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Federico Etro, Laura Pagani
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Federico Etro and Laura Pagani[1]

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Abstract

We study the art market in the XVI-XVIII centuries with an econometric analysis of a new dataset on original contracts between patrons and artists for commissions of oil paintings of historical subject in the Venetian Republic. Size of paintings, reputation of the painters as perceived at the time, type of commissions and aggregate demand shocks (the plague) affect prices as expected. We find evidence of contractual solutions to moral hazard problems: since quality was not contractable, prices were made conditional on measurable features correlated with quality as the number of human figures. We also find strong evidence of price equalization between high-demand and low-demand towns due to painters'mobility. Finally, we provide support for the Galenson hypothesis of a positive relation between age of experimental artists and quality as priced by the market. The results are confirmed for other Italian art centres.

1   Introduction

Art objects are often perceived, and sometimes defined, as handmade works that are valuable independently of their objective features (i.e.: their material composition or other quantifiable aspects) and as the fruit of pure talent and inspiration independently from monetary and contractual incentives. This is more so for artworks by old masters, and possibly even more for religious or historical paintings by geniuses as Titian, Tintoretto or Caravaggio. At the same time, the pricing of a unique art object is often perceived as highly subjective and largely dependent on the tastes, wealth and prestige of buyers, with little regard for factors affecting demand and supply, especially when one is thinking of the Renaissance and Baroque periods, in which honour and prestige were claimed to be the drivers of social and economic activities (of patrons and artists) more than the profit-seeking behavior of the *homo economicus*. The purpose of this paper is to show that these perceptions are misleading.

A look at the prices of famous old paintings may even reinforce the impression that little can be rationalized in the market for paintings in the XVI-XVIII centuries. The *Wedding at Cana* by Veronese (Figure 1) was commissioned for a wall of the nave f the Venetian church of S. Giorgio Maggiore in 1563 for 324 silver ducats. It is, and was at the time, considered a masterpiece for its imposing composition, the splendid contemporary costumes, and the luminous colors, probably not because of its size (about 70 square meters) or for the number of figures depicted (more than a fifty). Today we find it at the Louvre Museum, right in front of another painting whose size is much smaller, but whose value is hardly so: the portrait of a single human figure, the Monna Lisa by Leonardo. Less known than the original painting by Veronese are its copies: one by the minor painter Antonio Zanchi for a private collection was paid 1000 ducats in 1671, more than the double of the original, even taking inflation into account![2] Another of the three great masters of the XVI century in Venice, Tintoretto, had a long and brilliant career, but he never managed to be paid as much as the rival Titian for his works. Only in 1583, at the age of 65, Tintoretto reached his highest fee (400 ducats) for a *Nativity* commissioned for the Escorial building by the king Philip II of Spain: apparently, Tintoretto did not put much effort in this work, since his son Domenico painted most of it. At the turn of the century, the fees for the revolutionary paintings by Caravaggio were extremely low, and also without any growing trend. Meanwhile, the more fashionable Guido

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[2]We remind the reader that all the paintings mentioned in anecdotical references and reproduced in the pictures are paintings from our dataset.

Reni was starting a successfull career that would have made him the best paid painter of the century in Italy. One of his last altarpieces, the *Adoration of the Shepherds* (1640-42) for the Certosa of S. Martino in Naples (Figure 2), was paid the equivalent of more than 3000 ducats: each figure depicted cost more than an average altarpiece by ordinary painters, including Caravaggio (whose fame came only centuries later). In 1625, an art dealer who was contracting an altarpiece by Cerano in Milan told the patron that the painter would have probably accepted 250 ducats, but also that if Cerano were to go to Rome he would be paid 500: because, he added, Rome is "where you go to get rich".

All this may leave much confusion on the pricing of paintings and some questions: what was determining the price of these paintings? did size matter? did the number of figures affect prices and why? what was the premium for quality? was there a life cycle of painters'earnings? was the demand of wealthy patrons and richest cities going to increase the average prices? The purpose of this article is to show that looking at the market for paintings as a fully fledged market and analyzing the contractual aspects of its deals and the endogeneity of its structure can shed light on some of these questions.

Analyzing a new dataset on original contracts between commissioners and painters based on the recent monumental art historical research by Spear and Sohm (2010)[3] we study econometrically a number of theoretical implications. We focus on commissions for large oil paintings of historical (religious or mythological) subject produced in Venice and Veneto in the period 1551-1746 and we investigate the relation between the price of paintings, adjusted for the cost of life, and a number of variables characterizing the same paintings, the painters, the commissioners and the macroeconomic context. We also confirm our results on a more limited dataset concerning the other main Italian art centers (Rome, Florence, Bologna and Naples) for the entire XVII century.

The equilibrium prices can be interpreted in terms of hedonic prices reflecting the expected aesthetic value of paintings - see Rosen (1974) for the theory and Combris, Lecocq and Visser (1997) for a recent empirical application to wines' prices. In our case, paintings' prices should depend on the reputation of painters as perceived at the time, which we capture by artists' fixed effects and through a quality index based on documentary evidence about the average income of painters. Beyond this, a number of supply and demand factors affect the

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[3]The work includes chapters by Richard Spear on Rome, Philip Sohm on Venice, Christopher Marshall on Naples, Raffaella Morselli on Bologna, Elena Fumagalli on Florence, Renata Ago on the economic history approach and Richard Goldthwaite on the painting industry in early modern Italy.

Figure 1: Veronese, 1562, Wedding at Cana, currently at the Louvre Museum, Paris

equilibrium prices as expected. For instance, a positive and concave relation between prices and size of paintings reflects economies of scale in the production of paintings. Other relevant explanatory variables include the placement of the paintings in the church (on the altar, on the ceiling or on the walls) or in a public or private building.

More interestingly, we find evidence of contractual solutions to moral hazard problems between patrons (principals) and artists (agents). Large commissions for oil paintings of historical subject required months or years of work and generated conflicts of interest for the simple reason that quality was observable *ex post* but not contractable *ex ante* (one of the first works to emphasize contract theory issues in art history matters is Nelson and Zeckhauser, 2008, which however focuses on signalling aspects). We support the idea that patrons and artists adopted a a typical solution to the moral hazard problem pointed out in the standard principal-agent literature (Holmstrom, 1979): prices were made conditional on measurable features of the paintings which were positively correlated with quality, one of which was the number of human figures in the composition.

Moving from microeconomic aspects to macroeconomic ones, we evaluate the impact of local (temporary) demand shocks and aggregate demand shocks. Differences in local demand could be detected when looking at different cities: demand was higher in big cities as Venice or Rome than in small provincial towns in the countryside. However, the mobility of painters was high, therefore we should expect that price differentials between high-demand and low-demand towns should be arbitraged away. Indeed, we find that prices in the periphery were lower than in center, but, after controlling for paintings' and painters' features, these differences disappear. This suggests that the structure of the market (the number of painters and the equilibrium prices) was endogenous and the opportunities for extra profits were eliminated through the mobility of painters:[4] Venice in Veneto or Rome in Italy were not paying more their painters (as often thought because of higher demand), but they were just attracting the best quality painters for more ambitious commissions. In other words, market forces were clearly at work to induce price equalization in a largely integrated market. On the other side, aggregate demand shocks exerted direct effects on prices. As an example, we study the impact of the plague, which hit Venice and all the surrounding regions in 1630, and we verify that its impact was to reduce prices in a significant way. The same happened in Central Italy with the plague of 1656.

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[4]On the theory of endogenous market structures in general equilibrium see Etro (2009).

Figure 2: Guido Reni, 1640-42, Adoration of the Shepherds, Certosa of S. Martino, Naples

Finally, we provide novel support for the Galenson (2006) hypothesis for which experimental innovators (exemplified by artists as Titian or Tintoretto) increase the quality of their work (as priced by the market) while aging and improving their techniques by experience, while conceptual innovators (exemplified by Caravaggio) do not exibit a positive correlation between quality and age.

The paper is organized as follows. Section 2 reviews some related literature. Section 3 describes the market and derives a number of theoretical implications. Section 4 presents the dataset. Section 5 presents the econometric investigation and the results for the analysis of Venetian data. Section 6 extends it to other major Italian art centres (Rome, Florence, Bologna and Naples). Section 7 concludes.

2   Related Literature

As far as we know, this is the first work to test econometrically theoretical predictions for the art market on data from original contracts between artists and their patrons, however our analysis is at least related to three strands of literature on the relation between art and economics. The first analyses the impact of economic factors on the art market. There is a long tradition in art history studies regarding the relation between social and artistic developments, as in the marxist approach of the social history of art (Hauser, 1951). Recently, economists as De Marchi (1995) and Monthias (2002) and economic historians as North (1999) have emphasised the importance of economic incentives in shaping the Dutch golden age of the art market, the '600s. O'Malley (2005) and Nelson and Zeckhauser (2008) have provided the first systematic studies of the art contracts during Italian Renaissance, focusing respectively on the contracts for altarpieces stipulated between painters and patrons in the period 1300-1600 and on more general signalling and reputational mechanisms in the contractual relations of the same period. In the same spirit of the first work, Spear and Sohm (2010) have extended the analysis of contracts to the subsequent Baroque period (widely defined as including the late Mannerism of the end of the XVI century and the Rococò of the early XVIII century), deriving an interesting analysis of the economic lives and incomes of the painters.[5]   However, the key contribution of these works is data collection because they provide a fine descriptive analysis of the market for oil paintings in those periods, but they do not carry out econometric investigations of the collected data. The only multivari-

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[5]See also the articles in Fantoni, Matthew and Metthews-Grieco (2003).

ate analysis of Renaissance and Baroque artworks' prices we are aware of is by Gérin-Jean (2003), who investigates the determinants of the prices of heterogeneous artworks, including statues, decorative objects and also paintings of any subject, from inventories (and not original contracts) of the Medici period, mainly with predictive and ranking purposes. However, the procedure used for converting prices, originally expressed in twenty different currencies, into a unique currency seems inaccurate.[6] Moreover, the work does not investigate at all the economic factors behind the empirical findings.

The second strand of literature related to our paper studies art prices derived from contemporary auctions. Starting from the classic paper by Baumol (1986), part of this literature is aimed at estimating the return from investment in art (see among others Buelens and Ginsburgh, 1993; Agnello and Pierce, 1996; Locatelli-Bley and Zanola, 1999; Mei and Moses, 2003). Another part of this literature analyses the determinants of art prices. For instance, Hellmanzik (2010) estimates the role of location (Paris versus New York) for prices of modern visual artists born between 1850 and 1945. Onofri (2009) studies the impact of a particular Italian regulation, the export veto on old masters paintings, on the price differential between pre-auction estimated price and post-auction hammer price. Our study differs deeply from these works because we consider artworks' past values, that is prices originally bargained between painters and commissioners. This is a very valuable feature of our dataset because it allows us to study the price structure in a primary market completely different from the secondary (auction) market. Only by studying the process of original prices formation it is possible to detect the role of economically crucial factors like contractual aspects or competition between painters.

The third relevant literature was started with the works of Galenson (2000, 2006) on the relation between age and artistic innovations. Most of the econometric evidence in support of the Galenson hypothesis relative to the different age profiles of quality production for experimental and conceptual innovators is based on data from contemporary auctions for modern art (Galenson and Weinberg, 2000; Hellmanzik, 2010). Our study allows us to evaluate the Galenson hypothesis for old master painters looking at the relation between their age and the aesthetic value of their work as perceived and priced at their time.

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[6] Gérin-Jean (2003) converts all prices of Italian artworks in Sterling Pounds of the year 1680 (without references for this procedure) and adjusts for inflation using an index computed for Southern England. See Guerzoni (2010, p. 23) for a critical assessment of this work.

3 The Market for Oil Paintings

During Renaissance a large part of the accumulating wealth of the Italian urban centers was channelled toward demand for durable goods with artistic content, from architecture (including building palaces, villas, churches, private chapels,..) to sculpture and any decorative element of the liturgical apparatus including, of course, altarpieces and other paintings (Goldthwaite, 1993). The peak of this process was reached in the Baroque period, with its churches and chapels filled with the richest and most extravagant decorations and paintings on the altars and on the entire space of walls and even ceilings. This early form of "consumerism" spread to public and private buildings developing a wide market for luxury goods, in which paintings of different kinds were playing a prominent role.

By the '600s, the market for paintings was characterized by a wide product differentiation.[7] While most paintings from the previous centuries were of historical (mainly religious or mythological) subject, the raising demand from private buyers induced the production of new subjects (as landscapes, genre paintings, still lifes,...) and even of further specialization within subjects (as still lifes of flowers, fruits, animals, fish, *trompe-l'oeil*,..), so as to establish a deep horizontal differentiation. Most painters were specialized in one of these submarkets, whose prestige and monetary compensations were clearly ranked, with still lifes at the bottom, genre paintings, landscapes and portraits in increasing value, and historical paintings at the top. Only few painters were perceived as good enough to specialize in historical paintings, whose more ambitious compositions could include many interacting figures depending on the ability of the painter at representing a particular subject (or plot) with complex relations between the protagonists and the marginal players - think of an Adoration of the Shepherds or stories from the Bible or even from the life of (almost) contemporary saints. Historical paintings could involve two different techniques: frescoes required a specialized and rapid method and were regarded as imperfect substitutes for oil paintings,[8] which represented the majority of large commissions for churches, chapels, council chambers, confraternities' boardrooms and also rooms in private palaces, mainly in the form of altarpieces.

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[7]See Wittkower (1958) for a classic introduction to Baroque art history.

[8]Especially in Venice frescoes were rare because humidity could easily damage them. In Central Italy they were more common and their price/size ratio was typically lower. However, their large (and often hardly measurable) size makes it hard to compare them properly with oil paintings. For this reason, and for the clear segmentation of these markets, our analysis will focus on oil paintings.

3.1 Market definition and market structure

Altarpieces had a long standing tradition in the previous centuries. Between the XIII and XVI century different kinds of altarpieces coexisted, with at one extreme polyptychs on wood panels with multiple surfaces painted with expensive colours (e.g.: gold and ultramarine blu) and surrounded by expensive carved and gilded frames (often provided by the artists as well),[9] and at the other extreme simple rectangular canvases prepared without golden backgrounds and frames.[10] By the mid XVI century and for the following two centuries, the second typology of altarpieces, and its minor variations for wall and ceiling decorations, became a rather common product whose market is the subject of this study.[11]

The market for oil paintings of historical subject was characterized by competition in prices between differentiated products with endogenous entry of producers. In the main art centres, as Venice, Rome or Florence, local artists were organized in guilds or academies and had to pay an entry fee to access the guild, create their own *bottega* (workshop), employ assistants and trade their paintings under common rules. However, these guilds were not effective at protecting rents. First of all, many low quality painters were able to avoid enrollment and practice the art without following the basic rules decided by the guild.[12] Second, competition was strong and sometimes even predatory, with painters undercutting each other, adopting different forms of price discrimination,[13] and heavily advertising their

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[9]The cost of the woodwork for these polyptychs was quite high and typically born by the painters. O'Malley (2005) estimates it between 15 % and 30 % of the total price. Another 30 % was also spent for gold leafs and gilding. For this reason the price of early altarpieces could be quite different from the net revenue of painters. This makes it convenient to focus on later altarpieces whose preparation did not include these costs.

[10]In Rome at the beginning of the '600s, ultramarine blue (obtained from the mineral *lapis lazuli*, imported from Afghanistan) could cost about a hundred times the cost of other colours, but patrons customarily paid for it (Spear and Sohm, 2010, p. 66). Patrons often covered also the costs for canvases, stretchers and priming.

[11]Also the painting technique changed over time. Initially *tempera* was used. During the second half of the XV century oil colours were imported from Flanders, first in Venice and then everywhere else. By the XVI century, oil colours were almost universally used.

[12]For instance, in 1596, the Venetian guild sued two minor painters, Giovanni Contarini and Pietro Malombra for refusing to join the association. They defended themselves claiming that they were only occasional painters practicing painting for delight and not for money. The guild rebutted this showing proofs of payment and the court punished them. Contarini joined the guild in 1597, but Malombra kept painting without enrolling in the guild for other twenty years (see Spear and Sohm, 2010, p. 212-213).

[13]Painters often adopted quantity discounts to obtain multiple commissions. There is also evidence of different quality levels made available for different prices. Luca Giordano said he could paint with three

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works. Tintoretto was an aggressive leader in the market, repeatedly using discounts and preemptive gifts to conquer commissions.[14] He also kept exibiting his works on the street against the rules of his guild. Salvator Rosa used prints to show and advertise his future paintings. Lotto and Renieri sold multiple paintings in lotteries. Of course, the painters were also engaged in vertical differentiation, with the best artists and the (stylistic) innovators able to obtain the best commissions, and the least successful artists representing a competitive fringe of entrants for minor commissions.

Effective mobility across Italy was extremely high in this market, not only because Italian and foreign artists could easily travel between the main art centres,[15] but also because painters could receive commissions from distant locations, paint in their own workshop, and send the finished products to the final destination, especially when canvases replaced heavy panels. Transport costs were low, though import tariffs existed between different countries. Commissioners were open to deal with painters from any provenance as long as they had a good reputation, therefore one can think of our market as a highly integrated market.

Large oil paintings required months of work and sometimes even years (though artists were used to work contemporaneously on multiple commissions and on other minor paintings). Most commissions were formalized in detailed contracts signed in front of notaries with validity throughout Italy, and defining the price and the mutual responsibilities of the principal (the patron) and the agent (the artist). Early contracts did not require the painter to directly paint the altarpiece: subcontracting was allowed (though rare) except in the presence of *Sua mano* (his own "hand") clauses (see O'Malley, 2005, p. 3). In the more advanced period under our consideration, however, the value of artistic personalities and signatures became more important and all commissions were directly undertaken by the painter, at most

brushes for different prices: a gold brush, a silver one and a bronze one (not by chance, he was called Luca fa' presto, literally "Luca does it quickly").

[14] In 1564 the Scuola di San Rocco asked a few painters to submit drawings for a ceiling painting. Tintoretto circumvented the competition (of Veronese, Zuccaro and Salviati) installing as a gift a quickly finished painting during the night before adjudication and, with this, he conquered a multi-decade monopolistic position in the decoration of the boardroom, chapter hall and meeting hall of the Scuola. Nevertheless, his prices remained low, as a sign of the competitive entry pressure that was still present. See Etro (2006) for an economic theory of aggressive leadership in front of entry pressure.

[15] Venice had a long tradition for receiving foreign artists (at least since the arrival of Durer), and Rome started attracting painters at least since the return of the Pope in the 1420's. During the XVII century Venice imported many foreign artists (as Loth, Strozzi, Heintz) and also temporarily exported others (as Ricci or Pellegrini), while Rome was the leading international centre for artists from all Europe.

with the help of assistants for background and decorative details, including architectural settings and still lifes.

Of course, these principal-agent contracts were largely incomplete, because the main issue, the quality of the paintings, could be observed, but it could not be defined *ex ante* and verified *ex post* (see also Nelson and Zeckhauser, 2008). Painters did care about their reputation, however this could set a lower bound on their effort, but could not provide the incentives to guarantee the quality levels that different patrons were looking for. To limit this moral hazard problem, a few contractual solutions were adopted. First of all, many contracts required preliminary drawings to be evaluated and possibly approved by the commissioners. Second, *ex post* rejection of the painting in case of low quality was a credible threat for the artists, but could only insure a minimum level of effort.[16] Third, contracts occasionally left space for bonuses for quality between 10 % and 20 % (O'Malley, 2005, p. 125): judgement was sometimes by the commissioners and other times by external painters, inducing conflicts of interests in both cases. The last practice may be seen as a sort of incentive contract, but its effectiveness appears to have been quite limited. However, as we will see, the Baroque age developed alternative incentive mechanisms, associated with quantifiable variables correlated with quality, in the spirit of the standard principles of the principal-agent theory (Holmstrom, 1979).

The demand for oil paintings of religious subjects derived mainly from new churches, to decorate their main altar and the lateral chapels (most of which were private and, therefore, under the budget of wealthy patrons) or their naves' walls and ceilings, and from old churches replacing ruined (or stylistically out of fashion) paintings. Moreover, demand derived also from public buildings (such as Palazzo Ducale in Venice or Palazzo della Podestà in Padua) and private collections (as the one of Stefano Conti in Venice in the mid XVII century) with similar needs extended also to mythological subjects. Richer cities, where more churches were built, more prestigious buildings existed and wealthier patrons were active, were clearly demanding more and higher quality paintings.

The supply of paintings was depending on the number of painters of different quality available and on their productivity. It is reasonable to expect that the supply of low quality painters was rather elastic, while that of high quality painters was constrained by the avail-

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[16]Many altarpieces by Caravaggio were rejected (but other private buyers immediately bought them). Partial revisions of the contracts were also possible, but penalties for delays and price renegotiations were rare.

ability of innovative talents in the Italian market and therefore was more rigid, at least in the short and medium run. Moreover, we can expect that productivity could increase with age, at least for painters that kept innovating and experimenting new methods and styles during their careers (Galenson and Jensen, 2001).

The equilibrium of the market for oil paintings can be interpreted in terms of hedonic prices reflecting the expected aesthetic values of paintings (Rosen, 1974), or at least the perceived reputation of the painters in producing works of quality. However, the impossibility of writing contracts contingent on the quality of paintings suggests that other quantifiable variables correlated with cost, effort and quality should affect prices. The equilibrium structure of the market can be regarded as endogenous, with the number of painters active in each art centre determined by the profitable opportunities available locally and, given the high mobility, also in the other towns.

3.2 The determinants of art prices

In the rest of this section, we discuss one by one the main variables affecting prices on the basis of economic considerations. These variables will generate the main predictions to be tested in the empirical analysis.

3.2.1 Aesthetic value

There is no doubt that the aesthetic value of a painting as perceived by the contemporary audience should be the first determinant of its price. However, in a primary market prices are established before the paintings are done and quality cannot be measured in an objective way. Therefore, prices can only depend on the expected quality and its determinants. The main one is the reputation of the painter for producing works of quality. Each painter can be seen as characterized by a specific style more or less appreciated and priced.

As it should be clear, the perception of aesthetic value in the XVI-XVIII centuries was not necessarily the same as that of our days. Many painters who are recognized today as great masters were not much appreciated at the time (Caravaggio being the main example), and many acclaimed painters at the time (as Arpino, Zuccari, Liberi or Maratta) are scarsely considered (and priced in the auction market) today. However, we have a wide documentary evidence on the reputation of the artists in their ages. A direct account of ranking between painters comes from Guido Reni, probably the most highly regarded (and paid) painter of the

'600s. In a letter of 1628 he wrote that three were the main categories of painters: the *pittori più bassi* (inferior painters) were at the bottom of the profession, while most of the respectable painters were *pittori ordinari*, and only few, including himself, could be considered as *pittori straordinari*, whose works were priceless.[17] As we will see in more detail in the next section, one can easily recognize this classification in the biographies and commentaries of the art critics of the time for each art centre. Of course, painters' total earnings were directly related to their contemporary appreciation: acclaimed painters received more commissions and were better paid for those that they could execute. Income differentials between low quality and high quality painters were remarkable, with the first ones reaching modest earnings, comparable to those of ordinary craftsmen, and the successful ones (almost) matching the lifestyle of the upperclass. As a consequence, if painters were engaged in a similar range of commissions over time, their average annual income would have been the ideal proxy for their perceived quality (at least from the perspective of the contemporary patrons).[18]

3.2.2 Size of paintings

The value of art can be hardly measured in square meters. In 1587 the minor painter Giovan Battista Armenini wrote an essay "*On the true precepts of the art of painting*" supporting the idea that pricing by size debases the noble art of painting and encourages artists to be sloppy and finish too rapidly their paintings. In 1667, the more famous Pietro Cortona, while petitioning for a payment for a work in St. Peter's, wrote in third person that "*he has never experienced that paintings are bought and sold by the palmo* [size] *and measurement*" (Spear and Sohm, 2010, p. 50).

There is weak evidence that the willingness to pay of the patrons depended on the size of

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[17]Another treatise by Giovanni Domenico Ottonelli and Pietro da Cortona of 1652, divided painters in three similar categories: those absolutely deserving to be called excellent, those who lived without the benefit of much fame and the pittori *infimi*.

[18]Again the most successful painter of the time give us a witty description of the relation between (his) quality and price. When asked who was the best painter between him and the rival Guercino, Guido Reni replies as follows: "*I am, Fathers,…, and I could tell you the reasons in terms of art but you would not understand them. Therefore these three simple reasons will do. First, because my pictures sell better than his. I, in fact, taught him how to be paid well. Secondly, because he fishes out my ideas and tries to work the way I do. I never followed his way of doing things. On the contrary I've always kept my distance from him. Finally, because all the other artists follow my style and not his*" (Spear and Sohm, 2010, p. 152). Reni was aware that his stylistic innovations, the quality of his ideas and his reputation increased his prices.

paintings. This was often constrained by a fixed space in the church or in another location, and therefore it was typically exogenous. O'Malley (2005, Ch. 5) provides some documentary evidence for the fact that the willingness to pay of Renaissance commissioners was mainly dependent on elements as their own prestige and "honour" rather than on objective features of the paintings: prices were often chosen on the basis of the "magnificence" that the patrons wanted to signal to their community, and adeguate painters for similar prices were contacted afterward.

On the other hand, size may have been important on the supply side: painters may have taken size in consideration when they were bargaining on prices. If anything, one may think that the cost of the main inputs as labor time, oil colours and help from assistants (often paid by day), should be positively related with the size of paintings, and this should be reflected in prices. However, while costs were increasing in the size, returns to scale were not constant: scale economies were likely to be present. A painting of any size required some time for thinking about the composition and for working on preparatory drawings or a small *bozzetto* (sketch) painting, which was justifying a less than proportional relation between size and prices. Moreover, even if there was a tendency to fill all parts of a painting with figures and objects (including complex still lifes) and background decorations (either with architectonical settings or landscapes), it is without doubt that larger altarpieces had larger areas that required less work. For this reason, *ceteris paribus*, one may expect a positive but concave relation between prices and size.

The evidence provided by O'Malley (2005, Ch. 6) on the prices of early altarpieces is in favour of this but inconclusive for the limited size of the sample (and the lack of a multivariate analysis on real prices): in the period 1450-1540 the average price of altarpieces between 2 and 4 square meters was 62 gold florins (out of 24 observations), the price between 4 an 7 square meters was 107 florins (for 22 observations), between 7 and 9 was 174 florins (for 9 observations) and between 9 an 12 it was 166 florins (two observations). The evidence provided by Spear and Sohm (2010, pp. 240-244) on Venetian paintings in the period 1550-1750 is more reliable for the larger number of observations, but equally inconclusive for the lack of any control variable. They show that the average price of paintings increases with size up to ten square meters. "Above 10 square meters, the numbers become erratic, dropping by a third or more for sizes between 10 and 25 square meters. Here, mysteriously, it appears that painters were paid less for larger paintings than for smaller ones" (Spear and Sohm, 2010, p. 241). Of course, these partial results are not reliable because size may be related

with quality or with high demand commissioners, or even with other objective features, such as the number of figures. Any deeper investigation should depart from such a univariate analysis and check how size affects prices for paintings of given features.

3.2.3 Number of figures

There are not deep artistic reasons for which the counting of the human figures in a painting should affect prices, especially if time of execution and quality are already rewarded through the size of paintings and the premium associated with the reputation of the painters. Even if reliable conclusions are not possible with the limited data available for Renaissance, O'Malley (2005, Ch. 6) does not find a positive correlation between prices and number of figures (for instance in five altarpieces of equal size painted by Neri di Bicci between 1455 and 1469). Moreover, she uses documentary, graphic and painted evidence to show that the subject matter of altarpieces was often discussed after signing the contracts, sometimes recorded in separate notes (*scripta*) and often changed without affecting the force of the initial contracts. In particular, "the number of main figures planned for a work might be increased after a contract was signed without having any impact upon the fee recorded in the notarial agreement" (p. 136).

At first sight, things do not seem to have changed much in the later period,[19] at least in Venice. Here, during the XVI, XVII and XVIII centuries Spear and Sohm (2010) do not find documentary evidence of an explicit impact of the number of figures on prices: "Of the 300 or so contracts and many more letters, diaries, etc. that have been gathered for this study, only three (all from the first half of the sixteenth century) give a specific figure price" (p. 244).[20] However, prices may have been decided on the basis of the number of figures even

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[19] In a letter by Cortona cited above, the great painter criticized a positive relation between number of figures and price: "Others say that the space between one figure and another are a weakness, [which] shows a lack of understanding of painting because sometimes those spaces are necessary for artistic reasons, as the petitioner has done, and not to save labor."

[20] Moreover, Spear and Sohm (2010) do not emphasize any correlation between number of figures and prices in the data. They also provide stylistic explanations for this based on the traditional distinction (going back to Vasari) between the Florentine focus on figure drawing and the Venetian focus on colouring: "What might be concluded from the Venetian tendency to price paintings by size rather than the number of figures? It could be taken to confirm an opinion that Venetian painters considered painting much more than just a figural problem. What constitutes the surface or adheres to it - color and brushwork - are just as important." However, once again a univariate analysis may be misleading and one should verify whether paintings with equivalent features exibit any relation between prices and number of figures.

without stating a price per figure in the contracts. Further agreements on the number of figures may have been established in separate notes, letters or even verbal communications. For instance, this happened in a rare epistolary negotiation survived until our days and involving the Venetians painters Liberi and Zanchi (see Spear and Sohm, 2010, pp. 13-15). Most important, pricing by number of figures became a typical procedure during the early '600s in Bologna, where the leading painters Guercino and Guido Reni were able to maintain their high fees justifying them with a high price per figure. Apparently, Guercino was an extreme (and possibily unique) example, because he claimed to commit to a fixed price of 100 scudi per full-lenght figure (50 for half-lenght figure, 25 for heads), but even this was part of a sophisticated bargaining technique because deviations from this "commitment" were the rule rather than the exception. In a letter cited above, Reni argued that the *pittori più bassi* could not obtain more than 2 or 3 scudi for large life-size figures and *pittori ordinari* could ask at most 15 scudi per figure, while a *pittore un poco straordinario* like himself could name his own price on the basis of the quality of his work independently from size and number of figures. This was probably another selling technique, but it may have reflected a way of thinking about the relation between prices and objective features as the number of figures.

From an economic point of view, there could be an incentive for the adoption of prices increasing in the number of figures. If contracts could not specify quality and moral hazard was a relevant issue (because quality required also costly effort), an explicit or implicit contract maximizing the payoff of the patrons had to be based on other quantifiable variables correlated with quality (according to the informativeness principle by Holmstrom, 1979). As already pointed out by Nelson and Zeckhauser (2008), the patrons' payoff could be seen as the difference between the benefits obtained with the commissions and the price paid to the artists. The benefits of the patrons were in terms of display of what they called "magnificence" in front of the contemporary audience, of the high class elite and, in case of altarpieces, even in front of God. In particular, for the private patrons, showing wealth and status through these commissions was a extremely useful for business and for the political and ecclesiastical careers (all being strongly interelated at the time), and showing devotion was useful to conquer a place in heaven. Clearly, the signalling benefits from these ostentatious commissions were positively related to the quality of the artworks. Since this was not directly contractable (and verifiable), the optimal patron-artist contracts had to be based explicitly or implicitly on any verifiable and measurable feature of the painting that was correlated, even poorly, with quality. In the case of historical paintings, this was possible through the

number of human figures, which was not equivalent to the absolute quality of a painting, but was correlated with it for at least three main reasons.[21]

First of all, the subjects of the commissioned paintings were biblical or mythological stories of man, women, saints, angels or mythological gods, where imagination and story-telling had a crucial function: therefore, one could safely conclude that the variety and complexity of the composition, summarized by the number of players, had a positive, though partial, correlation with the final quality (this was especially true during Mannerism and the Baroque age in which stylistic preferences were closely dictated by the *horror vacui*, the fear of empty spaces in compositions).

Second, at the time there was a precise ranking in the aesthetic evaluation of subjects, with historical compositions, portraits, landscapes and still lifes in decreasing order of appreciation: therefore, a higher number of human figures was reducing on average the space available for subjects of lower perceived quality, as background landscapes or decorative still lifes, which was automatically enhancing overall quality.

Third, painters were often focusing their own effort on human figures and especially on difficult parts as the heads (where their own "hand" was more easily recognized), delegating less relevant parts (including background decorations, landscapes and still lifes) to their own assistants: therefore, a higher number of figures was a proxy for a wider direct intervention of the painters in the overall execution, and consequently for higher quality.[22]

With the definitive affirmation of Renaissance painters as intellectual artists (rather than craftmen) and pricemakers (rather than subordinated pricetakers), the relation between patrons and painters changed. Once artists became more aware of thier role and power, moral hazard problems between artists and patrons became more important, and contractual solutions more relevant. For this reason, looking at paintings after the mid XVI century, *ceteris paribus*, one may expect a positive relation between prices and the number of figures.[23]

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[21] Notice that this prediction would not apply to other genres. The market for landscapes and still lifes was not based on commissions and buyers could look at the finished paintings before bargaining. However, portraits were on commission, and the nature of the incentive mechanisms for this case remains an open issue.

[22] There is another potential justification for a positive relation between number of figures and quality. Between and beside the main protagonists of each historical composition, patrons highly valued the presence of their own portraits and those of their relatives and assistants, either in contemporary or historical costumes: therefore, a larger number of figures was often a chance to introduce precise or sketched portraits that could please the patrons and enhance their perception of quality. However, this practice was quite common during the early Renaissance, but became less usual in the Baroque period.

[23] Incidentally, the explosion of decorative *putti* (child angels) in the skies of Baroque paintings (see Figure

3.2.4 Placement of the paintings

An interesting element of a commission for a painting is the final position: the hierarchy of spaces within churches and buildings may have affected prices. Looking at Venice, Spear and Sohm (2010, p. 235) claim the presence of clear differences: "The chapest paintings were placed on ceilings (13 ducats per square meter), closest to heaven but visually marginal, followed by wall paintings (18 ducats per square meter), on average 38 percent more than ceiling paintings. Meter-for-meter, however, altarpieces brought in the highest prices at over twice as much as ceiling paintings (27 ducats per square mete)." This comparison takes size into account, but of course ignores other aspects. It may be that marginal positions were destined to low quality painters implying lower quality and lower prices, and *vice versa* for the central positions. What one should verify is whether the same painting was paid more or less only for being destined to a different location in the church.

From an economic point of view, one can easily realize that the demand for altarpieces and ceilings was more rigid than the demand for wall paintings. Oil paintings were by far the standard solution for decorating the main altars of churches and chapels, whose number was also exogenously limited, at least in the short and medium run. Ceilings were mostly decorated with frescoes in the rest of Italy, but not in Venice for the problems related with humidity: therefore oil paintings became the standard solution for Venetian ceilings as well. For the decoration of walls, however, Venetian churches and buildings had multiple alternatives available (including statues, bronze decorations, tapestry and stucco and wood works), which were valid substitutes. Finally, the space on walls was wider than the space on the altar for obvious architectonical reasons. Therefore, the demand for oil paintings on walls' decoration was much more elastic than the demand for altarpieces and painting for ceilings. As a consequence, *ceteris paribus*, one may expect a price gap between wall paintings on one side and altarpieces and paintings for ceilings on the other side.

3.2.5 Commissioners

Besides churches, large oil paintings were bought by public authorities and wealthy private collectors for their domestic residences. One may expect some differences between the

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2 for instance) may not be unrelated with the practice of paying per figure.

demand of different patrons, probably in size, quality and especially in subject.[24] Most important, there are reason to believe that price differentials could emerge between different commissioners.

Public authorities, whose wealth derived from collecting taxes and printing coins (while retaining substantial seignorage), were able to pay more for their commissions. This could definitely be the case for the commissions by the Venetian Dogi for the Palazzo Ducale or by the Pope (who had both spiritual and temporal power at the time) for Saint Peter's church. Moreover, commissioners with larger endowments had higher willingness to pay (because of higher benefits from artworks of high quality), and were ready to give stronger incentives to exert effort. A sort of efficiency wage mechanism appears to have taken place for these commissions, especially for the occasional altarpieces directly commissioned by the Pope.

At the same time, we can expect that the few private collectors who were able to compete with churches and public authorities for the best painters were also able to pay more; this was crucial because painters may have asked higher prices for paintings destined to private rooms and not displayed in front of the public audience and appreciation (which could advertise their work and quality and enhance their reputation).

On the other side, in the religious context of the Mannerist and Baroque age (largely dominated by the fundamentalism of the *Counter Reformation*), another difference emerges between churches and laic patrons: most painters had devotional motives for working in churches and were often available to reduce prices for their favourite church, for poorer churches of the new mendicant orders (as for the Franciscans and Dominicans) or for confraternities. We have many examples of this (as Giovanni Bellini's gift to the Scuola di San Marco or Tintoretto's gift to the Scuola di San Rocco), even if sometimes it is hard to distinguish religious and strategic motives behind discounts.

In conclusion, *ceteris paribus*, one may expect a price premium for commissions from public buildings and domestic residences of private collectors with respect to religious commissions.

3.2.6 Demand factors

A standard common wisdom in art history is that prices were higher in cities where demand was higher than in small towns. In 1625, Fra Atansio, an art dealer who was negotiating

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[24]In principle, the subjects (Old and New Testament, Saints and Martyrdoms,...) may affect prices, thought we have no strong *a priori* on the direction of this correlation.

an altarpiece by Giovanni Battista Crespi called Cerano in Milan, told the patron that the painter would have probably accepted 250 scudi, but also that if Cerano were to go to Rome he would be paid 500, claiming the existence of a high price differential between a large art centre as Rome and a smaller, but not peripherical, centre as Milan (Spear and Sohm, 2010, p. 233). Similar understanding was quite spread at the time: large cities were perceived as paying better their commissions and Rome better than all the other cities.

O'Malley (2005, p.136-142) looks at a very limited dataset on Renaissance altarpieces suggesting that prices in Florence were higher than in the rest of Central Italy and Veneto (but lower than in Rome) in the second half of the XV century, but the relation reversed in the first half of the XVI century. Comparisons between main art centres and countryside are even less conclusive for the limited size of the sample and the lack of controlling factors.[25]

According to Spear and Sohm (2010, pp. 234-235) anecdotal evidence on the higher prices in richer cities is confirmed by the data for Venice and Venetian provinces between the second half of '500s and the beginning of '700s. Looking at average prices in this period, they find that Bergamo priced at 360 ducats, Venice at 218, Vicenza at 148, Verona at 119 and other minor Veneto towns at 126. Moreover, they find justifications for the outliers: "Bergamo places first because the *deputati* of S. Maria Maggiore were both wealthy and ambitious... The bottom ranking of Verona confirms Scipione Maffei's account in 1732 of seventeenth century Verona as a cultural backwater." Of course, these considerations must have been relevant, but a deeper investigation of the price differentials should take into account a number of control variables in order to verify whether Venice was paying significantly less than Bergamo or more than Verona for comparable paintings. After all, Bergamo may have simply commissioned larger paintings or Verona may have simply employed lower quality painters for lower prices.

From an economic point of view, the high mobility of painters suggests that important adjustment mechanisms could be at work when price differentials emerged between cities. Suppose that wealthy Venetian commissioners were systematically paying more than Verona's

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[25] "Before 1450, prices in Florence and Siena were higher than those paid in provincial towns, but in the later fifteenth century the contrary was the case, and Florentine prices continued to be lower than those in provincial towns in the early sixteenth century. Venetian painters may have had an opposite experience, that is, between 1450 and 1500, prices may have been lower in Venice than they were on the mainland, but the sample is very small and conclusions are tentative. After 1500, prices in Venice seem to have been higher than those paid in the Venetian provinces" (p. 142).

commissioners for similar paintings. In such a case, painters from Verona should start supplying their paintings only to Venice, moving there or simply sending their works there, which would tend to reduce the average prices in Venice and increase the average prices in Verona. The nicknames of many artists from our dataset and active in Venice immediately reveals that, indeed, many of them moved from minor towns (especially in the late '500s): Veronese, Massimo da Verona and Maffeo Verona came from Verona, the Bassano's from Bassano del Grappa, Padovanino from Padua, and so on (including Titian who was from Pieve di Cadore, while Tintoretto was born in Venice). On the other side, suppose that Venetian painters could systematically earn more by exporting their altarpieces to foreign cities: then they would all try to conquer foreign commissions (or migrate abroad, as Ricci and Pellegrini did in the early '700s) generating an upward adjustment of the local prices. As a consequence, prices of similar paintings should converge to the same level in Venice and Verona, as in other minor towns and foreign locations. If price differentials between destinations remain (and we saw above that they did), it must be that different destinations commissioned different paintings (with different size, number of figures, position, type of commissioner and quality of painter).

Such a convergence process should be quite rapid in the Venetian Republic because the mobility of painters could be regarded as almost perfect between Venice and its neighbouring towns (and there were no tariffs). If we think of low quality painters whose supply was rather elastic, price convergence should be not only rapid, but also complete. For the case of high quality painters, whose supply can be regarded as more rigid at least in the short run (foreign painters could be still attracted in the medium run), the convergence process could be only marginally weaker. In conclusion, the endogeneity fo the market structure associated with a high mobility of painters imply that, *ceteris paribus*, one may expect the lack of any significant correlation between prices and destinations.

3.2.7 The plague

While local or temporary differences in demand may create adjustments through the mobility of painters, aggregate shocks could not. During the XVII century there was a drammatic aggregate shock to the entire North of Italy, the plague of 1630-1631, which killed a large part of the population (another one had a similar impact on Central and Southern Italy in 1656). For instance, Venice counted 141 thousand citizens in 1624 and only 102 thousand in 1633, going back to 120 thousand in 1642 and 138 thousand only in 1696. The major impact

of this shock was definitely on the demand side. The economy was heavily hit, and spending money on art was hardly the priority in the years after the plague: this demand shock should have reduced the average prices. Of course, some painters died during the plague as well, but low quality painters could always replace high quality painters for large commissions, which may have strengthened the reduction of the prices of altarpieces even more. Therefore, *ceteris paribus*, one may expect a price reduction during the decade immediately following the plague.

3.2.8 The age of painters

The commissions for paintings of historical subject under our investigation represented the most important segment of the market for paintings and were assigned only to artists whose reputation and value was already established. This implies that any basic learning process for these painters was preliminary to the entry in the market for these important commissions. In spite of this, age could still affect the quality of paintings for a category of artists that a celebrated book by Galenson (2006) has defined as *experimental innovators.* These are painters able to develop a gradual and continuous path of improvements during their career. Typically, experimental innovators keep improving with age the quality of their work as appreciated by experts and priced by the market (or, at least, they reach a peak at a very advanced age). According to Galenson and Jensen (2001), leading examples of experimental innovators have been Michelangelo, Titian and Rembrandt, but other examples of these step-by-step innovators in Venice may have been Tintoretto and, for different reasons, the pioneer of the Rococò renaissance, Sebastiano Ricci.

The separate category of *conceptual innovators* does not need much time to develop innovations because these are pathbreaking (and often not understood and poorly priced) changes derived from a radically different perspective on the same artistic problems. The thesis of Galenson is that conceptual innovators tend to reach their maximum quality at a young age, and therefore they should not exibit a significant relation between age and quality as priced by the market (or, at least, they should reach a peak at a very young age). Galenson and Jensen (2001) propose the examples of Masaccio in the XV century and Raphael in the XVI century, but the first example is problematic because Masaccio died at the age of 26, which does not allow one to compare his young innovative activity with an older activity. The problem is only slightly less relevant for Raphael who died at the age of 37.

Galenson and Jensen (2001) and Galenson (2006) test what we will call the Galenson hypothesis on auction prices for modern painters, but give up such a challenging enterprise for the old masters given the lack of data on prices from the XV-XVII centuries. The Baroque period provides a wider dataset for a systematic analysis of the Galenson hypothesis on old masters. First of all, the coexistence of experimental innovators (with a positive relation between age and innovative quality, at least up to a certain age) with conceptual innovators and non-innovators (without such a positive relation) should preserve on average an increasing relation between age and innovative quality. If prices were reflecting quality, we may expect also a positive correlation between age and prices after controlling for the painting and painters' features. Beyond such a weak test of the Galenson hypothesis, one could examine single cases of different kinds of innovators for a stronger support of the Galenson hypothesis.

Art history research on old master paintings has not advanced a systematic investigation of the relation between age and artistic innovations, and even less between age and monetary compensation in the market. Only some anecdotical evidence is available and by no means conclusive. For instance, Spear and Sohm (2010, p. 28) limit their emphasis on the declining prices of some painters in their older age (as for Triva and Farinati in Venice or Artemisia Gentileschi active in Rome and Naples) due to physical decline, out of fashion style, increasing reliance on assistants and gradual withdrawal into voluntary retirement. In the absence of other implications from art historical studies, we will mainly focus our attention on the weak version of the Galenson hypothesis: *ceteris paribus*, one may expect a positive relation between prices and age.

4   Data and Descriptive Evidence

The data used for the empirical analysis are drawn from original commissions to painters. The main source of the dataset is the monumental work of Spear and Sohm (2010), who have collected data on prices (all converted in silver ducats) from original contracts and other documentary evidence (some of which was gradually rediscovered by various art historians in the last century) and on other characteristics of 254 oil paintings made between 1551 and 1746 by 61 artists located in Venice and in the Veneto region.[26] The artists included in the

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[26] We checked one by one the data, especially to separate multiple commissions (which required information on size of the paintings and number of figures). We also added additional data concerning the age of painters at the time of execution and other qualitative features from standard art history sources.

study are listed in Table 1. We can fairly look at the sample as representative of the (many more) commissions for oil paintings that took place at the time. The main reason is that the survival of documentary evidence on these contracts for about four centuries is largely random. Fires, wars and other accidental events have spread losses of documents across all the original archives. Art historians have looked at these archives for decades (usually to search for dates and names of the artists, or to verify other contractual conditions), finding in a rather random way contracts for more or less important paintings. While their value for art history may be different, for our purposes the heterogenous nature of the sample is extremely useful.

Many important informations on artworks' characteristics that potentially influence the price are available in the dataset. These are: title, author and size of the painting, number of figures included in the composition, town and building where it was planned to be located, position in the building (i.e. on a main or secondary altar, on the ceiling, or on lateral walls including the organ), commissioner's type, that is whether the artwork was made for a religious or for a secular commissioner (public authority or private collector), date of commission and age of the artist when the painting was made. We also built variables indicating the type of subject (for instance, common subjects were the *Crucifixion*, the *Annunciation of the Virgin* or *Moses saved from the Water*), whether the painting belonged to a commission of multiple works, the type of destination (Venice, several provincial towns, countryside destinations or foreign towns) and the perceived quality of the painters, which is discussed below in further detail.

Table 2 shows a partial list of the variables we use in the empirical analysis together with their main summary statistics. The average price of a painting was 193.5 Venetian silver ducats. However, a large variation in prices can be observed, with prices ranging between a minimum of 5 to a maximum of 2,306 silver ducats. To get a clearer picture of the price distribution in our sample, the histogram in Figure 3 illustrates the class-price distribution. The modal price value was between 50 and 100 silver ducats, with around 27% of observations; another 24% of the paintings were paid less than 50 silver ducats while less than 20% were paid more than 300 ducats.

Also painting's size and the number of figures vary a lot across paintings: the average painting's size is 12.4 square meters but while the smallest painting in the dataset measures 0.4 square meters, the largest size is around 85 square meters. The average oil painting contains 10 figures; nonetheless, this number ranges from 1 figure to the 59 figures of Tintoretto's
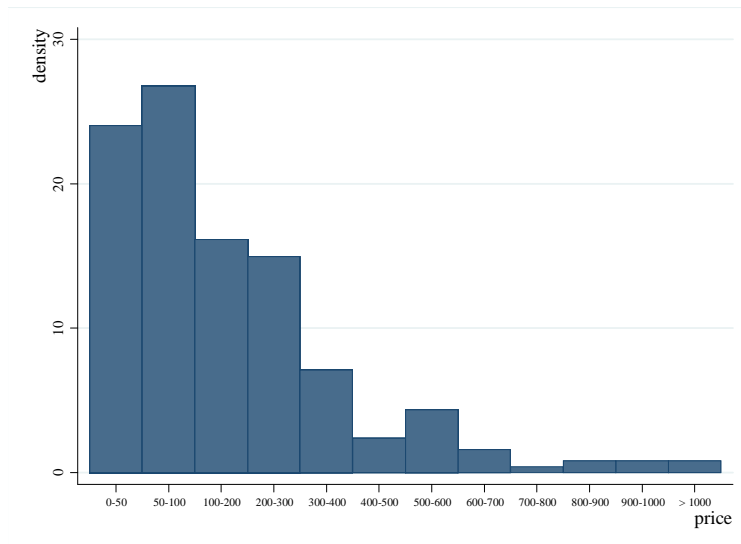
Figure 3: Price distribution (Venetian silver ducats)

Last Judgement. Almost half of the sample is made by artworks whose final location is lateral wall of a church or a building, followed by altarpieces (41%) and by paintings for the ceiling (11%).

Only 40% of Venetian artworks in our sample were for Venice. Among the other more common destinations in the Venetian Republic we find Vicenza (8.7%), Verona (6.3%), Bergamo (5.1%) and Padua (4.3%). Almost one fifth of the paintings were addressed to minor destinations, that is small provincial towns within the Republic (as Castelfranco Veneto, Trevenzolo, Lentiai, Salò,..). Export sales were also quite common for a trading center as the Venetian Republic: more than 13% of the paintings in our dataset were produced for commissioners located abroad (but mostly in Italy).

As regard artists' characteristics, the primary information collected in the dataset is their age when the paintings were executed. From Table 2 we see that the average age at which artworks were made in Venice was 52, spanning from a minimum of 22 to a maximum value of 81. Remarkably, a closer look at the data on painters' age suggests that artists became more productive after the age of 40: while only 18% of the oil paintings in our sample have been produced by artists younger than 40, almost half of our observations refer to artworks painted by artists in the 40-60 age range. This may reflect the importance of the commissions to which the observations in our dataset refer: most painters started their careers as assistants

Table 1
List of artists

LOW QUALITY (*pittori più bassi*)	INTERMEDIATE QUALITY (*pittori ordinari*)	HIGH QUALITY (*pittori straordinari*)
Ponchino	Jacopo Bassano	Titian
Campagnola	Leandro Bassano	Jacopo Tintoretto
Franco	Schiavone	Veronese
Michieli	Moroni	Zuccaro
Brusasorci	Palma Giovane	Liberi
G. Salviati	Francesco Bassano	Loth
C. Vecellio	Domenico Tintoretto	Giordano
Farinati	Strozzi	Ricci
Licinio	Padovanino	G.A. Pellegrini
D. Varotari	Renieri	Piazzetta
Cavagna	Heintz	Tiepolo
Maganza	Vecchia	
Marco Vicentino	Ricchi	
Maffeo Verona	Ruschi	
Molinari	Triva	
Prudenti	Zanchi	
Maffei	Celesti	
Massimo da Verona	Fumiani	
Carpioni	F. Pittoni	
Beverensi	Dorigny	
Prunato	Turchi	
Marchesini	Trevisani	
Canziani	Lazzarini	
Grone	Balestra	
	G.B. Bellotti	
	G.B. Pittoni	

Table 2

Summary statistics

Variables	Mean	Std. Dev.	Min	Max
Price	193,50	245,83	5	2306
Size	12,42	14,15	0,4	84,8
Nr figures	9,77	9,40	1	59
Altar	0,41	0,49	0	1
Wall	0,46	0,50	0	1
Ceiling	0,11	0,32	0	1
Venice	0,41	0,49	0	1
Minor destination	0,22	0,41	0	1
Verona/Vinceza	0,15	0,36	0	1
Bergamo	0,05	0,22	0	1
Padua	0,04	0,20	0	1
Treviso	0,03	0,17	0	1
Exports	0,13	0,34	0	1
Religious commissioner	0,75	0,43	0	1
Age	52,18	13,61	22	81
High quality	0,31	0,47	0	1
Intermediate quality	0,45	0,50	0	1
Low quality	0,23	0,43	0	1
Plague	0,02	0,14	0	1

to their masters, preparing minor works or even copying others' paintings and only after a few years they started receiving commissions from churches and other important patrons.

As stressed before, in principle aesthetic value should be the predominant factor of paintings' price, but it is not easy to identify quality and to measure it. Ideally, we would like to control for artists' fixed effects in order to take into account of individual specific characteristics (namely the style) that greatly influence a painting's price. However, our dataset contains just few observations for many artists, therefore we can control for artist fixed effects only when we possess sufficient information. This is the case for eight painters: Veronese, Tintoretto, Palma the Younger, Farinati, Celesti, Zanchi, Ricci and Tiepolo. In order to control for the perception of aesthetic value of the other artists, we divide them in three categories following the above mentioned classification suggested by Reni: inferior painters (*pittori più bassi*), intermediate painters (*pittori ordinari*) and top quality painters (*pittori straordinari*). To group the painters in these three classes of different perceived quality, we have followed as much as possible art historical accounts[27] and documentary evidence. First of all, in the second half of the '500s there is little doubt that three painters were (and still are) unanimously considered as extraordinary in the terminology of Reni: Titian, Veronese and Tintoretto. Compared to them, the contemporary Schiavone, Moroni and the members

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[27]For a comprehensive account of Venetian art in the XVII century see Pallucchini (1981).

of the Bassano family could be regarded as belonging to the intermediate category of ordinary painters. The decadence of Venetian art of the following century was recognized since its beginning by observers inside and outside Venice. The highly prolific Palma the Younger, Domenico Tintoretto (son of Jacopo) and Padovanino were not perceived as innovators, but only as valuable epigones of the earlier generation's masters, therefore ordinary painters. Only Liberi, the noble and rich prior of the painters' guild, reached international (but short) fame which was comparable (at the time) with that of the leading foreign painters.[28] Collectors and dealers appreciated the high standing of foreigner migrants as Loth (Spear and Sohm, 2010, p. 231), or internationally famous painters occasionally active in Venice, as Zuccaro or Giordano. Only at the turn of the century, a new renaissance of Venetian art was led by Ricci, Pellegrini, Piazzetta and Tiepolo - with Canaletto active in the separate market for *vedute* (views of the lagune).

Beyond this, we need to rely on some objective evidence. To build an approximate ranking of painters that follows the perception of quality at the time (even if subject to some uncertainty), we look first of all at the painters who were regularly enrolled in the guild *Arte dei Depentori*, later transformed in the *Collegio de' Pittori*: these were more likely to be considered as valid artists in the profession. As mentioned before, ideally we would like to have data on their average income: this can be seen as a good proxy for the demand of their paintings and for the willingness to pay for them, which should be a monetary measure of the average appreciation of these painters. Spear and Sohm (2010, pp. 216-218) provide data on average tax payments of the members of the guild in three periods (1639-1644, 1684-1686 and 1717): since taxes were based on income declared in rather small communities, these payments can be seen as reliable indicators of the average income of our painters in those periods. Moreover, these periods are spread enough to include all the later generations of painters and do not include any date of paintings in our dataset (which avoids any direct dependence of the associated average incomes from our prices). Restricting the attention to the top 20 % income earners in each of those periods, together with the high quality painters we find Renieri, Heintz, Vecchia, Triva, Ruschi, Zanchi, Celesti, Fumiani, Dorigny, Lazzarini, Pittoni and Trevisani. Other painters were earning much less than these or were only occasionally active as painters (so that they could avoid enrollment): on average, one may expect that these were regarded as lower quality painters compared to those mentioned

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[28] Also in Rome, Liberi was cited as a first-class painter by the expert Padre Resta advising the Spada in the selection of top painters for fifteen large canvases for Chiesa Nuova (Spear and Sohm, 2010, p. 90).

above. On this basis we have classified the group of ordinary painters,[29] and residually the inferior ones. According to this classification, in the Venetian art market 26 artists (43% of the total) are classified as low-quality artists, 24 (41 %) as medium-quality artists and 11 (18%) as high-quality artists (see Table 1).

Finally, we have examined historical macroeconomic events that may have affected the market for paintings. By far the major event was the 1630-1631 plague. We expect a reduction in the number of traded artworks in the period following this episode as a result of both demand and supply factors. Indeed, although our data do not represent the universe of the works of art produced and traded on the market, the paintings produced in the two decades immediately following the plague represent just 4.7% of our sample (less than the average percentage for a single decade). This same fact provides indirect evidence regarding the contraction of the art market in the period immediately following the plague. Further evidence may emerge from the impact on prices.

5   Econometric Analysis

5.1   The price equation

The purpose of this study is to examine the process of price formation of oil paintings by old masters in Venice in the Baroque period. Following the spirit of the hedonic price literature (Rosen, 1974), we regress the natural logarithm of the real sale price of these paintings on a set of paintings' and artists' characteristics. Our main interest is in testing the hypotheses put forward in Section 3.

We assume that the oil paintings price formation process is captured by the following

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[29]Movers to multiple cities as Turchi and Balestra did not appear in the lists of guild's members but were perceived as comparable to the other ordinary painters. Finally, Vecchia, Bellotti, Ricchi and Zanchi are only occasionally added by contemporary sources as top painters in Venice (Spear and Sohm, 2010, p. 90, 231 and 236), therefore it appears reasonable to consider them at least as ordinary painters. We should add that alternative indexes only marginally affected our results, because the artist fixed effects remained the major source of control for the perceived quality differences and because, as we will see, the explanatory power of our model is already high without controlling for quality: R^2 equal to 66 % against 74 % (see Table 4).

regression equation:

$$Ln(price_{ij}) = \alpha + \beta X_i + \gamma_1 AGE_{ij} + \gamma_2 AGE_{ij}^2 + \sum_{k=1}^{8} \delta_k I(j = k) +$$

$$+ \sum_{q=1}^{2} \phi_q I(quality = q) + \theta(sale\ year) + \lambda(plague) + \varepsilon_{ij}$$

The index i and j refer, respectively, to painting i and to painter j. The prices of paintings in the dataset are expressed in Venetian silver ducats. During the entire XVII century, the price level was surprisingly stable all over Italy, but the second half of the XVI century was characterized by a sustained inflation (due to the arrival of gold from the Americas), and the first half of the XVIII century exibited wide price variability. Therefore, we have to take into account changes in the price level over the two centuries under consideration. To this aim, we convert nominal prices in real terms by first converting ducats in the units of account, the *liras* (according to the exchange rate of 1 ducat *per* 6.4 liras),[30] and, secondly, by using information regarding the quantity of Venetian liras necessary to buy a hundred kilograms of wheat.[31] Using this procedure we translate nominal prices in real terms reflecting the cost of living and its changes during the period under analysis and, thus, we base our econometric investigation on a more reliable measure of artworks values, that is on ducats' purchasing power. The price variable in the above equation refers to price expressed in such real terms.

The X vector contains paintings' characteristics, first of all the size and the number of figures. Squared size and squared number of figures are also considered in order to test for decreasing returns. Moreover, we include a set of indicator variables for the paintings' position (i.e. altar, ceilings or wall), for the type of commissioner (i.e. religious or secular commissioner) and for the final destination, distinguishing between Venice (the excluded category), other important Venetian Republic destinations (i.e. Verona and Vicenza, Bergamo, Padua, and Treviso), other minor provincial destinations and exports (e.g. Turin, Milan, Genoa). The variable AGE represents the age of artists at the time the paintings were produced. Squared age is entered to check for concavity in the age-price profile. Additional dummies concern the eight artist fixed effects (δ_k) and the quality indexes mentioned above (ϕ_q). Finally, in order to take into account of changes in the Venetian art market in the period under analysis, we insert among regressors the year in which the painting was executed (whose

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[30] This exchange rate is constant over the entire period (Martini, 1883).

[31] Data on price of wheat are taken from Malanima (2002). Better inflation indexes are not available, but wheat was an essential good for most of the population and its price variations were likely to be reflected in those of many other goods.

coefficient θ represents the time trend). We finally control for the plague effect by means of a dummy variable for the decade immediately following this episode (1631-1640).

5.2 Empirical results

Table 3 shows OLS estimates of the price equation. The first remarkable thing to notice is that the R^2 is equal to 74%, pointing out a good overall fit and providing first evidence of the existence of a systematic pattern in the process of price determination. Moreover, generally the parameters take the expected sign and by and large they support our main hypotheses on the process of oil paintings' price determination.

Our results highlight a premium of around 9% per square meters and thus they confirm that larger paintings were paid more. Additionally, we find evidence of weak scale economies in the production technology, as suggested by the negative and significant coefficient of squared size.

The number of figures plays a key role for price formation. More specifically, each figure brings an increase in painting's price of around 3%, without indications of decreasing return to figures given that the coefficient of squared figures in not nearly statistically significant. As pointed out before, there can be a contractual rationale behind this result. Large oil paintings of historical subject were complex works often taking months or years to be completed and raised serious moral hazard issues on the effort exerted by painters in producing quality. Given the impossibility of specifying quality (or the "aesthetic worth") in contracts, the optimal patron-artist contract had to rely on measurable features that were correlated with perceived quality, a standard principle (known as informativeness principle) in principal-agent contract theory (Holmstrom, 1979). As argued before, the number of human figures was such a measurable feature and appears to have been extensively used in price determination.

Another factor correlated to paintings' price was the position where they were planned to be placed. In the estimated equation the excluded category is *Altar*, so that the negative and highly statistically significant sign of the *Wall* coefficient points out that artworks produced for this kind of location were paid much less than altarpieces (- 61%).[32] As explained in the previous section, because of the presence of a larger number of substitutes for decoration of lateral walls, especially in churches, the demand elasticity was higher for wall paintings

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[32] The category Wall includes paitings for the organ section and gonfaloni, which were rare and poorly priced. Excluding these two subcategories, the price gap remains around 50 %.

Table 3

Price equation

Independent variables		
PAINTINGS' CHARACTERISTICS		
Size	0.088***	(0.010)
Squared size	-0.001***	(0.000)
Nr figures	0.033**	(0.014)
Squared nr figures	-0.000	(0.000)
Wall	-0.614***	(0.108)
Ceiling	0.068	(0.171)
Minor destination	-0.077	(0.129)
Verona/Vinceza	-0.127	(0.148)
Bergamo	0.027	(0.199)
Padua	0.194	(0.207)
Treviso	-0.191	(0.278)
Exports	0.171	(0.154)
Religious commissioner	-0.316**	(0.122)
Multiple commission	-0.113	(0.101)
PAINTER'S CHARACTERISTICS		
Age	0.030**	(0.015)
Squared age	-0.000	(0.000)
High-quality	0.503**	(0.195)
Medium-quality	0.166	(0.152)
Tiepolo	-0.719**	(0.293)
Celesti	-0.702***	(0.242)
Farinati	-0.749***	(0.192)
Tintoretto	-0.635***	(0.227)
Veronese	-0.320	(0.258)
Ricci	-0.018	(0.233)
Palma il Giovane	0.199	(0.168)
Zanchi	0.146	(0.184)
OTHER		
Date	0.005***	(0.001)
Plague	-0.810***	(0.293)
Constant	-10.404***	(1.771)
Observations	254	
R-squared	0.741	

Notes. Standard errors in parentheses. Reference categories: altar, destination=Venice, Secular commissioner, Low-quality
*** p<0.01, ** p<0.05, * p<0.1

than for both altarpieces and ceiling. This higher elasticity is likely to be the reason for this negative premium. On the other hand, we do not find any statistically significant difference between prices of altarpieces and ceilings, whose demand was more rigid (because of the lack of substitute decorations and the limited space available for these artworks). Differences between the subjects of paintings did not appear to affect prices and we did not report them, but to some extent this is due to the correlation between certain subjects and the placement of the paintings (an *Assumption* or a *Crucifixion* were typical for altarpieces, while scenes from the lyfe of Christ or saints were typical of wall paintings).

Also the type of commissioner mattered for the price of Venetian oil paintings: our findings highlight a price premium in case the painting was commissioned by a secular commissioner instead of a religious one. This result may be driven by different sources. On the demand side, one can expect that public authorities and wealthy private collectors were able to pay more and were also willing to pay more to induce quality and effort in their occasional commissions (for a sort of efficiency wage mechanism). On the supply side, the fact that painters had wide visibility in case their artworks were displayed in churches rather than in a domestic context of a private collector might imply that the artists were price discriminating (selling their paintings at a lower price for churches because of a sort of "advertising effect" coming from artworks' placement). Completely different from this "strategic" goal, also a "devotional" motivation might have been at work when artists were willing to reduce their prices for favourite churches or poorer religious patrons. Obviously, all these effects may have been present at the same time.

In some cases contracts between painters and commissioners provided for multiple commissions, in the sense that in a single contract the parties involved in the transaction agreed upon more than one painting and the prices for all these pieces were bargained simultaneously. We expected that this could produce a reduction in the unitary price because of a "quantity discount" effect. However, although we find a negative coefficient's sign in case the painting was part of a multiple commission, the coefficient is not statistically significant at the conventional level.

A very interesting and remarkable estimation result is that, *ceteris paribus*, the final destination of the painting did not matter for its price determination. Hence, despite anecdotal evidence suggesting that in large and prestigious art centres prices of art were higher than in small provincial towns, our results seem to challenge this belief. Given the importance of this result, we will revisit this topic in greater depth in the following section.

Let us turn to what is probably one of the main determinant of the price of a painting, that is its aesthetic value, and let us recall that the artist dummies and the quality-groups we have entered in the estimation equation reflect painters' reputation as perceived by their contemporary audience. First of all, we find that a painting produced by an artist belonging to the highest-quality group is priced, *ceteris paribus*, 46% more than the comparable painting produced by inferior painters. On the other side, the price differential between artworks by ordinary and low quality painters is positive but not statistically significant. The artists' coefficients highlight in some cases interesting results. Veronese and Ricci appear to have been priced in a similar way to the other top quality painters as Titian and Piazzetta. At the same time, Palma the Younger and Zanchi were priced in line with their ordinary colleagues, while Celesti was paid significatively less then them. Farinati was ranked as a low quality painter, and was even paid comparatively less than his direct competitors. More interestingly, despite their fame, Tintoretto's and Tiepolo's paintings were relatively low-priced at their time. However, this should not be entirely surprising. During most of his life, Tintoretto had to compete with great masters as Titian and Veronese, and was known for his repeated predatory techniques: he often accepted low prices in exchange for sure commissions. Moreover, he was particularly productive: his sketchy style allowed him to complete numerous commissions (including the largest canvas of all times, the *Paradise* of Palazzo Ducale) and an impressive amount of portraits in a relatively short time, which made him available for lower prices than his rivals. On the other side, the prices of Tiepolo (1696-1770) grew while he conquered an international fame for his fresco decorations around Europe: our dataset ends in 1750 and therefore collects only his early paintings and not the late phase of his career (and none of the frescoes), therefore it is not surprising that the prices of his early paintings (mostly altarpieces) were relatively low.

Considering now the age of execution of paintings, our results suggest that the artists in our dataset were, at least partially, "experimental innovators", that is painters who, thank to a gradual development of their artistic ability, were able to improve their capability to produce high aesthetic-value artworks with the progress of their career. As a matter of fact, the coefficient for age of painter is statistically significant and it denotes an average increase in the price of paintings by around 3% a year. In Section 6 we will present some additional evidence on the role of age in the case of some specific significant painters present in the dataset (Tintoretto and Ricci for Venice) in order to see how the Galenson hypothesis relative to the age-quality profile was at work during the Baroque era.

Finally, the positive and highly significant coefficient of the date variable highlights an increase in paintings' prices by an average of 0.5% for year (mainly due to price increases in the early XVIII century).

5.3 Destination effects: endogenous market forces at work

In the previous section we found that, once controlling for painting's and painter's characteristics, there is no price differential between artworks placed in different geographical locations. This result goes opposite to the standard perception cited in Section 3 that art prices were higher in large and high-status cities than in smaller provincial centres, but in line with our theoretical predictions on market adjustments due to the mobility of painters. In this section we investigate further on this point in order to highlight which are the factors driving the vanishing of the destination effect. Table 4 presents destinations' parameters resulting from three different price equations specified following a stepwise procedure. In all three specifications we enter a set of dummy variables for the main destinations (Verona and Vicenza, Bergamo, Padua, and Treviso) and a dummy variable for the other minor provincial destinations of the Venetian republic. Moreover, we enter a dummy for exports, that is, destinations outside the Venetian republic (e.g. Turin, Milan, Genoa, Madrid). Venice is the reference group.

In column 1 coefficients result from estimation of the most parsimonious price equation containing only the dummies for destination and size of paintings. As it is clear from the table, we find that on average paintings addressed to Verona and Vicenza and to small provincial centres were considerably less valued than paintings produced for Venice, even controlling for size (- 34% for Verona and Vicenza and - 29% for minor towns). On the contrary, we detect a positive premium for export sales, as witnessed by the positive and significant sign of the coefficient of the dummy for exports (+ 53%). For the other main towns of the Republic, that is Bergamo, Treviso and Padua, we do not find a differential in prices per square meter with respect to Venice. In particular, as mentioned earlier, Bergamo did exibit total prices that were much higher than in Venice, but simply controlling for the size of paintings, the difference looses its significance.

So far it has emerged that actually there were towns less priced than Venice and that paintings made for exports were more rewarded than paintings produced for Venice. However, these results have been obtained without controlling for either paintings' characteristics or

Table 4
Destination effect

Independent variables	(1)		(2)		(3)	
PAINTINGS' CHARACTERISTICS						
Size	0.034***	(0.004)	0.098***	(0.010)	0.088***	(0.010)
Squared size			-0.001***	(0.000)	-0.001***	(0.000)
Nr figures			0.040***	(0.015)	0.033**	(0.014)
Squared nr figures			-0.000	(0.000)	-0.000	(0.000)
Wall			-0.819***	(0.110)	-0.614***	(0.108)
Ceiling			-0.075	(0.176)	0.068	(0.171)
Minor destination	-0.287*	(0.164)	-0.252**	(0.124)	-0.077	(0.129)
Verona/Vinceza	-0.337*	(0.185)	-0.315**	(0.140)	-0.127	(0.148)
Bergamo	0.277	(0.286)	0.052	(0.206)	0.027	(0.199)
Padua	0.441	(0.309)	0.263	(0.218)	0.194	(0.207)
Treviso	-0.289	(0.395)	-0.235	(0.279)	-0.191	(0.278)
Exports	0.525**	(0.216)	0.205	(0.156)	0.171	(0.154)
Religious commissioner			-0.457***	(0.117)	-0.316**	(0.122)
Multiple commission			0.046	(0.103)	-0.113	(0.101)
PAINTER'S CHARACTERISTICS						
Age					0.030**	(0.015)
Squared age					-0.000	(0.000)
High-quality					0.503**	(0.195)
Medium-quality					0.166	(0.152)
Tiepolo					-0.719**	(0.293)
Celesti					-0.702***	(0.242)
Farinati					-0.749***	(0.192)
Tintoretto					-0.635***	(0.227)
Veronese					-0.320	(0.258)
Ricci					-0.018	(0.233)
Palma il Giovane					0.199	(0.168)
Zanchi					0.146	(0.184)
OTHER						
Date			0.007***	(0.001)	0.005***	(0.001)
Plague			-0.719**	(0.312)	-0.810***	(0.293)
Constant	-0.813***	(0.116)	-11.996***	(1.195)	-10.404***	(1.771)
Observations	254		254		254	
R-squared	0.247		0.666		0.741	

Notes. Standard errors in parentheses. Reference categories: altar, destination=Venice, Secular commissioner, Low-
*** p<0.01, ** p<0.05, * p<0.1

for those of the painters. In order to see what is the role of differences between features of paintings addressed to different destinations, in column 2 of Table 4 we show destinations' dummies coefficients obtained after controlling for the attributes of the artworks (remarkably, these allow us to explain two thirds of price variability). What we find is that the negative price differentials registered for minor centres and for Verona and Vicenza remain but they are reduced in size. Most important, the export premium vanishes: the coefficient for foreign destinations decreases a lot and it loses completely its statistical significance. This result suggests that paintings with similar characteristics were paid abroad the same as in Venice, while the price differential detected before was simply due to the fact that exported paintings possessed more characteristics that were more valued by the market than those produced for Venice.

Finally, if we consider the high mobility of painters that characterized the Venetian market for art in the period under analysis, we expect that after controlling for painters' characteristics any price differential disappears. In effect, results in column 3 of Table 4 show that destinations' coefficients obtained from estimation of the fully specified equation are not at all statistically significant. The comparison of results in columns 2 and 3 reveals that minor centres' paintings were paid less because they were produced by lower quality painters, so that when controlling for painters' quality the differential disappears.

Our result is consistent with the hypothesis that the structure of this market was endogenous and painters' mobility was arbitraging away price differentials between towns with different demand. In a dynamic perspective, any price differential should induce painters to move toward high price towns (or send their works there), which would tend to put downward pressure on the prices of those towns and to increase the prices of the other towns.

On the other hand, aggregate shocks affecting demand in all the towns could affect equilibrium prices everywhere. We confirm this result with the dummy for the decade following the 1630 plague, which shows a drastic and significant reduction in the average prices (- 81 %). In conclusion, aggregate shocks affected prices, but local shocks tended to generate market adjustments (namely movements of painters or paintings) which avoided price differentials.

6 A Look at Rome, Florence, Bologna and Naples

The aim of this section is to check for the robustness of our findings by testing whether the main results obtained for the Venetian art market hold also for the other leading Italian art

Table 5
Summary statistics - Italy

Variables	All Mean	All Std. Dev.	Rome Mean	Rome Std. Dev.	Florence Mean	Florence Std. Dev.	Bologna Mean	Bologna Std. Dev.	Naples Mean	Naples Std. Dev.
Price	320.55	394.64	326.20	329.11	201.94	127.57	412.75	641.27	258.13	357.15
Size	8.95	7.08	9.06	8.10	6.90	2.20	10.39	6.55	7.99	4.21
Nr figures	6.44	3.74	5.95	3.55	6.28	2.97	7.23	5.04	7.53	2.85
Age	43.93	12.70	43.34	13.52	47.83	11.92	43.53	13.17	44.71	8.79
High quality	0.29	0.46	0.26	0.44	0.11	0.32	0.50	0.51	0.29	0.46
Intermediate quality	0.41	0.49	0.37	0.48	0.89	0.32	0.35	0.48	0.45	0.50
Low quality	0.29	0.45	0.37	0.49	0.00	0.00	0.15	0.36	0.26	0.45
Rome	0.60	0.49	-		-		-		-	
Florence	0.07	0.26	-		-		-		-	
Bologna	0.17	0.37	-		-		-		-	
Naples	0.16	0.37	-		-		-		-	
Plague	0.10	0.29	0.06	0.24	0.00	0.00	0.00	0.00	0.37	0.49
Observations	241		145		18		40		38	

centres, that is Rome, Florence, Bologna and Naples. Also in this case the source of data is Spear and Sohm (2010), from which we derive information on the original sale prices and on other characteristics of 241 artworks traded in these towns during the Baroque period and produced by 93 artists.[33] During 2010, the same source will reveal (through an online database administered by the Getty Research Institute) a more complete dataset with a thousand Roman paintings which will provide a chance for further validation of our and other results.

Here, we conduct a distinct empirical analysis for the four mentioned towns because the period to which their data refer is much narrower than in the case of Venice (we observe prices of paintings bargained only in the XVII century and, in Rome, from 1583 to 1700) and because we have a more limited set of explanatory variables.[34] Differently from the

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[33] To give a flavour of the most famous artists in the dataset, this includes late Mannerists (as Barocci and Arpino), Caravaggio and the so-called Caravaggists (as Honthorst, Vouet, Gentileschi, Caracciolo, Ribera, Preti), the leading Bolognese classicists (as Annibale and Ludovico Carracci, Domenichino, Albani, Guercino and Reni), the leading painters of the Roman Baroque (as Pietro da Cortona, Sacchi, Maratta and Gaulli), few painters mainly active in Florence (as Rosselli and Ferri), few others mainly active in Naples (as Lanfranco, Stanzione and Giordano) and many more.

[34] We excluded frescoes. Also in this case we checked one by one all the observations, correcting few size measures (occasionally mixing inches with centimeters) and collecting the data for the number of figures in paintings from Rome by visual inspection of the original paintings. In a few cases in which this was not possible we estimated the number of figures on the basis of the subject and size to avoid possible selection bias.

Venice dataset, in the case of Rome, Florence, Bologna and Naples the data do not provide information relative to the planned position (altar, ceiling or wall). Finally, the paintings in the dataset refer exclusively to bargaining between artists and religious commissioners (there are no public and private patrons).

The prices of paintings are expressed in the local contemporary currencies. More specifically, for Rome and Florence they are expressed in their own silver scudi, for Bologna in liras, which can be immediately converted in its silver scudi, and for Naples in silver ducats. All these silver coins were exchanged almost at parity between each other, and, most important for our purposes, without increasing deviations over time.[35] During the XVII century inflationary phenomena were virtually absent in Italy,[36] therefore we do not have the necessity of correcting prices for the cost of life (whose measure is also hardly available in comparable ways for the four cities under investigation). Nevertheless, we introduce dummies for prices in the currencies of the four cities and a time trend to control for residual differences between average prices in different cities and for inflationary trends.

Table 6 shows some key features of the whole sample and by town. First of all, notice that 60 % of the paintings were from Rome, which was indeed the leading art center of the continent. On average, prices were higher in Bologna and lower in Florence. However, while the paintings of the former town have both size and number of figures higher than the national average, for the latter the opposite is true. The oil paintings produced in our four cities were slightly smaller than in Venice (9 square meters instead of 12.4) and with less figures (6.4 instead of 9.7). Interestingly, the mean age of painters was very similar between the four towns, ranging from 43.3 (for Rome) to 47.8 (for Florence). The mean age of Venetian painters was instead higher (52 years old).

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[35] The quantity of silver in the different coins were occasionally changed (not in Rome and Florence during this period). However differences in the exchange rate were minimal for at least two reasons. First, the value of each silver coin was a matter of prestige for each town and was accurately defended. Second, when an exchange rate between silver coins was deviating from nominal parity, less valuable coins were systematically fused, leading authorities to adjustments to avoid this. The largest difference was between the Neapolitan ducat and the Roman scudo (but the cost of life was correspondingly lower in Naples). Nevertheless, even in this case, we have direct evidence of painters (as Artemisia Gentileschi) who were indifferent between being paid the same number of Roman scudi or Napolitan ducats (Spear and Sohm, 2010).

[36] To give a couple of examples from Rome, where the scudo was divided in 100 baiocchi, the price per 12-oz. pound of cow's milk cheese was 7 baiocchi in 1595 and 7.5 in1701; the price of sausages was 10 baiocchi in 1595 and 9 in 1701, and identical stable prices characterized all the common food products (Spear and Sohm (2010).

Table 6
Price equation - Rome, Florence, Bologna and Naples

Independent variables		
PAINTINGS' CHARACTERISTICS		
Size	0.083***	(0.023)
Squared size	-0.001**	(0.001)
Nr figures	0.163***	(0.041)
Squared nr figures	-0.005**	(0.002)
Multiple commission	-0.157	(0.167)
Christ	0.239**	(0.099)
Florence	-0.175	(0.180)
Naples	-0.111	(0.151)
Bologna	-0.370**	(0.152)
Saint Peter's altarpieces	0.596***	(0.151)
Minor destination	0.152	(0.114)
PAINTER'S CHARACTERISTICS		
Age	0.050**	(0.022)
Squared age	-0.000	(0.000)
High-quality	0.653***	(0.144)
Medium-quality	0.327***	(0.119)
Caravaggio	0.392	(0.240)
Cortona	0.356	(0.243)
Domenichino	0.291	(0.262)
Maratta	0.304	(0.274)
Reni	0.251	(0.230)
Tiarini	-0.156	(0.281)
Preti	-0.117	(0.311)
OTHER		
Date	0.001	(0.002)
Plague	-0.392*	(0.205)
Constant	0.910	(3.377)
Observations	241	
R-squared	0.661	

Notes. Standard errors in parentheses. Reference categories: subject?Christ, destination=Rome, Low-quality
*** p<0.01, ** p<0.05, * p<0.1

Turning to the price equation, our main explanatory variables are the same as before, including the size of paintings, the number of figures and their squared levels. Since we do not have systematic information on the positioning of the paintings (altar, wall, ceiling), we carefully build dummies for the subjects of the paintings (including those for the presence of Christ or the Virgin in the composition, Old versus New Testament stories, and so on), which were often depending on the placement of the painting in the churches. Moreover, we can classify a particular category of altarpieces, the few altarpieces that were commissioned by the Pope for the decoration of the Saint Peter's church. This was the centre of Christendom and the place where pilgrims from all over the Christian world went. We expect to see a remarkable price premium for altarpieces addressed to this church because of the general premium for altarpieces and of the unique wealth of the commissioner (with a high willingness to pay artists in order to provide unmatchable incentives to produce high quality). We test this hypothesis by including a dummy variable for Saint Peter's altarpieces. As we did for the Venetian art market, also in this case we used dummies for seven artists with enough observations (Caravaggio, Cortona, Domenichino, Reni, Maratta, Tiarini and Preti) and divided painters in three groups according to their reputation as perceived at the time, again on the basis of documentary evidence from contemporary sources (details available from the authors).

To verify the impact of different destinations on the price of paintings, we relied on a conservative test. We have built a dummy variable, *Minor destination*, which includes all the smallest destinations different from the four main towns and the other leading art centers (as Genoa or foreign cities which had high demand). We have experimented different definitions, including only small towns in the countryside as for instance Caprarola, Palestrina, Nola, Volterra, Spoleto and so on, or even larger provincial towns as Ancona, Lucca or Perugia (all together representing 25 % of the observations). If none of these definitions of minor destinations exibits lower prices than the main cities (after controlling for paintings' and painters' features), we can safely support the thesis for which market forces led to price equalization.

Finally, we checked for a time trend and for a macroeconomic shock identical to the one evaluated in the analysis of Venice. The plague of 1630 did not reach the towns below the Appenini. However, another plague hit Rome, Florence and Naples in 1656. As before, we checked for this aggregate demand shock by means of a dummy variable for the decade immediately following the plague (1656-1665) in these three cities.

Estimation results are in Table 6 and they largely confirm the pattern of price determination detected for Venice. Also in this case, the high value of the R^2 (66 %) points out a good overall fit of the model. First of all, the value of paintings continues to be strongly related to their objective feature: the return to size is identical to what we found for Venice (around 8 % per square meter) and again we find decreasing returns to size.

The number of figures is still positively related to price but its coefficient is much larger than for Venice: in that case we found that prices on average increased by 3 % per figure, while now we find that each figure brings a growth in price of around 15%. However, differently from Venice the negative and significant sign of the squared number of figures suggests concavity. Therefore we confirm the evidence for a contractual solution to the moral hazard problem between patrons and artists through prices depending on the number of figures. The higher marginal impact of the number of figures is consistent with the stronger evidence of pricing per figure between Bolognese artists as Guercino, Reni and Domenichino, all of whom spread their stylistic and contractual influence in both Rome and Naples. The more widespread adoption of pricing per figure in Central and South Italy is likely to explain the larger impact (on average) of the number of figures.

While subjects did not affect prices in our analysis of Venice, in the case of the rest of Italy we found that when the subject of the artwork included Christ the painting was paid 24 % more (other subject variables were not significant). This result may depend on the correlation between this particular subject and the position of the painting in the church (for which we cannot control here): the presence of Christ in a painting was more typical of paintings positioned on the altar (*Crucifixion*; *Nativity*: *Virgin, Child and Saints*, and so on), and for Venice we found that altarpieces were indeed paid more. While we do not have paintings for private or public buildings, our dataset includes few altarpieces destined to Saint Peter's church, which was the main display of the magnificence of the Pope, the secular and temporal head of Rome: not surprisingly, prices for these altarpieces were much more paid than average (+ 59 %). The fact that the painting was part of a multiple commission does not affect prices: similarly to what we found for Venice, the coefficient is negative but not statistically significant, suggesting that a quantity discount practice was not systematically at work in this market.

Again, quality played a decisive role in price determination: high-quality and intermediate-quality artists were paid on average respectively 70 % and 38 % more than low-quality painters. None of the artists' fixed effect coefficient is statistically significant, meaning that

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these artist were not paid differently from the painters of the group they belonged to (the top quality one for Cortona, Domenichino, Reni e Maratta, the intermediate quality one for Caravaggio, Tiarini and Preti).

Let us turn to the relationship between destination in different towns. First of all, one should keep in mind the caveat that here the dummies for the provenance from the four towns (Florence, Naples and Bologna relative to the omitted Rome) reflect differences in exchange rates between silver coins jointly with additional differences between average prices (and these differences are not significant, with the exception of Bologna). Given this, we are interested in evaluating price differentials between paintings destined to the high-demand cities and the minor destinations. The corresponding dummy *Minor destination* never had a negative coefficient, with the wider definition employed here and even when we included more restrictive definitions of minor destinations (and the coefficient always remained positive). This suggests that, after controlling for paintings' and painters' features, prices were not higher in Rome and the other main cities compared to the countryside and minor towns. We see this result as a strong support of our general hypothesis for which the mobility of painters, in this case mainly toward Rome, was eliminating price differentials in the Italian market for paintings. Once again, prices were indeed higher in Rome, but only because better painters went there and more ambitious commissions were available there: in equilibrium, painters of similar quality were paid the same everywhere for the same commissions.

Finally, we need to verify whether a macroeconomic shock affects prices in a predicted way. As before, we find that the decade immediately following the plague in Rome, Florence and Naples (1656-1665) was characterized by a strong reduction in the prices of art for these three cities (- 39%).

Overall, the results obtained by estimating our price equation for the other major Italian art centres are substantially identical, at least qualitatively, to those we found for Venice. Accordingly, we are confident that our analysis has described properly the process of price formation on the Italian market for paintings of the Baroque period.

6.1 The Galenson hypothesis

The positive relation between age of painters and price of paintings previously ascertained for Venice is even more robust for the other Italian towns, as suggested by the larger and equally significant coefficient of age (5 % a year versus 3 %). Hence, it is appears that Rome and the
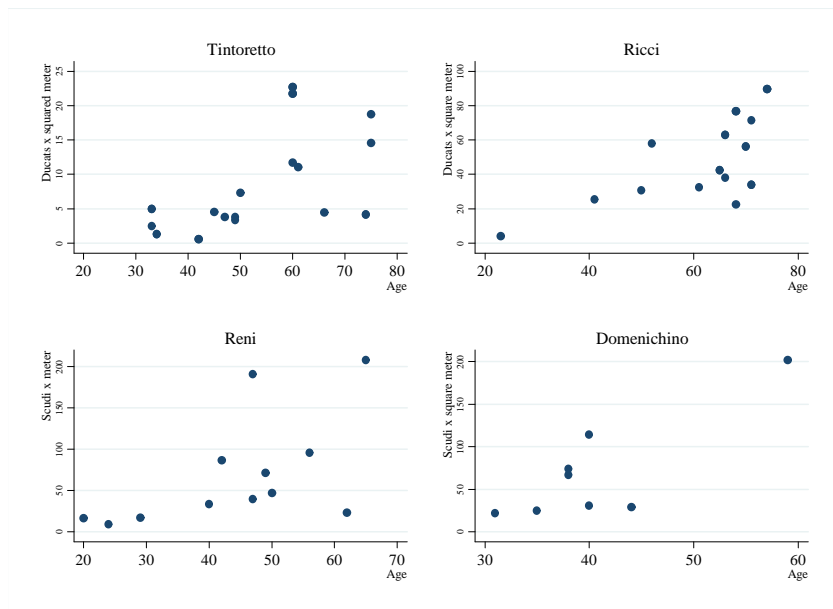
Figure 4: Age-price profile for selected top quality painters

other towns considered included many (possibly more than Venice) experimental innovators in the Galenson's terminology, that is artists able to develop their skills to produce high-quality works through experience. This is also supported by the fact (not detailed in the table) that high and medium quality painters drive the mentioned relation between age and price (actually, age is not significant for the subset of low quality painters, while its coefficient is maximal for the subset of high quality painters). Figure 4 reports the life cycle of the price per square meter for some famous and high-quality painters of different generations:[37] Tintoretto and Ricci from Venice and Reni and Domenichino who were active mainly in Bologna and Rome. For all of them a discernible increasing path of the normalized price of paintings is clearly visible. Most interestingly, all of them could be seen as belonging to the category of experimental painters in the Galenson's terminology. Leaving additional investigations for art historical research, we should add at least a few remarks on the careers of these painters.

Tintoretto developed his style during the second half of the XVI century in competition with the older Titian, and his sketchy technique gave him an impressionistic device to create

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[37]Similar patterns emerge also with absolute prices, but a normalization by size provides a more reliable measure of the pricing of the painters.

powerful theatrical images throughout his entire career, until the last year of his life in which, 76 years old, he completed one of his masterpieces, the *Last Supper* (S. Giorgio Maggiore, Venice).

Ricci is definitely less famous than the leading Venetian painter of the XVIII century (Tiepolo), but was the real starter of the Venetian renaissance in the Rococò period (after a century of artistic provincialism), traveling across all Europe and absorbing and rielaborating the most advanced international experiences of his time. One of the leading experts of Venetian art (Pallucchini, 1981) talks about a "slow development" (sviluppo lento) of Ricci's style. The majority of his works, and all the most famous ones are posterior to 1700 (when he was more than forty), which clearly points toward experimentalism.[38]

Finally, also the two leading Bolognese painters, Reni and Domenichino, experienced a deep and long evolution toward an ideal classicism which led them to increasing fame and appreciation. Reni reached his maturity when back in Bologna after more than a decade spent in Rome (and the initial apprenticeship in Bologna). His own words may be the best witnesses of his constant experimentalism: *"the most beautiful painting is the one I am doing, and if tomorrow I will do another, it will be that one."*[39] Also Domenichino improved his style in a long activity in Rome, but he reached his maximum achievements in the last decade of his life, almost entirely dedicated to the frescoes for the Cathedral of Naples (not included in our dataset but associated with the unparalleled payment of more than 20,000 ducats).[40]

Caravaggio followed a completely different path throughout his career. He moved from Milan to Rome without much experience, and rather than learning the mannerist style of his initial master Arpino (celebrated and well paid at the time, virtually forgotten today), he approached painting from a new and different perspective. Caravaggio was revolutionary in many ways: introducing (and giving unprecedented dignity to) new subjects as still lifes and genre paintings, adopting a new way to bring external light into the pictures, and pursuing extreme realism beyond anyone had ever done. All of these innovations emerged immediately in the early works during his twenties, as in the famous *Basket of Fruits* and the *Fortune*

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[38] His last and best paid work was an imperial commission from Charles VI for an *Assumption* (Vienna, Karlskirche, 1733-1734). Ricci died before receiving the agreed 6000 florins, and therefore this painting does not belong to our dataset. See *L'Opera Completa di Sebastiano Ricci* (1976, Daniels, J. Ed, Milan: Rizzoli).

[39] Our own translation from Italian: "il quadro più bello è quello che sto facendo, e se domani uno ne farò sarà quello". See *L'Opera Completa di Guido Reni* (1971, Garboli, C. Ed, Milan: Rizzoli)

[40] Apparently, the success of this last works created so much envy that some Neapolitan painters killed Domenichino poisoning his food (Spear and Sohm, 2010, p. 121-123).

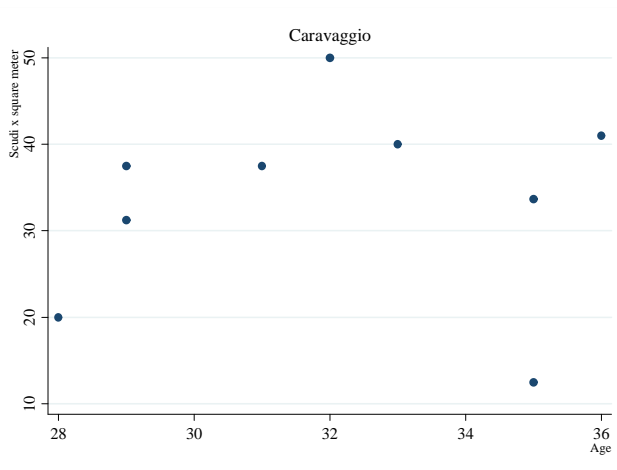Figure 5: Caravaggio, 1599, Calling of St. Metthew, S. Luigi dei Francesi, Rome

Figure 6: Age-price profile for a conceptual innovator

Teller, executed when about 24, or in altarpieces as *The Calling of St. Metthew* (see Figure 5), executed at the age of 28. His later works are considered equally valuable, but less innovative. Even looking at Caravaggio's compensations we do not find any increasing pattern with age. Besides being poorly priced from the beginning (but in line with ordinary painters), Caravaggio was not perceived as improving his quality or innovating during his career. Figure 6 shows the price per square meter of his altarpieces included in our dataset: the erratic path is in line with the hypothesis that we are in front of a conceptual innovator in the terminology of Galenson (2006).

6.2   Endogenous entry of painters

Drawing our conclusions on the comparison between the main Italian art centres, we point out few suggestions for future research emerging from our analysis of the endogenous entry of painters in the art market.

As for any occupational choice, the choice to become a painter required some talent and a long training, but was largely determined by economic motivations, namely by its expected profitability. The same could be said for the decision to specialize in historical paintings or portraits or still lifes, and to be based in a big city or in a smaller provincial town. We found indirect evidence that market forces were at work in determining these entry decisions when we emphasized a tendency toward price equalization between high-demand and low-demand

towns. Beyond this, it would be interesting to investigate how actual entry in the art market was affected by differences in demand between towns and by aggregate shocks.

Unfortunately, the data on the number of painters are highly unreliable and not available for all the cities and over time, also because little is known about many less famous artists active in the markets for portraits or still lifes. Therefore, we can only have a preliminary look at some estimates of the number of painters by Spear and Sohm (2010). They estimate that 190 painters were active in Rome in 1634 and 200 after the plague in 1665, which corresponds to 0,20 % of the population. We do not have good insights on the number of painters in Venice at the beginning of the XVII century, but after the plague in 1633, about 80 painters were active in Venice, growing to 180 at the end of the century (0,13 % of the population). Smaller numbers and, smaller percentages of the population have been estimated in minor towns of the Venetian Republic as Brescia (0,10 %) and Verona (0,07 %). Florence, which was much smaller and in clear decline relative to the Renaissance period, counted 68 painters in 1632, corresponding to 0,10 % of the population. Finally, the highest number of non-Italian painters was by far active in Rome, followed by Venice. All this is broadly in line with an endogenous entry process in the market for paintings, but further investigations in this direction would be useful.

Endogenous entry phenomena raise a deeper question, which we can only leave for future research: did profitability affect not only the number of painters, but also their search for innovation, productivity and quality? If this was the case, one could see some reverse causality: while in the short run painters' quality determines their profitability, in the long run profitability contributes to determine quality. More importantly from a cultural point of view, if prices and profits were indeed a source of artistic innovation, then one of the derminants of the path of art history may have been the endogenous structure of the art market. As the mannerist painter Vasari wrote in his "*Lives of the Most Excellent Painters, Sculptors, and Architects*" (1568), "*if in our century there were enough profits* [for painters], *we would paint greater and better works than the older masters.*"[41]

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[41]Our own translation from Italian: "se in questo nostro secolo fusse la giusta remunerazione, si farebbono senza dubbio cose più grandi e molto migliori che non fecero mai gli antichi". Incidentally, Vasari was the first art historian to mention "competition" as one of the sources of Florentine leadership in Renaissance art.

7 Conclusion

In this paper we have studied the market for important commissions for oil paintings of historical subject during the Baroque era through econometric analysis of the prices derived from original sale contracts. Our main purpose was to show that looking at the market for paintings as a fully fledged market and analyzing the contractual aspects of its deals and the endogeneity of its structure could shed light on the mechanism of price determination.

The market for oil paintings was extremely competitive and populated by players very similar to what we may now define as representatives of the *homo economicus*. They developed forms of horizontal and vertical differentiation which created separate markets where demand and supply conditions clearly affected equilibrium prices. They solved contractual problems between patrons (principals) and artists (agents) as we would expect in the presence of unverifiable quality and moral hazard issues: conditioning payments on measurable variables related to quality, as the number of figures depicted. They migrated between art markets trying to exploit opportunities for extra profits, to the point of eliminating any price differentials in equilibrium. And they exploited their experience to innovate and increase their market power.

In a celebrated historical account of the demand for art in the Renaissance period, Goldthwaite (1993) has pointed out that Italian cities have generated the first modern markets for durable luxury goods, which have been at the origins of modern capitalism based on "consumerism".[42] "Today the consumer instinct is taken for granted: the challenge to producers is to introduce new products, reduce prices, and change fashion... If, on the one hand, we decry what this consumerism has developed into in our own times, with its commodity culture of planned obsolescence, throwaway goods, and fashion-ridden boutiques, on the other hand we have enshrined its very spirit in our great museums. These veritable temples to the consumption habits of the past, where we worship as art one of the dynamics that gives life to the economic system of the West, mark the supreme achievement of capitalism" (pp. 253-254).

The market for paintings in the XVI-XVIII century is not only one of the first markets for durable luxury goods of the modern capitalistic society. Its surviving documentary evidence and even its surviving products are witnesses that it was also one of the first markets to

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[42]Incidentally, a key part of the industrial structure of the main Italian urban centres is still based on the production and export of durable luxury goods.

follow the main laws of economics.

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