



THE HISTORY OF ART MARKETS: METHODOLOGICAL CONSIDERATIONS FROM ART HISTORY AND CULTURAL ECONOMICS

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ABSTRACT | Quantitative historical art markets research's position at the crossroads between economics and art history poses serious methodological and theoretical challenges to two distinct groups of scholars while also embracing an aggregate vision of art that often employs digital tools. In this paper, we analyze two bodies of literature—art market research within art history and art market research within cultural economics—to assess their respective approaches and methodological distance. Our research highlights a set of desirable components for an innovative, interdisciplinary approach that speaks to both of these scholars using examples of recent publications that show strengths in these areas, stressing the importance of standardizing, diversifying, and sharing data among art market researchers; arguing for minimal standards for statistical analysis, to better consider and reflect the realities of art markets and related data; and providing suggestions for improving communication between disciplines, with collaboration being a clear option for achieving these goals. Based on these suggestions, this paper encourages the development of a hybrid discipline that overcomes the dichotomy between art history and cultural economics and make the most of digital tools' potential for data gathering and analysis. [187/250]¹.

KEYWORDS | methodology, historiography, data-driven narratives, interdisciplinary collaboration, quantitative methods

1. Introduction

The art market's position at the crossroads between economics and art history has long posed serious methodological and theoretical challenges to two very different groups of scholars. Arguably, interest in the relationship between art and the market can be traced to the origins of the field of art history, starting with Vasari's considerations on patronage and later continuing with the Marxist and social art histories of the twentieth century.² On the other hand, since the field's emergence in the 1960s,³ cultural economists have considered the arts an important ground for exploring “numerous nontrivial theoretical and empirical problems” that “challenge tradition-bound economists to focus their eyes on a wider horizon” and “[a] natural area for eclectic theoretical and methodological advance.”⁴

Within the field of art history, art market research has been at the forefront in its embrace of an aggregate vision of art that often employs digital tools for quantification. Following the pioneering precedents of Gerald Reitlinger

and Harrison and Cynthia White in the 1960s, John Michael Montias' contributions in the 1980s initiated a new approach in scholarship that combines economic concepts with a statistical approach to quantitative data to study the production and purchase of art.⁵ His contribution durably revolutionized the field and continues to gain momentum with the incursion of digital methods, as new generations of art historians study art markets from a hybrid humanistic, economic, and sociological perspective. While digitalization and quantification have provoked heated debates among art historians and critics,⁶ art markets researchers have put them to good use in pursuing innovative avenues of research, where the use of databases and the codification of historical information into statistically processable data has helped shed new light on economic behaviours in the art world. Data-driven approaches to the art market have contributed to unveiling the “great unseen,” shining a light on understudied or lost artworks otherwise neglected by historiography.⁷ From a sociological perspective, the economic approach has helped broaden our understanding of what Howard Becker termed as “art worlds,” namely the chain of actors that play a vital role in the production of art, by emphasizing the roles

of intermediaries, dealers and consumers.⁸ Art markets researchers' open interest in prices has also been informative of not only taste, but more broadly, of visual culture and the value that societies have attached to artworks.⁹

Despite the shared interest in art markets and increasing appeal of developing a syncretic approach from a combination of economics with art history, an epistemological chasm separates the two fields. Reflecting on the state of cultural economics in 2000, Bruno Frey noted that "there [were] so far few contacts with art history [...]", although "there [were] promising efforts underway to bridge the gap between art history and economics."¹⁰ Even in 2006, which marked the publication of two seminal books for art market research in both camps, the distance had not been narrowed. Victor Ginsburgh and David Throsby's *Handbook of the Economics of Art and Culture* was a significant contribution to the field of cultural economics that included multiple methodological and thematic chapters on art markets.¹¹ *Mapping Markets for Paintings in Europe, 1450-1750*, edited by economist Neil de Marchi and art historian Hans Van Miegroet, remains among the most ambitious and best-cited accomplishments within the art-historical branch of art market studies, putting art history in dialogue with economic concepts within a broad range of chronological and geographical contexts.¹² Though De Marchi and Van Miegroet suggested that statistical and econometric analysis "might have sparked a quiet revolution in art historical writing," even these scholars found the methodological distance between disciplines difficult to breach.¹³

More than fifteen years after the publication of these two seminal books and two decades of digital art history, this paper offers a timely opportunity to stake off on current methodological perspectives in quantitative art market research. While it was recently suggested that statistics have been over-used in art market studies and that new perspectives need to be pursued,¹⁴ and though we acknowledge that such research should be approached from a variety of directions, we believe that the use of the quantitative framework remains marginal within [digital] art history overall. Furthermore, as we will argue in this paper, few scholars who have engaged in quantitative art markets research have attempted rigorous statistical analysis. For these reasons, we believe that the quantitative economic approach should not be set aside, but rather be methodologically reinforced. Advanced scholarship in data-driven art market studies requires a minimum background in economic theory and methods, as well as an ability to deal simultaneously with numbers and narratives; two skill sets that can be challenging or counterintuitive to art historians who are often poorly equipped in quantitative methods and economic analysis.¹⁵ While art history's epistemology privileges qualitative, discursive, case-by-case exploration of specific events, economics generally favors quantification, modeling, and generalization. A disciplinary

chasm therefore separates the methods, tools, and questions between both fields and, despite a common area of study, the research produced by economists does not necessarily communicate with that of art historians and other humanists, and vice-versa.

This disjunction raises questions of how to conduct research on and communicate about quantitative art history to therefore develop mutual credibility among scholars of differing primary fields. Harald Klinke's considerations regarding the position of digital art history—whether it can be viewed as a methodological extension, a revolution, a transdisciplinary field or something completely new—also arise with quantitative art market studies and their relationship to art history, economics, and the digital tools it increasingly employs.¹⁶ Approaching this paper as art historians who engage in the field of cultural economics, we discuss the developments in two bodies of literature, namely art market research within art history and art market research within cultural economics. Our objective is to nurture the discussion of interdisciplinarity and the use of digital tools in a sub-branch of art history to help overcome the controversies around quantification which, in its extremes, result in either the denial or the fetishization of data processing and risk resulting in reductive art-historical conclusions. More precisely, we reflect on how economists and art historians can enrich each other's research by providing guidelines for data gathering, structuring, and conducting analysis.

The present paper is organized as follows. First, we outline the epistemic backgrounds of both art history and cultural economics, providing the readers with a general account of the research questions, methods and evidence used in both fields in the area of quantitative art markets research. Second, we outline a series of desiderata for future research, discussing a selection of papers that we believe successfully assimilate the methods and interests of both economics and art history. The desiderata chiefly relate to collaborative practices, data management and processing, the definition of research questions and communication.

2. Epistemologies of Quantitative Art Market Studies: The Views From Art History and Cultural Economics

The epistemologies of art history and cultural economics differ with respect to their understanding of method, theory, evidence and interpretation in ways that affect how they internalize digital methods and engage with quantitative data. In broad strokes, art historians tend to view method as their engagement with one or more theoretical schools

of thought, including major perspectives such as formalism, iconography, and social critical theories, such as Marxism, feminism, and postmodernism, among others. Prior to the debates generated around digital art history, the process of developing a body of research materials, as well as the critical analysis of sources, was naturally a part of research—but received less written attention, except in areas of art history, such as technical analysis that have made this a primary concern.¹⁷ In this methodological framework, art historians' vision of empiricism usually consists in addressing the broader research questions suggested to them by theory and performing a personal interpretation that synthesizes theory and evidence, a narrative supported by salient examples from a mental archive of artworks and primary and secondary texts.¹⁸ In doing so, they contribute to the understanding of art worlds past and present by providing causal explanations of its main facts, events, and outputs.¹⁹ By contrast, cultural economists part from a general underlying framework (the neoclassical economic model). The literature is dedicated to theoretical modifications of this model that attempt to better capture the complexities of reality, often by changing an underlying assumption or using data empirically to test these modifications. In this discipline, the relationship between two or more variables (dependent and independent facts or events) is tested using statistical methods, the goal being to infer a correlation or potentially a causality between them. By comparison, art history—up to the irruption of digital methods—has long discussed and debated theory, but has less deeply engaged with quantitative data.

Digital methods have forced this reckoning, generating standing discussions about the connection between method and data in art history.²⁰ Though digital approaches encompass an expanse of possibilities ranging from reconstructions, to mapping, network analysis and quantitative or statistical approaches among others, they ultimately all involve an important shift in the nature and/or scale of the data employed in crafting the history of art.²¹ Data affords the opportunity to externalize art historians' mental archive of information and to document the decisions, interpretations and selections made by the scholar. This prioritization of evidence is often countered by charges of false objectivity, often from scholars who are wary of digital art history, resulting in many calls for art history to “tighten its methods” with respect to data creation.²² But the criticism can only be countered by paying equal attention to data analysis, as well as how we communicate our findings.

In this section, we analyze research that employs quantification to analyze the art market in both art history and cultural economics. Acknowledgedly, the selection is much more narrowly focused than is typical across art history, ignoring Marxist histories of art and the history of collecting, both of which have a history of engaging with the

histories of art markets and/or the impact of the market on artistic production. The art-historical texts are drawn from a variety of journals and monographs, often books organized around an art market-related theme, and because of our choice to focus on studies that apply a quantitative economic approach to the history of art markets, focuses primarily research on the early modern period. The texts from the field of cultural economics are papers on the art market published in the *Journal of Cultural Economics* from 1977 to 2019.²³ While the latter reflects a particular editorial point of view and peer review process, it remains the journal of reference in cultural economics, in a discipline much more strongly oriented towards the journal article than art history. For these reasons, we believe that these non-exhaustive bodies of literature are an appropriate basis for our discussion.

2.1. Quantitative Art Market Research in Art History

The work of John Michael Montias (1928-2005) established the aggregative, quantitative methodology that distinguishes quantitative art markets research from other areas of art history.²⁴ Montias, who was trained in both economics and art history, distanced himself from a discipline that had long neglected to envision the economics of artists as producers, dealers as intermediaries, and collectors as consumers.²⁵ Much of the originality of his research lay in quantifying data from historical records of 16th- and 17th-century Delft and Amsterdam—inventories, guild documents, and parish records, among others—and reframing the analysis of early modern art by referring to economic methods and concepts.

A key component of Montias' legacy is the impulse he gave to a community of art historians who adopted his approach. The late 1990s and early 2000s witnessed the proliferation of scholarly publications dedicated to the trade in works of art and the business strategies developed by art market players. The Low Countries of the early modern period became the focus of extensive research by art historian Hans Van Miegroet, economist Neil de Marchi, and economic historians Filip Vermeylen, Michael North, David Ormrod, and Jan De Vries, amongst others.²⁶ The large-scale research project Mapping Markets, spearheaded by De Marchi and Van Miegroet—an art historian and an economist, respectively, working in collaboration—took shape within this emulative intellectual setting in the early 2000s. Published in 2006, this contribution represented an ambitious attempt to provide a general history of art markets in Europe, placing art history in dialogue with concepts more typical of economics scholarship. Mapping Markets contributed to our understanding of the visual culture in the Early modern period by going beyond the world of high-end commissions and extant art objects to focus on what was traded and

consumed by a broad audience.²⁷ More generally, the project spread a vision of the art world as a socio-economic system in which stakeholders (artists, dealers, auctioneers, experts, agents, collectors, etc.) continually interact with each other for business and collecting purposes. The role of dealers as agents of production and arbitrators of taste and the importance of artist networks and artwork mobility in the shaping of visual culture have since been extensively documented.

Since 2006, the “economic way of thinking” about the arts has continued to gain ground in art history thanks to the aforementioned scholars’ continued activity and the gradual adherence of a new generation.²⁸ Not only have numerous books and papers on related topics emerged from these efforts, but also monographs, exhibition catalogs, and art journals have increasingly welcomed art-market-related essays as complements to traditional approaches.²⁹ In this process, the publishing houses Brepols and Brill have bolstered this new wave of scholarly interest, materializing most tangibly in Brill’s *Studies in the History of Collecting & Art Markets* book series.³⁰ New journals dedicated to art market research such as *The Journal for Art Market Studies* and *Arts and the Market* have provided publication venues for art historians and other humanists, and universities have increasingly included art markets courses in their curricula. Scholars have also founded new associations, such as The International Art Market Studies Association, and organized events, including a thematic summer school on art markets in 2019.³¹ The aforementioned scholarly advances have occurred in tandem with the increased availability of data on historical and contemporary art markets. In this respect, large-scale projects of data gathering, such as the Getty Provenance Index, have undoubtedly stimulated the field of art market studies and facilitated access to formerly underexplored materials.³²

Fourteen years ago, Van Miegroet and De Marchi already deplored the fact that the methodological standards set by Montias had not been “taken up by art historians who, for the most part, have welcomed Montias’ archival finds but separated them off from his econometric analyses, which they simply leave aside.”³³ While *Mapping Markets* itself intentionally left the issue of statistical methods unresolved,³⁴ the authors pointed out the tendency of art historians to favor “descriptive statistics relating to the mean and median numbers and values of paintings in houses, changing subject-distribution in samples of inventories over time.” Fourteen years later, and despite the development of digital art history and the abundance of data, it seems that only a handful of historians have embarked in quantitative analysis using more sophisticated computational and statistical methods. A compelling example is a book released in 2019 and titled *Duveen Brothers and the Market for Decorative Arts between 1880-1940*.³⁵ This distinguished

research offers fascinating insight into the Duveen archives and investigates an underexplored market segment, but it also underuses the large amount of data collected by only listing prices instead of performing further analysis. Similarly, in a contribution to a more quantitative history of taste that stands out for the ambition of its time frame, Peter Carpreau amassed an impressive dataset accounting for more than 90,000 sales results dating from the 16th to the 21st centuries. Nonetheless, the analysis would have been more robust had it employed more sophisticated data processing than median-based price indices.³⁶ Though statistical analysis should not be the only approach to history, it is unfortunate that such impressive collections of data were not used to their full potential.

More generally, the methodological approaches in historical art market research conducted by lone art historians tend to reflect the latter’ reluctance towards using statistics. The three main approaches we have encountered in the academic literature are research based on i) narratives and historical testimonies without quantitative data, ii) data and descriptive statistics used for illustrative purposes, and iii) statistical testing of historical propositions using significance tests and econometric methods. Qualitative research based on historical narratives and testimonies, which is outside the scope of this paper, remains by far the most common approach. In terms of quantitative analysis, basic visualizations and descriptive statistics predominate and are mainly used to illustrate —without testing—art historians’ claims. The use of significance tests and econometrics remains marginal, so this point will be discussed further in Section 3.

Appendix 1 displays the main statistical tools used to visualize data in three important texts as examples of the methods employed in the field. Typical metrics include the number of data points or observations (facts or figures collected about a given variable), frequencies, percentages, medians, and averages. These appear in tables and graphs of moderate complexity, such as bar charts, pie charts, line graphs, time series, and occasionally histograms, scatter plots, and network graphs. Some visualizations are purely descriptive, relaying historical evidence or presenting summary information without generating estimates. Otherwise, they provide point estimates without necessarily conducting hypothesis tests that evaluate their level of validity. Other graphs and tables are more analytical, conducting more sophisticated analysis that moves from description to the suggestion of causality or at least correlation, but usually stop short of making explicit whether these correlations are statistically significant. Examples of such figures are a “Plot graph of quantity to painting [x-axis] and total value fetched [y-axis] by artist sold in Germany and Central Europe [1643-1678]” ; or “Coefficients of correlation between seven categories of goods.”³⁷

While graphs and tables help relay crucial information that is difficult to convey in a textual format, Appendix 1 suggests that they serve primarily as narrative supports of a more traditional art-historical approach. When data is used as an anecdote, the argument conditions the view of the evidence; that is, the data is pointed at to support an a priori conclusion, not used to evaluate a conjecture. Put in the language of the social sciences, the data is not used to test a clearly predefined hypothesis. Thus, somewhat paradoxically, when using data without testing for statistical significance, scholars simulate objectivity while never leaving the realm of speculation. Hence, despite *Mapping Markets*' emphasis on the need to assimilate economic concepts and methods in art market studies, these few examples suggest that though art history has incorporated the former, it has achieved limited success with the latter.

This criticism of data analysis by art historians would be illegitimate without recognizing the imperfect nature of historical data, as recently discussed by Van Miegroet et al.³⁸ While archival evidence has proven to be a great source of information on countless paintings that have been destroyed or lost, revealing the existence of unexpected historical market structures and phenomena, there are also important selection and survival biases in the documents themselves. Because of the ways information was—or was not—recorded, and due to historical losses of archival materials, available documents rarely give a comprehensive picture of the actual market situation in the past.³⁹ This results in geographical biases—some cities are better studied because their documents are better preserved or easier to employ—and thematic gaps, as certain objects such as artist account ledgers or dealer stock books having been disproportionately damaged or destroyed. Conclusions drawn by omitting these grey zones, even if by necessity, can lead to a biased understanding of history. In light of these issues, digital art historians have the responsibility of developing well-informed discussions around the appropriate methods for accounting for imperfect historical data.

2.2. Cultural Economics and Art Market Research

By contrast, an incursion into cultural economics literature shows the extent to which computational data processing is a key defining—and also, limiting—factor in art market analysis.

Within the set of cultural economics articles regarding art markets from the JCEC, we have defined seven thematic categories: i) art investment and price indices; ii) price formation mechanisms; iii) auction theory; iv) cultural value; v) history of the art market; vi) artists' careers, and vii) others. Table 1 displays the distribution of these research themes.

Over half of art markets papers in the JCEC focus on art investment and price formation mechanisms. The first category deals with estimating rates of return and building price indices to retrace and predict the evolution of a market segment over time. The second category uses hedonic regressions to estimate the effects of specific characteristics of artworks on prices.⁴⁰ In this case, pricing determinants serve as indicators of buyers' preferences.⁴¹ On the other hand, the ratios demonstrate that studies in other categories, including non-contemporary markets (e.g., early modern period, 19th century), cultural value, and artists' careers are marginal—an observation specific to this journal, but that the writers believe is indicative of a broader trend within a cultural economics that, when studying art markets, has largely focused on prices. In the third section of this essay, we discuss papers favoring a historical approach or connecting, for example, art market data with art historical practices.

A closer look at these papers also reveals that fifty rely on empirical analyses (66%), while the remaining are primarily theoretical. Sample sizes range from 159 to 330,000 observations with an average of 15,193 and a median of 6,189, which exceeds those found in art-historical art market studies, usually ranging from the tens to the hundreds. The

CATEGORY	FREQ.	PERCENT
Art Investment/Price Index	25	33.78%
Price formation mechanisms	18	24.32%
Auction theory	9	12.16%
Cultural value	8	10.81%
History of art market	7	9.45%
Artist careers	2	2.70%
Others	5	6.75%
Total	74	100%

Table 1. Distribution of papers published in JCEC by the main theme

great majority of data (70%) consists of auction results, vast majority are sales from the late-twentieth century to the present, beginning in the 1970s and 1980s. These decades correspond to both the boom of the art market and the publication of auction results through auction reports and specialized volumes such as the *Hislop's Art Sales Index* (1968), later made widely available through the Internet. These initiatives have contributed to increasing the transparency of the tertiary market and have made it more accessible to researchers, and most of the data has in fact been extracted mainly from online databases such as the Blouin Art Sales Index or Artnet. Their public nature partly explains the frequency of their use.⁴² This is reflected in the frequency of publication about art markets within the journal, which increased significantly after these databases were created. The majority of articles on the art market were published in the 1990s (22 obs.), the late 2000s (20 obs.), and the 2010s (18 obs.), ranging from one to five publications per year. On the other hand, data has occasionally been created manually using sales catalogs, museum inventories, or dealer archives, but these initiatives to exploit unpublished data or create new datasets are rare. Sectors that might better reflect the preferences of a broader population of buyers, such as direct sales by artists and indirect sales through dealers, as well as the sale of lower-quality works at auction, remain understudied, as do auction sales prior to the twentieth century.

Regarding the objects studied, more than three-quarters of the papers are concerned with the sales of paintings and graphic arts (i.e., prints and drawings). The formal homogeneity of these bi-dimensional artworks, whose technical and visual characteristics can easily be singled out, meets the requirements of econometric analysis, as they reasonably satisfy the *ceteris paribus* hypothesis that all variables that are unaccounted for remain equal. Regarding chronology, the period in which the artworks were produced differs from the date of sale. Contemporary and modern

art (20th century), followed by Impressionism (late 19th century) are the most represented art movements in those data sets, and constitute the high-end market at leading auction houses. A handful of studies deal with old masters (15th-18th century) and less-represented geographies such as African, Latin American, Canadian, and Australian art.

Finally, Table 2 summarizes the distribution of the papers by method and identification strategy

By far, the most frequently encountered model is the hedonic regression. A regression is a statistical tool that determines the relationship between a dependent variable with certain explanatory variables by calculating a line that best fits the data set. Based on the theory of goods as a "bundle of observable characteristics" developed by Kelvin Lancaster in the 1970s, it places price as a function of the painting's main characteristics and other control variables (e.g., context of the sale).⁴³ Repeat sales regressions are employed in five papers; this alternative method calculates changes in the sales price of the same work of art through multiple sales. In Section 3.2, we discuss some of the advantages and limitations of hedonic and repeat-sales regressions. "Hybrid regression models" (i.e., chiefly hedonic regression combined with Repeat-Sales Regression or Probit or Logit regression) and Probit/Logit models are equally represented. The category "others" encompasses a set of analytical methods including descriptive statistics, other forms of basic linear regressions, discrete choice model, difference-in-differences, and cluster/factor analyses, all of which remain of marginal use by comparison.

Such approaches require extensive modeling that, to some extent, has been described as the pitfall of the mathematization of economics, where a preoccupation with the model eclipses the goal for which the model was originally defined.⁴⁴ Most research in cultural economics investigates general market mechanisms by marginally adapting models developed for other areas of study. These models, tweaked

MAIN METHOD	FREQ.	PERCENT
Hedonic Pricing Model	23	47.92%
Others	10	20.83%
Probit/Logit Model	5	10.42%
Repeat Sale Regression	5	10.42%
Hybrid Regression Methods	5	10.42%
Total	48	100%

Table 2. Distribution of the Papers Published in JCEC by Method

to account for certain issues about the arts, have corseted the questions asked, partly explaining the field's insistence on a set of recurring research questions—the study of return rates, bidding dynamics, relationships between reserve prices and low estimates, price and information efficiency—that ultimately revolve around prices.⁴⁵ If this observation is not per se surprising in an economic journal, art often seems to be a pretext to carry out economic and financial analyses, rather than being the core subject of discussion.⁴⁶ Rarely do researchers attempt to develop new models that might better take into account the specificities of the arts, or better reflect particular purchasing behaviors. As a result, the idiosyncratic nature of the art goods themselves is set aside, seldom the main focus of these studies.

The hermeticism of economics as a field—even though more accustomed to collaborating, most of the co-authors in the corpus are economists—often undermines their conclusions, as the assumptions undergirding their models are sometimes disputable from an art historical perspective.⁴⁷ As a result, one might deplore the lack of a strong groundwork in art history and a lack of innovative research questions that would better harmonize finance and economic sciences with art history. The art market itself is built on art scholarship, and it is not a stretch of the imagination to suggest that explanations about the market within cultural economics could gain a new impulse through a hybrid approach with art history and the humanities.⁴⁸

3. Desiderata for a Hybrid Field of Art Market Research

Art historians' and cultural economists' shared interest in art markets necessitates a common ground from which to work, and a more integrated combination of epistemologies would be a valuable asset for quantitative art market research and digital art history more broadly. In this regard, the benefit of joint academic ventures between scholars of varied backgrounds is a recurring argument in digital humanities literature. The version of collaboration that we advance in this paper connects art historians not only with experts in the tools and precepts for creating data, but also with those with substantially different domain knowledge, in our case economists. Whereas these collaborations can take several forms,⁴⁹ we suggest that the most promising are mixed horizontal (i.e., non-hierarchical) ventures between at least two scholars skilled in their own disciplines and willing to develop some knowledge about the other, both equally committed to the research process. In this collaborative configuration, individual theoretical, computational and empirical skills are maximized, while the epistemic requirements of each discipline meet in pursuit of a more integrated scholarship. Needless to say, this ideal type of

collaboration has its own challenges. Not only do art historians and economists need to find each other, they will also need to manage conflicting epistemic views. The dilemma requires diplomacy, openness to risk taking, mutual understanding and the ability to make compromises. But these tensions are also times in which we can reflect on our own disciplines, and the greatest opportunities for innovation.

In the next subsections, we outline the desired qualities of a history of art markets at the intersection of economics and art history, as illustrated by some recent papers that, we believe, have successfully found a common area between both disciplines.

3.1 Data and the Art Market (Gathering & Structuring Data)

In 1994, Throsby already signaled that an important part of the future of cultural economics lay in collecting data and developing better datasets.⁵⁰ Recent developments have resulted in a proliferation of publicly-available collections data, namely information an institution publishes about the objects in its collections, but also research data—data created within a research-driven environment—, as well as information that can be used “against the grain” for statistical analysis. In the case of the art market, the latter categories include, among others, digitized auctions results and information from the Getty, which were originally created for the purpose of provenance, not aggregate, research.⁵¹

As human-designed representations of real-world phenomena, data sets are limited by the original intents for which they were envisioned, and require a critical assessment of their suitability towards a project's goal, including analysis of the entities and variables included or omitted, the structures chosen to represent them, other decisions and interpretations made in the translation of information to structured data, and a critical analysis of original sources themselves.⁵² The act of encoding information as data is in itself an act of interpretation to which art historians can contribute their domain knowledge, assessing whether the data is relevant, biased conducive to the intended research questions. In this regard, art historians have a comparative advantage, as they tend to spend long periods gathering historical information for personal research, have in-depth knowledge of their periods of study, and know relevant repositories of primary and secondary materials. Art-historical skills are essential for designing the boundaries of the historical problem to be addressed and the objects and variables to be included, as well as the potential gaps, ellisions and ambiguities of historical sources, to be used in conjunction with the statistician and economists' knowledge of the necessary data structures for mathematical or computational analysis.

The current possibilities for database creation have multiplied thanks to the increasing accessibility of digital tools for processing data. Digitization through scanning and OCR can help transform published (typescript) material from reference books into datasets; for example, the numerous compilations of transcriptions of archival documents published in the nineteenth and twentieth centuries could greatly diversify the resources of quantitatively-oriented art market scholars.⁵³ Tools such as OpenRefine or the Python programming language immeasurably increase the speed of data gathering and cleaning, providing a promising alternative to manual transcription of information. Learning to use these digital tools is relatively accessible and is becoming more common in art history. However, their use requires a change in our understanding of data gathering, no longer a linear process of transcription but an iterative, computer-aided process that requires discipline, creativity, and revision to ensure that data is adequately structured, complete and trustworthy.⁵⁴

The development of datasets should expand in ways that increase the potential for data sharing. Art historians tend to work individually, on research questions exclusive to their project, and creating databases according to their personal standards. The resulting information silos (systems of information that impede collaboration and communication) reduce the possibility of reaching more comprehensive visions of the art market. Instead, the data-gathering process should be documented to ensure reproducibility and the data should be made available online through platforms such as GitHub or Dataverse.⁵⁵ Because data encoding often requires excerpting information, providing access to reproductions or transcriptions of originals is ideal (but will in many cases be limited by reasons of cost, legality, and time, as well as, in the case of transcription, documentary ambiguities). At the very least, it is vital to document sources, decisions, intended research questions and estimated information coverage. Finally, the development of harmonized standards for collecting, cleaning, and processing data sets would lead to more transparent, reproducible analyses.

In this regard, major cultural institutions have led the push to overcome this situation by moving towards a system of Linked Open Data (LOD), a task recently embarked upon by the Getty Provenance Index. LOD is a standard for publishing data that ensures inter-usability between datasets by providing data in a standardized format and using shared, persistent identifiers to identify real-world entities (e.g., people or artworks) within the data.⁵⁶ The Getty Research Institute provides a series of standard vocabularies that are useful for structuring data on art and artists, such as the Union List of Artist Names (ULAN), Cultural Objects Name Authority (CONA), the Art & Architecture Thesaurus (AAT, Categories for the Description of Works of Art (CDWA) and the Getty Thesaurus of Geographic Names (TGN).⁵⁷ The data

cleaning tool OpenRefine provides a reconciliation service with the Getty dictionaries. Adhering to the LOD system comes with challenges, including, most practically, the difficulty of establishing certain identities and the technical issues that result from reconciling data using cleaning tools.⁵⁸ Yet relying on standard identifiers for artists and artworks, when possible, and using the Getty's controlled vocabulary for attributes, will help make data usable by other researchers.

If all else is impossible, the prerequisites of (1) making data available under an open license (2) as structured data and (3) in a non-proprietary format would go a long way towards making datasets more widely available.⁵⁹ Such data sharing would increase both the scale and scope of art markets research; scale because, as has been demonstrated, looking at large amounts of data has opened up new questions to be applied in new contexts, and scope because only by moving beyond the very localized research of most art markets studies can we start establishing comparisons and craft more balanced and illuminating comparative historical analyses.

3.2. Minimum Standards for Quantification: Beyond Descriptive Statistics

Though interest in big data is surging within digital art history, it is also worth thinking about “data” plain and simple, its structures, and the established quantitative methods that other disciplines take for granted.⁶⁰ While art history has always been empirical in the sense of being concerned with observation or experience (of the painting, or the document), it has not been empirical in the sense understood by other fields, where the strength of evidence in support or detriment of a hypothesis is evaluated probabilistically. Koenraad Broesens suggested that “art historians tend to produce best guesses inside a personal ‘black box’ containing insights gained from literature, expertise, gut feeling, and ‘common sense.’”⁶¹ Art historians who use numbers do so as a willing departure from the discursive approach based on selected examples, pointing instead at a volume of aggregate evidence. But simultaneously, as is often argued by digital skeptics, numbers can be given a false authority when used uncritically.

The misuse of statistics can lead to confirmation bias, or the risk that numbers only serve to reaffirm preexisting beliefs.⁶² While the use of basic graphs and tables of descriptive statistics is a necessary step in understanding and processing data, basic indicators of statistical significance such as T-tests when comparing means and confidence intervals should be calculated to better gauge the robustness of the findings. The evaluation of a hypothesis’

plausibility based on the data available, known as hypothesis testing, can be illustrated with an example. For instance, an art-historical commonplace is that attributed artworks are worth more than unattributed artworks. To verify this claim, taking the value of paintings in Amsterdam inventories from the Getty-Montias Database (from 1597-1681), we see that attributed paintings had a mean value of 67.2 gulden, whereas unattributed paintings had a value of 11.95.⁶³ Leaving the conversation here does not prove much: many reasons could lead to a chance difference between these means. Instead, with the mean, variance, and number of observations of each group, we could conduct a simple T-test. With a sample of 1,730 observations (including 1,127 unattributed and 603 attributed paintings) and calculating the mean difference and price variations in both groups, we get a p-value of less than 0.0001, meaning that our data sample is very very unlikely to occur randomly under the null hypothesis that there is no difference between means. Thus, we can reasonably discard the null hypothesis: namely, we can assume that there was indeed a systemic difference in the values of attributed and unattributed paintings. Confidence intervals are a valuable alternative to point estimates, yielding richer information. A confidence interval is an estimated range of plausible values for an unknown parameter, centered on the point estimate but giving extreme limits based on sample size, variance and an associated level of confidence that the true parameter is in the proposed range (by convention, 90, 95 or 99% chance).⁶⁴ The width and values of the range will give valuable insights into the possible values of a parameter, such as a mean, which is particularly useful when working with small-sized data sets. With the example above, using the same information from the t-test, we find that the difference between average prices lies between 62.8 and 47.6 gulden with 95% confidence (that is, very far from zero). Naturally, the practical implications of such a difference are a matter requiring further historical analysis.

The use of methods such as the above is particularly important when considering the fragmentary nature of archival documentation and historical sources because it provides information on the level of uncertainty in our conclusions. If the base hypothesis that there was no difference between means had not been statistically rejected, or equivalently if the confidence interval for the difference had encompassed the value of a zero difference, we would have needed to be transparent about the result. This situation occurs frequently but is a necessary act of academic integrity. Furthermore, if a data set does not allow the author to use more advanced treatments, researchers should provide reasonable arguments to justify the circumscription to descriptive statistics. An awareness of economics' methodological fundamentals is also necessary, including the use of real, and not nominal, prices, controlling for inflation and converting currencies.

When samples and data are sufficiently representative and robust, one might expect researchers to employ more advanced statistical methods. For historical data, economist Kim Oosterlinck recommends avoiding the use of rudimentary price indices based on medians, instead suggesting the use of regression analysis to control for variables that might affect prices.⁶⁵ As discussed in Section 2.2, hedonic regressions typically place the price of the work of art as a dependent variable, which is a function of the characteristics of the work of art, among other factors. Regressions not only allow us to model what pricing components affect the market value of art (in other words, buyers' preferences at a fixed point in time), but also to control for bias when retracing the evolution of market segments over time through the creation of price indices. Thomas M. Bayer and John R. Page's book entitled *The Development of the Art Market in England* and published in 2011 is a compelling example of these methods being applied to historical art markets.⁶⁶ This mixed horizontal collaboration between an art historian trained in economics and an economist provides interesting insight on the evolution of the London art market and the relationship between art genres and subjects with prices at the time. The use of more sophisticated methods when dealing with a significant amount of data is also attested in Diana Greenwald's book *Painting in Numbers: Data-driven Histories of Nineteenth-century Art*. The quantitative examination of more than five hundred thousand works of art from the Paris salon has allowed the author, trained in both art and economic history, to rethink art-historical questions on gender and industrialization and challenge art historical canons.⁶⁷

If such models offer obvious advantages for quantitative art market research, they are not free from criticism. Among their limitations are the potential for omitted variable bias, the fact that most variables included in hedonic pricing models are dummies (i.e., variables with a 0-1 value), and that fixed coefficients do not take into account potential shifts in consumers' preferences over time. Some parameters are also difficult to control for (e.g. personal taste, incentives to buy art, characteristics of buyers, etc.). Economists' propensity to simplify art historical concepts has been contested, for instance when the length of artist entries in reference dictionaries has been used as a proxy for artist reputation.⁶⁸ Convincing instrumental variables have yet to be found for essential parameters that are subjective cultural constructs with a slippery relationship to prices, such as artistic merit and quality. Though the artist's name, provenance, exhibition history, and mentions in the literature are the standard variables used for controlling for the quality of the work, this information is often missing and can be problematized (after all, quality is never constant over a given artist's body of work). The second main approach, repeat sales regression, comes with its own issues, of which Ginsburgh and Menger

[1996] mention samples' lack of representativeness, the difficulty of identifying all resales in art markets, and the selection bias resulting from the fact that works which appear multiple times at auction are not necessarily representative of the entire population of artworks sold.⁶⁹

The toolbox of statistics in its wide range of techniques can not only help us accrue interdisciplinary credibility, but also help us address intra-disciplinary concerns. If our purpose is to conduct interdisciplinary research—in our case, to address both art and the market—it stands to reason that we should be in conversation with the methods of multiple fields. Critiques of neo-positivism from within our own discipline can also be addressed through critical engagement with data—of its gathering, as is most often discussed, but also its analysis and interpretation.⁷⁰ Statistics can help strip numbers of their false sense of authority, allowing us to write careful quantitative narratives instead of jumping to spurious conclusions. Moreover, were we to internalize the scientific paradigm of repeated, reproducible experiments, we would understand data-based narratives not as definite answers, but as pondered arguments to be contested with further data or novel hypotheses.

3.3. Missing Data and Art Markets: Beyond Heroic Assumptions

In the face of incomplete information, much of art market research has relied on heroic assumptions or convenient hypotheses to resolve historical problems. For instance, to estimate the volume of artistic production, authors have used fixed hypothetical values for the number of annual working days, the number of painters in a city, and so on.⁷¹ Statistical models can provide innovative ways to calibrate assumptions based on estimates. Economists Federico Etro and Elena Stepanova provide a compelling example for the case of dealer activities in 18th-century Paris by testing the economic significance of dealer rings proposed by De Marchi and Van Miegroet. Instead of assuming that those rings existed, they used network analysis to determine the boundaries of those social groups before including this information in a regression that tested whether or not these rings affected prices, or, in other words, if there was evidence of their collusion on the market.⁷²

Where parameters must be arbitrary, scholars might consider providing ranges instead of point values. Few studies have engaged with the idea of simulating or imputing data, although it emerges as a need for historical analysis.⁷³ Randomized imputations for missing values would allow historians to relax assumptions by testing alternative scenarios that consider uncertainty. Matthew Lincoln and Sandra van Ginhoven's work on the profitability of art dealer

M. Knoedler & Co. [1848–1971] is an illustrative example of such novel approaches. Faced with the prospect of discarding half their data because it was incomplete, the authors opted for using artificial intelligence to create estimates based on 500 randomized imputations of missing data. By contrasting their findings using the subsample of complete data with those using imputed information, they demonstrated that apparent trends disappear when considering other plausible scenarios. They also provided an interface where readers could modify parameters to create imputations, and thus confidence interval estimates, of their own.⁷⁴ The resulting graphs and dependence plots offer a flexible way of testing the effects of historical assumptions. Hence, the combination of statistical techniques and artificial intelligence are promising tools not only for obtaining more accurate estimates,⁷⁵ but also for conceiving new models adapted to the peculiarities of this hybrid field. By doing so, and rather than applying existing economic methods, they do justice to Throsby's characterization of art and culture as a "natural area for eclectic theoretical and methodological advance."⁷⁶ Here again, the close collaboration between scholars trained in multiple fields (economics and art history in the case of van Ginhoven, and art history and data science in the case of Lincoln) is a compelling example of mixed horizontal collaborative venture that leads to innovative methods in quantitative art markets research that addresses the field's particular problems

3.4. Research Questions at the Intersection of Two Fields

Research directions within cultural economics might be transposed to underexplored historical contexts and markets. Etro and Stepanova have suggested that "to some extent, [historical data] is even more complete than what is usually available for modern auctions,"⁷⁷ giving, for instance, the names of buyers, which are rarely available for 20th and 21st-century sales. In the work, historical markets become a testing ground where current cultural economics issues find new life, analyzing the seminal issue of the return to investment in art in varied chronological and geographical frameworks, including seventeenth-century Spain, the Netherlands, and eighteenth-century Paris, among others.⁷⁸ Similarly, cultural economists and art historians might find a fruitful ground in testing existing art-historical claims through comprehensive statistics. In this regard, standard econometric methods can offer opportunities for innovative work. Here again, Etro and Stepanova or Page and Bayers are compelling examples as works grounded in a solid understanding of the humanistic claims about the art markets of the cities they study that stems from a thorough knowledge of the art-historical literature.

Innovative angles on underexplored issues such as taste, expertise and agents' strategies on the market can emerge from the creative combination of market data and art-historical sources.⁷⁹ For instance, building on the work of Ginsburgh and Weyers (2010), economist Kathryn Graddy demonstrated how an original approach to existing data, combined with an in-depth knowledge of primary sources, can be used to test issues of interest to both fields.⁸⁰ Her data were derived from contemporary auction sales that she combined with tabular information from Roger de Piles' 1708 *Balance des Peintres*, an early work of art criticism that established a rating scale to value the work of painters based on color, drawing, composition, and expression. All sources had been relatively well-studied, yet using hedonic regression, she approached them from an original angle, studying the changing effects on price over time of these four characteristics on painting prices. To art historians, this question relaunches a crucial debate: the importance of colorito versus disegno, and the issue of shifts in taste over time. On the other hand, economists would recognize the value of this study as a foray into the dynamics of art consumption.⁸¹ Similarly, David et al. explore the still under-investigated issue of inventory management, by combining data from Goupil, Boussod, and Valladon stock books (1860-1914) with modern business theories and regression analysis. Thanks to a remarkable documentary research effort, their conclusions about stock management strategies developed by this renowned gallery are of interest to both economists and art historians.⁸²

The previous examples illustrate that the most fruitful research results from collaboration. Joint research projects between economists and, for example, philosophers or art historians, have led to the publication of innovative empirical papers on topics relating to the formation of canons in art history, reputation, and authentication of art. Based on a data set containing auction results of autograph and non-autograph paintings by Pieter II Brueghel and using a difference-in-difference model, Ginsburgh et al. calculated that the publication of a catalogue raisonné by the artist's renowned expert in the late 1990s had an effect of +60% on sales of autograph works.⁸³ The output of this research is not only of interest for art historians (regarding the cultural importance of authorship and reliable connoisseurship), but also for economists, as it provides complementary empirical evidence on the effects of experts' judgments in the valuation process. Flemish old masters have also been used as case studies to better understand branding strategies in the contemporary art market. K. Oosterlinck and A.S. Radermecker use a dataset of sales of paintings by masters with provisional names to show how this identification strategy used to label works by unknown artists tend to overperform in the art market. Their study not only pushes forward understudied

price determinants but also reveals how connoisseurial practices, such as creating fictive names, are taken up by art market players and increase the perceived value of goods.⁸⁴

3.5. Communicating with Two Audiences

The difference in the languages, formal structures, and methodological requirements of art history and economics discussed throughout this paper and embodied in the reward structures, publishing venues and methods of peer review within each field, represent a significant challenge for communication among scholars. Economists usually write articles centered on one idea, calibrating a statistical model with data or testing a hypothesis through statistical analysis. Such articles have a rigid conventional format, where the organization into sections (introduction, data, method, analysis and conclusions) must be respected. On the other hand, art historians write discursive texts that, even if in article form, will include multiple conceptual contributions. Therefore, requirements and expectations differ enough that the balance of communication requires concessions towards one field or another depending on the targeted journal or publication. From that perspective, spaces for publishing hybrid content still need to be developed and promoted.

The balance between a focus on methodology or a more narrative discussion around history also depends on the primary audience one has in mind. Papers written for an art-historical publisher might benefit from more graphic visualizations over tabular representations, stressing immediacy for those more comfortable with visuals. It might also require moving detailed tables, analyses, and results into an appendix. Victor Ginsburgh and Sheila Weyers provide a good example of shifting the emphasis on method to promote interdisciplinary communication.⁸⁵ In a paper published in 2010, the authors assess art canons' stability over time, thanks to an in-depth investigation into historiographical sources of art history.⁸⁶ Their method consists of relatively basic computation by tracking the appearances of a selection of artists across different sources. They transcribe and then quantify this information into comparative tables and place their findings into an art-historical discussion. Interestingly, the authors take great care to keep the core discussion free of complex mathematics by placing technical details (the statistical rationale for their selection of 50 artists) in the appendices. By doing so, they succeed in structuring the text to incorporate the fundamental requirements of both art history and economics writing. Published in *The Empirical Studies of the Arts*, its content was therefore appropriate for a mixed group of readers. In another paper, Ginsburgh and Weyers test similar questions by measuring the present-day relevance of Roger de Piles' *Balance des Peintres* through regression analysis. The dependent variables are carefully

justified in both humanistic and economic terms, and a thorough explanation of De Piles' historical and present importance is provided, serving as the basis for a reasoned justification of the experiment. Finally, they explain the analogy of De Piles' measurements with the contemporary notion of the hedonic regression, explaining the basic method of univariate OLS and their assumptions clearly and succinctly. By doing so, they maintain a language that can be understood by various audiences while still including the necessary technical perspective on data.

Conclusions

All history is a model, “a deliberately simplified account of the past which is illuminating because of, not despite, its simplifications.”⁸⁷ Whether using a quantitative or qualitative approach, we build a historical narrative that involves interpretation at all stages, from the phase of data gathering, through that of analysis (examination of the evidence), to the final stage of historical interpretation. Digital tools have provided the means for approaching research questions of new scale and scope, with the potential to “radically [...] reorient historiographic debates, make visible what has been rendered invisible, and address art-historical questions of true significance to an analysis of individuals and systems.”⁸⁸ As scholars, we should be compelled to pursue these opportunities and develop the critical and technical tools for a quantitative art history, drawing from and in collaboration with other disciplines while foregrounding the preoccupations and domain knowledge of the art historian. In this regard, the art market is a natural sphere for quantitative art history which has drawn from both art history and economics without fully resolving the methodological chasm between the two fields or fully exploiting the possibilities afforded by the digital turn. In this paper, we have explored a selection of works on art markets in both art history and cultural economics and have discussed the directions in which studies might move to achieve a more cohesive, hybrid field. Undoubtedly, art history and economics each have their own distinct theoretical frameworks, analytical tools, research questions, and communication strategies which must be negotiated if scholars with disparate backgrounds are to collaborate, communicate, and develop mutually-beneficial synergies.

The two bodies of literature we investigated present distinct areas of scientific inquiry and modes of research. We have noted an increased interest of historians of art markets in data and quantification, which stems in part from an increased availability of online art market data. This growth in data has been encouraged by a series of digital initiatives by cultural institutions, art market players, and individual scholars. However, in a methodological sense, in the field of art history, most quantitative art market studies since the publication of *Mapping Markets* in 2006 have remained in the same line as

John Michael Montias' contributions of the 1980s, when he first applied statistics to the art markets of the Netherlands. The encouraging move towards an aggregative approach still needs to be strengthened with statistical analyses to verify claims. Art historians should also open themselves to the mentality prevalent in economics: that of testing other scholars' statements, which includes revisiting well-known datasets and issues.

On the other hand, cultural economists apply more sophisticated empirical strategies to their data to answer economic questions, but are corseted by their models and approaches to data gathering. In cultural economics, rather than being just used for illustrative purposes, art market data is exploited as a laboratory to test clearly defined research questions. However, the art market articles published in the *Journal of Cultural Economics* suggest that economists often limit themselves to price analysis and to refining existing analytical methods, rarely taking into account the context and specificities of art objects themselves. One might expect better contextualization and more acute knowledge to enhance and diversify research perspectives, which is all the more critical because the particularities of art can undermine their conclusions. Additionally, exploring sources other than readily available online auction data might lead to new research questions and approaches. Cultural economists should consider primary sources and soften their assumptions through the careful consideration of historical knowledge to assess whether method leads to novel historical insights. For this purpose, regular discussions with art historians might help refine theoretical assumptions and models and guarantee the credibility of conclusions.

Our paper has highlighted a set of desirable components for an innovative, interdisciplinary approach that speaks to the theoretical and methodological inclinations of both disciplines. We have stressed the importance of standardizing, diversifying and sharing data among art market researchers, and have argued that more considerable attention must be paid to statistical methods—ranging from the use of simple statistics to more complex model specifications—in order to better consider and reflect on the realities of art markets and their data. This is a necessary step for revisiting existing research questions and developing novel, interdisciplinary approaches to data and the art market. In that regard, we have discussed concrete examples of recent publications that show strengths in each of these areas. One immediate option for achieving these goals, given the differing skill sets of art historians and economists, is to encourage collaboration among scholars. Following these suggestions, we may see, in the near future, the development of a convincingly interdisciplinary branch of digital art history that seeks to overcome the dichotomy between the disciplines from which it draws while taking full advantage of the novel possibilities afforded by digital tools.

APPENDIX

Appendix 1. Examples of Graphs and Tables Found in Three Reference Books in Historical Art Market Research⁹¹

VERMEYLEN (2003)	DE MARCHI AND VAN MIEGROET (2006)	VAN GINHOVEN (2017)
New members of the Antwerp guild of Saint Luke (1400-1539)	Distribution of household rents (Antwerp 1667, 1680)	Number of ships to the Americas per year 1505-1699
Maps showing concentration/gathering of artists	Percentage distribution of probate inventories	Exports of artworks from transatlantic: shipping documents 1630-1699 (shipments with artworks and artists materials; total boxes or bundles with paintings; estimated total difference of paintings; total difference of paintings from Kinkead-García Fuentes)
Revenues of our Lady's Pand (in Brabantine Pounds), 1465-1560W	Percentage of paintings unidentified	Number of shipments with artworks to New Spain and Tierra – Firme by decade, 1630-1680
Demographic evolution of Antwerp during the long Sixteenth century	Percentage of painting ownership	Estimated number of paintings to New Spain and Tiera (grouped by type of goods, by type of people directly involved, etc.)
Renters of Our Lady's Pand (by profession) 1543-1560	Relative distribution of painted subject	Quantity sold/total revenues/revenue per units by painting, sculpture, furniture, frame, mirror
Revenues of the Schilderspand (in guilders)	Percentage distribution of Spanish chairs	Paintings and furniture items sold by destination (% of total), 1648-78
Art dealers in the Guild of Saint Luke during the sixteenth century (data of registration and names)	Percentage distribution of subject categories	Approximation of Guiliam Forchondt's revenues and expenses per year (in guilders)
The appearance of art dealers in Antwerp (before 1600) – Decade – Number of art dealers	Number of shopkeepers selling paintings (Venice)	Sales of imagery and furniture: quantities and total revenues (in guilders)
The export of paintings 1543-1545 (percentage of total value)	Auction advertised in London	Proportional size of paintings found in the Forchondt documentation
Origin of tapestries exported to the Iberian Peninsula in 1553 (percentage of total value)	Number of shops selling paintings in Rome	Sales and purchases prices for paintings by support and size (in guilders) – 1643-78
Export of works of art from Antwerp to France (1543-1545)	Coefficients of correlation between categories of goods (Amsterdam, 17th century)	Categories of description used in Forchondt's sales documents by destination as relative frequencies (% total paintings sold per destination)
Paintings in the Dierick Bijns inventory	Comparative analysis of probate inventories ('s-Hertogenbosch, 1630-1780)	Relative frequencies of descriptors used in sales documents by destination (% total), 1643-78 (relative frequencies of 3% and up are indicated)
Masters in the Antwerp Guild of Saint Luke (1588-1589)	Comparative statistics on house rent taxpayers and inventory testators	Spatial distribution of Forchondt's painting sales by destination and main types of support 1643-78
Art dealers as deans in the Guild of Saint Luke (before 1600)	Penetration of painting ownership ('s-Hertogenbosch, 1630-1780)	Average price of paintings by support and destination (in guilders) 1643-78
Median and average number of paintings in Antwerp probate inventories	Auctions advertised in England by year (1976-1699)	Plot graph of quantity to painting (x-axis) and total value fetched (y-axis) by artist sold in Germany and Central Europe (1643-1678)
Composition of median paintings ownership according to subject category in Antwerp probate inventories	National origins of paintings in German auctions	Absolute frequencies of descriptors used in Forchondt's documentation for paintings sold per year to known destinations, 1650-78
	Paintings identified by subject in Amsterdam estate inventories (1620-1689)	Size and scope of GF business network per role (top pie chart) and per destination of sales (bottom diagram)
	Most popular painters in Germany (1800s)	Network map of intermediate and end destinations for Forchondt's sales of paintings. Diagram A shows all sales while diagram B highlights sales to the Iberian Peninsula only and their route through intermediate cities and ports
	Gersaint's presale price expectations and outcomes, Fonspertuis Sale (1748)	GF's buyers and agents in the Iberian Peninsula: Activity by decade sized by the number of sales transactions in which they participated
	National origins of paintings in Hamburg collections (1747-1793)	Network of agents the transatlantic art trade

NOTES

- 1 Our heartfelt thanks to Kim Dosterlinck (Université Libre de Bruxelles), Kaylee Alexander (Duke University), and Sandra van Ginhoven (Getty Research Institute) for their feedback while drafting this paper. We also thank the two anonymous reviewers for their valuable comments.
- 2 Marxist art history has long applied a systemic approach to analyze the relationship between capitalism and the arts, while social art history has given particular attention to economic exchanges in the art world, through a structural and systemic analysis. Influential members of either school include Jane Willimas, Martin Warnke, Barbara Abu el-Haj, Arnold Hauser, Nicos Hadjinicolaou, Nicholas Green, Andrew Hemingway, Karl Werckmeister, Michael Baxandall, or Francis Haskell, among others.
- 3 The book that is considered the foundational text of Cultural Economics is William J. Baumol and William Bowen's *Performing Arts—The Economic Dilemma* (New York: Twentieth Century Fund, 1966). It was followed by the creation of the Association of Cultural Economics International in 1973, and the *Journal of Cultural Economics* in 1977. Baumol is also the author of a pioneering paper on art as an investment. See William J. Baumol, "Unnatural Value: Or Art Investment as Floating Crap Game," *The American Economic Review* 76, no. 2 (1986): 10–14.
- 4 David Throsby, "The Production and Consumption of the Arts. A View of Cultural Economics," *Journal of Economic Literature* 32, no. 1 (1994): 26.
- 5 Gerald Reitlinger, *The Economics of Taste. The Rise and Fall of the Picture Market* 1 (London: Barrie & Rockcliff, 1961); Harrison C. and Cynthia A. White, *Canvases and Careers. Institutional Change in the French Painting World* (Chicago: Chicago University Press, 1965); John Michael Montias, *Artists and Artisans in Delft: A Socio-Economic Study of the Seventeenth Century* (Amsterdam: Amsterdam University Press, 1982).
- 6 Claire Bishop, "Against Digital Art History," *International Journal of Art History* 3 (2018): 122–31; Johanna Drucker and Claire Bishop, "A Conversation on Digital Art History," *Debates in the Digital Humanities* (2019).
- 7 Klinke, Harald, "The Digital Transformation of Art History," in *The Routledge Companion to Digital Humanities and Art History*, ed. by Kathryn Brown, New York and London: Routledge (2020), 35.
- 8 See, for example, Raymonde Moulin, *Le marché de la peinture en France* (Paris: Éditions de minuit, 1967); idem, *L'artiste, l'institution et le marché* (Paris: Flammarion, 1992); Olav Velthuis, *Talking Prices. Symbolic Meanings of Prices on the Market for Contemporary Art* (NJ: Princeton University Press, 2005); Krzysztof Pomian, *Collectionneurs, amateurs et curieux. Paris, Venise, XVIe-XVIIIe siècle* (Paris: Gallimard, 1987); Susan Bracken, Andrea M. Galdy, and Adriana Turpin (eds), *Collecting and Dynastic Ambition* (Cambridge: Cambridge Scholars Publishing, 2009); idem, *Women Patrons and Collectors* (Cambridge: Cambridge Scholars Publishing, 2012); idem, *Collecting East and West* (Cambridge: Cambridge Scholars Publishing, 2013); Inge Reist, and José Luis Colomer (eds), *Collecting Spanish Art: Spain's Golden Age and America's Gilded Age* (Madrid: Centro de Estudios Europa Hispánica, 2012); Inge Reist, *Market for Merchant Princes: Collecting Italian Renaissance Paintings in America* (Pennsylvania: Penn State University Press, 2014); idem, *British Models of Art Collecting and the American Response: Reflections Across the Pond* (Oxford: Routledge, 2014b).
- 9 Victor Ginsburgh has identified areas such as the history of taste, the mobility of art objects, the evolution of artistic and cultural values, artists' trajectories and careers, and the economics of copies and fakes being particularly suitable for a cross-disciplinary approach. See Victor Ginsburgh and François Mairesse, "Dimensions of Dialogue: Art history and the Discourse of Economics," in *Art History and Visual Studies in Europe*, ed. by Matthew Rampley et al., 167–84 (Leiden/Boston: Brill, 2012); Victor Ginsburgh, "The Economics of Arts and Culture," in *International Encyclopaedia of the Social and Behavioural Sciences*, ed. by Neil Smelser and Paul Baltes, 758–64 (Amsterdam: Elsevier, 2001). For works that follow these suggestions, see for instance Gianfranco Mossetto and Marilena Vecco (eds), *The Economics of Copying and Counterfeiting* (Milan: F. Angeli, 2005), 93–118.
- 10 The author also lists six areas of possible advancement for the future of economic research on art markets: taxation, methodological approaches, testable propositions, behavioral anomalies, importance for practice, and policy. Bruno Frey, *Arts & Economics. Analysis & Cultural Policy* (Berlin/Heidelberg/New York: Springer-Verlag, 2003), 5.
- 11 Victor Ginsburgh and David Throsby (eds), *Handbook of the Economics of Art and Culture*, Vol. 1 (Amsterdam/New York: North Holland, 2006).
- 12 Neil De Marchi, and Hans J. Van Miegroet (eds), *Mapping Markets for Paintings in Europe, 1450-1750* (Turnhout: Brepols, 2006). On Google scholar, excluding citations of individual chapters, the book's citations are estimated at 72, while their chapter in the Handbook of the Economics of Art and Culture, "The History of Art Markets" has been cited 67 times.
- 13 De Marchi and Van Miegroet, *Mapping Markets for Paintings in Europe, 1450-1750*, 7–8.
- 14 Fletcher, Pamela and Anne Helmreich, "Digital Methods and the Study of the Art Market," in *The Routledge Companion to Digital Humanities and Art History*, ed. by Kathryn Brown (New York and London: Routledge, 2020), 167–77.
- 15 Béatrice Joyeux-Prunel, "L'histoire de l'art et le quantitatif. Une querelle dépassée," *Histoire & Mesure* 23, no. 2 (2008): 3–34; idem (ed.), *L'art et la mesure* (Paris: Éd. Rue de l'Ulm/Presses de l'École normale supérieure, 2010).
- 16 Klinke, "The Digital Transformation of Art History," 32–42.
- 17 The field of technical studies in itself provides a model for interdisciplinary collaboration and attention to methodology. In this particular field of research, mathematical models are used for image processing and related issues such as authentication, detection of forgeries, underdrawing analysis, restoration, etc. For instance, see Bruno Cornelis, Ann Doods, Ingrid Daubechies, Peter Schelkens, Report on Digital Image Processing for Art Historians. SAMPTA'09, May 2009, Marseille, France. Special session on sampling and (in) painting; Bruno Cornelis et al., "Digital Image Processing of The Ghent Altarpiece: Supporting the painting's study and conservation treatment," *IEEE Signal Processing Magazine* 32, no. 4 (2015): 112–22.
- 18 Elkins points out the ambiguity of empiricism in art history by stating that "There are two reasons why a "Defense of Empiricism in Art History" has not been written. First, art historical practice does not incorporate even a local or heuristic theory to explain or discuss itself. Second, its 'position' is not a latent theory, waiting to be eloquently stated, but something which is presupposed in a vague and variable manner by the art historical texts themselves." See James Elkins, "Art

- History without Theory," *Critical Inquiry* 14, no. 2 (1988): 357–58.
- 19 Often according to a logic that recalls that of Aristotelian causality, based on four causes that allow researchers to engage in the causal explanation of the natural world, including the art world. These four causes are: the material cause ("that out of which," e.g., the bronze of a statue), the formal cause ("the form," "the account of what-it-is-to-be," e.g., the shape of a statue), the efficient cause ("the primary source of the change or rest," e.g., the artisan, the art of bronze-casting the statue, and the final cause ("the end, that for the sake of which a thing is done"). See Andrea Falcon, "Aristotle on Causality," in *The Stanford Encyclopedia of Philosophy*, ed. by Edward N. Zalta (2019) <https://plato.stanford.edu/entries/aristotle-causality> [Page accessed on 29 March 2021].
- 20 See, among others, Tanya E. Clement, "Where Is Methodology in Digital Humanities?" (2018) <https://dhdebates.gc.cuny.edu/read/untitled/section/cfa5a92d-0d35-4e3d-b632-85644039cb1c> [Page accessed on 27 March 2021]; Lev Manovich, "Data Science and Digital Art History," *International Journal of Art History* 1 (2015): 13–35; Anna Bentkowska-Kafel, "Debating Digital Art History," *International Journal of Art History* 1 (2015): 51–64; Mario Carpo, "Big Data and the End of History," *International Journal of Art History* 3 (2018): 100–111; Emily, Pugh, "Art History Now: Institutional Change and Scholarly Practice," *International Journal of Art History* 3 (2019/21): 347–57; Ewa Machotka, and Panagiotis Papapetrou, "Method in Interdisciplinary Research: Data Science for Digital Art History," *International Journal of Art History* 3 (2019/21): 503–10.
- 21 Pamela, Fletcher, Anne Helmreich, David Israel, Seth Erickson (2017), *Local/Global: Mapping London's Art Market*. Getty http://www.getty.edu/iris/dah_fletcher_helmreich_israel_erickson.pdf [Accessed 27 March 2021].
- 22 Klinke, "The Digital Transformation of Art History," 35
- 23 The journal is edited by the Association for Cultural Economics International. It defines its own editorial perspective as "economic analysis to all of the creative and performing arts and the heritage and cultural industries, whether publicly or privately funded. Furthermore, the journal explores the economic organization of the cultural sector and the behavior of producers, consumers, and governments within the cultural sector. Readers will find original papers dealing with the theoretical development of cultural economics as a subject, the application of economic analysis and econometrics to the field of culture, and the economic aspects of cultural policy. In addition to full-length papers, the journal offers short papers and book reviews." <https://www.springer.com/journal/10824> [Page accessed on 8 March 2021].
- 24 Earlier works dedicated to the art market were more oriented toward sociology. See, for example, Hanns Floerke, *Studien zur niederländischen Kunst- und Kulturgeschichte: die Formen des Kunsthandels, das Atelier und die Sammler in den Niederlanden vom 15.-18. Jahrhundert* (Munich-Leipzig, [1972 [1905]]); Martin Wackernagel, *The World of the Florentine Renaissance Artist [Der Lebensraum des Künstlers in der florentinischen Renaissance]* (Princeton: Princeton University Press, 1981 [1938]); Lorne Campbell, "The Art Market in the Southern Netherlands in the Fifteenth Century," *The Burlington Magazine* 118, no. 877 (1976): 188–98. One exception to this lack of numeracy is White and White, *Canvases and Careers*. The authors study the evolution of two competing art market institutions in 19th-century France, the academy and the dealer-critic system. The book's primary innovation lies in its quantitative interest and interest in the market as a whole.
- 25 Among his main publications see, for instance, John Michael Montias, "The Guild of St. Luke in 17th-Century Delft and the Economic Status of Artists and Artisans," *Simiolus* 9, no. 2 (1977): 93–105; idem, *Artists and Artisans in Delft*; idem, "Art Dealers in the Seventeenth-Century Netherlands," *Simiolus* 18, no. 4 (1988): 244–56; idem, *Vermeer and his milieu*, Princeton [Princeton: Princeton University Press, 1989]; idem, *Art at Auction in 17th Century Amsterdam*, Amsterdam [Amsterdam: Amsterdam University Press, 2002]; idem, "Artists Named in Amsterdam Inventories, 1607-80," *Simiolus* 31, no. 4 (2004-2005): 322–47.
- 26 For an overview of the history of art markets see Neil De Marchi, and Hans J. Van Miegroet, "The History of Art Markets," in *The Handbook of the Economics of Art and Culture*, Vol. 1., ed. by Victor Ginsburgh and David Throsby (Amsterdam/New York: North Holland, 2006), 69–122. For other references, see Jan de Vries and David Freedberg, *Art in History, History in Art: Studies in Seventeenth-Century Dutch Culture* (Chicago: University of Chicago Press, 1919); Filip Vermeulen, "Exporting Art across the Globe: The Antwerp Art Market in the Sixteenth Century," *Nederlands Kunsthistorisch Jaarboek* 50, no. 1 (1999): 13–30; idem, "The Commercialization of Art: Paintings and Sculpture in Sixteenth-Century Antwerp," in *Early Netherlandish Painting at the Crossroads. A Critical Look at Current Methodologies*, ed. by Maryan W. Ainsworth (New York: The Metropolitan Museum of Art, 2001), 46–61; Filip Vermeulen and Bruno Blondé, "A Taste for Bruegel? Genre Painting in Antwerp Probate Inventories, Sixteenth-Eighteenth Centuries," *Bulletin/Handelingen symposium De Firma Brueghel* (2002, unpublished); Filip Vermeulen, *Painting for the Market: Commercialization of Art in Antwerp's Golden Age* [Turnhout: Brepols, 2003]; Michael North and David Ormrod, eds., *Art Markets in Europe, 1400-1800* (Aldershot: Ashgate, 1998); Neil de Marchi and Sophie Raux, eds., *Moving Pictures: Intra-European Trade in Paintings, 16th-18th Centuries* [Turnhout: Brepols, 2014]. On the importance of production centers such as Mechelen, see, for example, Hans Van Miegroet, and Neil De Marchi, "The Antwerp-Mechelen Production and Export Complex," in *Essays on Netherlandish Art in Memory of John Michael Montias*, Ed. Amy Golahny, Mia M. mochizuki and Lisa Vergara (Amsterdam: University of Amsterdam Press, 2007), 133–147; Hans Van Miegroet, "Copies fantômes la culture imitative au début de l'époque moderne en Europe," in *L'estampe, un art multiple à la portée de tous*, ed. by Sophie Raux [Lille: Presses Universitaires de Lille, 2008], 47–64; Neil De Marchi, and Hans J. Van Miegroet, "Pricing Invention: "Originals," "Copies" and their Relative Value in Seventeenth-Century Netherlandish Art Markets," in *Economics of the Arts. Selected Essays*, ed. by Victor Ginsburgh and Pierre-Michel Menger, (Amsterdam: Elsevier, 1996), 27–70. Scholars have also paid sporadic attention to Italy and its main artistic centers (e.g., Florence, Rome, and Venice), 18th-century France and England. For a reference book, see Marcello Fantoni, Louisa C. Matthew, Matthews Grieco, Sara F., *The Art Market in Italy : 15th-17th Centuries. Il mercato Dell'arte in Italia : Secc. XV-XVII* (Modena : F.C. Panini, 2003); Richard A. Goldthwaite, *The Building of Renaissance Florence* [Baltimore: The Johns Hopkins University Press, 1982]; idem, *Wealth and Demand for Art in Italy, 1300-1600* [Baltimore: Johns Hopkins University Press, 1994]. Note that Naples remains proportionally less documented so far, though the city and his port has played a central role in international exchanges in the Early Modern period.
- 27 Mapping Markets is organized into four sections: i) material culture and paintings; ii) rules and market practices; iii) drawing connoisseurship into the market; and iv) creative Dealing. Covered topics are buyers'

- preferences, shifts in taste, institutional controls and guild regulation, marketing customs, entrepreneurship, art valuation, dealers, and artists' specific business strategies.
- 28 De Marchi and Van Miegroet, *Mapping Markets for Paintings in Europe, 1450-1750*, 3.
- 29 Peter Carpreau, "Vanished like Smoke along with Fleeting Time: Michiel Coxcie's Lost Reputation," in *Michiel Coxcie (1499-1592) and the Giants of His Age*, ed. by Koenraad Jonckheere (Turnhout: Brepols, 2014), 10–21; Anne-Sophie Radermecker, "The Market Reception of New Connoisseurship: Have Recent Advances in Art Scholarship Affected the Way of Buying and Selling Early Flemish Paintings?" *Nederlands Kunsthistorisch Jaarboek* 69 (2019): 339–72.
- 30 For Brepols' recent publications, see, for example, Peter Carpreau, *The Value of Taste. Auction Prices and the Evolution of Taste in Dutch and Flemish Golden Age Paintings 1642-2011* (Turnhout: Brepols, 2017); Neil De Marchi and Sophie Raux, eds., *Moving Pictures. Intra-European Trade in Images, 16th-18th Centuries* (Turnhout: Brepols, 2014); Dries Lyna, Filip Vermeulen, and Hans Vlieghe, eds., *Art Auctions and Dealers: The Dissemination of Netherlandish Art during the Ancien Régime* (Turnhout: Brepols, 2009), 139–53. For the Getty publications, see for example, Christian Huemer and Susanna Avery-Quash, *London and the Emergence of a European Art Market (1780-1820)* (Los Angeles: Getty Research Institute, 2019). For the Brill series, see Sandra van Ginhoven, *Connecting Art Markets Guiliam Forchondt's Dealership in Antwerp (c. 1632-78) and the Overseas Paintings Trade 1* (Leiden/Boston: Brill, 2017); Lynn Catterson, *Dealing Art on Both Sides of the Atlantic, 1860-1940 2* (Leiden/Boston: Brill, 2017); Darius Spieth, *Revolutionary Paris and the Market for Netherlandish Art 3* (Leiden/Boston: Brill, 2018); Sophie Raux, Lotteries, *Art Markets, and the Visual Culture in the Low Countries, 15th-17th Centuries 4*, (Leiden/Boston: Brill, 2018); Paolo Coen, *The Art Market in Rome in the Eighteenth Century 5* (Leiden/Boston: Brill, 2019); Jan Dirk Baetens, and Dries Lyna, *Art Crossing Borders 6* (Leiden/Boston: Brill, 2019); Eloisa Doderio, *Ancient Marbles in Naples in the Eighteenth Century. Findings, Collections, Dispersals 7* (Leiden/Boston: Brill, 2019); Joanna Smalcerz, *Smuggling the Renaissance. The Illicit Expert of Artworks Out of Italy, 1861-1909 8* (Leiden/Boston: Brill, 2020); Lynn Catterson, *Florence, Berlin, and Beyond: Late Nineteenth-Century Art Markets and their Social Network 9* (Leiden/Boston: Brill, 2020).
- 31 For example, this is the case of Erasmus University Rotterdam and its Cultural Economics and Entrepreneurship program, Duke University and DALMI (Duke Art Law and Markets Initiative), the Forum Kunst und Markt/Centre for Art Market Studies at Technische Universität Berlin, and the Master in Art Market Studies at New York Fashion Institute of Technology.
- 32 The Getty Provenance Index is the most comprehensive database of information regarding historical art markets. These include archival inventories, auction records, dealer stock books, sales catalogs (22,000 of them, with 1.8 million records) from the 1500s to the 20th century for many locations in Europe. See <https://www.getty.edu/research/tools/provenance/search.html>. The database has noticeably contributed to provenance and looting research, which has led to a huge expanse of research on art markets and exchange. Another leading institution is the Zentralinstitut für Kunstgeschichte (Munich). More specialized digital databases have been launched, such as Project Cornelia (Leuven) for 17th-century tapestry and paintings (<https://projectcornelia.be/>), Ecartico. Linking cultural industries in the early modern Low Countries, ca. 1475 - ca. 1725 (Amsterdam) for painters, engravers, printers, booksellers, gold-
- and silversmiths and others involved in the "cultural industries" of the Low Countries in the sixteenth and seventeenth centuries (<http://www.vondel.humanities.uva.nl/ecartico/>), the Art Reference Library's Montias Database of 17th-Century Dutch Art Inventories (<https://research.frick.org/montias>), RKD artists& with biographical information for artists, but also art dealers, collectors and art historians from the Middle Age to present days (<https://rkd.nl/en/explore/artists>).
- 33 De Marchi and Van Miegroet, *Mapping Markets for Paintings in Europe, 1450-1750*, 7.
- 34 Idem, 3-4: "As a group we represent training in art history, economics, and social, urban and economic history. Some early efforts to bring individuals with these disciplinary backgrounds into fruitful collaboration resulted in frustration—discussed below—but we believe that is only to be expected if techniques and tools are thrust upon others unused to them and without the training to appreciate and employ them. We have attempted instead to proceed on an agreed basis of concepts and ways of thinking, in this case the economic, but with low emphasis on technique and empirical tools. The economic way of thinking, and its categories and concepts, can be used to good effect by those with only a modest awareness of the body of theoretical results and applied studies and their associated empirical methods that make up modern economics."; "Few of these ideas and concepts are employed explicitly in this volume, but the thinking they represent infuses the essays collected here. It is not that art historians have become practicing economists or vice versa; but within this group at least there has been a readiness to add economic questions and concepts to traditional ways of viewing art objects. This, to repeat, is something that can be done without sacrificing the integrity of economic thinking, and positively it produces mutual enrichment, adding a dimension to the art historian's thinking while creating a familiar way into art historical territory for the economist and economic historian."
- 35 See Charlotte Vignon, *Duveen Brothers and the Market for Decorative Arts, 1880–1940* (New York: The Frick Collection, 2019).
- 36 Carpreau, *The Value of Taste. Auction Prices and the Evolution of Taste in Dutch and Flemish Golden Age Paintings 1642-2011*.
- 37 Van Ginhoven, *Connecting Art Markets Guiliam Forchondt's Dealership in Antwerp (c. 1632-78) and the Overseas Paintings Trade*, 140 and De Marchi and Van Miegroet, *Mapping Markets for Paintings in Europe, 1450-1750*, 63. The former plots trend lines over the quantity of paintings sold vs. the price they fetched. The scholar argues that "these lines convey that the relationship between the number of paintings per artist of that period and the prices their works commanded varied for each group." The latter describes how inventory holdings of specific categories of goods vary with (or in the absence of) the holdings of other categories, as measured statistically with a correlation coefficient ranging from -1 to 1.
- 38 Hans Van Miegroet, Kaylee P. Alexander, and Fiene Leunissen, "Imperfect Data, Art Markets and Internet Research," *Arts* 8, no. 76 (2019).
- 39 For instance, particularly valuable information such as the artist's name, signature, prices, or even certain transactions, were not necessarily recorded or specified.
- 40 Variables typically included as determinants of painting prices are the artist's name, dimensions of the works, subject, technique, support, signature, date, provenance, exhibition history, literature, auction house, and year of the sale. For more details on these determinants, see Luc Renneboog and Christophe Spaenjers, "Buying Beauty: On

- Prices and Returns in the Art Market," *Management Science* 59, no. 1 (2013): 36–53; Kim Oosterlinck, "Art as a Wartime Investment. Conspicuous Consumption and Discretion," *The Economic Journal* 127, no. 607 (2017): 2665–701.
- 41 Categories (i) and (ii) are interrelated, since controlling for pricing characteristics is a necessary step in creating price indices.
- 42 Links of databases: Blouin (<http://www.blouinartsalesindex.com/>), Artnet (<https://www.artnet.com/>), ArtPrice (<https://www.artprice.com>). For leading auction houses, see Christie's (<https://www.christies.com/>), Sotheby's (<https://www.sothebys.com>). On the limitations of using online auction data, see On the limitations of using online auction data, see Van Miegroet et al. "Imperfect Data, Art Markets and Internet Research."
- 43 The term "hedonic" alludes to the value of a good depending on the consumer's enjoyment of its traits. Kelvin Lancaster, "A New Approach to Consumer Theory," *Journal of Political Economy* 74, no. 2 (1966): 132–57.
- 44 Imad Moosa, "The Mathematization of Economics: Useful, Inevitable, Indispensable or Simply Extravaganza," *Management and Economics Research Journal* 7, no. 1 (2021): 1–4.
- 45 For a general overview on the rate of returns of art computed by economists and published in different journals, see Bruno Frey and Reiner Eichenberger, "On the Rate of Return in the Art Market: Survey and Evaluation," *European Economic Review* 39, nos. 3-4 (1995): 528–37; Benjamin Mandel, "Art as an Investment and Conspicuous Consumption Good," *American Economic Review* 99, no. 4 (2009): 1653–63 [esp. 1655].
- 46 This leads us to believe that the rationale for their choice is often arbitrary, based on personal preference or data availability and potentially linked to the authors' nationality and academic affiliation. For instance, this is the case of the following papers, whose great majority of authors are based in Australia and Canada. See Lisa Farrell, Jane M. Fry, Tim R. L. Fry, "Determinants of Sales and Price at Auction for Three Australian Indigenous Artists: To Pool or not to Pool?" *Journal of Cultural Economics* 42 (2018): 507–20; Douglas J. Hodgson, "Age-price Profiles for Canadian Painters at Auction," *Journal of Cultural Economics* 35 (2011): 287–308.
- 47 For instance, Yi Zhou, "Narcissism and the Art Market Performance," *The European Journal of Finance* 23, no. 13 (2017): 1197–218. In this paper, the author argues that artists should use larger and exuberant signatures to be more profitable on the market, which is a reductive conclusion from an art-historical perspective. ["Our results show that there is a positive and significant relationship between an artist's narcissism and the artist's creativity and productivity" 19]. Though the hedonic analysis is valuable, particularly in the very original approach to including signatures as a variable, we believe the conclusions should have moved in another direction. To begin with, the equation of larger signatures with narcissism is unfounded. Size of signature may be related with painting size, period of production and artistic movement, thus reflecting other causalities. Similarly, measuring creativity and productivity through individual paintings' market performance is not appropriate (productivity, for instance, would need to involve some measure of total output). There is also an underlying question of whether the size of signature (or signing at all) is valuable for all artists, or just established ones, and whether starting artists might benefit from an alternative strategy. In fact, the latter might be confused and even disadvantaged by such advice.
- 48 Raymonde Moulin, *Le marché de l'art : mondialisation et nouvelles technologies* (Paris: Flammarion, 2009).
- 49 Among these alternative forms of collaborations are: two art historians or two economists, an art historian distantly supervised by an economist (or vice-versa). This scenario should also not obscure the existence of individual research by art historians with economic skills or vice-versa.
- 50 Throsby, "The Production and consumption of Art," 26.
- 51 Fletcher and Helmreich, "Digital Methods and the Study of the Art Market," 167-77.
- 52 Alison Langmead and David Newbury, "Pointers and Proxies: Thoughts on the Computational Modeling of the Phenomenal World," in *The Routledge Companion to Digital Humanities and Art History*, ed. by Kathryn Brown (New York and London: Routledge, 2020), 356-73.
- 53 Many print books published in the 19th and 20th centuries are valuable sources of art market data that have not yet been transformed into publicly available datasets. To the best of our knowledge, Reitlinger's *Economics of Taste*, *World Collectors Annuary*, or *Art Prices Current*, have also not been digitized and structured into data. Typescript, unpublished sources such as museums' purchase books are another potential source that can be quickly digitized. Other sources particular to specific fields will be familiar to scholars. Handwritten sources still require dedicated transcription, although the Transkribus project (<https://www.transkribus.eu>) seems to be a promising tool for automated transcription.
- 54 For some valuable considerations for structuring art markets databases from historical sources, see Victoria Szabo, "Transforming Art History Research with Database Analytics: Visualizing Art Markets," *Art Documentation: Journal of the Art Libraries Society of North America* 31, no. 2 (2012): 158–75.
- 55 GitHub is a platform that was created with the intent of documenting and managing code-based projects; Dataverse is an initiative for the publication and dissemination of citable academic databases. One example of an art-historical database on the latter platform is Saint-Raymond, Léa, 2018, "Le pari des enchères : le lancement de nouveaux marchés artistiques à Paris entre les années 1830 et 1939. Corpus bibliographique des ventes aux enchères publiques considérées", *Harvard Dataverse*, V1 <https://dataverse.harvard.edu/dataset.xhtml?persistentId=doi:10.7910/DVN/MZIBKB>.
- 56 Jonathan Blaney, "Introduction to the Principles of Linked Open Data," *The Programming Historian* 6 (2017) [online]: <https://doi.org/10.46430/phen0068>.
- 57 The Getty Research Institute, *Getty Vocabularies* [Online]: <https://www.getty.edu/research/tools/vocabularies/index.htm> (Page accessed on 15 May 2020).
- 58 Among other challenges are the necessity to adapt to shifting research behaviours and scholars' needs, accessing obsolete information, server management and dealing with simultaneous access by multiple users, an increasing complexity of naming and addressing of data elements (especially for anonymous artworks), URL instability, the institutional willingness to use metrics, attention diversion towards objectives that are currently out-of-reach or peripheral to digital humanities' disciplinary development, or the potential negative externalities of a too democratic information system. For further information, see Allana Mayer, "Linked Open Data for Artistic and Cultural Resources," *Journal of the Art Libraries Society of North America* 34 (2015): 1-14; Dominic Oldman, Martin Doerr, and Stefan Gradmann (2015), "Zen and the Art of Linked Data: New Strategies

- for a Semantic Web of Humanist Knowledge,” in *A New Companion to Digital Humanities*, ed. by Susan Schreibman, Ray Siemens and John Unsworth (London: Blackwell), 251-273.
- 59 Anne Luther cites the five stars of open data: “1) make data available online in any format under an open license 2) make it available as structured data (i.e., not a scan or image); 3) make it available in a non-proprietary format 4) use URIs [Linked Data]; 5) Actually link your data to provide context”. See Anne Luther, “Digital Provenance, Open Access, and Data-Driven Art History,” in *The Routledge Companion to Digital Humanities and Art History*, ed. by Kathryn Brown (New York and London: Routledge, 2020), 450.
- 60 Big data is commonly defined as data with high volume, velocity and variety that demand “cost-effective, innovative forms of information processing.” In the sense implied by computer science—of billions of records culled from disparate, unstructured digital sources—, it is rarely applicable to art historical research. It could simultaneously be argued that any amount of aggregate information is big data insofar as it disrupts the established means of writing art history— but the methods for handling aggregate data can then easily be appropriated from other fields. For the definition of big data, see Rob Kithin and Gavin McArdle, “What makes Big Data, Big Data? Exploring the ontological characteristics of 26 datasets,” *Big Data and Society* 3, no. 1 (2016): 1-10. For big data within art history, see Carpo, “Big Data and the End of History,” 100-111.
- 61 Koenraad Brosens et al., “Slow Digital Art History in Action: Project Cornelia’s Computational Approach to Seventeenth-century Flemish Creative Communities,” *Visual Resources* 35, nos. 1/2 (2019): 117.
- 62 For further details on quantitative methods of analysis applied to humanities, see Claire Lemerrier and Claire Zalc, *Quantitative Methods in the Humanities. An Introduction* (Charlottesville and London: University of Virginia Press, 2019).
- 63 Using the data presented in a table in Ad van der Woude, “The Volume and Value of Paintings in Holland at the Time of the Dutch Republic,” in *Art in History, History in Art. Studies in Seventeenth-Century Dutch Culture*, ed. by David Freedberg and Jan de Vries, 318 (Santa Monica: Getty Center for the History of Art and the Humanities, 1991). Note that inflation does not seem to have been taken into account in this data set, but more elaborate analysis is beyond the scope of this example.
- 64 Frederik Michel Dekking. *A Modern Introduction to Probability and Statistics: Understanding Why and How* (Berlin: Springer, 2005).
- 65 Kim Oosterlinck, “The Value of Taste: Auction Prices and the Evolution of Taste in Dutch and Flemish Golden Age Painting 1642–2011 by Peter Carpreau,” *Journal of Cultural Economics* 43 (2019): 413–415. For reference papers on hedonic regression, see Victor Ginsburgh, Jianping Mei, and Michael Moses, “The Computation of Price Indices”, in Ginsburgh and Throsby, *Handbook of the Economics of Art and Culture*, 947–79; Nathalie Buelens and Victor Ginsburgh, “Revisiting Baumol’s ‘Art as Floating Crap Game,’” *European Economic Review* 37, no. 7 (1993), 1351–1371; William N. Goetzmann, “Accounting for Taste: Art and the Financial Markets over Three Centuries,” *The American Economic Review* 83, no. 5 (1993): 1370–76; Olivier Chanel, Louis-André Gérard-Varet, and Victor Ginsburgh, “The Relevance of Hedonic Price Indices: The Case of Paintings,” *Journal of Cultural Economics* 20, no. 1 (1996): 1–24.
- 66 Thomas M. Bayer and John R. Page. *The Development of the Art Market in England. Money as Muse, 1730–1900* (London: Pickering & Chatton, 2011).
- 67 Diana Seave Greenwald, *Painting by Numbers: Data-driven Histories of Nineteenth-century Art* (NJ: Princeton University Press, 2021).
- 68 See, for instance, Renneboog and Spaenjers, “Buying Beauty,” 36-53 and John O’Hagan and Karol J. Borowiecki, “Birth Location, Migration, and Clustering of Important Composers,” *Historical Methods: A Journal of Quantitative and Interdisciplinary History* 43, no. 2 (2010): 81–90. The limitations of these methods are discussed in Diana Seave Greenwald and Karol J. Borowiecki, “Arts and Culture,” in *Handbook of Cliometrics*, ed. by Claude Diebolt and Michael Hauper (Berlin/Heidelberg/New York: Springer-Verlag, 2018), 6–7. The authors point out three biases of using art dictionaries or retrospective expert opinions; the fact that artists who lived longer are better documented, and that longevity can be correlated with fame; artists born prior the 18th century are also less documented because of archival losses; and the existence of biases to the home or target market country of the reference work.
- 69 On the limitation of hedonic regressions, see Victor Ginsburgh and Pierre-Michel Menger, eds., *Economics of the Arts. Selected Essays* (Amsterdam: Elsevier Science, 1996), xi; Clare McAndrew (ed.), *Fine Art and High Finance. Expert Advice on the Economics of Ownership* (New York: Bloomberg Press, 2010), 76–78.
- 70 For an argument that defends that this discussion is outdated, see Joyeux-Prunel, “L’histoire de l’art et le quantitatif. Une querelle dépassée,” 3-34.
- 71 See for example Federico Etro, and Elena Stepanova, “Art Auction and Art Investment in the Golden Age of British Painting,” *Scottish Journal of Political Economy* 64, no. 2 (2017): 210. “In the absence of comprehensive data on dividends, we adopt the heroic assumption that the dividend rate was constant, so that all the variability of the stock market return is captured by the capital gains.”
- 72 Federico Etro, and Elena Stepanova, “The Market for Paintings in Paris between Rococo and Romanticism,” *Kycklos* 68, no. 1 (2015): 28–50.
- 73 Brosens et al. include a valuable discussion of the types of missing data encountered (missing at random, missing completely at random, and missing not at random) in historical sources. See Broesens et al., “Slow Digital Art History,” 116–19.
- 74 Matthew Lincoln and Sandra Van Ginhoven. “Modeling The Fragmented Archive: A Missing Data Case Study From Provenance Research” 2018 [online]: <https://dh2018.adho.org/en/modeling-the-fragmented-archive-a-missing-data-case-study-from-provenance-research/> (Page accessed on 15 May 2020); Matthew Lincoln, “Predicting the Past: Digital Art History, Modeling, and Machine Learning,” in *The Iris: Behind the Scenes at the Getty Blog* July 27, 2017 [online]: <http://blogs.getty.edu/iris/predicting-the-past-digital-art-history-modeling-and-machine-learning/> [accessed 05-15-2020].
- 75 Machine Learning has also been used to confront the valuation of art based on experts’ prediction and actual prices fetched at auction. See Mathieu Aubry, Roman Kräussli, Gustavo Manso, and Christophe Spaenjers, “Machine Learning, Human Experts, and the Valuation of Real Assets,” HEC Paris Research Paper No. FIN-2019-1332 10th Miami Behavioral Finance Conference, 2019.
- 76 Throsby, “Production and Consumption of Arts,” 26.
- 77 Etro and Stepanova. “The Market for Paintings in Paris,” 34.
- 78 Etro and Stepanova, “The Market for Paintings in Paris between Rococo and Romanticism,” 28-50; idem, “Art Auction and Art Investment in the Golden Age of British Painting,” 191–225; idem, “Art collections

and Taste in the Spanish Siglo de Oro," *Journal of Cultural Economics* 41 (2017): 309–55; idem, "Entry of painters in the Amsterdam Market of the Golden Age," *Journal of Evolutionary Economy* 26 (2016): 317–48.

- 79 Further references provide interesting perspectives on issues related to the arts by using advanced statistical methods. See for example Diana Seave Greenwald, "The Demand for Peasants: A Statistical Analysis of Rural Imagery at the Paris Salon," in *Paintings for the Salon/Peindre pour le Salon, 1791-1881*, ed. James Kearns and Alister Mills (Berne: Peter Lang, 2015), 341–54; idem, "Colleague Collectors: A Statistical Analysis of Artists' Collecting Network in Nineteenth-Century New York", *Nineteenth-Century Art Worldwide*, 17, no. 1 (2018); idem, "Modernization and Rural Imagery at the Paris Salon: An Interdisciplinary Approach to the Economic History of Art," *The Economic History Review* 72, no. 2 (2019): 531–67; Léa Saint-Raymond, "Revisiting Harrison and Cynthia White's Academic vs. Dealer-Critic System," *Arts*, 8, no. 96 (2019). Other papers venture into sources seldom analyzed by economists or art historians. Pommerehne and Feld examine the extent to which purchasing policies defined by museums affect price trends in the art market by taking into account the location and status of the museums. Although relatively outdated, especially in regard to the increasing loss of the museum's competitiveness in the contemporary art market, this research had the merit of connecting art market analysis with museums practices, whose first mission is to purchase works of art for collection enhancement. It also contributed to showing empirically that museums, despite their education and conservation missions, are actual art market stakeholders. See Werner Pommerehne and Luc Feld, "The Impact of Museum Purchase on the Auction Prices of Paintings" *Journal of Cultural Economics* 21, no. 3 (1997): 249–71.
- 80 Kathryn Graddy, "Taste Endures! The Ranking of Roger de Piles (†1709) and Three Centuries of Art Prices," *Journal of Economic History* 73, no. 3 (2013): 766–91.
- 81 David Ormrod, "Art and its markets," *Economic History Review* 52, no. 3 (1999): 550.
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