

Market Evolution, Bidding Strategies, and Survival of Art Dealers*

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Abstract

This paper analyzes the acquisition strategies of London-based fine-art dealers during their industry evolution period between 1800 and 1913. While art dealers captured a market share of on average 17% between 1800 and 1850 as buyers at auction, the number increased to 56% in the period from 1850 until 1913. As the first study to use the identity of buyers in art auctions, we analyze the bidding strategies and long-term survival of art dealers in the market. Using London-based auction house transactions, we examine whether accumulated experience of an art dealer can explain differences in the acquisition or bidding strategies. We show that more experienced dealers pay up to 23% more for an artwork of the same quality than less experienced dealers. This price difference can be attributed to the informational advantage of the experienced bidders. Additionally, our results indicate that less experienced dealers are less likely to survive in the market. Our evidence supports the conjecture that common value auctions with information asymmetries offer benefits to bidders with better information.

KEYWORDS: Auctions, Bidding, Art Dealers, Market Evolution, Common Value

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*All errors pertain to the authors.

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1 Introduction

Art sales are booming all over the world. Wealthy investors are spending record sums on fine art. Almost monthly a new price record is reached. In May 2015, Picassos' *Women of Algiers, Version O* (1955), was sold for over \$179million at the auction house Christie's. As of May 2016, this was the highest price ever paid for an artwork sold at auction. Despite ambiguity on the magnitude of returns and dynamics that rule over price formation and development, the popularity of art as a financial asset is increasing. This was again highlighted by the recent disclosure of the Panama Papers whose records have revealed possessions of significant amounts of artworks held by prominent owners. Throughout the course of the commoditization of art, market efficiency and transparency have increased. Nevertheless, due to the heterogeneous nature of art as a good, significant information asymmetries still exist concerning its true quality its true quality. Every artwork is unique and it's quality cannot only be derived from the technical skill of the artist or the material and time used in the production process (Karpik and Scott, 2010). The value of art is socially constructed and depends on the institutions within this field (Bourdieu, 1979).

The art market as we know it today has its roots in the 19th century Britain. The period between the 19th and the 20th century is characterized by an unprecedented growth of the art market. The evolution of the modern art market was facilitated by the institutionalization of auction houses and professional dealers in the UK (Bayer, 2015). The prevailing market dynamics during these times have produced trade mechanisms and professional market practices which are still dominating the trade today. These emerging dynamics formed competitive behavior of art dealers, created determinants of market success and eventually led to the evolution of the modern art trade.

In this paper, we investigate industry evolution of dealers during the first 100 years of the development of the modern art market. First, we analyze the growth of the modern-day art dealers since their uprising in the 19th century. Next we analyze the effect of experience on acquisition strategies of art dealers within the context of English fine art auctions. In particular, we are interested whether dealers with more experience display different buying patterns than less experienced dealers. We distinguish between strong and weak dealers based on their market shares and analyze their effect on the hammer price beyond what is predicted by transaction characteristics. Our expectation is that more experienced dealers will on average acquire artworks at higher prices than less experienced dealers

as they can extract higher rents from the future resale of the artworks. This difference stems from the the dealer's superior ability to promote artists in the market which gives him an informational advantage over less experienced dealers. We further investigate whether experience impacts survival in the market. We expect that less experienced dealers are more likely to be driven out of the market than more experienced dealers as the former fail to generate sufficient profits.

In markets, where information asymmetries prevail, signals play an important role to alleviate these (Akerlof, 1970). Credible signals are costly to imitate and can take several forms. Prices in the art market, for instance, have information content and provide a signal about the future viability of an artist (Velthuis, 2003, 2013). Auction price records for artists however, are the only public source for past price information as over half of the market consists of private trades where prices are purposely not disclosed. Novice buyers can also infer signals about the quality of an artwork from the prestige and quantity of the venues where the artist is exhibited, instances when prominent collectors are in possession of the artist's work as well as media resonance. Among one of the most important signals can be provided by the reputation of the dealer who represents the artist. Art dealers are the brokers of the art market and coordinate demand and supply as intermediaries. A good dealer is able to remove uncertainty from the buying decision of a client by certifying the value of an artwork. This is usually materialized in a future price appreciation. Art collectors are therefore willing to pay a premium for this uncertainty alleviation. Highly prominent art dealers such as Larry Gagosian, who by now runs a chain of galleries, exerts great influence on buyer preferences and can therefore have decisive power over the success of an artist. The attainment of a certain level of reputation which enables the dealer to effectively promote an artists, requires time and is conditioned on the expertise and network of the dealer. Characterized by opaqueness, the art market therefore offers advantages to buyers with superior information.

While a lot of research has been conducted on the determinants and evolution of art prices in auctions (Anderson, 1974; Ashenfelter and Graddy, 2003; Frey and Pommerehne, 1989; Grampp, 1989), little empirical research has been done on the strategies of dealers in the art market and the industry dynamics that govern entry, exit and growth. As buyer identities usually remain undisclosed, research in this field has been rather limited to qualitative socio-economic studies (Arora and Vermeulen, 2013; Bayer, 2015; Montias, 1988; Stourton and Sebag-Montefiore, 2012; Velthuis, 2003). The source of market success and the effect of art dealers on prices therefore still remain a puzzle.

While there is empirical evidence from other markets demonstrating how information asymmetries determine bidding behavior and eventually profits in auctions (as provided by Hendricks and Porter (1988) for the case of oil auction), comparable evidence is so far lacking for the art market. Up until now, the bidding strategies of art dealers and how they influence their market survival, have not been researched. This study is therefore motivated by the lack of empirical evidence in this field.

Our unique data set provides a snapshot of the first 100 years of the modern art market and the competitive landscape of buyers. The sample includes the seller and buyer identities and consists of 16,582 transaction records from London-based fine art auctions where the buyer was identified as a professional art dealer. The data further provides information on several idiosyncratic characteristics of sales transaction. As a first step, we analyze the drivers which have led to the emergence of the modern-day industry of art dealers. Secondly, we investigate bidding dynamics of different dealers. We determine the incremental effect of more experienced (strong) and less experienced (weak) dealers on price given the quality of the artwork. Finally, we examine exit patterns to infer which bidding strategy provides a greater chance for market survival.

The findings of the study show that the increase in the number of art dealers in the market coincides primarily with the intensity of trading activity. The results further provide clear evidence that more experienced dealers pay on average 23% more for an artwork of the same quality than less experienced dealers. This holds for the whole distribution of prices and is especially pronounced in the upper part of the distribution. Our results indicate that less experienced dealers are able to compete with more experienced dealers in lower price segments. We further find that less experienced art dealers are about 8% more likely to exit the market than experienced dealers. This supports the conjuncture that more experienced art dealers benefit from information asymmetries which prevail in the market and enable them to extract higher rents on future resales.

As far as we are aware, this study provides the first empirical evidence on the evolution of modern-day art dealers and their acquisition strategies in auctions. We shed light on the importance of expertise and reputation in markets where large information asymmetries prevail. The findings have practical applications for bidding strategies in art auctions. Participants, for instance, can benefit if they take into account the composition of bidders at auction and adjust their bidding strategy based on their relative level of market experience and reputation. This could help alleviate the winner's

curse and prevent irrational price records caused by bidding wars which can be detrimental to artists and buyers. Further, economists are interested in the factors that induce firm entry, stimulate growth and lead to success in various markets. The results therefore have general implications for research on evolution dynamics in markets characterized by opaqueness. The emergence of online commerce, for instance, facilitates the accumulation and distribution of information among buyers and can thereby potentially lower information asymmetries. For future research, it would therefore be of interest to study how the alleviation of information asymmetries transforms market evolution and competitive strategies.

The paper is organized as follows. In section 2 we provide a background on the the role of art dealers and the drivers that led to the evolution of the modern dealer trade. Our conceptual framework is presented in section 3 and explains how we relate the level of experience to different bidding strategies. Section 4 is dedicated to the empirical analysis and presents our sample, methodology and findings. We finish with some concluding remarks and implications for the art market as well as other fields in section 5.

2 Institutional Background

2.1 The Evolution of the Art Market

By 1700 London became the wealthiest and largest city in Europe, after the economic decline of the Netherlands. Aristocrats built large mansions and used art as decoration which was directly commissioned from artists. These artworks rarely circulated to other buyers and tended to remain in family estates. Therefore, the supply of artworks for trade was very low during the 17th century. When aristocrats fell into financial distress around the mid 19th century, posthumous estates increased the availability of artworks in the market and constituted the main source of supply at auctions. The establishment of the auction house Christie's in 1766 which became the largest auctioneer of fine arts, revolutionized the art trade. Christie's had a monopoly position among auction houses as it managed to built up an exceptional reputation in the art world. The founder, James Christie, cooperated with dealers and offered financial (lending) services to sellers. As a result, many important collections consisting of both Old Masters and contemporary art were disposed through the auction house and it was the primary source of supply for dealers. The auction house hence became an irreplaceable

institution in the art market as a supplier of artworks which also led to an increase in liquidity in the art market (Stourton and Sebag-Montefiore, 2012).

The economic prosperity of Great Britain which has elevated a larger share of the population into social upper classes, the establishment of auction houses as well as large demand for local artists has fueled the evolution of the art market in the 19th century. Due to the popularity of British contemporary artists, which was mainly facilitated by dealers, supply of artworks grew exponentially. Artist, such as William Hunt, William Frith or Benjamin West became mass producers of art. To increase market competitiveness, most artists were specialized in a certain signature subject or style (e.g. Hunt's Bird Nest). To reach a larger target audience, artists started to produce along different levels of quality. While copies or prints were affordable for a larger mass, so called *sensation paintings* were in a price range that could only be paid by the wealthiest part of the population. Similar to what can be observed in today's art world, art started to become a commodity and was created to please the consumer. As a result, the total amount of buyers at auction increased which further contributed to the liquidity and efficiency in the market.

We use data collected from the Albert & Victoria Museum in London which provides a good snapshot of the competitive landscape of professional art dealers as well as other buyers in the UK between the 19th and 20th century. It shows that the number of buyers tripled from 1850 to 1913 (figure 1(a)). While in the 1850s there were about 50 non-commercial buyers per year, the number increased to over 150 by the end of the century.¹ Even though dealers represented a smaller buyer group in absolute terms, they grew faster from less than 10 dealers per year in 1850 to almost 50 in the beginning of the 20th century. Taking a closer look at the difference in the number of dealers who enter and exit the market (figure 1(b)), the net change, we can see that despite large fluctuations in the amount of dealers entering the market every year, on average more dealers enter than exit the market. During times of decline, the amount of dealers reduced on average by three dealers. In periods of growth there was a net increase of four to five dealers in a given year. As a result and as already indicated in figure 1(a), the dealer industry expanded over time. When investigating the acquisition activity of the different buyer groups, the emerging dominance of dealers as the main buyers at auction becomes evident. While figure 1(c) shows the market share captured by dealers versus other buyers by the number of acquired paintings, figure 1(d) depicts the market share of

¹The group of non-commercial buyers includes aristocrats, the bourgeoisie, artists and civil servants

both groups by the value of their acquisitions. Before 1850, art dealers captured an average market share of 17% by number of acquisitions while non-commercial buyers bought up to 80% of the whole supply at auction. The difference becomes smaller and the lines of the two buyer groups eventually intersect close to 1880. Between 1850 and 1913, art dealers reach an average market share of 57% and between 1880 and 1913 it increases to almost 60%. The gap between dealers and other buyers widens even further in the beginning of the 20th century when dealers buy above 60% of all items sold at auction. In terms of value of the artworks, it amounts to a proportion of almost 70% or a sum of on average £140,000 per year. Expressed in numbers, this means that in peak years about 50 dealers bought up to 600 artworks valued at £150,000. Other buyers added up to a number of 150 distinct acquirers in peak years who bought up to 380 artworks for a maximum total amount of £100,000. This graphical analysis illustrates that even though art dealers were a smaller group compared to other buyers, they grew faster and clearly dominated the market acquiring over half of the whole supply sold at auction after 1880.

[Figure 1: Evolution of the Art Market]

We are also interested in what is driving this increase in the number of art dealers. We therefore we estimate a count model to examine the effect of market factors and volume of art sales on the number of dealers in the market. Our dependent variable, the number of art dealers, is a count variable, for which we assume a Poisson distribution. As the variable exhibits overdispersion (the variance is greater than the mean), the standard Poisson assumption of mean-variance equality of the dependent variable, conditional on independent variables is violated. Hence, a standard Poisson model would produce inconsistent estimators. We therefore employ a Poisson quasi-maximum likelihood (QML) estimation technique which is particularly efficient and robust (Wooldridge, 1999). For QML estimation, the data does not have to follow a Poisson distribution to produce consistent estimates. The only condition required for consistency is the correct specification of the conditional mean of the independent variable. It is moreover consistent for fixed effects (Silva and Tenreyro, 2010).

The variables we use to explain the number of dealers in the market, is the number and value of artworks sold in a given year, the mean price of an artwork as well as the level of the population

and the real income per capita.² ³ We furthermore add the past year's net change of new entrants with the expectation that with the entry of new players, the number of dealers in the market should increase. The results are presented in table 1 and show that the increase in the number of dealers is mainly driven by the increase in the number and value of the artworks sold at auctions to dealers. The coefficient is always positive and highly significant. Neither of the two national market variables seem to be an important factor in explaining the number of dealers in the market. The coefficients are insignificant in all three specifications. We can infer that the concentration in the market coincides with higher trading activity of art dealers. To investigate what drives market entry of new dealers, we run a second set of regressions using QML estimation with the number of entries in a given year as the dependent variable. New entrants are defined as dealers who are completely new in the market or did not participate in the market for at least three years. The explanatory variables remain the same as in previous specification for the number of art dealers. We use the number of incumbents in the market as an additional independent variable to see whether these inhibit new players from entry. The results are shown in table 2. Again, we see that new entrants are attracted to join the market in times of increased acquisition activity by dealers. Market factors remain statistically insignificant in explaining number of entries. As suggested, new entry is discouraged the higher the number of incumbents in the market. The coefficients on this variable are negative and highly significant in all three specifications.

Overall, we can infer from these results that high market activity attracts a larger number of dealers, while market entry of new players decreases when more established players are already in the market. This finding hints at the competitive dynamics of the dealer industry. New, inexperienced dealers might already anticipate that they cannot compete against more experienced dealers and decided to rather stay out of the market.

[Table 1: Regression Results - Drivers for Market Concentration]

[Table 2: Regression Results - Drivers for New Market Entry]

To summarize, the art market as we know it today emerged in the 18th century and has entered a growth stage in the 19th century where professional art dealers have taken over stage and became

²It is known to the dealers ex-ante how many artworks are sold in the market. Hence, they can incorporate this information when making the decision whether to participate in the market or not.

³The data on the GDP and population was not part of the original data set and was extracted from the Bank of England and the UK Office for National Statistics.

the dominant buyers in auctions. Having provided an overview of the British 18th and 19th century art market of the 19th century, we will now take a deeper look into the world of art dealers.

2.2 The History of Art Dealers

The professional art trader emerged in the late 17th century and matured during the 19th century to what is known as an *art dealer* today. The dealer is part of the socio-economic, institutional network in the art world and is responsible for the establishment of the value of art (Bourdieu, 1979). When the supply of artworks was still scarce in the 17th and 18th century, dealers had to travel to Continental Europe to acquire paintings (the Grand Tour) which they would sell on through auctions or to a network of private buyers (Bayer, 2015). Due to the relatively high financial and operational risk, dealers initially acted as agents and mainly bought on behalf of their clients. When supply of artworks increased through liquidations of aristocrats, the conflicts in Continental Europe as well the rise of local artists, business risk decreased.⁴ As a result, art dealers started to become more daring by buying artworks for their own stock which was sold on their own premises. A mature financial infrastructure in London greatly supported this development. The growing reputation and influence of certain art dealers, granted them taste making abilities and a faster turn over of inventory. It led the dealer-controlled and consumer-oriented London art trade to become the most important art market internationally at the time until the start of the first world war (Stourton and Sebag-Montefiore, 2012).

Art dealers catered to both the middle and upper classes of society. While the high end art market in the 18th and 19th century was dominated by a hand full of art dealers, the mid and lower end was characterized by fragmentation and it was difficult to make a distinction between collectors, artists, art dealers and scholars. Art was often seen as a speculative venture and no degree or professional society certificate was needed, lowering the barriers to entry. It was lucrative, even for the rich, to sell parts of their valuable collections (Stourton and Sebag-Montefiore, 2012, p.14). Building a reputation as a trustworthy dealer who resolved uncertainty about the quality of art was however crucial as collectors often relied on the dealer's judgment about the future potential of an emerging artist. With respect to Old Masters, the dealer's reputation played an important role in certifying the authenticity of an artwork as most of these paintings appeared for the first time on the market

⁴Conflicts in Continental Europe during that time included among others the French Revolutionary Wars (1792-1802) and the Napoleonic Wars (1803-1815).

(Arora and Vermeyleylen, 2013). In building a reputation, the dealer's network to artists, collectors, auction houses, the media and other dealers played a decisive role. The network provided the dealer with privileged information about the quality of the artworks, sources of supply, access to wealthy clients as well as good publicity. In the 19th century, art dealers eventually took over the role of art academies in dictating what constituted good art and greatly influenced buyer preferences. They further took over the role of patronage from the aristocracy and started to support emerging artists. As a consequence, art dealers also had a say in the productive process of artists advising them on popular themes which would lead to commercial success. By boosting the artist's popularity, they simultaneously also improved their own reputation in the market. In general, one could categorize art dealers in the 19th century as middlemen, gatekeepers of quality and taste makers who were largely responsible for the cross-border proliferation of the London art market.

Despite being associated with certain movements or styles, most dealers were not highly specialized. They employed risk mitigation techniques such as the trading of portfolios of Old Masters and contemporary artists which helped them to introduce new emerging artists to the market. Often alliances were built between the dealers whereby artworks which could not be sold by one dealer were sold on to another dealer who would then try to sell it to his clients. Especially for new artists, there is also anecdotal evidence of price manipulation where dealers intentionally bid up prices during the auction. As auctions were and still are the only platform where art prices are public, they enable the dealer to send a positive signal to the market about the value of an artist which would allow him to charge higher prices. Such practices are however difficult to prove (Bayer, 2015).

The vast majority of the major art dealers were family businesses with a background as artists, print- and frame makers or passionate collectors. The most important and successful art dealers of that time emerged in the early 19th century. Despite some changes in ownership, they remained in business over generations. Agnew & Sons was the most influential art dealer and also the biggest buyer in our data set. Their gallery opened in 1860 on Mayfair in London and was already operating as a print publisher since 1817 in Manchester. In 2013, the gallery was taken over in the sixth generation by Lord Anthony Crichton-Stuart, a former head of Christie's Old Master paintings department (Agnew's Gallery, 2014). The second biggest player in our data, Paul Colnaghi, is still active as a dealer in the market for Old Masters. Located on Mayfair, it is now the oldest gallery in the world. The dealership of the Vokins family, who constitutes the third largest dealer in the data

set, became active in the end of the 18th century and remained in the market until the beginning of the 20th century. It was originally a carving, gilding and frame-making business and enjoyed a very high reputation. Figure 2 shows the market shares for the top three dealers (Agnew, Colnaghi and Vokins) by the number of acquisitions over the whole sample period within the population of professional art dealers. Agnew clearly dominates the market with a share between 30% and 60% over the whole period after 1860 and an overall average market share of 40%. The dealer lost market shares in times when art market sales increased and a large number of new players entered the market. Agnew is followed by Colnaghi and Vokins who had both an average market share of about 9% during the whole sample period. Consequently, the top three players in the market consistently captured a market share between 40% and 70% among all dealers. When looking at the full market of buyers (figure 3), the market shares of the top three dealers dilute but remain nevertheless sufficiently high to claim large market power. While Agnew still captures a market share between 10% and 40%, with an average share of 20%, Colnaghi and Vokins each overall maintain a market share of 5%. In terms of value, the leap of Agnew over the other dealers becomes even more evident. From a total market value of about £4.8 million, £2 million can be attributed to Agnew, which amounts to a share of 43% . Each of the next ten largest players by market value reach only a tenth of this amount. This observation highlights how persistent the market positions of the top players were and how difficult it was to challenge these as an entrant.

[Figure 2: Market Shares Dealer Market]

[Figure 3: Market Shares Whole Market]

In this section we have shown how rapidly the dealer industry evolved. By the end of the 19th century, art dealers became the dominant force in the art market and responsible for its overall development. It further became clear that the dealer industry was very fragmented. It consisted of a hand full of dealers who dominated the market and captured a large part of market share in addition to a larger mass of dealers who were less influential with a significantly lower market share. Hence, there seem to be strong differences between art dealers and the factors which determine success and survival in the market. In the next section, we present our conceptual framework which sets out our expectations with respect to how these differences reflect on a dealer's acquisition strategy in auctions and their likelihood to remain in the market.

3 Conceptual Framework

As described in the section above, art dealers are professional traders who acquire art on stock with the goal to resell it at a future point in time for a profit. It is fair to assume that a dealer does not derive any personal utility from holding the artwork but acquires it merely for its investment value. Hence, we assume that the expected future resale price of the artwork is estimated at the time of the purchase. Under perfect information, the expected resale price will be the same for all bidders. Therefore, we consider artworks as common value goods. In common value auctions, all bidders have estimates regarding the value of objects and their value estimates are correlated. However, the signals the bidders receive about the value of the artwork differ based on the level of previous market experience. In their seminal paper, Milgrom and Weber (1982) show that bidders with more precise information can extract positive rents. They further stress that privacy of the information is more crucial than its accuracy.

In art auctions, public information is available through the auction catalogue, while private information varies considerably across dealers. This private information is a function of their experience in the market. As argued in the section above, it is accumulated by extending their expertise and network to other important actors in the art market which lowers the costs of information gathering. For instance, close ties to important collectors who exert influence on other buyers, give art dealers information on future trends in the market. Good relationships with artists, help dealers influence themes or subjects of future projects. Reputation creates trust which makes the client acquisitions process easier and enables the dealer to extract rents from buyers and sellers through higher commissions. Additionally, contacts to selected curators give dealers a higher chance to exhibit the artist's work and thereby exposing them to larger audiences. All of these factors increase a dealer's market power and facilitate pushing and promoting an artist in the market more effectively. Thus, enabling them to extract more revenues from selling artworks and therefore bidding higher prices at auction than less experienced dealers. As a result, dealers who possess additional information are more accurate in predicting the future value of an artwork compared to dealers who lack this information. This is our conjecture, which we test empirically.

Auctions for oil tracts represent another prominent example of a common value good. Bidders in these auctions have uncertainty about the amount of oil in the tract, its quality, the ease of

recovery and/ or the future market price. Hendricks and Porter (1988) find in their empirical study on drainage lease auctions that bidders with an informational advantage won most of the profitable drainage tracts, while uninformed bidders earned about zero profits on the tracts they won. In particular, uninformed bidders earned positive profits when informed bidders participated and negative profits when no informed bidders were present in the auction. The participation of informed bidders therefore predicted the profitability of a tract. In their analysis, informed buyers who are defined as bidders who already owned a neighboring tract and could thus infer private information about the auctioned tract from it. The study was based on a first-price sealed bid auction scenario. Our study follows a similar path for English auctions for fine art. We analyze winning bids from more and less experienced bidders and determine each group's likelihood to survive in the market. Similar to Hendricks and Porter (1988), we hereby aim to provide evidence for the conjuncture of Milgrom and Weber (1982) who show that bidders with more private information can extract higher rents and should therefore survive in the market.

In this study, we distinguish between strong and weak dealers based on the accumulated market shares in the year preceding a transaction. We define weak dealers as professional art traders who are below the top 10% in terms of their market share, while strong dealers are composed of art traders who are above this threshold.⁵ The number in addition to the value of completed transactions is used to calculate market shares. Note that the latter value can easily be driven up by dealers who are rather inactive and unknown to the market but have bought some very expensive artworks. We use both of these measures to identify weak and strong bidders. While there are in total 6,973 transactions completed by strong dealers (6,501 when market share is calculated in terms of value of transactions), there are 9,708 transactions completed by weak bidders (10,071 when market share is calculated in terms of value of transactions). The number of strong and weak dealers in the market changes from year to year. The amount of strong dealers ranges from 1 to 7 per year with an average of 3 strong dealers per year. Weak dealers are larger in number and range from 15 to 59 weak dealers per year.

We expect that art dealers who have a large capacity and/ or experience, which we call strong bidders, to have an informational advantage over their peers who have less experience, which we

⁵A threshold of 10% best identifies the leading dealers at the time based on historical records. Our results, however, are also robust market share thresholds of 5% and 1%.

call weak bidders. This should result in more aggressive bidding by strong dealers. Uninformed art dealers do not have the same capacity or capability to promote artists and extract higher rents, and cannot afford to compete with strong dealers in the auction. As a result, the distribution functions of the winning bids should differ between weak and the strong bidders. On average we should observe higher prices to be paid by strong dealers. This should especially be the case for artworks in the higher price segment due to the limited funds and ability of weak dealers to extract sufficiently high rents from their acquisitions. Weak dealers might however be able to compete in bidding contests for lower priced artworks. As a result, the difference in prices paid by weak and strong dealers should not differ as much as in the lower as it does in the upper price distribution. The summary statistics in tables 3 and 4 show the level of prices and number of acquisitions for different quantiles of the price distribution. While table 3 presents summary statistics for strong and weak dealers defined by number of acquisitions, table 4 shows summary statistics for both groups when market shares are calculated in terms of values. We observe that the price distribution of strong dealers stochastically dominates the price distribution of weak dealers. This means that over the full distribution of prices, strong dealers pay on average more than weak dealers do. Additionally, the difference in price level paid between the two dealer groups becomes larger, the higher the price segment. The amounts of artworks purchased by both groups are equally distributed in every quantile. This implies that, for instance, strong dealers proportionally do not buy more artworks in higher price segments than weak dealers do. The pattern is the same when we consider the dealers market shares in terms of value (table 4).

[Table 3: Summary Statistics for Weak and Strong Dealers (by number of acquisitions)]

[Table 4: Summary Statistics for Weak and Strong Dealers (by value of acquisitions)]

Figures 4 and 5 present the corresponding unconditional densities for different distributions of the logarithmic function of the price (at constant 1850 £) for strong and weak dealers defined by the number of acquisitions and by the value of acquisitions over the sample period from 1850-1913. We can see that the cumulative distribution function of strong dealers is shifted to the right. This depiction confirms our findings in tables 3 and 4, namely that the distribution of winning bids of strong dealers stochastically dominates the distribution of weak bidders. Again, the difference between the curves when market share is specified in terms of number of acquisitions (figure 4)

versus in terms of the value of acquisitions (figure 5), is marginal. Both graphs outline the same pattern, namely that strong dealers appear to pay on average more for artworks than weak dealers do.

[Figure 4: PDF Strong and Weak Dealers (by number of acquisitions)]

[Figure 5: PDF Strong and Weak Dealers (by value of acquisitions)]

Another way to categorize bidders with experience is by looking at entrants and incumbents in these auctions. Following De Silva et al. (2003), we define entrants as bidders submitting a bid for the first time. Re-entrants are bidders who exited the market and are considered as entrants with experience. Entry status is not permanent and all dealers are considered incumbents after the initial year entry or re-entry. We allow for a break of three years, before we define dealer inactivity as an exit to allow for the possibility that the data set does not capture the dealer's market activity as he might replenish his supply either through private acquisitions or in other auction houses. If a dealer has not completed a transaction for three consecutive years before the end of the period (1913), it is categorized as an exit. In the case of an exit, we cannot exclude the possibility that the dealer is still active as an art dealer in a different market or auction house. Nevertheless, as the British auction market constituted the most important art market during that time, we interpret an exit as a negative sign of market success. While most of the dealers entered after 1850, many dealers exited and reentered the market several times.

We expect that incumbents have more time to accumulate market experience and should therefore have an informational advantage over both re-entrants and entrants. The summary statistics for incumbents, entrants and re-entrants in table 5 show slightly different results than those observed in the comparison of strong and weak bidders. While in the lower price distribution (10th and 25th quantile) incumbents pay on average two to three times as much as entrants or re-entrants do, the differences become smaller in the middle of the price distribution (50th and 75th quantile). Here incumbents pay only 10% to 15% more than re-entrants and entrants. Surprisingly, entrants pay in these quantiles more than re-entrants do. This might indicate that while entrants who already have some market experience refrain from competing against incumbents, completely novice bidders are bolder and try to challenge the position of incumbents. The gaps between incumbents and other newer dealers becomes again larger for higher price segments (90th quantile) where the former group

seems to pay on average up to 20% more. This value should be interpreted with caution though as the number of observation is rather small in this quantile. From this we can infer that entrants and re-entrants try to compete with incumbents in the mid price segment but forgo bidding against them in the low and high range of the price distribution. As in the comparison between strong and weak dealers, the number of artworks acquired in every quantile is equally distributed for each of the three groups. Figure 6 depicts the probability density function for the winning bids of incumbents, entrants and re-entrants. We see similar results to those that were observed in figures 4 and 5. The incumbents' winning bids distribution is shifted to right, showing that they pay higher prices compared to entrants or re-entrants. As expected, re-entrants show a price distribution which lies in between the curve of the incumbents and the entrants. The results emphasizes the role of experience in the acquisition of higher priced artworks. It further implies that while less experienced dealers are not able to compete in the high price segment of the market, they rather employ their funds to acquire mid-priced artworks.

[Table 5: Summary Statistics for Incumbents, Entrants and Re-entrants]

[Figure 6: PDF Incumbents, Entrants and Re-entrants]

The graphical depiction of the distributions of winnings bids above reveals that strong bidders tend to pay higher prices for their acquisitions than weak bidders. However, it might also be the case that strong dealers do not have an informational advantage and suffer from the winner's curse by constantly overbidding. If this conjuncture is true, we should observe that strong bidders are more likely to exit the market than weak bidders who bid less aggressively. If, however, weak dealers are more likely to exit the market we can infer that the information set of strong bidders is better due to more experience. This enables them to extract higher rents while weak dealers fail to make sufficient profits to remain in business.

4 Empirical Analysis

4.1 Sample

Our data sample are collected from the Victoria & Albert Museum Library in London. The unique feature of this data set is the availability of the identities of the original sellers and buyers in the

auctions sales. Overall, the data set includes 37,735 sales transactions for fine artworks in London-based auction houses in the time period between 1756 and 1913. Historical records indicate that the data set is a representative sample of auction sales over this time period (Bayer, 2015). The data provides information on the name of the artist and his living status, the name of the artwork and year of origin, the medium used as well as the school or movement the artwork can be attributed to. Furthermore, transaction data is available such as the name of the auction house where the sale took place, whether the transaction was part of collection sale, the date of sale and lastly the nominal sales price in Pounds, Shillings and Dimes. All prices are converted into British Pounds. For the analysis, we consolidate acquisitions per dealer on a yearly basis. Price estimates which were formed by the auction houses were not published in auction catalogs before 1973 and are therefore not available in the data at hand. Further, an index based on the hedonics of the artwork (i.e. the aforementioned attributes of the sale) is created in order to deflate sales prices with 1850 as the base year.⁶ In creating the hedonic index, we follow the methodology of Anderson (1974); Chanel (1995); Frey and Pommerehne (1989) where the logarithm of the price is regressed on the set of the idiosyncratic characteristics of the artwork in addition to time (year) dummies.⁷

All transactions are based on the English auction in which the buyer with the highest bid receives the item. Only the final hammer prices but not the individual bid values are observed. This implies that for every auction the winner and the final bid are known. As we are interested in the behavior of professional art buyers, our selected sample consist of 16,581 transactions where an art dealer is identified as the buyer. This results in 130 distinct buyers who account for 43 percent of all transactions. All dealer names with their numbers and values of acquisitions are listed in table A1 of the appendix. Buy-ins are excluded from the analysis.⁸ Note, that in order to obtain the true position of the dealers in the market, all measures of market share in our analysis were constructed using the full sample of buyers. We further limit the time period of the analysis to the period between

⁶The values of the index are the exponents of the time dummy coefficients which are then indexed to a selected base year (in our case 1850) which is set equal to 1. A hedonic index is particularly useful for the data at hand as, in contrast to the repeat sales index, it makes efficient use of the data. While for the repeat sales index at least two transactions of each artwork are needed, every transaction can be used in the hedonic index. It should be noted that hedonic indexes for art auctions are prone to a selection bias as not every artwork has the same chance to be traded at auction. Artworks of lower quality or those that have declined in value are less likely to be offered for sale. Similarly, very high-end works (such as Old Masters) are also less likely to be put up for auction as these are often in hands of museums.

⁷the hedonic index can be provided upon request.

⁸In auctions a buy-in takes place when an artwork was not sold (e.g. the reserve price of the seller was not reached) and has been returned to the owner

1850 and 1913. The rationale behind this choice is that, according to historical records, this was the time when the auction market in the UK has reached a high level of maturity with a stable supply of Old Masters as well rising interest in contemporary art. More importantly and already mentioned in section 2, at that time art dealers started to act as principals buying for their own stock instead of acting as agents on behalf of major wealthy buyers which might affect acquisition strategies in a different way. The time period between 1800 and 1850 is however used to build up a history of initial market shares and to create a snapshot of the current competitive landscape of art dealers.

4.2 Bidding Behavior

Based on our conceptual framework, we expect experienced bidders to bid more aggressively. We examine whether bidding behavior differs between less and more experienced bidders. In particular, we want to see whether more experienced dealers bid more aggressively than less experienced dealers given the idiosyncratic characteristics of the painting.

As described in section 3, the buyer is expected to exert an influence on the price depending on his value estimate of the artwork which will in turn determine his reserve price and bidding strategy at auction. According to our conceptual framework, strong dealers should have a higher value distribution than weak dealers due to their superior capability to promote artists in the market. As a result, strong dealers should bid more aggressively than weak dealers which should be reflected in a positive effect of strong dealers on price. To estimate the influence of the dealer on price, we regress the price of an artwork on the weak dealer dummy, the variable that identifies an experienced and inexperienced dealer, in addition to the idiosyncratic characteristics of the transaction in a hedonic regression model. The rationale behind a hedonic regression model is that if two goods differ only in a single attribute, then the good with a more desirable attribute should command a higher price and vice versa. Therefore the goal of such a model is to determine estimates for each characteristic. It assumes that if it was possible to correctly estimate the price of every characteristic, their sum should equal the final sales price of the artwork. (Ashenfelter and Graddy, 2003). Next to the characteristics of the artwork, we control for the liquidity of the dealer. The variable capacity is defined as the dealer's maximum amount ever spent in a year before the current acquisition. We expect that a higher availability of funds will enable the dealer to afford more artworks at higher prices. Further, to have a proxy for the dealer's experience apart from his market power, the number

of years of experience in the market up to the current transaction are added as a control variable. Due to the high correlation between the three explanatory variables (the weak dealer dummy, the capacity variable and the experience variable), they are not included simultaneously in the regressions. The size of an artwork significantly contributes to its price as well but has a large amount of missing values in our sample. To avoid loss of statistical power due to a reduced sample size but at the same time remain conservative, we estimate every regression including as well as excluding the artwork size. The regression model has the following specification:

$$\ln P_{it} = \alpha_i + \tau_t + \beta \text{WeakDealer}_{it} + \gamma \ln \text{Capacity}_{it} + \delta \ln \text{Experience}_{it} + \theta X_{it} + \epsilon_{it}, \quad (1)$$

where $\ln P$ indicates the logarithmic transformation of the real price of an artwork, i , in a given year t . α_i represents the dealer fixed-effects and τ_t the time fixed-effects. θ denotes the value of the coefficients of the hedonic characteristics in X . Lastly, ϵ_{it} is the error term of an artwork.

In table 6 we present the first set of regressions. Columns 1 and 2 show the effect of a weak dealer on price when market shares are calculated based on the number of acquisitions, while columns 3 and 4 depict the results when market shares are based on the value of acquisitions. In all four regressions the weak dealer dummy coefficient is negative and statistically significant. The interpretation of this result is that when the buyer is a weak dealer, the expected estimated price is approximately 23% lower than if the buyer was a strong dealer. The magnitude of the coefficient is approximately the same when we use the value instead of the number of acquisitions to calculate the market share. In column 5 and 6 we use capacity as the main independent variable. The coefficient on capacity is positive and highly significant. It indicates that high capacity dealers on average pay about 8% more. Experience, which is defined as the number of years in business, has also a statistically important effect on the expected estimated price. Columns 7 and 8 show the regression results for the model specifications where experience was included as the main explanatory variable. The coefficient is positive and statistically significant indicating that an additional year of experience increases the predicted price by about 10%. All results are robust for the inclusion of size as a control variable.

[Table 6: Regression Results - Influence of Dealers on Price]

As the identity of the seller can have an impact on prices as well, all regressions are estimated

incorporating the seller as an additional hedonic variable. By conferring information on provenance, the seller identity can serve as a signal for the authenticity and quality of an artwork. When we run the regression without the seller as an explanatory variable (appendix table 2), the magnitude of all coefficients is about 2% to 8% higher. Consequently, the seller identity picks up some of the effect which was previously attributed to the buyer. Nevertheless, the results with respect to the weak dealer dummy are economically and statistically significant in both specifications.

So far, the results support our conjuncture that strong dealers pay higher prices at auction which can be explained by more experience and a higher financial capacity. As prices for artworks typically follow a skewed distribution with some extremely high-value and many low-value artworks, we are also interested whether these results hold for the entire distribution of prices. We therefore run a quantile regression as proposed by Koenker and Bassett Jr (1978) with the logarithm of the real price as the dependent variable. While table 7 presents the results when bidder market share is calculated based on the number of acquisitions, table 8 shows the results when the market share is calculated based on the value of acquisitions. In both specifications, results indeed confirm that, the higher the price is, the less are weak bidders able to compete with strong bidders. In the lowest two quantiles of the price distribution, the coefficient of the weak dealer dummy is negative and ranges from -18% to -22%. Interestingly, differences between more and less experienced dealers are lower in the 25th percentile of the distribution (-16% and -18%) than in the 10th percentile. This might indicate that even if a dealer is less experienced, he nevertheless rather tries to compete for the mid-quality instead lowest quality artworks. This is consistent with what was previously observed univariate analysis (tables 3, table:sumdealv and table:exit). From the 50th percentile onwards, the difference becomes even more pronounced peaking in the 90th percentile where strong dealer pay up to 46% more than weak dealers given the characteristics of the artwork. Generally, the difference between the two dealer groups with respect to their respective effects on price is a bit larger when the value of transactions is used to construct market shares. We can therefore conclude that market influence is decisive for the dealer's acquisition strategy and leads to relatively higher prices paid for artworks in auctions.

In summary, the results in this section lend statistical support to the conjuncture that strong dealers pay higher prices in auctions compared to weak dealers especially in higher price segments of the market given the characteristics of the artwork.

[Table 7: Quantile Regression Results (by number of acquisitions)]

[Table 8: Quantile Regression Results (by value of acquisitions)]

4.3 Exit Patterns

Finally, we are also interested whether the strong dealers' strategy of acquiring artworks at higher prices is sustainable. If strong dealers pay higher prices due to their experience in the market which enables them to command higher prices in the future, we expect them to be driven out of the market with a lower likelihood than weak dealers. In this case, weak dealers would leave the market as a result of their failure to generate sufficient profits. If strong dealers however consistently overpay and follow an economically unsustainable strategy, we should observe them exiting with a higher probability than weak dealers. To investigate which group of dealers has a relatively higher chance of exiting the market, a simple probit model is employed. The binary dependent variable, *Exit*, takes the value of 1 if the dealer exits the market in a given year and 0 otherwise. It is regressed on the weak dealer dummy and a dummy for the dealer's entry status (past experience) which is equal to 1, if the dealer is a re-entrant as control variables. We also control for the market conditions and add variables for the yearly market size in terms of total value and amount of sales as well the mean price of an artwork in a given year. We expand our sample period and start in the year 1800 instead of 1850. This allows us to capture the entire dealer market from its infancy. The regression model has the following form:

$$\begin{aligned} Exit_{it} = & \alpha_i + \tau_t + \beta WeakDealer_{it} + \gamma PastExperience_{it} + \delta \ln MarketSize_{it} \\ & + \theta \ln PriceArtwork_{it} + \epsilon_{it}. \end{aligned} \tag{2}$$

The results of the probit regression are reported in table 9. We report marginal effects of all regression coefficients. In columns 1 and 2 market shares for the dealer dummy are calculated based on the number of acquisitions. The results show that the likelihood to exit the market is 8.1% higher if the dealer is weak. When market shares are calculated based on the value of acquisitions (columns 3 and 4), the probability to exit the market increases to 8.6% for weak dealers as compared to strong dealers. In all of the four regressions, the coefficient on the weak dealer dummy is highly significant. The coefficients on past experience is insignificant. This means that if a dealer previously participated in the market, it does not alleviate the risk of exit when his market share is low. A longer absence

from the market consequently has a negative impact on the dealer's market success. Similarly, all proxies for the market conditions turn out to be insignificant. This indicates the likelihood to be pushed out of the market is independent of current industry conditions. These results stress the importance of experience and capital for market success. If a dealer does not manage to increase liquidity in order to elevate his experience and become a strong dealer within a given year, his likelihood to survive in the market is about 8.5% lower than for a strong dealer.

Overall, the results in this part of the analysis show that the strategy of paying higher prices by strong dealers reflects their information advantage. This can be explained by their superior ability to promote an artist in the market and eventually extract higher rents. Furthermore, our findings provide evidence that dealers are more likely to fail to compete in the market unless they manage to build up sufficient financial capacity and experience to develop into a strong dealer.

[Table 9: Probit Regression Results]

5 Concluding Remarks

This is the first study to shed light on the evolution of the art dealer industry and the strategic behavior of different art dealers in auctions. Our data shows how sales of artworks sold at auction exponentially increased over a century. At the same time, the amount of art dealers quadrupled within a period of 60 years (1850-1913). During this time dealers became the dominant buyers at auction indicating their establishment as an industry. We further provide insights on the strategic acquisition behavior of dealers. In particular, our evidence suggests that art dealers who are in the top 10% in terms of their market share, have a positive effect on the auction price beyond what is predicted by the hedonic characteristics of an artwork. Strong dealers tend to pay about 23% more than weak dealers. This effect is valid for the whole distribution of prices. We further show that weak dealers are 8% less likely to survive in the market than strong dealers. Our results are robust for market shares specified as the value of total acquisitions as well as the number of total acquisitions.

Our findings stress the importance of experience of dealers in auctions for fine art. More experienced art dealers have a higher capacity to promote an artist in the market due to better information set as compared to less experienced dealers. Consequently, strong dealers can extract higher rents from the acquisitions they make in auctions. Knowing that the artwork can be resold at a higher

price in the future, enables the dealer to pay a higher premium at the time of the acquisition. The viability of this bidding behavior is further supported by the outcome of the probit regression which shows that weak dealers are eventually also more likely to exit the market than strong dealers. Dealers with less experience who are unable to follow such an acquisition strategy, could have had more difficulties to credibly market an artist among consumers and extract positive rents. Due to a lack of profits, they eventually have been driven out of the market faster.

Our results support the conjuncture put forward by Milgrom and Weber (1982), who state that auctions provide an advantage to bidders who have an informational advantage. The findings are further in line with the evidence provided by Hendricks and Porter (1988) who show that in drainage lease auctions, bidders who have operations adjacent to the auctioned tract, pay on average more and extract higher rents from the acquired tracts than uninformed bidders. The results also in line with the findings reported by De Silva et al. (2008) who study the impact of public information on bidding in highway procurement auction and find that bidders adjust their cost estimates and respective bids downwards after a public information release.

Our findings can be widely applied to auctions for common value goods, where the expected value to every bidder is the same, while information sets vary. This is the also case for most collectable items such as old timers (classic cars), coins and antiques. Another prominent application is the real estate market. In the acquisition of real estate, information asymmetries are a central concern. There are large uncertainties about, for instance, the future development of the neighborhood where the object is located, the construction quality of the building as well as the outlook of the real estate market as a whole. The results can further be applied to any other industry where entry, exit and growth is subject to information asymmetries between firms.

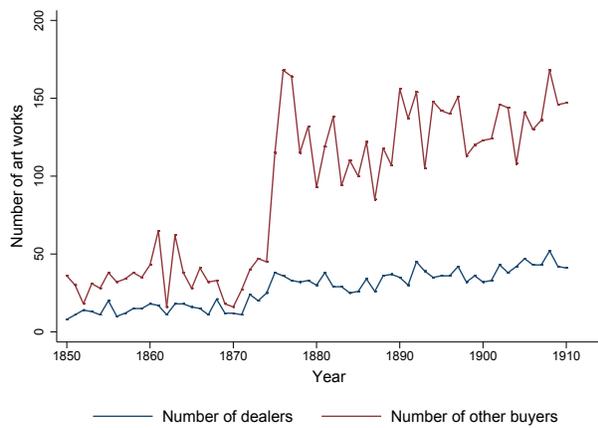
We are providing a useful empirical study for observing auction markets in an industry with significant information asymmetries. The dynamics in the art market until now have suffered from are a lack of transparency. By quantifying how experience affects dealer behavior in art markets as well as their effect on prices, our results provide a crucial step in understanding how institutions evolve and influence the market as a whole.

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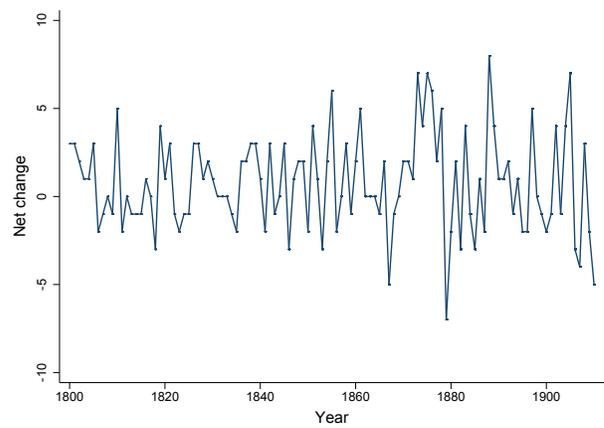
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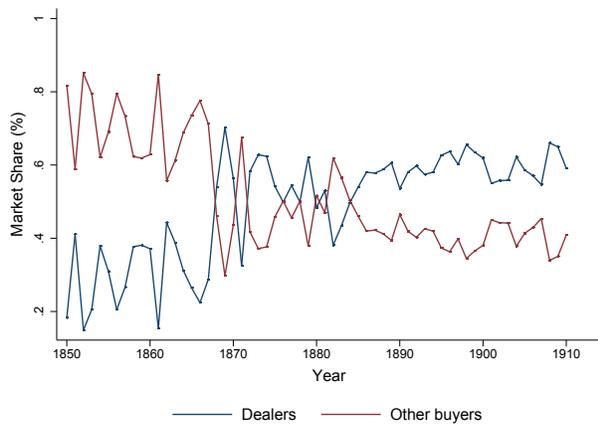
Figures



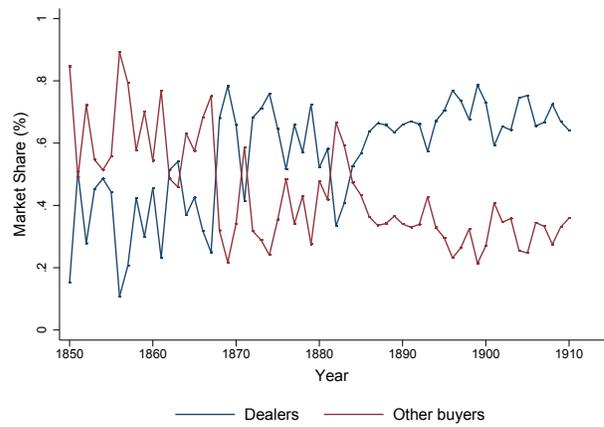
(a) Number of buyers in the market



(b) Net change of dealers in the market



(c) Proportion of market captured by buyers (by number)



(d) Proportion of market captured by buyers (by value)

Figure 1: Market Evolution 1850-1913

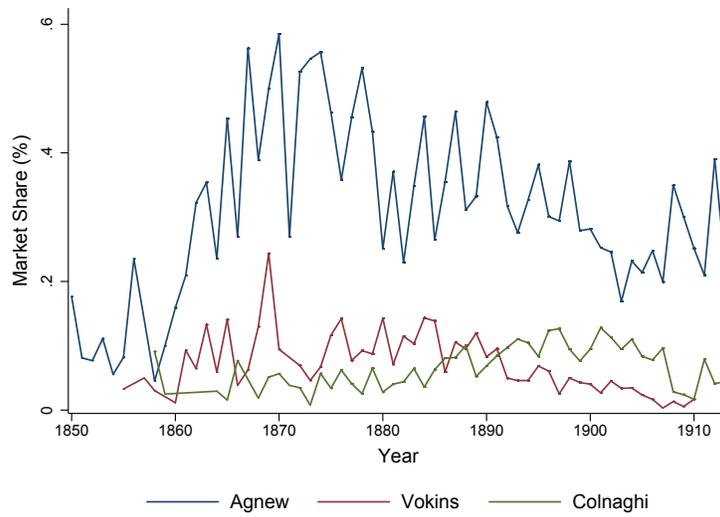


Figure 2: Market Shares - Top 3 (dealer market)

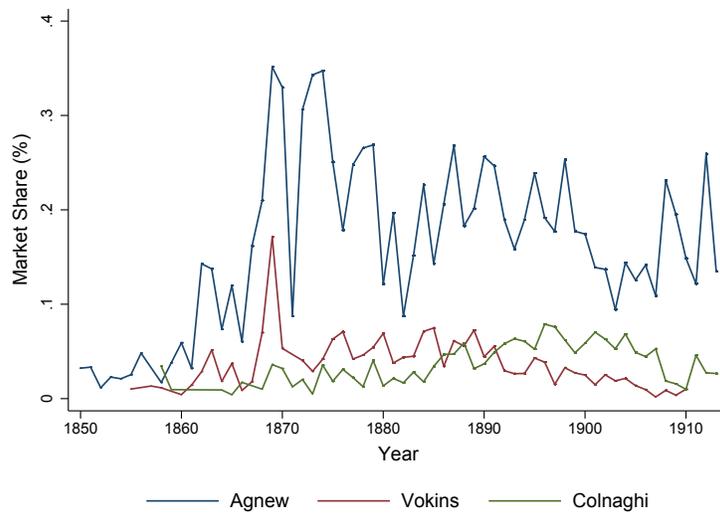


Figure 3: Market Shares - Top 3 (whole market)

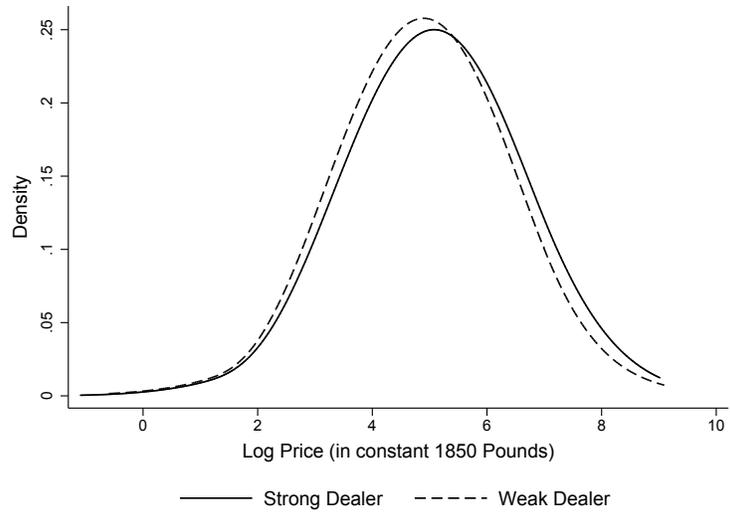


Figure 4: PDF for Strong Weak Dealers (by number of acquisitions)

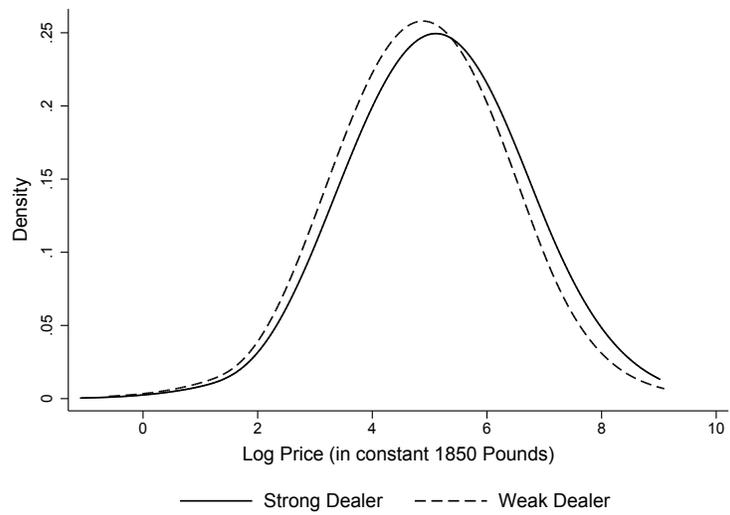


Figure 5: PDF for Strong Weak Dealers (by value of acquisitions)

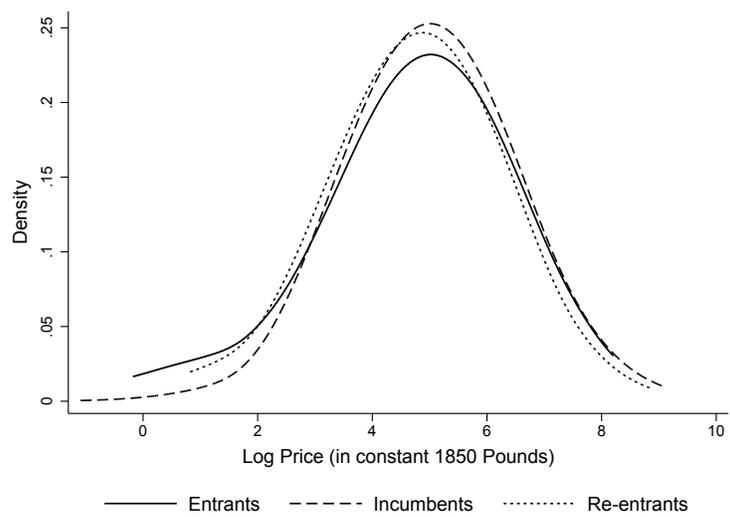


Figure 6: PDF for Incumbents, Entrants and Re-entrants

Tables

Table 1: Regression Results - Drivers for market concentration

Variables	Number of dealers		
	(1)	(2)	(3)
Log of number of artworks bought by dealers	0.351*** (0.036)	0.369*** (0.047)	
Log of value of artworks bought by dealers			0.299*** (0.036)
Net change in new entrants			0.004 (0.006)
Log of mean price artwork	0.095* (0.051)	0.089 (0.054)	
Log of per capita income (real)	0.056 (0.231)		-0.121 (0.266)
Log of population		-0.750 (1.107)	
Year	0.004 (0.004)	0.013 (0.012)	0.007 (0.005)
Observations	64	64	64
R-squared	0.898	0.898	0.871

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 2: Regression Results - Drivers for market entry

Variables	Number of entrants		
	(1)	(2)	(3)
Log number of incumbents	-1.044*** (0.374)	-1.135*** (0.372)	-0.590** (0.261)
Net change in new entrants			-0.012 (0.018)
Log of number of artworks bought by dealers	0.733*** (0.155)	0.606*** (0.161)	
Log of value of artworks bought by dealers			0.603*** (0.129)
Log of mean price artwork	0.270 (0.220)	0.244 (0.216)	
Log of per capita income (real)	0.681 (0.789)		0.581 (0.830)
Log of population		3.846 (3.161)	
Year	-0.024* (0.014)	-0.056 (0.037)	-0.026* (0.015)
Observations	64	64	64
R-squared	0.362	0.354	0.338

Robust standard errors in parentheses
 *** p<0.01, ** p<0.05, * p<0.1

Table 3: Summary Statistics for Strong and Weak Bidders (by number of acquisitions)

Quantiles	Strong Dealers		Weak Dealers	
	N	Price	N	Price
q10	683	56.96	972	49.65
q25	1,036	89.52	1,456	76.88
q50	1,718	162.69	2,426	125.04
q75	1,717	353.77	2,426	241.70
q90	1,028	774.60	1,457	479.46

Table 4: Summary Statistics for Strong and Weak Bidders (by value of acquisitions)

Quantiles	Strong Dealers		Weak Dealers	
	N	Price	N	Price
q10	653	60.88	1,008	47.32
q25	974	92.20	1,501	76.63
q50	1,629	167.06	2,527	124.30
q75	1,626	358.67	2,515	241.40
q90	977	776.03	1,514	482.91

Table 5: Summary Statistics for Incumbents, Entrants and Re-entrants

Quantiles	Incumbents		Entrants		Re-entrants	
	N	Price	N	Price	N	Price
q10	1,633	53.53	9	14.11	18	27.45
q25	2,445	80.62	11	68.38	27	72.48
q50	4,076	138.53	22	132.92	45	114.78
q75	4,093	280.99	21	281.47	45	228.34
q90	2,451	604.79	11	514.18	27	475.02

Table 6: Regression Results - Influence of Dealer Type on Price

Variables	Log Price (in constant 1850 £)							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Weak Dealer <i>(Bottom 90% by number)</i>	-0.229*** (0.021)	-0.231*** (0.029)						
Weak Dealer <i>(Bottom 90% by value)</i>			-0.243*** (0.021)	-0.228*** (0.029)				
Log Capacity					0.077*** (0.007)	0.080*** (0.009)		
Log Experience							0.107*** (0.015)	0.095*** (0.020)
Log Size		0.442*** (0.016)		0.443*** (0.016)		0.442*** (0.016)		0.441*** (0.017)
R-squared	0.539	0.621	0.540	0.621	0.542	0.623	0.536	0.616
Year Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Season Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Auction house Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Artist Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Seller Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	13,838	4,943	13,838	4,943	13,838	4,943	13,838	4,943

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 7: Quantile Regression Results (by number of acquisitions)

Variables	Log Price (in constant 1850 £)				
	q10	q25	q50	q75	q90
Weak Dealer (Bottom 10% by number)	-0.181*** (0.034)	-0.159*** (0.016)	-0.224*** (0.021)	-0.340*** (0.023)	-0.458*** (0.040)
Other characteristics	Yes	Yes	Yes	Yes	Yes
Observations	16,360	16,360	16,360	16,360	16,360

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 8: Quantile Regression Results (by value of acquisitions)

Variables	Log Price (in constant 1850 £)				
	q10	q25	q50	q75	q90
Weak Dealer (Bottom 90% by value)	-0.221*** (0.028)	-0.182*** (0.017)	-0.248*** (0.020)	-0.357*** (0.027)	-0.457*** (0.037)
Other characteristics	Yes	Yes	Yes	Yes	Yes
Observations	16,360	16,360	16,360	16,360	16,360

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 9: Probit Regression Results

Variables	Exit			
	(1)	(2)	(3)	(4)
Weak Dealer (Bottom 90% by number)	0.081*** (0.009)	0.081*** (0.009)		
Weak Dealer (Bottom 90% by value)			0.086*** (0.008)	0.086*** (0.009)
Dealer with Past Experience	-0.019 (0.013)	-0.019 (0.013)	-0.021 (0.013)	-0.021* (0.013)
Log of total size of market (In £ per year)	-0.003 (0.005)			
Log of total size of market (By number per year)			-0.005 (0.005)	
Log of mean art price (In £ per year)		0.009 (0.016)		0.008 (0.016)
Observations	2,733	2,733	2,733	2,733

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

The regression coefficients are transformed into marginal effects.

Appendix

Table 1: Summary Statistics for Strong and Weak Bidders

Rank	Dealer	Number of Acquisitions	Value of Acquisitions (in constant 1850 £)
1	AGNEW	5,469	2,048,069.00
2	COLNAGHI	1,126	343,614.60
3	VOKINS	999	213,989.70
4	TOOTH	906	221,443.80
5	WALLIS	823	213,925.50
6	MCLEAN	754	127,714.60
7	GOODEN&FOX	609	150,744.30
8	PERMAIN	399	59,701.42
9	WERTHEIMER	322	225,116.60
10	LESSER	304	54,234.73
11	SAMPSON	277	39,956.71
12	SMITH	262	49,071.33
13	WHITE	232	46,380.61
14	LEGGATT	208	21,783.16
15	SHEPHERD	200	22,163.04
16	GRAVES	197	37,295.82
17	POLAK	170	15,524.76
18	LAWRIE	144	68,065.40
19	DOWDESWELL	136	39,376.35
20	SEDELMEYER	128	40,439.52
21	DAVIS	128	76,061.21
22	GAMBART	115	31,009.02
23	PILGERAM&LEFEVRE	114	31,560.53
24	GRINDLEY	113	12,582.82
25	OBACH	102	31,209.49
26-130	OTHERS	2,344	569,018.93

Table 2: Regression Results - Influence of Dealer Type on Price

Variables	Log Price (in constant 1850 £)							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Weak Dealer <i>(Below top 10%)</i> <i>(by number of acquisitions)</i>	-0.300*** (0.018)	-0.259*** (0.025)						
Weak Dealer <i>(Below top 10%)</i> <i>(by value of acquisitions)</i>			-0.317*** (0.018)	-0.255*** (0.025)				
Log Experience					0.147*** (0.012)	0.139*** (0.017)		
Log Capacity							0.112*** (0.006)	0.103*** (0.008)
Log Size		0.401*** (0.013)		0.402*** (0.013)		0.402*** (0.014)		0.404*** (0.013)
Observations	16,360	5,842	16,360	5,842	16,360	5,842	16,360	5,842
R-squared	0.302	0.426	0.304	0.425	0.296	0.421	0.313	0.436
Year Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Season Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Auction house Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Artist Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Seller Effects	No	No	No	No	No	No	No	No

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1