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1.Introduction

The economic literature offers two main different positions on the problem of price determination in the art market in general, and for paintings in particular. On the one hand, Baumol (1986, p.10) writes that "the demand fluctuates widely, following collectors' fads and manias and painting prices are therefore inherently unpredictable". On the other hand, Frey and Pommerehne (1989) assert that art objects are assimilated to any other economic good, for which price is determined by market forces.

Following this second approach, the research has recently focused on the structure of prices in the art market, in order to find a common structure, a general framework beyond the heterogeneity of paintings prices. Most works (Candela, Figini, Scorcu (2002); Agnello (2002)) focus on the attempt to measure prices in order to compute price indices[2] that could provide for solid predictive indicators.

In the paper, the identification of the crucial elements that determine the price of a painting (in particular, Italian Old Masters Paintings, (OMP) is effectuated through the hedonic regressions method. The estimation results are then discussed, in an institutional perspective.

The main research questions are: if a common OMP prices structure is identifiable, then, is it possible to derive further information on institutional perspective? And, can the policy maker elicit useful insights for the targeting of policies in the art markets and the design of proper rules?

Our econometric exercise, aiming at the explanation of the formation of OMP market price, has a twofold "institutional" objective. First, understanding OMP price formation is important in order to better understanding the way art markets work. Second, understanding the market mechanisms is a useful exercise in order to design proper institutional rules.

The paper is organized as follows: section 2 describes the data and methodology adopted for the analysis; section 3 illustrates the regression results; section 4 discusses some institutional implications of OMP price formation. Finally, section 5 concludes the paper.

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[2] At least four approaches were develop : 1) Indices which reflect expert personal judgements (Sotheby's Art Index); 2) Indices based on the repeated sales regressions; 3) Indices based on the average painting method; Indices based on hedonic regressions.

2. Data and Methodology

Data and methodology choice strictly follow the paper by Candela *et al.* (2002).

Data

In this study we use a database provided by a private company, Gabrius s.p.a. The data set collects more than 350.000 observations of art objects sold in auctions by the most important auction houses worldwide. The paper, however, focuses only on Old Masters Paintings (OMP) sold from 1990 until 2002. The OMP database provides us with about 100.000 observations of paintings sold in auctions.

For each observation, the database contains several variables, including *inter alia* the name and code of the artist, its nationality and period, title and code of the painting, date, city and house where the item has been auctioned, auction price, dimensions (length times height), lot number, genre, subject, material, support level of attribution of the painting. Moreover, the database includes information about whether the painting was quoted by the artistic literature, or was presented in exhibitions; whether it comes from a private collector or it has an *expertise*.

The original database was enriched by two additional pieces of information: art market variables (i.e. annual and artist specific percentage of sold paintings, behavior over time of the price indices for the artist and for the school he/she belongs to) and macroeconomic variables (CPI indices, interest rates, stock exchange indices an do on).

We aggregate all this information in terms of artistic schools defined by the century and by the nationality of the artist, whose work has been auctioned. We distinguish the schools on the basis of the certainty of the attribution and assign the following values for each attribution different level: 0 = certain; 1= attributed to; 3 = studio of; 4 = circle of; 4 = after; 5 = manner of, 6 = artist, 7 = school of..

The present work only considers Italian OMP from the 16^{th} until the 18^{th} century.

Methodology

Once the OMP schools are created and selected, we run our econometric hedonic model, in which the logged auctioned price depends on some regressors. The intuition behind the hedonic approach is that the hedonic price function describes the (log) price as a function of a number of characteristics. We have, therefore, to select the price of a "gray" (Candela and Scorcu 1995) item with average characteristics and then add the prices of the deviations of the item characteristics with respect to their respective averages.

The following basic regression model is selected, for each artistic school and each sub-school division (certain attribution-uncertain attribution):

$$(1) \qquad Inp_{k,t} = a_0 + \sum_{i=1}^{N} a_i x_{i,k,t} + bt + e_{k,t}$$

where $Inp_{k,t}$ is the log of price of painting k sold at time t; $x_{i,k,t}$ is the I-th characteristics of painting k; $e_{k,t,}$is the error term and a and b are parameters.

Several characteristics are available from the data set, like the dimension of the painting; the material with which it is painted; the support on which it is painted, the subject represented on the painting; the auction city; and auction house where the painting was sold; the quota (percentage of

paintings sold by the artist in year t); the position of the painting during the auction session and many others.
We created dummy variables to disentangle the characteristics log price from "the average" item price. Each dummy is taking the value of 1 when a certain characteristics is present and zero otherwise. In particular, the dummy variables assume the value of 1 when they represent the most frequent considered variable, and zero otherwise.
Particular attention was dedicated to the creation of the artist dummies. In particular, we created an interaction variable by multiplying the author's code by the author market index (expressed in monetary terms). We then created the dummies for every artist, taking the value of 1 if the painting was painted by painter "x" and 0 otherwise. The artist dummies (being to many and in order to avoid problems of multicollinearity) were aggregate in sub-groups.
We also included some macroeconomic variables in the regression, in particular the price of gold; the Dow Jones Index in month; the U.S. gross domestic product, the U.S inflation rate and others.

3. Results

After several checks on various specifications, the following regressions were selected – see Tables 1, 2 and 3 - that show the estimation results. The following points can be derived:

Insert Tables 1-3.

1. The regression for every school (and sub-school) suggests a strong effect played by the artists and by the level of attribution attached to each item on the auction price[3]. The effect is so strong to warn that there are in fact two different price structures, one for the paintings whose attribution to the author has been unequivocal beyond any doubt and the other for those paintings for which the level of attribution is classified ranking from 1 to seven, where one is the closest to certainty. A benchmark example can be represented by the author Giovanni Paolo Panini (18^{th} century). When the OMP is attributed with certainty to such author, then the estimated coefficient has positive sign. However, when the OMP is NOT attributed with certainty to such author, then the estimated coefficient has negative positive sign
2. Estimated macroeconomic coefficients differ in sign and significance according to the school considered. The variable gold-price, for instance, always has positive estimated coefficients, with the exception of the 17^{th} century school, with uncertain attribution.
3. The city where the auction has taken place and the name of the auction house appear not to affect the evaluation of the OMP. Estimated coefficients are, in fact not statistically significant, with the exception of the 17^{th} century with uncertain attribution school, where the auction city coefficient is statistically significant. The same holds for the U.S. gross domestic product, whose estimated coefficients are both positive (16^{th} century school, certain attribution) or negative (17^{th} century school, uncertain attribution).

[3] For each school of the two groups the R^2, the F statistics and the estimated coefficients for the group in which the level of attribution is certain, are constantly better and more significant than the statistics of the other groups.

4. The month and the year when the OMP were sold both affect the market prices: the highest market prices, ceteris paribus, where found in the month of January and during the mid-90es.
5. The level of attribution presents negative and statistically significant estimated coefficients, if compared to the very certain attribution;
6. The idiosyncratic characteristics of the considered paintings, subject, support and material, also affect the OMP buyer's valuation. In the OMP data set, the great majority of pieces are oil painted on canvas. The effect played by other types of support or material is different. Copper and panel, for instance, have positive coefficients if compared to canvas; whilst board, paper and stone have negative coefficients. Watercolors and charcoal have negative coefficients if compared to oil. With respect to the represented subject, the estimated coefficients are positive if compared to the religious subject. Only for the 17th century school with certain attribution, the OMP that represent studies have negative estimated coefficients.
7. Another set of important variables includes those variables like 'literature', 'exhibition', 'expertise' and 'provenience' that represent and capture the prestige, the importance and the name popularity of the OMP. The estimated coefficients are always positive and statistically significant for all schools. This result can provide further support to our interpretation that the OMP author name and the certainty of the attribution mostly "make" the price of the painting.
8. The currency, with which the OMP were hammered, also plays an effect in the price definition: OMP sold in UK Pounds, for instance, have negative estimated coefficients.

We can assert that our results support the idea that it is possible to find a common structure for OMP prices. This results are coherent with the theoretical stream of research started by Frey and Pommerehne.

4. Institutional Setting: Discussion

If a common OMP prices structure is identifiable, then, is it possible to derive further information on institutional perspective? Can the policy maker elicit useful insights for the targeting of policies in the art markets and the design of proper rules?
In our opinion, understanding OMP price formation is important in order to better understanding the way art markets work. Understanding the market mechanisms is a useful exercise in order to design proper institutional rules. In this section, we discuss about the relationship between empirical results and institutional aspect.

1) Italian Government Option Right "Diritto di Opzione"

The Italian Law n. 1089/1939 states that if a private collector owns one or more OMP and wants to sell it (them), he is forced to offer the painting to the Italian government that can exercise an option right. The private seller offers a price. The government defines its bid on the basis of the expertise formulated by governmental agents.
Understanding price formation can avoid opportunistic behavior and hold-ups from the government and therefore diminish illegal markets (and bribes for art market experts). From our results, for instance, *ceteris paribus*, an art expert should value less an OMP belonging to the 17th century

Italian school and with a certain attribution, if painted on board rather than on canvas or if representing a study rather than a battle.
In particular, the degree of certainty of attribution plays an effect in this cases (see G.P. Panini -18th century- estimated coefficients for certain and uncertain attribution). The estimated coefficients for the degree of attribution (all having negative signs) and the estimated coefficients for the 'literature', 'exhibition', 'expertise' and 'provenience' variables (all having positive signs) should inspire the legislator to define strict rules for the definition of OMP expert valuations.
When the law settles strict criteria inspired by scientific studies, there might be less space for discretional or biased price valuations. All this, might diminish uncertainty in the OMP market.

2) *Auction Taxes*
In Italy, auction houses pay an "auction tax" (*diritto d'asta*) for every item they sell. The tax is a proportional tax (13%) on the auction hammered price. By disentangling the determinants of paintings price, the governments could differentiate the tax incidence and make it more "progressive". As shown, there is a significant difference when considering OMP with a certain attribution or OMP with an uncertain one.

3) Export of auctioned national OMP
Article 17 contained in the Italian Law n. 88/1998 totally forbids the export of art objects if this damages the historical and cultural Italian patrimony[4]. Article 18 of the same law states that for those art object for which Article 17 does not apply, the export is allowed, but after that the competent authority has released a free circulation permit[5].
The legal thinking behind such provisions is the attempt to guarantee the integrity of the national artistic and cultural heritage.
In economic terms, however, such legal provisions represent transaction costs that affect the OMP the buyer reservation price and, consequently, the auctioned price, that embody the veto provided for by the law.
As shown in the results, the certainty of attribution and the well-known "name" of the artist mostly make the price. Therefore, a legal provision that forbids the buyer of an OMP to export the painting outside the Italian territory constitutes an extra-price that he should add to the hammered price or that is also captured in the buyer's reservation price formation process. Moreover, such veto is typical of the Italian legislation and does not exist in other countries were OMP are auctioned. Therefore, it might also create an obstacle for the competitive dynamics to develop or an incentive to illegal markets to expand. As pointed put by many art market operators, art has a value as investment that can be enjoyed for its own sake. If particular characteristics of OMP (a religious subject or a big dimension or a well-known painter) do affect the buyer evaluation and are reflected in the painting price, such legal veto might loose power in enforcement.

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[4] "*E' vietata se costituisca danno per il patrimonio storico e culturale nazionale, l' uscita dal territorio della Repubblica dei beni di cui all'articolo 1 della presente legge ed al decreto del presidente della Repubblica 30 settembre 1963, n. 1409, e successive modificazioni, che in relazione alla loro natura o al contesto storico e culturale a cui appartengono presentino interesse artistico, storico, archeologico, etnografico, bibliografico, documentale o archivistico". Art. 17, comma 1, legge 88/1998.*

[5] "*Chi intenda far uscire dal territorio della Repubblica beni culturali deve farne denuncia e presentarle a competenti uffici per l'esportazione, indicando contestualmente per ciascuno di essi il valore venale. L' ufficio di esportazione, accertata la congruità del valore indicato, rilascia o nega, con motivato giudizio, l' attestato di libera circolazione." Art. 18, comma 1, legge 88/1998*

We investigate whether the observation of the determinants of OMP price structure might suggest some institutional direction, by supporting a better understanding about how the market works and consumers behave. Important information that can affect the definition and enforcement of legal provisions can be derived.
This might also be possible for the definition of efficient auction rules. For instance, if the auction house, knows how price is formed and on the basis on which characteristics buyers create their reservation price, it can set the starting auction price more efficiently and overcome "gaming" in auctions or opportunistic behavior.
More in general, in a neoclassical perspective prices dynamics rule the markets. However, in a North's institutional perspective, rules (from legal provisions to social norms) also affect the existence and the working of markets. It becomes, therefore, very important to understand how prices are formed and how institutions work in a certain market (in our case, the Italian OMP market) in order to have a broad view and design effective political economy policies.

5. Conclusive Remarks

In this paper, we have used the hedonic models methodology for explaining the market price structure of art works. Using data about 100.000 observations of Old Masters paintings auctioned world wide in the period 1990-2002, we have grouped individual data in terms of artistic schools defined by the century and the nationality of the artist whose work has been auctioned. We have selected the Italian schools from the 16^{th}, 17^{th} and 18^{th} century. Those groups were sub-divided further in order to consider the level of attribution. On such groups. The econometric model was run, in which the (logged) hammered price depends on a set of selected regressors that represent the painting characteristics (subject, material, author, support, dimension and so on). Other information relating to macroeconomic variables, the auction house, the market place, the artists' indices and the percentage of the artist paintings sold (that both embody information about the market performance of the artist), were considered.
The regression of the empirical model at for every school (and sub-school) suggests a strong effect played by the artists and by the level of attribution attached to each item on the auction price.
The paper has then discussed the empirical results in the Italian institutional setting, because understanding OMP price formation might be important in order to better understanding the way art markets work. Understanding the market mechanisms might represent a useful exercise in order to design proper institutional rules.
Further research should focus on the definition and inclusion in the data set of some "legal dummy variables" that indicates if, for instance, a certain OMP trade is grieved by the export veto or not; or by the government option right and in checking the sign and the significativity of the related estimated coefficients.

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Table 1. ITALIAN SCHOOL, 16th CENTURY

VARIABLE	CERTAIN	UNCERTAIN
Constant	11.15638***	10.22871***
Dimension	.0000279***	.0000268***
Quota	.178***	
us_dj	.0001749***	
us_gdp	-.0003285***	-.0000299**
gold_price	-.0023853***	
January	base	base
February	-1.818***	-.434***
March	-.923***	
April	-.781***	
May	-.451***	
June	-.798***	
July	-.577***	
September	-1.035***	-.339***
October	-.851***	-.200***
November	-.868***	-.196***
December	-.568***	
GBPound	-.679***	
expertise	.122**	
exhibition	.367***	.274***
literature	.493***	.484***
provenience	.224***	.149***
Attributed to		base
Studio of		-.208***
Circle of		-.472***
After		-1.084***
Manner of		-1.141***
School of		-.698***
Canvas	base	base
Copper	.441**	
Panel		.235***

Other		.188**
Religious	base	base
Animals	3.777***	
Architecture	1.843**	
Mythological	.260***	.266***
Still Life	.413***	
Allegory		.348***
Art		2.104***
Portrait		.089***
Oil	base	base
Charcoal	-2.660***	
Ink	-1.837***	
Sanguigna	1.833**	
Watercolour	-2.813**	
Gilding		-.412**
Andrea da Salerno	**.**502***	
Maestro di Torralba	.605***	
Giulio Campi	.690***	
Carlo Bonomi	.898***	
Santi di Tito	.811***	
Paolo Veronese	.664***	
Domenico Robusti	.824***	
Odoardo Fialetti	2.065***	
Francesco Morandini	1.107***	
Girolamo da Santacroce	2.628***	
Licinio Bernardino	1.016***	
(Uncertain attribution to) Palma il Vecchio		.337***
(Uncertain attribution to) Calisto da Lodi		.361***
(Uncertain attribution to) Guido Reni		.716***
(Uncertain attribution to) Lavinia Fontana		.851**
(Uncertain attribution to) Antonio Molinari		.667***
(Uncertain attribution to) Leoncello Spada		.652*
R^2	.570	.476
F	31.77	33.10
N	796	2284

Note: * = coefficient significant at the 10% confidence level; ** = coefficient significant at the 5% confidence level; *** = coefficient significant at the 1% confidence level;

Table 2. ITALIAN SCHOOL, 17th CENTURY

VARIABLE	CERTAIN	UNCERTAIN
Constant	15.00108***	14.83794***
Dimension	.0000313***	.0000383***
Quota	.154***	
Position in the lot	-.001***	
us_dj	.0000275*	.000088***
us_gdp	.0006383***	.0002817**
gold_price	.0018639**	.000088***
us_cpi	-.112***	-.078***
us_inf_r	-.1285963***	-.078***
January	base	base
February	-1.035***	-.448***
March	-.500***	-.185*
April	-.536***	-.219**
May	-.384***	-.197**
June	-.398***	-.227*
July	-.319***	-.242***
September	-1.258***	-.734***
October	-.700***	-.366***
November	-.523***	-.222**
December	-.391***	-.2608***
1990	base	
1994	-.338***	
1995	-.276***	
1996	-.248***	
1998	.103*	
GBPound	-.402***	
Sweden Kr		.730***
Switzerland FR	.390***	
expertise	.360***	
exhibition	.371***	

literature	.464***	.507***
provenience	.307***	.260***
Attributed to		base
Circle of		-.354***
After		-.716***
Manner of		-.802***
School of		-.802***
Canvas	base	base
board	-.982*	
paper	-.655***	
other		-.254**
Religious	base	base
Animals	.287*	
Architecture	.224**	
Art	.218**	
Battle	.151***	.241***
Mythological	.310***	.216***
Still Life	.510***	.324***
Allegory	.381***	.254***
General Scene	.299***	
Naval	.279*	
Study	-.491*	.540***
Oil	base	base
Pastels	.917***	
Pen	-2.583***	
Watercolour	-1.028*	-.678***
Antonio Balestra	.329***	
Bernardo Strozzi	.310***	
Gennari Benedetto Il Giovane	.479***	
Giovanni Ghisolfi	.550***	
Giovanni Coli	.843***	
Valerio Castello	.835***	
Giovanni Paolo Recchi	.795***	
Antonio Amorosi	.997***	
Isidoro Bianchi	.201***	
Bernardo Cavallino	1.087	

(Uncertain attribution to) Donato Creti	.164***	
(Uncertain attribution to) Paolo Paoletti	.308***	
(Uncertain attribution to) Carlo Dolci	**.**419***	
(Uncertain attribution to) Giacomo Recco	1.628***	
namecity	.002*	
R^2	.52	0.46
F	55.27	44.20
N	4210	3157

Note: * = coefficient significant at the 10% confidence level; ** = coefficient significant at the 5% confidence level; *** = coefficient significant at the 1% confidence level;

Table 3. ITALIAN SCHOOL, 18th CENTURY

VARIABLE	CERTAIN	UNCERTAIN
Constant	8.720***	7.587***
dimension	.00027***	.0000158***
us_growth rate	.063**	
gold_price	.003***	.004***
us_inf_r	-.085***	-.150***
January	base	base
February	-.654***	-.593***
March	-.443***	
April	-.316***	
May	-.100*	
June	-.302***	
July	-.328***	
September	-1.023***	-.577***
October	-.482***	
November	-.372***	
December	-.111**	
1990	base	
1993	-.138**	-.386***
1994	-.515***	-.731***.
1995	-.629***	-.984***
1996	-.550***	-.966***
1997	-.371***	-.858***
1998	-.496***	
2000	.137***	.164*
2002	-.238***	
GBPound	-.586***	
Switzerland FR		.586**
expertise		
exhibition	.200***	

literature	.444***	.626***
provenience	.325***	.564***
Attributed to		base
School of		-.175***
Canvas	base	base
Stone		-1.053**
board		-.576*
paper		.048*
panel	-.254***	-.241*
other	-.220*	
Religious	base	base
Animals	.291*	
Architecture	.315***	.195***
Art	.686*	
Battle	.382*	
Mythological	.356***	
Still Life	.564***	.325***
Allegory	.2431***	
Portrait	.143*	
General Scene	.450**	.090***
Landscape	.235***	.081*
Naval	.379***	
View	.717***	.482***
Study	.482***	
Oil	base	base
Charcoal		
Ink	-1.680***	
Sanguigna	-3.104***	
Watercolour	-.808***	
Pencil	1.157***	.978***
Pen	-.534***	
Salvatore Sciarra Colonnelli	.623***	
Giuseppe Gobbis	1.505***	
Antonio Joli de Dipi	1.461***	
Giovanni Paolo Panini	1.987***	
Candido Vitali	2.836	
(**Uncertain attribution to) Gian Battista Cipriani**		-.133***

(Uncertain attribution to) Giuseppe Zais		-.165***
(Uncertain attribution to) Nicola Casista		-. 479***
(Uncertain attribution to) Giovanno Paolo Panini		-.535***
(Uncertain attribution to) Michele Marieschi		.145***
(Uncertain attribution to) Canaletto		.392***
R^2	.70	.40
F	101.19	25.00
N	3794	2054

Note: * = coefficient significant at the 10% confidence level; ** = coefficient significant at the 5% confidence level; *** = coefficient significant at the 1% confidence level;