as follows: first, the literature review presented in chapter 2 sets the historical, artistic and economic contexts of this research. Chapter 3 draws on the research design and the methodology. The analysis of the data is presented in chapter 4, followed by a discussion on the results in chapter 5. Finally, limitations and avenues for further research precede the conclusion to this paper.

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<sup>2</sup> see Table 3.1, Appendix 1



## **2 LITERATURE REVIEW**

The literature review is divided into six sections. First, digital art and new media art are introduced and a definition is provided. Second, the dynamics underpinning artistic innovation, with a focus on the role of experts, the construction of quality and the pricing mechanism are explained. In section 2.3, the relation between artistic innovation and the market is developed further taking the rise of the photographic market and the limited edition model as an example. Then, the distinction between financial and non-financial returns on art is highlighted in section 2.4 before moving on to the main methods applied to the study of the art market and presenting the hedonic regression method in section 2.5. The literature review concludes with a brief summary of the main arguments developed.

### **2.1 From digital art to new media art**

#### **2.1.1 Historical background**

With respect to digital technologies, the computer technology represents a central tool (Rush, 1999: 170), which initially developed in the military context of the Second World War. The first electronic digital computers able to store and process data – the Manchester Mk 1 and the ENIAC – were simultaneously created by British and North American universities during the 1940s. Besides computer machines, the post-war era also witnessed the development, spread and rising adoption of media and communication systems such as the telephone, the radio, the recorded music and eventually the television. All together these innovations gave rise to a set of information and communications technologies that opened up a new range of possibilities to modern societies through telecommunications, networking, interactivity and multimedia (Gere, 2004).

In the 1950s, the computer language reached the artistic context. Computation allowed artists to set and control the behavior of the machine according to pre-defined instructions (Dietz, 2005). While computer art illustrates the first attempt to bridge the gap between computer tools and the artistic process, the definition of an artistic language based on computer technology and sharing a common set of characteristics appeared to be

problematic. Of an experimental nature, early computer art essentially bore a scientific scope and used the visual arts as a field for testing the possibilities of the machine, rather than as an objective to contribute to the realm of artistic innovation. In such circumstances the computer art language that developed in the 1960s mainly stayed inside scientific labs as the result of scientists, engineers and artists' collaboration (Rush, 1999: 172).

Despite a couple of interesting experiments in the following years, it is not before the 1990s that artistic practices based on technology took off significantly. By that time, digital technologies had become more sophisticated and accessible to the general population, which in turn made it a more attractive tool to artists. These improvements prompted the development of new media and most importantly led to the advent of the Internet, all together participating to build a world of global connectivity (Paul, 2008: 7).

Far from the limited possibilities of the computer technology brought in the 1960s, digital art eventually entered a new field of artistic experiments better fitting under the terminology of new media art. Relying on digital technologies and based on new media, this set of artistic practices brings together a multitude of tools and mediums that can hardly be categorized within one strict aesthetic language (Rush, 1999: 170; Paul, 2008: 7).

### 2.1.2 The institutional context

From the beginning in the 1960s, digital art practice caught the attention of the artistic sector, especially at an institutional level. International museums such as the Institute of Contemporary Arts in London, The Museum of Modern Art (MoMA), the Jewish Museum New York and the Los Angeles County Museum of Art (LACMA) were already paying a great deal of attention to the artistic experiments merging art and science at the very end of the 1960s (Manovich, 2002). In an attempt to show the growing impact of technology within artistic processes, these venues reported on the emerging trends of the field, among which E.A.T. (Experiments in Arts and Technology) was deemed to be one of the most meaningful. Renowned artists like Jean Tinguely, Andy Warhol and Robert Rauschenberg contributed to it in the second half of the 1960s and special exhibitions devoted to E.A.T. took place at the Brooklyn Museum and at the MoMA around the same time (Paul,

2002). While these early developments cannot entirely account for the rise of digital and new media art as it stands today, they allow to draw a line of filiation and to show that the interest for embedding technology into visual arts was perceived by more than just a few amateurs as a new field of artistic experience.

However, as mentioned in the previous section, the institutional enthusiasm for technology-related art faded quite abruptly in the 1970s and only came back in the early 2000s with two important shows hosted by the Whitney Museum and the San Francisco Museum of Modern Art (SFMOMA)<sup>3</sup>. Meanwhile, smaller non-profit organizations ran by experts took over and ensured that such experimentations would continue by offering digital art a new supportive and promotional setting which allowed it to keep developing its own aesthetics. Both the Linz-based organization Ars Electronica (aec.at) founded in 1979 as well as the German ZKM Center for Art and Media Karlsruhe (www.zkm.de) created ten years later, provide meaningful examples of organizations involved into research and conservation programs, publications, festivals, exhibitions and awards. Digital-based artistic practices would have hardly been able to survive and get the acknowledgment they have recently gained without the long-term support – in terms of both conservation and diffusion – of such cultural organizations (Manovich, 2002).

### 2.1.3 Definition

The definition of digital and new media art presented hereafter results from a personal elaboration. Reviewing academic literature such as art history books (Rush, 1999; Paul, 2008), scientific articles (Wands, 2001; Dietz, 2005; Crowther, 2008) and catalogue exhibitions (Bitstreams, 2001; Holy Fire, 2008) – to name a few, has allowed to grasp the main developments of the practices embedded into digital and new media art. However, the literature also highlights justifications for the striking lack of clear definitions and the limitations bound to appreciating digital and new media art either as one artistic movement, or as two groups of artistic practices involved in one same

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<sup>3</sup> *Bitstreams* at the Whitney Museum (New York, 2001) and *010101: Art in Technological Times* (SFMOMA, 2001)

set of experimentations (Paul, 2008: 8; Dietz, 2005; Wands, 2001: 398). Consequently, the definition operates a main distinction, where,

Digital art primarily refers to the early artistic experimentations taking initially place in the mid 1950s and 1960s, based on the newly available digital tools mainly embedded in the computer technology. It mainly includes, but is not limited to:

- Computer graphics<sup>4</sup>, aka computer art and algorithm art
- Computer film<sup>5</sup> (also computer animation<sup>6</sup> in the early 1990s)

New media art encompasses mainly artistic practices flourishing in the 1990s, prompted by the advent of the Internet and by the range of new technologies that have come to characterize the era of global connectivity that prevails in current modern societies. It mainly includes, but is not limited to:

- Net based art<sup>7</sup>
- Computer animation<sup>8</sup>
- Interactive art<sup>9</sup>
- Light (and sound) environments, audiovisual installations<sup>10</sup>

Meaningful from an historical and artistic perspective, the distinction between digital art and new media art and its respective categories can however – for clarity purposes and within the scope of the present research – be merged into one unique definition, where digital and new media art refers to

### **Artworks produced and experienced through the use of digital tools and devices**

The technology embedded in digital and new media art points out to the reproducible nature of artworks that become potentially available to everyone

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<sup>4</sup> see the works of Manfred Mohr [www.emohr.com](http://www.emohr.com) and Vera Molnar [www.veramolnar.com](http://www.veramolnar.com)

<sup>5</sup> see Catalog, 1961, by John Whitney, <http://youtu.be/TbV7loKp69s>

<sup>6</sup> see the works of William Kentridge (South Africa, 1955) and William Latham (Great Britain, 1961)

<sup>7</sup> see Rafaël Rozendaal's websites <http://newrafael.com>

<sup>8</sup> see Julian Opie's films <http://www.julianopie.com/#/artwork/film/2005>

<sup>9</sup> see *Polar* (2001), by Carsten Nicolai and Marko Peljhan <http://archive.aec.at/prix/#36645>

<sup>10</sup> see *Vanishing Point*, from United Visual Artists (2:22) <http://vimeo.com/74308529>

For more see the work of French artist Miguel Chevalier (1959) <http://miquel-chevalier.com>

at the same time. From a market perspective and taken in their genuine format, these artworks resemble homogeneous goods and may take the characteristics of non-rival and non-excludable goods. The neoclassical economic theory classifies such goods as public goods, that is goods that cannot be traded on the market (Krugman & Wells, 2013). Accordingly, digital and new media artworks would appear to be most likely unmarketable art formats.

However, the rise of the photographic market in the second half of the 20<sup>th</sup> century provides an interesting illustration of artworks based on mechanical reproduction that eventually made their way to the art market through the limited edition model. Section 2.2 and 2.3 elaborate on the development of the photographic art market as it should help to understand how an artistic innovation becomes an art good traded on the market. This is deemed relevant in order to better understand the position of digital and new media art in the market.

## **2.2 Artistic innovation**

The development of the visual arts in the 20<sup>th</sup> century impacted both on the structure of the market and on the role of its agents. Focusing on contemporary art since the 1960s, Moulin (1994) describes how artistic innovation is brought to market and explores the values associated with art works. She argues that in order to enter the market and to be attractive to buyers, an artistic innovation requires the joint appreciation of dealers, collectors and cultural institutions. Together they assign cultural and economic values to an artwork, both of which are extrinsically constructed (Belk, 1986).

### **2.2.1 Modern art markets and the role of experts**

Among the agents involved in the construction of art values, art dealers have lately occupied a prominent position, especially on the primary contemporary art market where artworks are being sold for the first time. Appearing initially in the late 19<sup>th</sup> century, entrepreneur-dealers and leader galleries deeply transformed the artistic selection system (Wijnberg & Gemser, 2000). As they developed and expanded in the first half of the 20<sup>th</sup> century, dealers have more recently become reference agents influencing

both cultural and economic agents around them (Moulin, 1994). The central role of dealers and their proliferation comes from the need for knowledgeable experts able to evaluate critically the numerous artistic innovations that have appeared throughout the century. Initiated by the French Impressionists in the last quarter of the 19<sup>th</sup> century, the role of the dealer-expert has expanded as the pace of innovation increased. Prompted by “conceptual innovators” (Galenson, 2011: 1923), artistic innovation in the 20<sup>th</sup> century resulted from the artist’s personal ideas and inspiration, which led to a variety of artistic practices and of artistic movements (Galenson, 2011). Such developments also affected the structure of the market since art dealers favored competition among artists and urged artists to create innovative art. In this particular artistic context the dealer became a referent for quality to buyers and hence a reliable intermediary on the art market.

At that time, dealers also collaborated closely with museum institutions that adapted to this new valuation system based on innovation (Wijnberg & Gemser, 2000). On top of their traditional mission for conservation, museums started to participate actively in the assessment of quality of art through temporary exhibitions and the acquisition of contemporary art works. As modern museums entirely dedicated to the collection of contemporary art developed, curators gained the expertise and entered the sphere of art experts, hence developing closer ties with art dealers and galleries. With the additional collaboration of art historians and critics, all these experts came to work together and share the cultural knowledge necessary to make the artworks credible to the audience (Bonus & Ronte, 1997).

### 2.2.2 The construction of quality

Collaboration and consensus among experts operating in the art world is key, since it signals credibility to the public and generates economic value. Unlike the auction market where the economic value of an artwork is put to a test, the primary art market is the place where the economic value is being assigned for the first time (Velthuis, 2003). There, the dialogue with the public is especially important as the quality assessment of an artwork does not rely on objective criteria but specifically depends on the information released by knowledgeable experts. Whether an artist is credible to the public or not

ultimately depends on these certifiers of quality and their ability to recognize all together the artistic value of such artist's work. Forming a strong network of insiders, these experts initiate credibility but remain dependent on the reception by the audience. It is indeed crucial that a critical mass acknowledges and recognizes the quality of a new artist, before an economic value can be generated on the market. Long and uncertain, the process of creating credibility shows similarities to path-dependency, a mechanism that tends to occur in incomplete markets characterized by high transaction costs. Path-dependency is noticeable in so far present choices are likely to impact on future ones. Indeed, since high search costs are invested upfront in order to spot a noteworthy artist, to display his or her work and to familiarize the public to his or her style, it is very unlikely that a dealer drops an artist halfway through. In light of these arguments, the path-dependency process provides a good explanation of why, regardless of the skills or of the objective qualities of an artwork, some artists become more successful than others on the market (Bonus & Ronte, 1997).

### 2.2.3 The meaning of price

Since the economic value of an artwork rests on the credibility of the public, the price works as a signifier of the quality of the artwork, of the reputation of the artist and of the status of both buyers and market intermediaries (Velthuis, 2003). Thus, rather than expressing a simple economic value, prices are important for the subjective meanings they convey. Drawing from a sociological analysis of prices, Velthuis (2003) highlights two particular dynamics of price that regulate the art market and which seem to have been widely adopted by market agents. The first dynamic consists in avoiding the decrease of the selling price of an artwork whereas the second sets artworks' prices according to size. According to Velthuis (2003), the first mechanism provides a stable point of reference to buyers and prevents from harming the credibility of artists, and consequently intermediaries – a credibility that is, as mentioned above, hard to set in the first place and tends to be path-dependent. In turn, Velthuis' (2003) findings also prove that setting price according to size offsets the lack of clear and objective standards to measure the aesthetic quality of art. Indeed, seeing

price increase as the size increases (until a certain point) tends to indicate to some buyers that the main change translated in the price relates to the size and that all artworks of the same size share an equivalent quality<sup>11</sup>. Most interestingly, Velthuis (2003) describes these two pricing norms as economic anomalies because the first mechanism – never decreasing the price – ignores the concept of price elasticity – while the second one – setting price according to size – does not take the state of the demand into account.

Bonus and Ronte (1997) as well as Velthuis (2003) illustrate the subtlety of the functioning of the art market and the power of subjective meanings attached to purchasing and owning a piece of art. Since the art market is characterized by a lack of transparency, meaning that information about the quality of the piece or about the willingness to pay of the buyers is difficult to obtain (Velthuis, 2011), price provides an alternative reference to dealers and buyers (Sagot-Duvaroux, 2011). In the primary market, where reputation is being built and quality uncertainty is high, price provides buyers a comparison tool and a reference point to appreciate the evolving career of living artists. In the secondary art market the role of price as a conveyor of symbolic meanings is more striking as prices inform not only about the fame of the artist but may also tell about the history of the artwork and the status of the previous owner. Finally, in the secondary art market the price paid will most importantly serve the status and reputation of its future owner.

### **2.3 The artistic revolution of the 20<sup>th</sup> century**

On the primary art market, the process of assessing the quality of innovative artworks and making them credible to the public is often complex, especially because supply is potentially unlimited. This was clearly illustrated when photography and video became attractive means of production to visual artists in the 20<sup>th</sup> century. Challenging the traditional characteristics of heterogeneous and thus unique artworks being sold on the market, both the photography and the video media deeply affected how art is produced and how it is collected.

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<sup>11</sup> Beside Velthuis (2003), other price setting systems exist in the contemporary art market. Setting price multiplying the squared size of the artwork by the coefficient of the artist is one of them.



### 2.3.1 Mechanical reproduction

While the French Impressionists were the first to break the Academic classification of genres and to use their direct surroundings as inspiration for the subject of their paintings, mechanical reproduction probably represents the most meaningful artistic innovation of the 20<sup>th</sup> century. Benjamin (1955) describes mechanical reproduction as a process through which the aura of art is getting lost in favor of a massive adoption of the art object. Whereas the pure essence of the aura, which does not exist per se, has traditionally assimilated external values such as religious, political or social ones, the development of photography and movies has operated a change in the perception of art. With mechanical reproduction being acknowledged as an artistic process, the uniqueness and authenticity of the artwork – what Benjamin (1955) defines as the cult value of art – have been lost, favoring its exhibition value and its existence as a product.

Unlike paintings that are unique artworks reserved to the elite and connoisseurs, photography and film have allowed for the simultaneous contemplation and consumption of an artwork by a large number, making it an artistic good available to the greatest number. On the other hand, mechanized artistic production has soon been perceived as a powerful means to reach masses, and as highlighted by Benjamin (1955), to potentially manipulate them. In the end, with the advent of artistic photography in the beginning of the 20<sup>th</sup> century, artworks have taken on the social function of art, a dimension key to the development of the contemporary art market.

The reproducibility of artworks combined with a rising demand from a wider audience has deeply transformed the structure of the art market. Art market agents more specifically had to bring these new artworks on the market in a way that would on the one hand meet traditional buyers' expectations and habits, while, on the other hand, responding to the general increase of interest for visual art.

### 2.3.2 Photography: from artwork to art good

If innovation became central to the valuation of an artwork (Wijnberg & Gemser, 2000) by the end of the 19<sup>th</sup> century, it only constitutes one of the

three criteria characterizing the artistic convention that was established in the 20<sup>th</sup> century art market. Defined as the “convention d’originalité” by Moureau and Sagot-Duvaroux (2008), it adds uniqueness and authenticity as key criteria considered for the quality assessment of an artwork. Already implicitly considered for traditional productions such as paintings, these two last characteristics gained importance with the era of mechanical reproduction. Indeed, relying on a production process that potentially allows unlimited replication, photography did not meet in the first place the requirements of the market. Therefore, in order to attract buyers, experts had to assign photography the status of an artwork. The transformation implied to build public credibility, and thus to transform an initially unlimited resource into a scarce good. Limited editions slowly appeared to be an interesting solution since they enabled the photographic innovation to enter the market for visual art while artificially limiting the supply (Balsom, 2013). Rarity, the key principle of the new convention would then be preserved and stand as the point of reference everyone would agree on, be it market and cultural agents or collectors.

In the 1960s, three main reasons accounted for the development of the limited-edition model (Sagot-Duvaroux, 2008). First, an increasing number of artists began to use photography as part of their artistic process. This in turn raised the attention of experts such as collectors and curators who recognized the new artistic possibilities brought along by the photographic medium. Finally, this enthusiasm reached the market and the dealers who seized the new opportunity and opened the first galleries in the USA and in Europe. In addition, limited editions helped to keep track of the number of prints made from an original print and more importantly to create a hierarchy according to their rarity (Moureau & Sagot-Duvaroux, 2008). For the sake of preserving the authentic dimension of the photograph, the vintage print – the print made at the time of the shooting by the artist – was established as the most authentic and thus the most valuable, whereas prints such as reprints – made by someone else after the artist’s death – occupy the lower end of the hierarchy.

Toward the end of the 20<sup>th</sup> century the limited edition model had become a norm, which allowed defining and hierarchizing the market value of initially homogeneous and unlimited artworks. Whereas the model was first

intended for the development of photographic market, it did not limit its application to it. Prints (i.e. screen prints, lithographs, etchings) should also be added to the list, as well as – using Horowitz’s words, immaterial art (Horowitz, 2012). Referring to photographs for they provide a means to capture the physicality of ephemeral artworks, Horowitz (2012) includes video art and installations as well. Primarily intended to impose an artificial scarcity to photographic art works, the limited edition model has actually proved to be a useful market tool for many more contemporary artistic innovations that are not to be seen as marginal or oriented against the market anymore, but merely as mainstream practices used in both commercial and non commercial artistic contexts.

## **2.4 Art and the market**

The price mechanism underpinning the emergence of the photographic market provides a meaningful illustration of the complex process through which the symbolic value of art is constructed. The adoption of the limited-edition model plays a key role in reducing uncertainty and determining a market value. This requires the interplay of knowledgeable experts who all together build a discourse of legitimation that makes the innovation credible to the public and eventually valuable in market terms. Furthermore, the adoption in the 1990s of the same model for video art (Balsom, 2013) comes to confirm its suitability and approbation by all the parties involved in the diffusion, buying and selling of contemporary artistic processes that proliferated throughout the past century and continue to do so today. However, regarding movies and films, the Balsom (2013) remains skeptical as the model may also restrict and undermine the development of media artworks which were initially created as an alternative to the market and which original scope often overlooked the financial return and, in most instances, still does.

### **2.4.1 The limited edition model and financial returns**

Although including an important tradeoff – the imposition of an artificial scarcity – the limited edition model rose in the 1980s, especially with regards to the market for photographs. Among the first research on the investment value of photographs, (1996) considers sales realized at American auctions

for the period between 1980 and 1992 and finds an average annualized rate of return of 33.3%. Particularly high, this rate is however not representative of the real value of the photographic market as it merely reflects the takeoff of a young market segment that received a great deal of attention at a time when the art market as a whole was doing really well. In addition the short period under study (1980-1992) represents a great limitation to the repeated-sale method (RSR) that is employed by Pompe (1996), as it does not capture the possible fluctuations and adjustments of the market over time. As one of the two main methods used for the measurement of returns on art investment, the repeated-sale method compares the change in the price of an artwork within a certain timeframe and is thus only applicable to artworks that have been sold at least twice on the market. Therefore, the larger the timeframe under study, the more accurate the repeated-sales results are likely to be. Applying a repeated-sales method on an almost 30 year period (1977-2004) Pesando and Shum (2008) were able to get a more accurate idea of the real return on modern prints – another type of art goods sold in the form of limited editions. Their analysis yields a real average return of 1.51% per year, which confirms the limitations of Pompe (1996) and shows that the return is actually lower than the estimated returns on paintings observed for a similar period and analyzed by Mei and Moses (2005).

#### 2.4.2 Non-financial returns

Empirical studies devoted to the measurement of art as a financial asset have led scholars to make a distinction between the financial and the psychic returns on art. Indeed, as in many occasions it appears that art investment yields lower financial returns than for investments in conventional assets, focusing on psychic returns can allow to better understand the motivation underlying the purchase of art goods. Identified in the form of aesthetic pleasure by Baumol (1986), these psychic returns have been discussed in detail by Frey and Eichenberger (1995). In an attempt to explain the anomalies that characterize the art market (i.e. lack of rational behavior, especially regarding utility maximization) the authors argue that art holds a consumption good dimension that needs to be included in the returns resulting from the ownership of an art piece. One interesting valuation method

used to estimate the psychic returns of owning art is the rental fee model, carried out by Atukeren and Seckin (2007). Although ignoring the possible returns yielded by the ownership effect (Frey & Eichenberger, 1995), the estimated psychic return reaches about 28% of the sale price of an art good. However, this percentage tends to be cancelled out by the transaction costs bound to purchasing art (calculated according to fees applicable at international auction houses). The estimated 28% found in Atukeren and Seckin (2007) study nonetheless help to grasp the singularity of the art market compared to traditional financial market and to understand why pure speculators are likely to be mainly attracted by the latter market rather than the former (Frey & Eichenberger, 1995).

## **2.5 Methods for the study of the art market**

As introduced in section 2.4.1, the repeated-sale regression is suitable for the construction of indices on works of art that have been sold at least twice on the market. The method thus requires taking into account large time spans in order to increase the chances to see one same artwork on the market again. In addition, aggregation problems may also arise in the calculation of a single market return, since one same artwork may have been sold repeatedly on markets using different currencies and subject to different fiscal laws (Candela & Scorcu, 1997). An alternative to the repeated sale method is provided with the average painting method that calculates a market index based on the average sale price of a sample of artworks traded in a given period. As Candela and Scorcu (1997) illustrate taking Stein's (1977) study as an example, one specific criterion is chosen in order to select as systematically as possible artists and artworks that will be included in the sample under study. Stein (1977) for instance included in his sample artworks that were traded on the market only after the authors had deceased. Although the average painting method enables to consider more observations than the repeated sales method, the logic of creation of the sample remains somehow subjective and assumes unique artworks being closed substitutes to each other.

A third way to build art market indices consists of the representative painting method. Elaborated by Candela and Scorcu (1997) and drawing from the average painting method, this representative painting method bypasses the randomness of the sample selection highlighted in the average painting method by including the average estimate prices in the calculation. Indeed the index is drawn from computing the ratio of the average market price (that is the hammer price) to the average estimated price of the artwork. Initially used to measure the market performance of individual artists' works, the method can be aggregated to consider artistic movements as well.

Whereas the representative painting method assumes that the quality of the artwork is embedded in its average estimates, the hedonic regression method (HR) regresses the quality components from the price of the artwork. This method is thus the only one that considers non-price variables for the construction of art market indices. Moreover, as for the average and the representative painting methods, the hedonic regression method is not limited to artworks that have already been sold at least twice (Chanel et al., 1996). By controlling for the characteristics of an artwork, the hedonic regression method also informs about the willingness to pay of buyers for specific characteristics (Worthington & Higgs, 2006). The method may therefore provide an interesting tool to dig a little further into the consumption components attached to the ownership of art goods highlighted in the previous section.

### 2.5.1 The hedonic regression method

Together with the repeated-sale regression, the hedonic regression represents the most common estimation methods used for the construction of art market indices (Ginsburgh et al., 2006). Initially developed in the context of agricultural economics as a method allowing measure the weight that qualitative characteristics have on vegetable prices (Waugh, 1928), the hedonic method was for the first time applied to the art market by Anderson in 1974 and later by Chanel et al. (1996). The main principle of the method consists of splitting up the value of an object, here an artwork, into its various characteristics, each of which bears an implicit price. The selection of the characteristics varies according to the available information at hand but

generally includes intrinsic qualities of the artwork such as size, medium, technique and provenance, as well as extrinsic qualities such as the name of the artist, the auction house and the place of auction. Then, the price of each artwork is regressed on the selected characteristics, and the residuals – that is the characteristic-free prices – are used for the construction of the price index (Ginsburgh et al., 2006).

The present study uses the log-price hedonic model (Chanel et al. 1996), based on dummy variables that reflect the price variation of an artwork over time. Given a total of  $N$  artworks indicated as  $i$  ( $i=1, \dots, N$ ), and a set of periods  $t$  ( $t=0, \dots, T$ ), the existing relationship between the characteristics of the artwork  $i^{\text{th}}$  sold at the time  $t$  and its price  $p_{it}$  is

$$p_{i,t} = f(v_{1,it}, v_{2,it}, \dots, v_{m,it}, t), \quad (1.1)$$

With  $p_{i,t}$  the price of the artwork  $i$  ( $i = 1, \dots, N$ ) sold at the time  $t$  ( $t = 0, \dots, T$ ) and  $v_{k,it}$  the generic characteristic  $k$  ( $k = 1, \dots, m$ ) which describes the artwork. The formula (1.1) can then be broken down as a product of 3 different terms: the effect of the characteristics on the price of the artwork, the overall effect of the market on the price of the artwork at the period  $t$ , and a factor representative of the non-measurable components. Considering the natural logarithm of the price of  $i^{\text{th}}$  artwork, the relationship can be written

$$\ln p_{i,t} = a(v_{1,it}, \dots, v_{m,it}) + b(t) + \varepsilon_{it}, \quad (1.2)$$

With  $a(v_{1,it}, \dots, v_{m,it})$  the function (stable in time) relative to the impact of the characteristics on the price of the artwork,  $b(t)$  the market effect (variable in time) on the price of the artwork, and  $\varepsilon_{it}$  the random error. Once the characteristics of the artwork have been included in the term  $a(v_{1,it}, \dots, v_{m,it})$ , the term  $b(t)$  can be defined as a 'grey painting' in the sense that the artwork  $i$  ( $i = 1, \dots, N$ ), which has been removed of the weight of the characteristics that make it a unique piece, can now be confronted to the other artworks. Rewriting the term  $a(v_{1,it}, \dots, v_{m,it})$  and  $b(t)$  as a summation, we obtain

$$\ln p_{i,t} = \sum_{k=1}^m a_k v_{i,k} + \sum_{\tau=0}^T \delta_{\tau} c_{it} + \varepsilon_{i,t}$$

(1.3)

Where  $a_k$  the implicit marginal values associated to every characteristic of  $v_{i,k}$  artworks (with  $k=1, \dots, m$ );  $\delta t$  ( $t = 1, \dots, T$ ) represents the log-price indexes normalized to 1 for the base year 1987 and it is also the intercept of the regression line, whereas  $c_{i,t}$  is a dummy variable with the value 1 if the artwork has been sold in the time period  $t \in [t, T]$ , and with the value 0 otherwise, and  $\varepsilon_{it}$  the random error. With the implicit prices  $a_k$  known (obtained through the regression of the dummy variables  $v_{i,k}$ ), these can be extracted from the selling price  $p_{i,t}$  of the artwork  $i$ , as to only get the impact of time and the influence of the error (the non-observable components) for the construction of the price indexes over the time period under study. (1.3) can therefore be written isolating the impact of time and the error in the right part of the equation

$$\ln p_{i,t} - \sum_{k=1}^m a_k v_{i,k} = \sum_{t=0}^T \delta t c_{i,t} + \varepsilon_{i,t} \quad (1.4)$$

In (1.4) the right part of the equation is the logarithm of the price of the artwork  $i$  sold at a time  $t$  without the implicit prices of its characteristics. The price of the 'free' characteristics can be obtained regressing all the 'free' characteristics on the dummy variables (one for every observation) relative to the time  $t$ . The dummies take the value 1 when the artwork was sold during the period under study, or the value 0 otherwise.

The hedonic regression is suitable for the study of the art market as a whole and some macro categories as well as for particular artistic movements, artists' careers and specific genres (paintings, photographs and so on) and their corresponding periods. The method thus allows for flexibility in the creation of a variety of indices. However, as a general observation, the hedonic method works better with large databases. Indeed, the more observations are included, the more accurate the analysis is likely to be. A critical step of the method regards the selection of representative qualitative variables – dummy variables – to be included in the regression model (Ginsburgh et al., 2006). As pointed out by Candela and Scorcu (1997), the



hedonic method requires a strong hypothesis: a global appreciation of the factors that influence art market prices. In order to prevent a bias, it is important not to leave key characteristics out, be they linked to the components of the artwork, the artist or the auction house. However a good balance is not easy to find. Whereas a few variables may not capture the main characteristic of an artwork, too many variables may miss it out just as much.

### 2.5.2 The Heckit Model

In the hedonic regression the price represents the dependent variables on which the different qualities of the artwork – the independent variables – are regressed. Therefore, as it is, the method does not take unsold artworks into account. A few studies have however shown that leaving these unsold artworks out can lead to a selection bias and therefore yield inaccurate results (Collins et al., 2009). This can become particularly compromising when studying art segments that present a relatively high rate of unsold artworks as for instance is the case with recent or less renowned artistic movements such as digital and new media art. The two-stage Heckit model consists first of the estimation of a probit model in order to understand what determines whether an artwork is sold or not (Seckin & Atukeren, 2012). As the following equation explains:

$$z_i^* = w_i' \gamma + u_i \quad i = 1, \dots, N$$

The latent variable has a binary outcome that can take either the value 1 for prices realized at auction, or the value 0 otherwise.

The second stage of the Heckit model is based on a modified hedonic model obtained with the following conditional regression function:

$$E(y_i | z_i^* > 0) = x_i' \beta + \delta \lambda_i \quad i = 1, \dots, n$$

Which, unlike in the traditional hedonic model, contains the conditional latent variable  $z_i^*$  and an additional variable  $\lambda_i$  that corresponds to the Inverse Mill's Ratio ([IMR here after] Verbeek, 2008: 241, equation 7.84), which equals to:

$$\lambda_i = \frac{\phi(w_i' \gamma)}{\Phi(w_i' \gamma)}$$

The IMR variable is used to test whether both the sold and unsold artworks derive from random independent samples or not. It may therefore help to define whether to consider only sold artworks creates a bias in the selection of the sample used for the creation of the indices (Seçkin & Atukeren, 2012).

Developed later than the other methods reviewed above, the Heckit model offers a useful complement to the traditional hedonic regression model. It may be useful to consider it in the present research.

## 2.6 Summary

The literature review has first contextualized and defined digital and new media art stressing both its innovativeness and its limited suitability for trade.

Section 2.2 introduced artistic innovation and described how it became a key criterion on the primary art market since the end of the 19<sup>th</sup> century. It was argued that besides being innovative, an artwork also has to be compatible with the market by being authentic and unique. Together these three criteria – innovativeness, authenticity and uniqueness – have come to account for the quality of an artwork and have thus characterized the selection process through which an artwork is being assigned a market value. Acting as certifiers of quality, art dealers, collectors and institutions are all agents of the market that collaborate together to make an artwork credible to the public and therefore valuable to buyers.

In section 2.3, the rise of the photographic market served as an illustration for the complex dynamics underpinning the construction of quality and economic value of artworks on the primary art market. Mechanically reproducible, photographs are radically different from the artworks traditionally traded in the first half of the 20<sup>th</sup> century. In this respect photographs share striking similarities with digital and new media art today. It was shown that photographs were only able to enter the art market through the adoption of the limited edition model, which however represented an important tradeoff,

namely the alteration of the genuine quality of the artwork. Initially disputed, the limited edition model eventually proved its worth and became widely acknowledged within the art market, spreading to other artistic innovations such as videos by the end of the 20<sup>th</sup> century.

Section 2.4 then drew on the returns on art. A distinction was operated between the financial and the non-financial returns of investing in art. Considering both types of returns was essential in order to get a complete insight of the motivations of buyers.

Finally the literature review ended with section 2.5 which presented key methodologies used to analyze quantitatively the art market. The method used in this research, the hedonic regression, was explained in greater details.

### 3 METHODOLOGY

In this chapter, the research question and preferred methodology are stated in section 3.1. Information on the process of data collection is given in section 3.2 to explain how the sample of 3413 auction records was created taking as the main selection criterion artists acknowledged as digital and new media artists. The sample of artworks is then described in section 3.3, thus highlighting the different types of art genres included in the sample, with digital and new media artworks accounting for only 2.1% of the total. On the other hand, photographs, paintings and prints abound and represent a good share of the artworks made by digital and new media artists.

Given the importance of photographs, paintings and prints in the sample, and given the postulate made in chapter 2 that digital and new media art could follow the steps of photographs in order to enter the market, performing the hedonic regression on the total sample is confirmed as the preferred methodology in section 3.4. Indeed, whereas the number of digital and new media artwork is insufficient to grasp the specific attributes that sell or not at auction, the hedonic regression will nonetheless allow to inform on the characteristics of the artworks sold by these artists. Section 3.5 then explains how the variables were selected.

#### 3.1 Research question and method

The research question is:

**Have artists recognized as digital and new media artists ever sold any digital and new media artwork at auction?**

A definition of digital and new media art was provided in section 2.1.3:

**Artworks produced and experienced through the use of digital tools and devices**

The following digital and new media art formats are considered:

- Computer film
- Net based art

- Computer animation
- Interactive art
- Light (and sound) environments, audiovisual installations

Computer graphics is not taken into account as the practice mainly refers to an early experimental stage of the digital art, and stands apart from the rest of the formats listed above.

The hedonic regression (HR) method was initially preferred as it is suitable for the study of relatively recent artistic productions that may not have a long history on the resale market. Moreover, by attributing a price to each characteristic of the artwork, the method allows to grasp the willingness to pay of buyers for specific characteristics. These aspects were of utmost relevance in the case of digital and new media art, which development appears a quite recent one and which practice embeds a variety of experimentations.

The hedonic regression was performed using a program developed within the European project Marie Curie IAPP Glocalfineart (Global contemporary art market: The intrinsic and sociological components of financial and artistic value of artworks). The features of the program are similar to those offered by SPSS, including some improvements.

### **3.2 Data collection**

A critical step of the hedonic regression that is widely reported in the literature regards the representativeness of the sample under observation (Candela & Scorcu, 1997, Ginsburgh et al., 2006). A particular attention was devoted to the selection of the artists in order to avoid a sample bias. Only artists known as digital or new media artists, or that are acknowledged as participating actively to these artistic fields, were included in the sample following verifications that they had sold artworks at auction. This implied numerous researches on the websites of relevant artistic institutions and organizations, as well as consulting art history literature. In order to increase the chances to find marketable artists, both non-commercial and commercial artistic platforms were considered.

Table 3.2 summarizes the creation of the sample of artists by institution. The second column of the table gives the total number of artists listed in each of these sources, whereas the third column adds up only the number of artists found with sold records on Artvalue. The Artvalue price database (artvalue.com) was used to collect the auction records for these artists. Whereas more than 400 artists were initially found, the third column of the table shows that only 86, which actually refers to 70 artists<sup>12</sup> after withdrawing repeated occurrences, were found with auction records on Artvalue. The Artvalue price database is an access free database created in 1987, that includes approximately 1 500 000 auction results, dispatched over 160 000 artists and around 900 international auction houses worldwide.

**Table 3.2:** Creation of the sample of artists

<b>Institution</b>	<b>Tot. artists listed</b>	<b>Num. artists artvalue</b>
Compart	208	29
New York Digital Salon	57	25
Ars Electronica	81	5
ArtSy	74	10
Bitforms art gallery	28	6
Unpainted art galleries	11	1
<b>Total artists</b>	<b>449</b>	<b>86 (70)</b>

Source: own elaboration

The collection of the auction records of the 70 artists on Artvalue led to the creation of a dataset adding up 3413 observations between 1987 and 2014. Of this total of records, 2597 are sold artworks (76%) and 817 unsold artworks (24%).

Details about the selection process of artists by institution are provided hereafter. First, among the non-commercial online platforms, Compart (Centre of Excellence Digital Art) a database for digital art (dada.compart-bremen.de/) listed a total of 208 artists of which 29 appeared on Artvalue.

Then, the annual exhibitions organized by the New York Digital Salon, 1993-2005 (nydigitalsalon.org/), enabled to add 25 artists among the 57 who participated to it.

The online archive of the art and research center, festival and prize Ars Electronica found five artists on Artvalue, out of the 81 winners of the Golden

<sup>12</sup> see Table 3.1, Appendix 1 for the listing of the 70 artists including full name, birth (and death) year, nationality.

Nica Award ([archive.aec.at/prix/](http://archive.aec.at/prix/)) in the following categories<sup>13</sup>: computer graphics, computer animation, interactive art, net based art, hybrid art, media art research. The category interactive art yielded 3 artists on Artvalue, computer graphics and hybrid art one artist each, whereas no artists was found for computer animation and media art research.

Artsy ([artsy.net](http://artsy.net)), an online artistic platform that has both an education and a commercial dimension, facilitated the research process thanks to categories helping to browse artworks by genre. The categories 'computer art' and 'net art' included several artists that were also listed in other databases, but ten additional artists belonging to the computer art section (out of 66) could however be added to our list. On the other hand, none of the 23 artists – of which 15 also appeared in the computer art section – were found on Artvalue.

Moreover, among the 28 artists represented by the Bitforms gallery, New York ([bitforms.com/](http://bitforms.com/)) and those whose works are available there, six artists were found to have records on Artvalue. The Bitforms represents one of the very few art galleries entirely dedicated to selling digital and new media art, and was therefore an important source to consider. Other galleries selling digital and new media art were considered, mainly those which participated to the first edition of Unpainted art fair taking place in Munich in January 2014. However it was rather difficult to gather information on these art galleries' websites since most of them are not exclusively active in the digital and new media art segment. It was thus challenging and very time consuming to differentiate which artists presented on their websites met the criteria to be included in our sample. A quick look on a couple of well structured and clear websites led to pick up one additional artist that did not show in any of the other institutions mentioned above.

It is important to stress that as the search for artist was moving forward, the repetition of artists increased, which in turn provided a sign for a satisfactory and comprehensive research. This impression was confirmed by the information found in the art history literature that was either poor in term of naming artists or in a few instances when it did featured names of artists,

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<sup>13</sup> The Golden Nica prize is also distributed in other categories that appeared of secondary importance within the scope of this research

these had either already been inserted in the sample or were not listed on Artvalue.

In addition, it should be noted that a few institutions, including the Archive of Digital Art (ADA - digitalartarchive.at) and the Los Angeles Center for Digital Art (LACDA - lacda.com/) were contacted by email in the hope of receiving artists' names more rapidly and in a convenient format such as an excel table or equivalent .To date none replied.

### 3.3 Descriptive statistics

#### 3.3.1 Composition of the sample

The sample contains 3413 records of artworks sold at auction, spread over 70 artists selected on the criterion of being acknowledged as digital and new media artists or following this stream of artistic practices. Table 3.3 shows that taken as a whole the type of artworks included in the dataset resulted very heterogeneous.

**Table 3.3:** Sample distribution by artistic genre

ARTISTIC GENRE	N° OBSERVATIONS	% TOTAL SAMPLE
photographs	968	28.36
paintings	802	23.5
prints	700	20.51
installations, video, multimedia	136	3.98
drawings	101	2.96
watercolor	101	2.96
sculptures	359	10.52
collages & assemblages	214	6.27
others	32	0.94
<b>total</b>	<b>3413</b>	<b>100</b>

Source: own elaboration

The division by genre of artwork operated by Artvalue shows that the sample at hand is largely dominated by photographs (28%), paintings (24%) and prints (21%). Many sculptures (11%) are also found. On the other hand, this sample composition reduces the chances for digital and new media artworks that are likely to be found within the installations, video and multimedia category that accounts for a tiny 4% of the sample.



### 3.3.2 Installations, video, multimedia

The Artvalue category Installations, video and multimedia contains a total of 136 observations, of which 71 correspond to electronic based artworks, meaning that the electronic component stands at the core of the artwork. These artworks match the definition of new media and digital art applying to this research, and can thus be considered as such.

Of the 71 artworks, there are:

- 47 computer animations
- 10 video installations (installations made up of several elements, one of which is the video)
- 5 videos which type is not specified
- 1 video game
- 1 interactive multimedia application
- 1 video projection including an audio system
- 6 artworks featuring a screen but complementary information is missing.

The 65 remaining records are mixed media artworks which feature for the most part electric components such as wire, neon, light box and alike. Electronic components such as TV sets and recorders may also be used, but are in all cases presented as sculptural objects, meaning that their electronic system does not run.

Table 3.4 shows the distribution of the 71 digital and new media artworks among artists. Julian Opie (UK, 1958) accounts for the biggest share with 47 artworks (66%), followed by Pipilotti Rist (Switzerland, 1962) with 12 artworks (17%). The 12 artworks left are thus dispatched among nine remaining artists. It is interesting to note from the table that, except for the artists with only a few observations, these digital and new media artworks represent a minimal percentage of the artist's total artworks brought to auction. Indeed, the 47 digital and new media artworks produced by Opie only account for 11% of the 404 auction records reported, whereas it reaches 14% for Rist.

Of the artists for which digital and media artwork(s) represents 100% of the artists' total number of observations in the sample, a quick internet search allows to observe that two out of three artists, namely Rafael Lozano-Hemmer (Mexico, 1967) and Mark Napier (Usa, 1961), clearly describe themselves as digital and new media artists. Their presence in the sample, though marginal, seems to hint that digital and new media art is making its way on the secondary art market.

**Table 3.4:** Distribution of digital and new media artworks among artists

<b>Artist</b>	<b>n° obs.</b>	<b>% electronic based artworks</b>	<b>% artist's tot n°obs</b>
OPIE	47	66%	11%
RIST	12	17%	14%
MENGBO	3	4%	15%
ARCANGEL	2	2.8%	40%
CAMPBELL	1	1.4%	50%
HUYGUE	1	1.4%	6%
KIENHOLZ	1	1.4%	0.8%
LOZANO-HEMMER	1	1.4%	100%
NAPIER	1	1.4%	100%
NICOLAI	1	1.4%	100%
WEINSTEIN	1	1.4%	14%
<b>total</b>	<b>71</b>	<b>99.60%</b>	

Note: The totals may not add up to 100 due to rounding  
Source: own elaboration

Looking at the hammer prices of the 71 occurrences, 18 digital and new media artworks report a zero value, which means that the artwork did not sell. The lower price realized goes for a DVD dated from 2005, made by Matthew Weinstein (Usa, 1964) and sold for £380 at Phillips, London, in December 2012. Although impossible to confirm, the probability of a bought-in is likely as the estimation for this artwork ranges between £3,000 and £4,000. At the other end of the tail, the most expensive digital and new media artwork sold for £61,250 at Sotheby's London. Made by Julian Opie (UK, 1958) in 2004, the artwork represents a LED animation, estimated between £40,000 and £60,000.

Leaving out the 18 unsold observations, Table 3.5 shows that the mean price (in euros) of the sold digital and new media artworks (n=53) is 18977 Euros (SD=19463). With a value of 17205 Euros, the median shows

that the prices are essentially equally distributed around the mean price. In the total sample of sold artworks (n=2597) the mean price (13320) is considerably higher than the median (4520). This difference seems to indicate that the mean price of the total sold artworks is positively skewed by outlier prices of artworks that achieved particularly high prices at auction compared to the rest of the sample. Moreover, the high value reported by the standard deviation (SD=30346) confirms that the prices of sold artworks in the total sample are very much dispersed around the mean.

**Table 3.5:** Mean price for sold digital and new media artworks and for total sold artworks

		<b>Hammer price total digital and new media artworks sold (Euros)</b>	<b>Hammer price total sample sold (Euros)</b>
N	Valid	53	2597
	Missing	2544	0
Mean		18977.36	13320.38
Median		17205.00	4520.00
Std. Deviation		19463.423	30346.344
Range		67575	487450
Minimum		467	50
Maximum		68042	487500

Source: SPSS

The small number of digital and new media artworks in the total sample does not allow for further analysis. Based on the sample and the distribution of artworks among artistic genre it appears that only 71 artworks correspond the definition of digital and new media art, which represents 2.1% of the total sample. One main observation derived from the above is that artists recognized as digital and new media artists do not primarily sell digital and new media art on the auction market, with a few exceptions.

### **3.4 Hedonic regression**

Section 3.3 highlighted how only 2.1% of the total artworks considered match the definition of digital and new media art elaborated in the present study. More importantly, such artworks tend to only represent a fraction of the artists' work, except for two artists, despite the fact that data collection of

auction records was based on the selection criterion of artists known as digital and new media artists.

Given the importance of photographs, prints and paintings in the sample and the postulate made in chapter 2 that digital and new media art could follow the steps of photographs and prints to access the art market through the limited-edition model, running the hedonic regression on all artworks sold by these artists remains valid in the eye of the author. This should allow to comment on the characteristics of the artworks sold by these artists and their relative impact on the price. Further, market indices on the three main medium categories of the sample – photographs, paintings and prints – are deemed relevant to potentially inform on market trends and to eventually formulate assumptions and observations regarding digital and new media art.

### 3.4.1 Selected variables

In order to perform the hedonic regression, six qualitative variables were created. The variables were created in conformity with the usual procedures described in the literature (Ginsburgh et al., 2006, Sproule & Valsan, 2006), where the characteristics taken into account generally depend on the information reported in auction catalogues. Table 3.6 lists all six qualitative variables, with a description.

**Table 3.6:** List of variables and description

<b>Variable</b>	<b>Description</b>
Artistic genre	The broad artistic category to which the artwork belongs
Main technique / medium	The principal characteristic of the artwork (further developed in 3.4.2)
Auction house	Variable that groups the auction house with one (or several) cities
Production year	The year at which the artwork was produced
Auction year	The year at which the auction sale took place
Artist nationality	The nationality of the artist

Source: own elaboration

Tables 3.7 to 3.12 (Appendix 1) list all the dummies for each of the six variables, including their distribution in the total sample. The dummies for the auction house were created taking the place of the sale into account. Indeed capital cities such as New York and London are notable hubs of the art market where major auction houses hold their most important sales (Sproule & Valsan, 2006). Although regarded as one of the most important vector of value (Becker, 1982; Moulin, 1992; Bonus & Ronte, 1997), the name of the artists were not added as dummies because of the fairly new and marginal character of digital and new media art and the consequent relative anonymity of its artists. Moreover, although included in most of the hedonic regression performed on the art market (Ginsburgh et al., 2006), the variable size was not included. Information provided by Artvalue was not consistent enough in this respect and did not systematically report the dimensions, or only partially.

#### 3.4.2 Elaboration of the variables: restrictions

The creation of the variables resulted difficult due to the heterogeneity of the artworks included in the sample (see Table 3.3, Appendix 1). Operating a systematic distinction between the medium of the artworks and their techniques did not appear possible as most of the time several media were used for a single artworks and techniques were either multiple, incomplete or in some instances not very understandable from the given description. These difficulties led to the definition of the variable 'main technique/medium' that is based on the selection of one representative characteristic of the artwork – although it may often not be the only one. While this approach helped to create categories encompassing a significant share of the artworks present in the sample, some other artworks presented components that were too specific. Taking most of the time the form of sculptural works, such problematic artworks were made of so many components that it was impossible to get an idea of their actual form. Moreover, in this respect the artworks' descriptions provided by Artvalue did not help as they listed one after the other the different materials of the artwork without additional precision that could justify the selection of one specific component that could take precedence over the others. With more time available, an alternative could have consisted of deducing the main medium or technique of these

artworks by looking at the pictures accompanying the description on the Artvalue website<sup>14</sup>.

In the end, the best option available was to group a considerable amount of these artworks within a dummy named 'other', as a category of the variable main technique/medium. In light of this limitation, the rest of the dummies for the variable main technique/medium were defined in the best possible way, as reported in Table 3.7. A dummy named 'screens' accounts for the digital and new media artworks of the sample.

**Table 3.7:** Dummies for main technique/medium

<b>D</b>	<b>BY MAIN TECHNIQUE / MEDIUM</b>	<b>N° OBSERVATIONS</b>	<b>% SAMPLE</b>
1	acrylic	265	7.7
2	mixed media	222	6.5
3	oil	304	8.9
4	vinyl	55	1.6
5	paintings others	97	2.8
6	(vintage) gelatin silver print	509	14.9
7	chromogenic print	136	4
8	photographs others	315	9.2
9	silkscreen/screen print	503	14.7
10	prints others	212	6.2
11	screens	71	2.1
12	installations	69	2
13	watercolor + gouache	82	2.4
14	ink	76	2.2
15	others	497	14.6
	<b>total</b>	<b>3413</b>	<b>99.8</b>

Source: own elaboration

Note: The total may not add up to 100 due to rounding

<sup>14</sup> Considering the pictures published by Artvalue is however bound to the assumption that they are available and of descent quality – which was not guaranteed.

## 4 DATA ANALYSIS

The hedonic regression reported hereafter was performed on a total of 2597 observations, which refers to the total sold artworks in the dataset. As reported in Table 3.6 in the previous section, the regression included the following six variables: 1) Artistic genre 2) Artist nationality 3) Production year 4) Auction house 5) Auction date 6) Main technique/medium. The dummies for each of these variables are presented in Tables 3.7 to 3.12 (Appendix 1).

The global index has an  $R^2$  of 0.59 (Adj.  $R^2 = 0.58$ ),  $df = 82$ ,  $df$  residual = 2515, and is significant at  $p < 0.001$ , meaning that the regression is solid and the model statistically valid. In other words, the variables considered in this model account for nearly 60% of the price of the artworks included in the sample. Furthermore, the  $R^2$  and the adjusted  $R^2$  are essentially equal, which shows that the sample is large and well structured.

### 4.1 Hedonic estimates for the global index

While some of the hedonic estimates yield interesting findings on the general index, especially with regards to artistic genres and auction houses, observations on the technique/medium of the artworks are more limited. This may be explained by the great heterogeneity of the artworks included in the sample, which accounts for the several non-significant coefficient values reported for the corresponding categories.

**Table 4.1:** Estimates for main technique/medium

<b>MAIN TECHNIQUE / MEDUIM (Base category acrylic)</b>				
	Coeff.	Sig.	Std. Error	t-stat.
prints others	-0.22		0.16	-1.35
screens	1.04		0.63	1.65
installations	1.00		0.57	1.82
watercolor + gouache	-0.05		0.28	-0.18
ink	0.09		0.20	0.44
others	-0.14		0.13	-1.06
mixed media	-0.12		0.13	-0.86
oil	0.15		0.10	1.50
vinyl	0.56	**	0.20	2.77
paintings others	0.03		0.14	0.25
(vintage) gelatin silver print	0.47	*	0.21	2.26
chromogenic print	-0.21		0.22	-0.99

photographs others	-0.03		0.20	-0.17
silkscreen/screen print	-0.41	*	0.17	-2.43

Source: own elaboration

Table 4.1 shows that among the 15 categories for the variable main technique/medium, artworks made out of vinyl appear to sell for more than artworks made out of acrylic (0.56,  $p < 0.01$ ). However, this result should be considered carefully since the number of observations for artworks made out of vinyl is significantly lower than for artworks made out of acrylic. With a beta coefficient of 0.47 and  $p < 0.05$ , the gelatin silver print technique sells at a higher price than artworks made with acrylic. On the other hand, the trend goes the other way around for silkscreen and screen print based artworks that sell in average for less than those with acrylic (-0.41,  $p < 0.05$ ).

Table 4.2 shows that price differences between the printing and the photographic techniques are reflected in the statistics for artistic genres.

**Table 4.2:** Estimates for artistic genre

<b>ARTISTIC GENRE (Base category photographs)</b>				
	Coeff.	Sig.	Std. Error	t-stat.
paintings	0.91	***	0.19	4.91
prints	-0.41	*	0.16	-2.56
installations, video, multimedia	-0.34		0.57	-0.59
drawings	-0.10		0.20	-0.51
watercolors	0.20		0.29	0.69
sculptures	1.01	***	0.18	5.68
collages & assemblages	0.91	***	0.19	4.86
others	-0.15		0.27	-0.56

Source: own elaboration

With a coefficient of -0.41 ( $p < 0.05$ ) prints generally reach lower prices than photographs. Paintings is the leading category among artistic genres, with prices that are significantly higher than for photographs (0.91,  $p < 0.001$ ). Furthermore, both sculptures and collages & assemblages categories appear to command higher prices (with coefficients respectively at 1.01 and 0.91,  $p < 0.001$ ) than photographs. However no straight conclusion can be drawn from these two estimates since the number of observations for both sculptures and collages & assemblages is substantially smaller than for



photographs (and paintings and prints). Moreover, the multi-compositional nature of the artworks belonging to the sculpture and collage & assemblages categories (see section 3.3.2 *Elaboration of variables: limitations*) should be regarded too.

Table 4.3 reports the statistics on the provenance of the artists, where British (0.68,  $p < 0.001$ ) and Iranian are the two best selling nationalities (1.17,  $p < 0.001$ ). In reality these values concern mainly the works of two specific artists that both present an important number of observations in the sample and that can thus be thought of as having an established reputation and value on the auction market. Prices for French artists also appear to be higher (0.57,  $p > 0.001$ ), whereas German artists on the other hand tend to reach lower prices (-0.32,  $p < 0.01$ ) than the base category USA. Finally, other nationalities, which include Asian and South American artists seem to sell for more than American artists (0.70,  $p < 0.01$ ).

**Table 4.3:** Estimates for artist nationality

<b>ARTIST NATIONALITY (Base category Usa)</b>				
	Coeff.	Sig.	Std. Error	t-stat
Germany	-0.32	**	0.12	-2.71
Argentina	0.28	*	0.12	2.37
France	0.57	***	0.11	5.32
Switzerland	0.18		0.11	1.60
UK	0.68	***	0.12	5.69
Iran	1.17	***	0.11	10.22
Europe + Canada	-0.07		0.11	-0.66
others	0.70	**	0.22	3.2

Source: own elaboration

Estimates on the auction houses (in table 4.4 below) show that, regardless of the place, Christie's, Sotheby's and Phillips, do not yield any statistical difference with respect to the base category Christie's New York. These results match with the literature (Sagot-Duvaroux, 2006) and previous research (Worthington & Higgs, 2005, Sroule & Valsan, 2006) about the overall dominance of these three auction houses on the secondary art market. On the other hand, it is found that all other auctions venues sell for considerably less, with significance at  $p < 0.001$  everywhere, except for Artcurial auction house, Paris ( $p < 0.01$ ). However, the estimates regarding the

auction house should not to be taken as a specific characteristic of the sample, but rather as an invariant result regardless of the attributes of the artworks. Such perspective helps understand why on the other hand, the dummies for the other variables do not give as many significant estimates.

**Table: 4.4:** Estimates for auction house

<b>AUCTION HOUSE (Base category Christie's - New York (Usa))</b>				
	Coeff.	Sig.	Std. Error	t-stat
Meeting Art - Vercelli (IT)	-0.77	***	0.16	-4.85
Cornette de Saint-Cyr - Paris (FR), Bruxelles (BL)	-1.21	***	0.15	-7.84
Van Ham Kunstauktionen - Köln (D)	-0.98	***	0.16	-6.24
Lempertz (D)	-0.97	***	0.16	-6.04
Artcurial Briest, Poulain, F. Tajan - Paris (FR)	-0.40	**	0.15	-2.61
Bonhams - London (UK)	-0.95	***	0.18	-5.37
Bonhams - other	-0.76	***	0.19	-3.92
Auction houses low sales - German speaking countries	-1.21	***	0.11	-10.73
Auction houses low sales - other Europe	-1.45	***	0.11	-13.59
Auction houses low sales - extra Europe	-0.91	***	0.13	-7.13
Sotheby's - New York (USA)	0.10		0.12	0.89
Christie's - London (UK)	-0.12		0.11	-1.08
Sotheby's - London (UK)	0.21		0.13	1.68
Christie's - other	-0.12		0.12	-1.02
Sotheby's - other	0.21		0.13	1.56
Phillips - New York (USA)	-0.24		0.12	-1.89
Phillips - UK	-0.04		0.17	-0.26
Germann Auktionen - Zurich (CH)	-1.14	***	0.15	-7.74

Source: own elaboration

Finally, not much can be deduced from the estimates of the production year (see Table 4.6, Appendix 1). For what regards the auction year, none of the statistics are significant (see Table 4.5, Appendix 1). This observation, coupled with the large diversity of artistic genre and their different degrees of representativeness in the sample, are all factors that make the elaboration of a global price index irrelevant. For this reason the next section focuses on the creation of market indices related to the three artistic genres present in the sample that command the highest prices – photographs, paintings and prints.

## 4.2 Sub-indices

The similar number of records between the sub-samples for photographs, paintings and prints allows not only to comment on individual market indices but also to compare their respective trends.

Observations on the hedonic estimates for each of these three artistic genres substantially relate to those on the global index. However estimates for the variable production year, especially for photographs and paintings, deserve a greater attention. Within photographs (see Table 4.7, Appendix 1) it is found that later productions sell for significantly more than the early photographs of the 1980s. Indeed, photographs produced between 1990 and 2000 – and thus sold at auction afterwards – reach higher prices than in the previous periods (0.51,  $p < 0.05$ ). This tendency then increases with photographs produced and sold after 2006 (0.76,  $p < 0.01$ ), which may in turn inform about the growing interest of buyers for the photographic medium and its artists. Interestingly, paintings (see Table 4.8, Appendix 1) produced between 1980 and 1990 as well as between 1990 and 2000 seem to loose the attention of the buyers at auction (respectively -0.95,  $p < 0.001$  and -0.46,  $p < 0.01$ ). All the statistics for all three indices are reported in Tables 4.7 to 4.9 (Appendix 1).

**Table 4.7:** Estimates for oroduction year within the photographic index

<b>PHOTOGRAPHS - PRODUCTION YEAR</b>				
	Coeff.	Sig.	Std. Error	t-stat
1980-1990	0.28		0.27	1.03
1990-2000	0.51	*	0.22	2.34
2000-2006	0.34		0.22	1.56
2006 -	0.76	**	0.28	2.68
no data	0.32		0.26	1.24

Source: own elaboration

**Table 4.8:** Estimates for production year within the painting index

<b>PAINTINGS - PRODUCTION YEAR</b>				
	Coeff.	Sig.	Std. Error	t-stat
1980-1990	-0.95	***	0.15	-6.16
1990-2000	-0.46	**	0.15	-3.18
2000-2006	0.04		0.18	0.23
2006-	-0.27		0.25	-1.09
no data	-0.48	**	0.17	-2.84

Source: own elaboration

Looking at the price indices should help grasp the overall market trend of the three artistic genres. The indices spread from 1991 to 2013 and are normalized at 100 in the year 1999, with all values reported hereafter in Table 4.10.

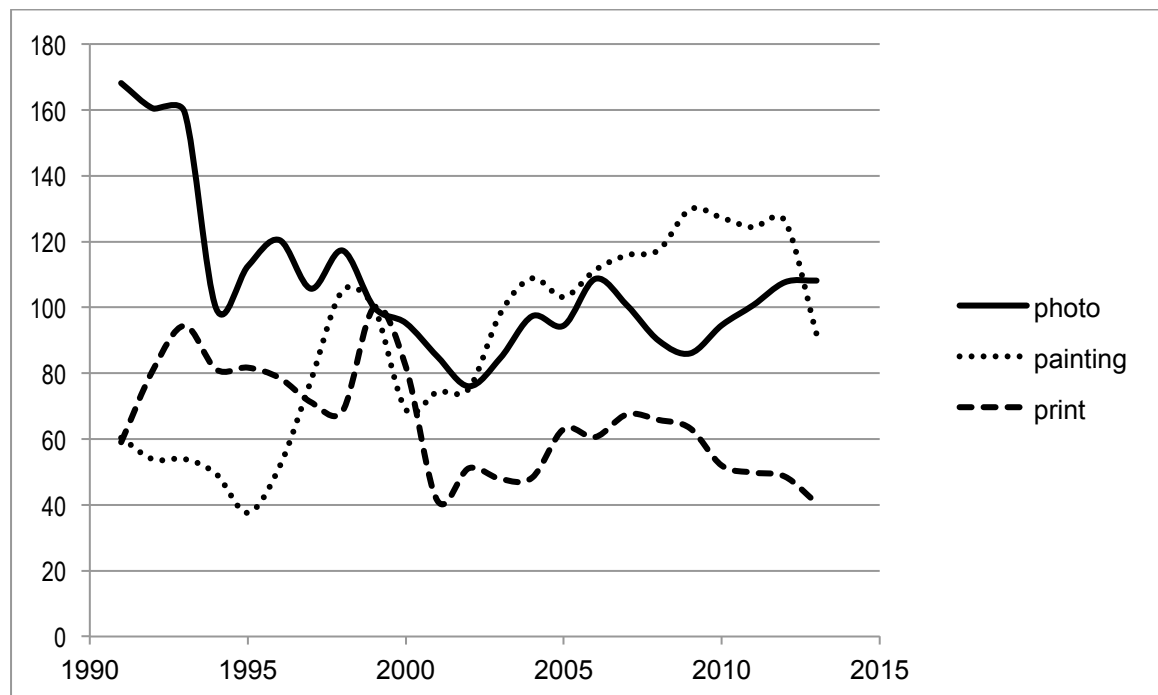
**Table 4.10:** Art indices for photographs, paintings and prints (%)

index	photographs	paintings	prints
1991	168	60	59
1992	160	54	81
1993	159	54	94
1994	100	49	81
1995	112	38	82
1996	120	52	79
1997	106	78	71
1998	117	105	68
1999	100	100	100
2000	95	69	82
2001	85	74	41
2002	76	75	51
2003	85	98	48
2004	97	109	48
2005	94	103	63
2006	109	111	61
2007	101	116	68
2008	90	117	66
2009	86	130	63
2010	95	127	52
2011	101	124	50
2012	108	126	49
2013	108	92	41

Source: own elaboration

As a general observation it can be said that the market trend over the selected period appears rather unstable for all three indices. Indeed, as shown in Figure 4.1, the annual averages vary greatly from year to year. The Anova test (Figure 4.2, Appendix 1), used to compare the variance between means confirms that the variance between the mean value of each index – respectively photographs (mean value: 107.48), paintings (mean value: 89.58) and prints (mean value: 66.22) is statistically significant at  $p < 0.001$ . Taking a closer look at the movement of these three indices over the years 1991-2013 will help discuss this variance further.

**Figure 4.1:** Market trend for photographs, paintings and prints (1991-2013)



source: own elaboration

Interestingly enough, in 1991 the value of the photograph market (168%) surpasses significantly the value of the painting (60%) and the print (60%) market segments. This phenomenon mirrors Pompe's (1996) findings regarding the high returns yielded by photographs on the art market in the period going from 1980 to 1992. Growing significantly in the 1970s, the market for photographs reaches a peak in the 1980s (Moureau & Sagot-Duvaroux, 2008) and probably also benefits from the recession that affected the art market in 1990. Indeed, at that time photographs were relatively new on the market and affordable, which made them an attractive alternative to collectors and new buyers willing to start purchasing art (Balsom, 2013). The great deal of attention drawn on the photographic market in turn affects the existing traditional market – as illustrated here with paintings and prints – which ends up losing a portion of their market value in the early 1990s. However, the fleeting high value of the photographic market is shown in the following years, especially between 1993 and 1994, when the market loses about 40% of its value (from 160% to 100%). After this important loss, the photographic market seems to start stabilizing, with average values ranging

between 80% and 120% from 1995 and 2013, except for 2002 where the aggregate market value for the segment reaches its lowest point at 76%.

Reaching its highest peak in 1999, the value of the market for prints over the period from 1991 to 2013 is substantially lower than both the markets for photographs and paintings. Decreasing slightly in 2000, the value of the print market drops by half of its value in 2001, falling from 81% in 2000 to 42% the following year. Recovering at 67% of its value in 2007, the market for prints represents the less profitable market with respect to the photographic market and most importantly in comparison to paintings. Indeed, while the value of both the print and the painting market segments decreases between 2000 and 2001, the painting market segment goes up again in 2001, slowly but steadily increasing in value, and reaching 126% in 2012.

The opposite movement in trends for the print market and the painting market developing from 2001 onwards is also observable in the correlation matrix between all three indices (see Table 4.11, Appendix 1). At  $p < 0.05$  the painting and print price indices indeed appear negatively correlated (-0.51). The same goes for the prices between the painting market and the market for photographs (-0.49,  $p < 0.05$ ). Although decreasing less importantly than the market for prints, the average annual prices for photographs did not significantly increase either. Except in recent years (2009-2013) where a 22% increase is noticeable, the evolution of the photograph market over the entire period (1991-2013) shows that on average the global value of the market has decreased. A similar general market pattern can be observed on the print market where average annual prices over the entire period are characterized by a downward sloping trend line. The correlation matrix indeed confirms the positive correlation between market trends for photographs and prints (0.42,  $p < 0.05$ ), meaning that both indices are negatively correlated with the painting index over the entire period (1991-2013).

## 5 RESULTS

The results of the hedonic regression performed on a sample of 2957 digital and new media artists' artworks sold at auction between 1987 and 2014 do not allow to assert the existence of a market segment for digital and new media art. Accounting for only 2.1% of the total of sold artworks in the sample, digital and new media art appears to be a marginal phenomenon on the auction market. The hedonic regression suggests that it is indeed too early to estimate the price-characteristics of digital and new media art, and to draw a price index.

However, the descriptive statistics on the composition of the sample give a positive answer to the initial research question formulated in this paper – as to whether digital and new media artists have ever sold digital and new media art at auction. Although digital and new media art accounts in most cases for a minor share of the artist's total amount of artworks sold at auction, it is being traded on the secondary market and can therefore not be totally ignored.

Beyond digital and new media art, the estimates of the hedonic regression on the global index of artworks enable to see which attributes of artworks produced by digital and new media artists do sell best at auction. Overall, it is found that paintings and photographs command higher prices than the rest of the artistic genres present in the sample. On the other hand, prints appear to sell for significantly less. Including a similar number of occurrences, the estimates yielded for these three artistic genres can be considered with confidence. Further observations regarding the best selling techniques or mediums are difficult due to the heterogeneity of the artworks included in the sample and their unequal distribution.

The analysis of the market trend for photographs, paintings and prints over the years 1991-2013 shows that the three price indices follow different dynamics. Whereas the value of the painting market keeps increasing overall, the value of the photographic market decreases significantly in the first ten years before stabilizing around the 2000s.

To conclude, the analysis of the hedonic price indices for paintings and photographs allows to articulate the hypothesis that both paintings and

photographs serve as an alternative to digital and new media artists who are confronted to an art market that is yet not ready for digital and new media artworks. While paintings represent a traditional artistic format, bearing thus an ascertained market value, the predominance of photographs in the sample under study shows that the photographic format may offer a good compromise to digital and new media artists.

As for digital and new media art, the presence of such artworks in the sample confirms that their sale at auction exists but is fairly rare. Should this type of art be able to find a marketable model like photographs did through the limited-edition model, trends in the photographs market segment are likely to be relevant by informing on the volatility and stabilization process of the segment.



## **6 LIMITATIONS**

The aim of this research is somewhat ambitious and points out to four main limitations.

First, the research attempts to construct a price index for digital and new media art based on sales on the auction market. Digital art and new media art is however a recent artistic practice that may be too young to be accurately analyzed on the resale market.

Second, the creation of the sample of digital and media artists is based on the assumption that the artists are known as digital or new media artists or have actively participated to these artistic fields. The selection criterion could be more specific.

Third, the heterogeneity of the sample of artworks does not facilitate the creation of dummies, which may affect the accuracy of the hedonic estimates and hence limit the comparison between categories.

Fourth, the traditional hedonic regression model used in this paper does not take into account the unsold artworks present in the sample. Considering also unsold records, the Heckit model enables to be more comprehensive and hence to reduce the chances of a sample bias.

## **7 FURTHER RESEARCH**

At this point, the primary art market is probably more suitable for the study of the digital and new media art segment and for analyzing its marketability. Art fairs focused on new media art, such as Unpainted Munich, provide a good starting point to have access to art galleries and artworks.

Four reasons make such research particularly appealing:

- Art fairs are accessible to everyone
- Artworks are on display and can thus be appreciated with precision
- Gallerists are present and can provide meaningful information
- Prices are available

All together these conditions should allow getting a better insight of the most common digital and new media art formats available for sale on the primary art market. In turns, art fairs also provide a favorable environment to approach

potential buyers and understand the motivations driving their presence at such art fair and their purchases of digital and new media artworks.

On a second stance, it would also be interesting to analyze whether the market for digital and new media art has evolved, following a similar method than the one used in the present study. Indeed, performing a hedonic regression, using this time the Heckit model, on a sample of auction records would allow to understand which specific attributes of digital and new media art have durably entered the art market.

## 8 CONCLUSION

This research has attempted to draw a market trend for digital and new media art. This was motivated by the great deal of attention that this artistic practice has received in recently, both on the primary and on the secondary art markets. First emerging in the 1960s with digital art, new media art appears in the 1990s, spurred by the emergence of the Internet and other technologies.

In order to test the hypothesis of a market, a hedonic regression was performed on a sample of 3413 auction records corresponding to artworks from 70 artists specifically selected for being known as digital and new media artists. Digital and new media art was defined as referring to artworks produced and experienced through the use of digital tools and devices.

The overall findings do not attest for the existence of an established market for digital and new media art. Only 71 auction records, which account for 2.1% of the total occurrences, match the given definition. The hedonic estimates demonstrate that paintings and photographs are the best selling types of artwork sold by the digital and new media artists of the sample.

However, this paper suggests that it is possible to draw a parallel between the rise of the photographic market and the development of a market for digital and new media art. During the first half of the 20<sup>th</sup> century photographs represented a criticized artistic practice that – given its reproducible nature – came to challenge an art market used to deal with unique artworks. A similar phenomenon could well apply to digital and new media artworks. Relying on computer and new media technologies, these artworks do not necessarily fit the rules of a market where scarcity – in other words uniqueness – represents a key condition.

The photographs price index drawn from the sample demonstrates that the market segment for photographs did take some years to stabilize and to be able to compete with acknowledged artistic formats such as paintings.

Taking the development of the photographic market as an example, this paper concludes that digital and new media art could be currently experiencing a similar stage of development on the art market. This transitional phase may in turn explain why it is found that digital and new

media artists appear to sell a majority of non-digital and new media artworks on the secondary market.

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## Chapter 3

**Table 3.1:** Sample of artists including number of observations, full name, birth (and death) year, nationality

<b>NUM. OBS.</b>	<b>LAST NAME</b>	<b>FIRST NAME</b>	<b>BIRTH YEAR</b>	<b>DEATH YEAR</b>	<b>COUNTRY</b>
5	ARCANGEL	Cory	1978		USA
45	BENEDIT	Luis Fernando	1937	2011	Argentina
82	BERNI	Antonio	1905	1981	Argentina
233	BIASI	Alberto	1937		Italy
1	BRIAND	Mathieu	1972		France
2	CAMPBELL	Jim	1956		USA
11	CAO	Fei	1978		China
51	CHEVALIER	Miguel	1959		France
1	COLDWELL	Paul	1958		UK
44	COLLISHAW	Matt	1966		USA
16	DEIRA	Ernesto	1928	1986	Argentina
36	DOUGLAS	Stan	1960		Canada
18	DUPUY	Jean	1925		France
27	FONTCUBERTA	Joan	1955		Spain
1	GARTEL	Laurence	1956		USA
69	GERSTNER	Karl	1930		Switzerland
10	GREENFIELD-SANDERS	Isca	1978		USA
12	HAACKE	Hans	1936		Germany
5	HART	Claudia	1955		USA
26	HEIDERSBERGER	Heinrich	1906	2006	Germany
2	HERSHMAN	Lynn	1941		USA
3	HOROWITZ	Ryszard	1939		Poland
17	HUYGHE	Pierre	1962		France
2	JACKSON	Barry	1949		South Africa
6	JOHAN	Simen	1973		Norway
1	JOHANNESSON	Sture	1935		Sweden
1	KAC	Eduardo	1962		Brazil
212	KEETMAN	Peter	1916	2005	Germany
124	KIENHOLZ	Edward	1927	1994	USA
277	LOHSE	Richard Paul	1902	1988	Switzerland
1	LOZANO-HEMMER	Rafael	1967		Mexico
7	MAC ENTYRE	Eduardo	1929		Argentina
46	MARCACCIO	Fabian	1963		Argentina
2	MARINO	Mario	1967		Austria
20	MENGBO	FENG	1966		China
13	MOHR	Manfred	1938		Germany
367	MORELLET	François	1926		France
7	MUNTADAS	Antonio	1942		Spain

Source: own  
elaboration

1	NAPIER	Mark	1961		USA
474	NESHAT	Shirin	1957		Iran
56	NICOLAI	Carsten	1965		Germany
404	OPIE	Julian	1958		UK
8	PAMULA	Jan	1944		Poland
97	POLESELLO	Rogelio	1939		Argentina
4	QUEJIDO	Manuel	1946		Spain
66	QUINTE	Lothar	1923	2000	Germany
9	RA'AD	Walid	1967		Lebanon
2	REDL	Erwin	1963		Austria
3	RIDELL	Torsten	1946		Sweden
83	RIST	Pipilotti	1962		Switzerland
15	ROMBERG	Osvaldo	1938		Argentina
4	SALAVON	Jason	1970		USA
3	SCHNITGER	Lara	1969		Netherlands
132	SCHÖFFER	Nicolas	1912	1992	Hungary
1	SEGAL	Miri	1965		Israel
2	SEVILLA	Soledad	1944		Spain
36	STAUDT	Klaus	1935		Germany
4	STEELE	Jeffrey	1931		UK
45	STRUYCKEN	Peter	1939		Netherlands
3	VERHOEVEN	Jeroen	1976		Germany
11	VIDAL	Miguel Angel	1928		Argentina
13	VOGEL	Peter	1937		Germany
61	VRIES de	Herman	1931		Netherlands
7	WEINSTEIN	Matthew	1964		USA
3	WILLATS	Stephen	1943		UK
20	WILLIAMS	Christopher	1956		USA
22	YTURRALDE	José Maria	1942		Spain
1	ZIEGLER	Toby	1972		USA
20	ZOUNI	Opy	1941		Greece
<b>3413</b> <b>obs.</b>	<b>70 artists</b>				<b>23</b> <b>nationalities</b>

**Table 3.2:** Creation of the sample of artists

<b>Institution</b>	<b>Tot. artists listed</b>	<b>Num. artists artvalue</b>
Compart	208	29
New York Digital Salon	57	25
Ars Electronica	81	5
ArtSy	74	10
Bitforms art gallery	28	6
Unpainted art galleries	11	1
<b>Total artists</b>	<b>449</b>	<b>86 (70)*</b>

Source: own elaboration

\*The total of artists adds up to 70 after withdrawing the repeated occurrences

**Table 3.3:** Sample distribution by artistic genre

<b>ARTISTIC GENRE</b>	<b>N° OBSERVATIONS</b>	<b>% TOTAL SAMPLE</b>
photographs	968	28.36
paintings	802	23.5
prints	700	20.51
installations, video, multimedia	136	3.98
drawing	101	2.96
watercolour	101	2.96
sculptures	359	10.52
collages & assemblages	214	6.27
others	32	0.94
<b>total</b>	<b>3413</b>	<b>100</b>

Source: own elaboration

**Table 3.4:** Distribution of digital and new media artworks among artists

<b>Artist</b>	<b>n° obs.</b>	<b>% electronic based artworks</b>	<b>% artist's tot n° obs</b>
OPIE	47	66%	11%
RIST	12	17%	14%
MENGBO	3	4%	15%
ARCANGEL	2	2.8%	40%
CAMPBELL	1	1.4%	50%
HUYGUE	1	1.4%	6%
KIENHOLZ	1	1.4%	0.8%
LOZANO-HEMMER	1	1.4%	100%
NAPIER	1	1.4%	100%
NICOLAI	1	1.4%	100%
WEINSTEIN	1	1.4%	14%
<b>total</b>	<b>71</b>	<b>99.60%</b>	

Source: own elaboration

Note: the total may not add up to 100 due to rounding

**Table 3.5:** Mean price for sold digital and new media artworks and for total sold artworks

		<b>Hammer price total digital and new media artworks sold (Euros)</b>	<b>Hammer price total sample sold (Euros)</b>
N	Valid	53	2597
	Missing	2544	0
Mean		18977.36	13320.38
Median		17205.00	4520.00
Std. Deviation		19463.423	30346.344
Range		67575	487450
Minimum		467	50
Maximum		68042	487500

Source: SPSS

**Table 3.6:** List of variables and description

<b>Variable</b>	<b>Description</b>
Artistic genre	The broad artistic category to which the artwork belongs
Main technique / medium	The principal characteristic of the artwork (further developed in 3.4.2)
Auction house	Variable that groups the auction house with one (or several) cities
Production year	The year at which the artwork was produced
Auction year	The year at which the auction sale took place
Artist's nationality	The nationality of the artist

Source: own elaboration

**Table 3.7:** Dummies for main technique/medium

<b>D</b>	<b>MAIN TECHNIQUE / MEDIUM</b>	<b>N° OBSERVATIONS</b>	<b>% SAMPLE</b>
1	acrylic	265	7.7
2	mixed media	222	6.5
3	oil	304	8.9
4	vinyl	55	1.6
5	paintings others	97	2.8
6	(vintage) gelatin silver print	509	14.9
7	chromogenic print	136	4
8	photographs others	315	9.2
9	silkscreen/screen print	503	14.7
10	prints others	212	6.2
11	screens	72	2.1
12	installations	68	2
13	watercolor + gouache	82	2.4
14	ink	76	2.2
15	others	497	14.6
	<b>total</b>	<b>3413</b>	<b>99.8</b>

Source: own elaboration

Note: the total may not add up to 100 due to rounding

**Table 3.8:** Dummies for artistic genre

<b>D</b>	<b>ARTISTIC GENRE</b>	<b>N° OBSERVATIONS</b>	<b>% SAMPLE</b>
1	photographs	968	28.36
2	paintings	802	23.5
3	prints	700	20.51
4	installations, video, multimedia	136	3.98
5	drawing	101	2.96
6	watercolour	101	2.96
7	sculptures	359	10.52
8	collages & assemblages	214	6.27
9	others	32	0.94
	<b>total</b>	<b>3413</b>	<b>100</b>

Source: own elaboration

**Table 3.9:** Dummies for auction house

<b>D</b>	<b>AUCTION HOUSE</b>	<b>N° OBS.</b>	<b>% SAMPLE</b>
1	Christie's - New York (USA)	233	6.83
2	Sotheby's - New York (USA)	198	5.8
3	Christie's - London (UK)	224	6.56
4	Sotheby's - London (UK)	167	4.89
5	Christie's - other	185	5.42
6	Sotheby's - other	138	4.04
7	Phillips - New York (USA)	162	4.75
8	Phillips - UK	76	2.23
9	Germann Auktionen - Zurich (CH)	168	4.92
10	Meeting Art - Vercelli (IT)	127	3.72
11	Cornette de Saint-Cyr - Paris (FR), Bruxelles (BL)	120	3.52
12	Van Ham Kunstauktionen - Köln (D)	117	3.43
13	Lempertz (D)	100	2.93
14	Artcurial Briest, Poulain, F. Tajan - Paris (FR)	97	2.84
15	Bonhams - London (UK)	65	1.9
16	Bonhams - other	46	1.35
17	Auction houses low sales* - German speaking countries	480	14.06
18	Auction houses low sales - other Europe	550	16.11
19	Auction houses low sales - extra Europe	160	4.69
	<b>total</b>	<b>3413</b>	<b>99.99</b>

\* Low sales refer to a maximum of 10 sales per auction house over the entire period

Source: own elaboration

Note: the total may not add up to 100 due to rounding

**Table 3.10:** Dummies for production year

<b>D</b>	<b>PRODUCTION YEAR</b>	<b>N° OBSERVATIONS</b>	<b>% SAMPLE</b>
1	before 1980	1325	38.82
2	before 1990	300	8.79
3	before 2000	755	22.12
4	before 2006	384	11.25
5	from 2006	232	6.8
6	no data	417	12.22
	<b>total</b>	<b>3413</b>	<b>100</b>

Source: own elaboration

**Table 3.11:** Dummies for artist nationality

<b>D</b>	<b>ARTIST'S NATIONALITY</b>	<b>N° OBSERVATIONS</b>	<b>% SAMPLE</b>
1	USA	226	6.62
2	Germany	437	12.8
3	Argentina	319	9.35
4	France	454	13.3
5	Switzerland	429	12.57
6	United Kingdom	412	12.07
7	Iran	474	13.89
8	Europe & Canada	617	18.08
9	provenance others	45	1.32
<b>total</b>		<b>3413</b>	<b>100</b>

Source: own elaboration

**Table 3.12:** Dummies for auction year

<b>D</b>	<b>AUCTION YEAR</b>	<b>N° OBS.</b>	<b>% SAM.</b>	<b>D</b>	<b>AUCTION YEAR</b>	<b>N° OBS.</b>	<b>% SAM.</b>
1	1987	2	0.06	15	2001	51	1.5
2	1988	2	0.06	16	2002	54	1.6
3	1989	9	0.3	17	2003	68	2
4	1990	19	0.6	18	2004	132	3.9
5	1991	15	0.4	19	2005	140	4.1
6	1992	20	0.6	20	2006	195	5.7
7	1993	16	0.5	21	2007	286	8.4
8	1994	27	0.8	22	2008	329	9.6
9	1995	20	0.6	23	2009	302	8.8
10	1996	41	1.2	24	2010	302	8.8
11	1997	37	1.1	25	2011	376	11
12	1998	40	1.2	26	2012	434	12.7
13	1999	48	1.4	27	2013	369	10.8
14	2000	44	1.3	28	2014	35	1
<b>total</b>						<b>3413</b>	<b>100.02</b>

Source: own elaboration

Note: the total may not add up to 100 due to rounding



## Chapter 4

Statistics for the global index:

Number of Observations = 2597

$R^2 = 0.59$

Adj  $R^2 = 0.58$

DF = 582

DF Residual = 2515

$p < 0.001$

**Table 4.1:** Estimates for main technique/medium

<b>MAIN TECHNIQUE / MEDIUM (Base category acrylic)</b>				
	Coeff.	Sig.	Std. Error	t-stat.
prints others	-0.22		0.16	-1.35
screens	1.04		0.63	1.65
installations	1.00		0.57	1.82
watercolor + gouache	-0.05		0.28	-0.18
ink	0.09		0.20	0.44
others	-0.14		0.13	-1.06
mixed media	-0.12		0.13	-0.86
oil	0.15		0.10	1.50
vinyl	0.56	**	0.20	2.77
paintings others	0.03		0.14	0.25
(vintage) gelatin silver print	0.47	*	0.21	2.26
chromogenic print	-0.21		0.22	-0.99
photographs others	-0.03		0.20	-0.17
silkscreen/screen print	-0.41	*	0.17	-2.43

Source: own elaboration

**Table 4.2:** Estimates for artistic genre

<b>ARTISTIC GENRE (Base category photographs)</b>				
	Coeff.	Sig.	Std. Error	t-stat.
paintings	0.91	***	0.19	4.91
prints	-0.41	*	0.16	-2.56
installations, video, multimedia	-0.34		0.57	-0.59
drawings	-0.10		0.20	-0.51
watercolors	0.20		0.29	0.69
sculptures	1.01	***	0.18	5.68
collages & assemblages	0.91	***	0.19	4.86
others	-0.15		0.27	-0.56

Source: own elaboration

**Table 4.3:** Estimates for artist nationality

<b>ARTIST NATIONALITY (Base category Usa)</b>				
	Coeff.	Sig.	Std. Error	t-stat
Germany	-0.32	**	0.12	-2.71
Argentina	0.28	*	0.12	2.37
France	0.57	***	0.11	5.32
Switzerland	0.18		0.11	1.60
UK	0.68	***	0.12	5.69
Iran	1.17	***	0.11	10.22
Europe + Canada	-0.07		0.11	-0.66
others	0.70	**	0.22	3.2

Source: own elaboration

**Table 4.4:** Estimates for auction house

<b>AUCTION HOUSE (Base category Christie's - New York (Usa))</b>				
	Coeff.	Sig.	Std. Error	t-stat
Meeting Art - Vercelli (IT)	-0.77	***	0.16	-4.85
Cornette de Saint-Cyr - Paris (FR), Bruxelles (BL)	-1.21	***	0.15	-7.84
Van Ham Kunstauktionen - Köln (D)	-0.98	***	0.16	-6.24
Lempertz (D)	-0.97	***	0.16	-6.04
Artcurial Briest, Poulain, F. Tajan - Paris (FR)	-0.40	**	0.15	-2.61
Bonhams - London (UK)	-0.95	***	0.18	-5.37
Bonhams - other	-0.76	***	0.19	-3.92
Auction houses low sales - German speaking countries	-1.21	***	0.11	-10.73
Auction houses low sales - other Europe	-1.45	***	0.11	-13.59
Auction houses low sales - extra Europe	-0.91	***	0.13	-7.13
Sotheby's - New York (USA)	0.10		0.12	0.89
Christie's - London (UK)	-0.12		0.11	-1.08
Sotheby's - London (UK)	0.21		0.13	1.68
Christie's - other	-0.12		0.12	-1.02
Sotheby's - other	0.21		0.13	1.56
Phillips - New York (USA)	-0.24		0.12	-1.89
Phillips - UK	-0.04		0.17	-0.26
Germann Auktionen - Zurich (CH)	-1.14	***	0.15	-7.74

Source: own elaboration

**Table 4.5:** Estimates for auction year

<b>AUCTION YEAR (Base category 1987)</b>				
	Coeff.	Sig.	Std. Error	t-stat
1988	0.64		1.27	0.50
1989	0.68		1.10	0.62
1990	1.19		1.07	1.12
1991	0.61		1.08	0.57
1992	0.34		1.07	0.31
1993	0.78		1.07	0.72
1994	0.45		1.06	0.43
1995	0.46		1.07	0.43
1996	0.76		1.05	0.72
1997	0.78		1.05	0.74
1998	0.72		1.06	0.69
1999	0.62		1.05	0.59
2000	0.75		1.05	0.72
2001	0.58		1.05	0.55
2002	0.55		1.05	0.52
2003	0.64		1.05	0.61
2004	0.62		1.05	0.60
2005	0.73		1.05	0.70
2006	0.84		1.04	0.80
2007	1.07		1.04	1.03
2008	0.94		1.04	0.90
2009	0.84		1.04	0.81
2010	1.00		1.04	0.95
2011	0.79		1.04	0.75
2012	0.85		1.04	0.82
2013	0.98		1.04	0.94
2014	1.09		1.06	1.02

Source: own elaboration

**Table 4.6:** Estimates for production year

<b>PRODUCTION YEAR</b>				
	Coeff.	Sig.	Std. Error	t-stat
before 1990	-0.41	***	0.08	-5.04
before 2000	-0.1		0.08	-1.3
before 2006	0.01		0.089	0.08
from 2006	0.22		0.11	1.98
no data	-0.57	***	0.07	-7.9

Source: own elaboration

**Table 4.7:** Estimates photographic index

Statistics for the photographic index

Number of Observations = 758

 $R^2 = 0.65$ Adj  $R^2 = 0.62$ 

DF = 57

DF Residual = 701

 $p < 0.001$ 

	Coeff.	Sig.	S.E.	t-stat
<b>AUCTION HOUSE</b>				
Cornette de Saint-Cyr - Paris (FR), Bruxelles (BL)	-1.01	**	0.35	-2.87
Van Ham Kunstauktionen - Köln (D)	-0.56	**	0.18	-3.15
Lempertz (D)	-0.51	**	0.19	-2.70
Artcurial Briest, Poulain, F. Tajan - Paris (FR)	-0.24		0.30	-0.78
Bonhams - London (UK)	-1.53	***	0.30	-5.17
Bonhams - other	-0.43		0.25	-1.73
Auction houses low sales - German speaking countries	-0.75	***	0.15	-4.98
Auction houses low sales - other Europe	-0.97	***	0.16	-6.03
Auction houses low sales - extra Europe	-0.74	***	0.20	-3.70
Sotheby's - New York (USA)	0.10		0.14	0.73
Christie's - London (UK)	-0.03		0.13	-0.26
Sotheby's - London (UK)	0.13		0.14	0.95
Christie's - other	0.29	*	0.14	1.99
Sotheby's - other	0.28		0.18	1.53
Phillips - New York (USA)	-0.18		0.13	-1.37
Phillips - UK	0.10		0.19	0.55
Germann Auktionen - Zurich (CH)	-1.76	***	0.36	-4.90
<b>ARTIST NATIONALITY</b>				
Germany	-0.48	*	0.24	-2.05
France	-0.48		0.30	-1.60
Switzerland	-0.52	**	0.18	-2.87
UK	0.59	**	0.22	2.65
Iran	0.77	***	0.13	6.19
Europe + Canada	-0.50	**	0.17	-2.99
others	0.42		0.26	1.61
<b>PRODUCTION YEAR</b>				
1980-1990	0.28		0.27	1.03
1990-2000	0.51	*	0.22	2.34
2000-2006	0.34		0.22	1.56
2006 -	0.76	**	0.28	2.68
no data	0.32		0.26	1.24
<b>MAIN MEDIUM/TECHNIQUE</b>				
ink	0.55		0.33	1.64
others	1.92	*	0.87	2.22
(vintage) gelatin silver prints	0.76	**	0.27	2.77
chromogenic print	0.17		0.26	0.65

photographs others	0.25	0.26	0.96
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**AUCTION YEAR**

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1992	-0.35	0.90	-0.39
1993	-0.01	0.92	-0.01
1994	-1.24	0.90	-1.39
1995	-0.70	0.92	-0.76
1996	-0.36	0.92	-0.40
1997	-0.96	0.71	-1.34
1999	-0.42	0.72	-0.58
2000	-0.84	0.61	-1.37
2001	-0.77	0.58	-1.33
2002	-0.89	0.57	-1.56
2003	-1.09	0.58	-1.88
2004	-1.02	0.57	-1.80
2005	-0.61	0.57	-1.07
2006	-0.97	0.56	-1.72
2007	-0.55	0.56	-0.98
2008	-0.72	0.56	-1.29
2009	-0.86	0.57	-1.52
2010	-0.97	0.56	-1.73
2011	-0.80	0.56	-1.42
2012	-0.68	0.56	-1.22
2013	-0.75	0.57	-1.33
2014	-0.47	0.62	-0.75

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Source: own elaboration

**Table 4.8:** Estimates painting index

Statistics for the painting index:

Number of Observations = 603

 $R^2 = 0.56$ Adj  $R^2 = 0.51$ 

DF = 65

DF Residual = 538

 $p < 0.001$ 

	Coeff.	Sig.	Std. Error	t-stat
<b>AUCTION HOUSE</b>				
Meeting Art - Vercelli (IT)	-1.67	***	0.28	-5.92
Cornette de Saint-Cyr - Paris (FR), Bruxelles (BL)	-1.60	***	0.32	-4.94
Van Ham Kunstauktionen - Köln (D)	-1.71	**	0.56	-3.08
Lempertz (D)	-1.94	***	0.35	-5.52
Artcurial Briest, Poulain, F. Tajan - Paris (FR)	-1.51	***	0.35	-4.29
Bonhams - London (UK)	-0.56		0.40	-1.40
Bonhams - other	-1.23	*	0.52	-2.36
Auction houses low sales - German speaking countries	-1.56	***	0.24	-6.42
Auction houses low sales - other Europe	-1.88	***	0.22	-8.61
Auction houses low sales - extra Europe	-1.42	***	0.23	-6.08
Sotheby's - New York (USA)	-0.06		0.22	-0.28
Christie's - London (UK)	-0.52	*	0.23	-2.29
Sotheby's - London (UK)	-0.65	*	0.26	-2.54
Christie's - other	-1.30	***	0.23	-5.59
Sotheby's - other	-0.95	***	0.24	-3.96
Phillips - New York (USA)	-0.52		0.28	-1.84
Phillips - UK	-1.03	*	0.48	-2.13
Germann Auktionen - Zurich (CH)	-1.37	***	0.35	-3.87
<b>ARTIST NATIONALITY</b>				
Germany	0.46		0.33	1.41
Argentina	0.62	*	0.27	2.31
France	2.12	***	0.30	7.13
Switzerland	1.84	***	0.31	5.89
UK	1.08	***	0.31	3.52
Iran	-0.89		1.06	-0.84
Europe + Canada	0.80	**	0.30	2.64
others	1.70	***	0.44	3.85
<b>PRODUCTION YEAR</b>				
1980-1990	-0.95	***	0.15	-6.16
1990-2000	-0.46	**	0.15	-3.18
2000-2006	0.04		0.18	0.23
2006-	-0.27		0.25	-1.09
no data	-0.48	**	0.17	-2.84
<b>MAIN TECHNIQUE/MEDIUM</b>				
prints others	0.67		1.01	0.66
others	-0.61	*	0.26	-2.38

mixed media	0.37	*	0.18	2.11
oil	0.22	*	0.11	2.06
vinyl	1.13	***	0.26	4.32
paintings others	0.13		0.16	0.82
photographs others	0.50		0.45	1.11
silkscreen/screen print	0.33		0.36	0.93

#### AUCTION YEAR

1991	-0.64		0.57	-1.12
1992	-0.89		0.54	-1.65
1993	-0.83		0.62	-1.34
1994	-0.75		0.53	-1.40
1995	-1.49	*	0.63	-2.37
1996	-1.08	*	0.50	-2.16
1997	-0.26		0.51	-0.52
1998	-0.33		0.49	-0.68
1999	-0.12		0.53	-0.23
2000	0.05		0.54	0.09
2001	-1.13		0.58	-1.94
2002	-0.36		0.59	-0.62
2003	-0.66		0.55	-1.20
2004	-0.16		0.49	-0.34
2005	0.02		0.48	0.05
2006	-0.24		0.47	-0.51
2007	-0.08		0.47	-0.17
2008	0.02		0.47	0.05
2009	-0.12		0.48	-0.25
2010	0.15		0.47	0.32
2011	0.06		0.47	0.12
2012	0.01		0.47	0.03
2013	0.02		0.47	0.05
2014	-0.40		0.61	-0.65

Source: own elaboration

**Table 4.9:** Estimates print index

Statistics for the print index:

Number of Observations = 524

 $R^2 = 0.62$ Adj  $R^2 = 0.57$ 

DF = 65

DF Residual = 459

 $p < 0.001$ 

	Coeff.	Sig.	Std. Error	t-stat
<b>AUCTION HOUSE</b>				
Meeting Art - Vercelli (IT)	-0.33		0.51	-0.64
Cornette de Saint-Cyr - Paris (FR), Bruxelles (BL)	-1.02	*	0.41	-2.47
Van Ham Kunstauktionen - Köln (D)	0.05		0.77	0.06
Lempertz (D)	0.10		0.85	0.12
Artcurial Briest, Poulain, F. Tajan - Paris (FR)	-0.09		0.43	-0.21
Bonhams - London (UK)	-0.82	*	0.40	-2.07
Bonhams - other	-1.05		0.67	-1.57
Auction houses low sales - German speaking countries	-1.06	**	0.38	-2.79
Auction houses low sales - other Europe	-1.08	**	0.38	-2.84
Auction houses low sales - extra Europe	-0.38		0.43	-0.88
Sotheby's - New York (USA)	0.37		0.58	0.64
Christie's - London (UK)	0.20		0.42	0.49
Sotheby's - London (UK)	0.82		0.43	1.91
Christie's - other	0.88		0.46	1.90
Sotheby's - other	2.15	***	0.58	3.72
Phillips - New York (USA)	0.50		0.48	1.04
Phillips - UK	1.03	*	0.52	2.00
Germann Auktionen - Zurich (CH)	-0.97	*	0.40	-2.44
<b>ARTIST NATIONALITY</b>				
Germany	-0.24		0.38	-0.62
Argentina	0.80		0.45	1.79
France	0.25		0.33	0.77
Switzerland	0.02		0.33	0.05
UK	1.26	***	0.36	3.55
Iran	0.81		0.47	1.74
Europe + Canada	-0.63		0.38	-1.67
<b>PRODUCTION YEAR</b>				
before 1990	0.33		0.17	1.96
before 2000	0.34		0.22	1.57
before 2006	-0.32		0.27	-1.20
from 2006	0.30		0.26	1.16
no data	-0.44	***	0.12	-3.76
<b>MAIN MEDIUM/TECHNIQUE</b>				
print others	-0.99		0.98	-1.02
ink	-0.72		1.02	-0.71
others	-1.59		1.01	-1.58



mixed media	0.59	1.42	0.42
painting others	-0.76	1.06	-0.72
chromogenic print	-1.47	1.15	-1.28
photograph others	-0.90	1.04	-0.86
silkscreen/screen print	-1.12	0.97	-1.15

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**AUCTION YEAR**

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1989	-0.43	0.81	-0.54
1990	-0.46	0.81	-0.57
1991	-0.19	0.82	-0.23
1992	0.12	0.98	0.12
1993	0.51	0.85	0.60
1994	0.02	0.75	0.02
1995	0.21	0.81	0.26
1996	0.08	0.76	0.11
1997	0.16	0.76	0.21
1998	-0.52	0.77	-0.68
1999	-0.24	0.77	-0.32
2000	0.52	0.78	0.67
2001	0.44	0.72	0.36
2002	-2.31	**	0.89
2003	-0.20	0.74	-0.27
2004	-0.27	0.76	-0.36
2005	-0.72	0.73	-0.99
2006	0.12	0.72	0.17
2007	-0.29	0.72	-0.40
2008	0.07	0.72	0.10
2009	-0.11	0.70	-0.15
2010	0.02	0.71	0.03
2011	-0.43	0.70	-0.61
2012	-0.32	0.69	-0.45
2013	-0.42	0.70	-0.60
2014	-0.51	1.01	-0.50

Source: own elaboration

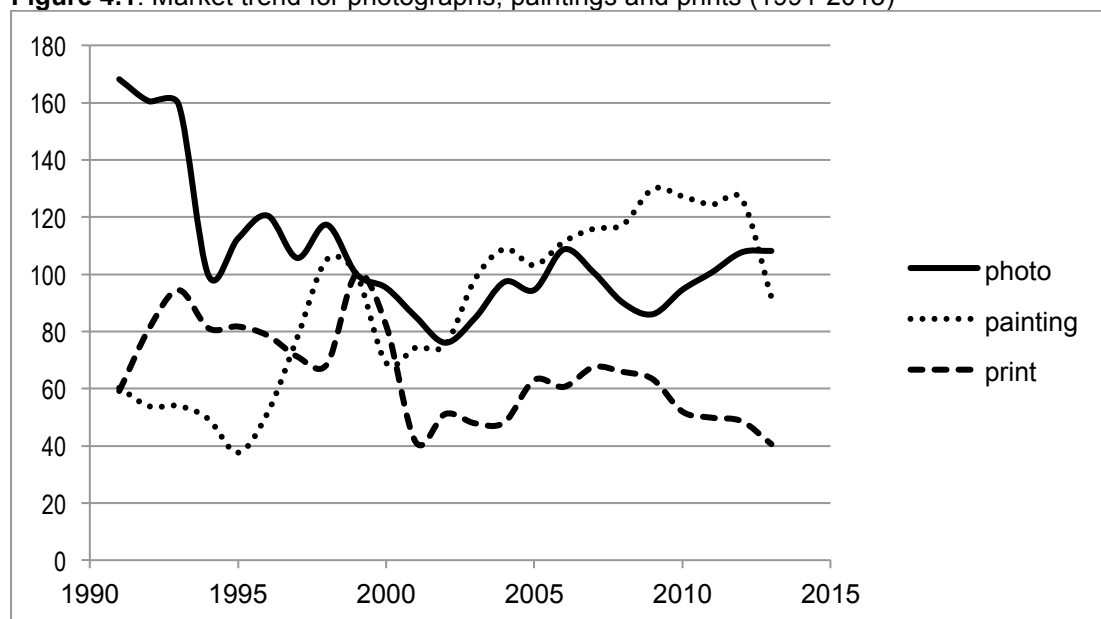
**Table 4.10:** Price index for photographs, paintings and prints (1991-2013)

Index*	photographs	paintings	prints
1991	168	60	59
1992	160	54	81
1993	159	54	94
1994	100	49	81
1995	112	38	82
1996	120	52	79
1997	106	78	71
1998	117	105	68
1999	100	100	100
2000	95	69	82
2001	85	74	41
2002	76	75	51
2003	85	98	48
2004	97	109	48
2005	94	103	63
2006	109	111	61
2007	101	116	68
2008	90	117	66
2009	86	130	63
2010	95	127	52
2011	101	124	50
2012	108	126	49
2013	108	92	41

\* Indices normalized at 100 in 1999

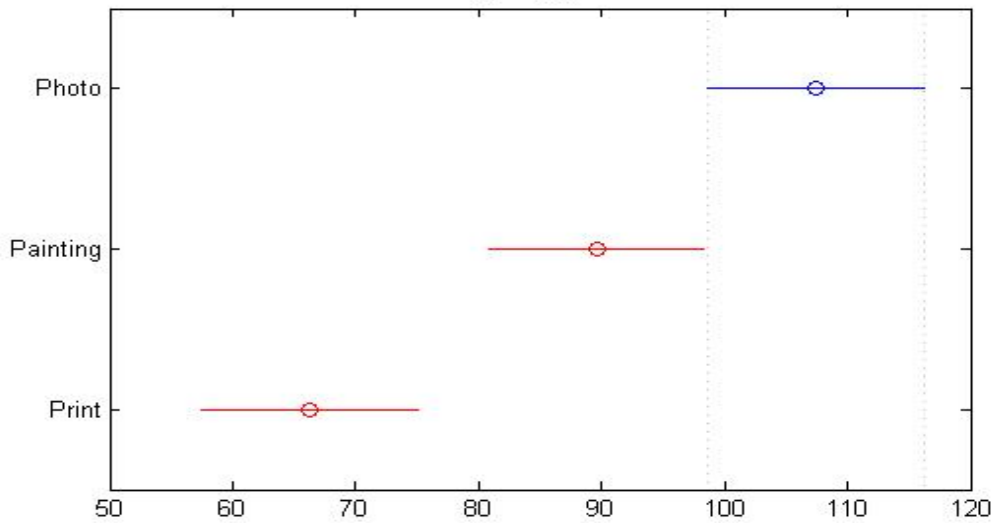
Source: own elaboration

**Figure 4.1:** Market trend for photographs, paintings and prints (1991-2013)



Source: own elaboration

**Figure 4.2:** Anova test for variance between means



Source: own elaboration

	photographs	paintings	prints
<b>mean value</b>	107.48	89.58	66.22

**Table 4.11:** Correlation matrix

<b>Correlation matrix</b>			
	photographs	paintings	prints
photographs	1	-0.4873 (*)	0.4177 (*)
paintings		1	-0.508 (*)
prints			1