Art in Africa: Market Structure and Pricing Behavior in the South African Fine Art Auction Market, 2009 - 2013

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Art in Africa: Market Structure and Pricing Behavior in the South African Fine Art Auction Market, 2009 - 2013*

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Abstract

In contrast to the international market in major centers such as New York and London, the South African market is distinguished by the presence of a clear market leader, and market follower amongst two auction houses that together virtually exhaust the domestic art market. A central concern of the present paper is how this market structure affects behavior in the market. We develop a theoretical framework to consider the interaction between market leader and follower in the context of a fine art market. Core implications are that the market follower is forced to issue excessive price estimates on art work that it attempts to attract for auction, at the cost of a higher buy-in rate in auction. We test the implications of the theory against a data set of 7554 auction lots. A direct and an indirect test of the theory on our data robustly and strongly confirms the prediction of our model.

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Introduction

International art markets are characterized by art auction houses engaged in close strategic and competitive interaction, without any evidence of a market leader. The emergence of regional loci to the art market, especially with the growth of art markets specific to emerging economies, is likely to lead to a greater diversity of market structures than has been analyzed to date in the context of art markets. Studies that explore the significance of market structure on the art market will therefore be required.

The focus of the present paper is the South African fine art auction market. In contrast to the international market in major centers such as New York and London, the South African market is distinguished by the presence of a clear market leader and market follower. The central concern of the present paper is how this market structure affects behavior in the market. Two questions are examined in detail. First, how the market leader and follower price their art works in terms of a range of art work characteristics, marketing techniques, and economic determinants. Second, how the market leader and follower in the art auction market strategically respond to each other's pricing behavior.

In the literature that examines art auction markets, focus has been on the pricing mechanism of art works in general. Pricing is examined without distinguishing which market player (auction house) sold the art work. In this literature, the three main approaches to studying the pricing mechanism are provided by the repeated sales, hedonic and the hybrid methodologies. A second approach to the study of the art auction market is through case studies of different art auction houses. The case studies, in emphasizing the limited number of prominent international art houses, such as Christie's, Sotheby's, Phillips de Pury & Co, also point to the strong competitive interaction between the auction houses.

What distinguishes the approach of the present paper, is the exploitation of a novel market structure that emerges in the South African art market. While the focus is on South Africa, we postulate that the growth of regional art markets, and art markets in emerging economies in general, will favor the emergence of regional art auction houses, and market structures that allow for market leaders due to the likely limited size of regional art markets, at least in the first instance. As a consequence the theoretical framework and empirical methodology developed for this paper, will likely carry insight for other contexts.[1]

[1] As yet the analysis of emerging art markets is relatively rare - though see Taylor and Coleman (2011), Kraeussl and

We develop a new theoretical framework to consider the interaction between market leader and follower in the context of a fine art market. Core implication is are that the market follower is forced to issue excessive price estimates on art work that it attempts to attract for auction, at the cost of a higher buy-in rate in auction - a prediction that differs from that conventionally invoked for auctions, including art auctions.[2] We test the implications of the theory against a data set hand coded from the catalogues directly issued by the art auction houses, and the sale results from subsequent auctions, providing 7553 observations for individual art works across the market leader and market follower. A direct and an indirect test of the theory on our data robustly and strongly confirm the predictions of our model.

The South African Art Market

In recent decades, the number of transactions in the African art market have risen considerably. With increased interest from international curators, and the development of an international art market, African artists have experienced raised profiles in the global art market, including greater involvement in a range of exhibitions and biennales. Major interest within the African continent is focused in South Africa (henceforth SA).

Internationally, Bonhams in London remains the only major auction house with a dedicated SA art department, though some competition is emerging from Sotheby's and Christie's. The established domestic SA art auction houses are primarily located in Johannesburg and Cape Town.[3] Among the indigenous auction houses, Strauss & Co. (henceforth SC) and Stephan Welz & Co. (henceforth SWC) are the principal representatives of SA fine art auction houses, and have handled the bulk of sales in recent years.

Both SC and SWC follow the English auction style with a secret reserve price, minimum bids, and hence an open, ascending auction, where the winner pays the highest bid. If the hammer price of an artwork fails to reach the reserve price, the artwork is bought in (remains unsold).[4]

Logher (2010) and Seckin and Atukeren (2006).

[2]Thus Ashenfelter (1989) finds no evidence of bias in auction house estimates relative to hammer price. Generally the literature confirms this finding, though there is some evidence of bias on particular types of art work (Beggs and Grady, 1997), or by auction house (Bauwens and Ginsburg, 2000; Chanel et al, 1996).

[3]These include Ashbey's Galleries Fine Art Auctioneers, Bernardi's, Dales Bros Auctioneers, the Fifth Ave Auctioneers, Old Church Auction Galleries, Rudds, Sandton Auctioneers, Strauss & Co., Stephan Welz & Co., and Whale Rock Auctioneers.

[4]For an examination of reserve prices ad their relation to expert appraisal, see McAndrew et al (2014).

Campos and Barbosa (2009) suggest that the art market is hierarchical across a series of closely linked markets. In this stratified market structure the South African market falls into the secondary level. At the primary level, unorganized individual artists supply works to galleries, local art fairs, collective exhibitions, small dealers, and private buyers. At the secondary level, art markets locate mostly in major cities, such as Cape Town and Johannesburg, where art is frequently traded. In those cities, established artists, dealers, and public or private collectors circulate works by artists who have managed to make the transition from the primary market. Finally, at the highest level, the international market is characterized by the activities of the major auction houses such as Sotheby's and Christie's.

Gerard-Varet (1995) interprets the transition from local to international markets in terms of reputation building: while at the primary or local markets, a limited number of buyers and less liquidity obtains because of a high degree of uncertainty regarding artwork quality, at the other extreme in international markets, reputation resolves the information problem and generates a much higher number of buyers, much more liquidity and less market volatility. This would imply higher prices in international markets, with secondary markets lying in between the primary and the international market. A countervailing force would be that local artists enjoy greater cultural recognition and acceptance of the aesthetics of their artworks within the regional market, thus less uncertainty and higher demand from the market. Regional (secondary) art markets may thus have some efficiency advantages due to lower information asymmetries, that allow for more ready market clearing.[5]

Evidence from auctions for the 2009-13 period, suggests that the South African art auction market is itself stratified, in at least two senses. First, the market has a clear dominant player amongst the auction houses. Second, a small number of artists (30) account for a large proportion of art work sold, and a strong preponderance of the market value of auctions.

For the period 2009-13, Table 1 gives the data of how the two South African auction houses have performed. SC has a larger total transaction value, a larger volume of works sold, as well as a higher realized mean and median value of artworks sold.

Of the two auction houses, SC has a dominant position, not so much in terms of the number of auction

[5]This is consistent with our observation that when the paintings of the work of the South African artist Walter Battiss are on sale in Bonhams, the price on average appears lower than when sold in SA art auctions. In addition, the buy-in rate at Bonhams on South African art appears higher than for SC or SWC.

lots sold, but in terms of market valuation of the auction lots sold. Thus while SC sold 547 more lots than SWC, the market value of the lots sold by SC was approximately 500% of that realized by SWC, which is reflected in mean and median value ratios per art work of 4:1 and 3:1. The dominance of SC in the domestic market is present despite the fact that SWC has a higher frequency of sales than SC.

INSERT TABLE 1 ABOUT HERE

INSERT FIGURE 1,2,3 ABOUT HERE

The total value of sales in the aggregate South African market is reported in Figure 1. There is no strong trending behavior in the market, though there is a peak in 2010. The 2010 peak is primarily due to a single auction which grossed more than ZAR66 million. The absence of trending behavior in the market is also evident when considering the mean and median values realized at auction by the two houses, though the 2010 peak is replicated in the SC mean value series. Figures 2 and 3 illustrate. Any fluctuation in the mean value of art works sold, is due to the disproportionate impact of a small number of works that sell for relatively high prices. By contrast, the median value of art work sold over our sample period of 2009 - 2013 remains constant at ZAR50 thousand for SC, and ZAR20 thousand for SWC.

INSERT FIGURES 4 AND 5 ABOUT HERE

Two further features emerge from the total sales data by auction house. First, from Figure 4 sales under the SC auction house have been subject to a cycle over the four year sample period, peaking in 2010, troughing in 2012, and subject to a recovery into 2013. Since the median value of art works sold has been constant, the fluctuation of sales must therefore be a reflection of either the number of art works sold, or the buy-in rate. As is clear from Figure 7, the buy-in rate for both auction houses has been roughly constant, for SC at 20%, for SWC at 30-40% (there is one auction with a more than 50% buy-in rate). The inference of the constant buy-in rate, constant median value of items sold, and fluctuating sales totals, is that the number of works sold fluctuates cyclically - and this is confirmed by Figure 6.

INSERT FIGURES 6 AND 7 ABOUT HERE

INSERT TABLE 2 ABOUT HERE

Finally, the South African art market is stratified by artist also. Table 2 reports the 30 top ranked artists over the 2009 - 2013 period both for the total number of works sold, and the total market value of works traded over the sample period. Thus, while our data set contains 584 identified artists whose work

appeared at auction over the 2009-13 period, the top 30 artists account for 43% of all art works sold, and 75% of the total market value over the 2009-13 period.

Theory

Our descriptive evidence suggests that we face a market structure with two dominant firms, one of which is the market leader. The market leader has a competitive advantage in the market, both because of reputational advantages in a lower buy-in rate thereby promising sellers of art work a higher probability of realizing any reserve price, and since its capture of the dominant market share allows it to realize scale efficiencies in marketing, information dissemination to potential buyers, and by attracting a larger pool of buyers.

Let both auction houses posses the relevant expertise to be able to establish the "true" market value, of any art work. Thus both auction houses are aware of:

$$P = P(S) \tag{1}$$

where P denotes the equilibrium market value of the art work, based on the set of hedonic characteristics, S, that buyers deem relevant to the valuation of the art work.

Each of the two auction houses offers owners of art works estimates of the anticipated market price of the art work to be realized at auction. Hence, the owner of the art work anticipates:

$$E(P) = m(P)[P - \mathbb{Q}(P)] \tag{2}$$

where E denotes the mathematical expectations operator, $m(P)$ the probability that a sale will occur at the price P predicted by the auction house corresponding to specification (1),[6] $\mathbb{Q}(P)$ denotes the commission due the auction house as a function of the realized price P.[7] Since art work is unique (exists in lots of one), market price determines the sales value realized by the seller.

We assume that $d\mathbb{Q}(P)/dP > 0$, i.e. that any decline in the percentage commission is not sufficient to offset the rising price, so that the amount paid in commission increases in the price of the art work

[6] Note that for both auction houses, in the event of the sale not occurring with probability $1-m(P)$ the associated expected value is given by $(1 - m(P))0$, simplifying the expected value problem for the seller.

[7] Both the buyer's premium and the seller's commission to the auction house typically vary in price. While there may be additional transactions costs for the seller, such as transport and insurance costs, we suppress these in the analysis since they are likely either symmetrical across the auction houses, or themselves a function of the value of the art work.

sold (else there is no incentive on the part of the auction house to realize a higher price).

We also assume that $dm(P)/dP < 0$,[8] on the grounds that higher cost of the art work lowers the pool of potential buyers, thus shrinking potential demand, and since $dP > 0$ for any $P > P(S)$, constitutes a case of mispricing (auction houses have no incentive to signal $P < P(S)$).

This implies the following expected profit function for an auction house:

$$E(\Pi) = m(P)\mathbb{Q}(P) - C(P) \tag{3}$$

where notation is as defined above, and $C(P)$ is the cost faced by the auction house in effecting the auction for the art work.[9] In general we assume that $dC(P)/dP > 0$, since more expensive art work requires more elaborate marketing (increased catalogue space and printing costs, media releases, web advertising). The auction house bears the cost with certainty, irrespective of whether the sale occurs.

Auction houses, sellers and buyers in the market know which auction house is the market leader, which is the follower.

The presence of a market leading auction house exercises material influence on the functioning of the market. Where the market leader has a lower buy-in rate, realizes scale efficiencies in information dissemination, and attracts a larger pool of buyers, for the seller, if the two auction houses provide an identical valuation under (1) and identical commission structures $\mathbb{Q}(P)$, the rational seller will always prefer the market leader to the follower.

We approach the problem solution as follows.[10] The seller approaches the market leading auction house, which provides a market estimate of price based on (1), anticipating that the seller will also approach the market following auction house. The market leader does not exceed the price based on (1) in order not to diminish its credibility, thereby compromising its leadership status in the market.[11] The seller then approaches the market following auction house for a price estimate. The market follower is aware of the fact that the seller has already approached the market leader. A rational market follower knows that the market leader will provide its price estimate on (1). Hence, the market following auction

[8] Note that the assumption is consistent with the findings of Ashenfelter and Graddy (2011).

[9] Again, for both auction houses, in the event of the sale not occurring with probability $1 - m(P)$, the expected value is given by $(1 - m(P))\,0$, simplifying the expected value problem for the auction house.

[10] Note that there are affinities between our approach and undercut proof equilibria. See the discussion in Schonfeld and Reinstaller (2007) and Morgan and Shy (2014).

[11] This would be consistent with the result of Milgrom and Weber (1982) that auction houses have an incentive to give accurate price estimates.

house therefore has only two means by which to try and attract sellers. First, to offer more aggressive price estimates by means of a mark-up, μ, over hedonic pricing:

$$\widetilde{P} = (1+\mu)\, P(S)\,,\ 0 < \mu < 1 \tag{4}$$

beyond those suggested by the hedonic characteristics of the art work. Second, to offer a more competitive commission structure by means of a discount, δ:

$$\widetilde{\mathbb{Q}}(P) = (1-\delta)\, \mathbb{Q}(P)\,,\ 0 < \delta < 1 \tag{5}$$

Both strategies carry negative consequences for the anticipated profitability of the market following auction house, in the case of price inflation due to the negative impact raised prices carry for the probability of sales (recall $dm(P)/dP < 0$), and in the case of reduced commissions due to the direct negative impact on revenue streams.

We have suggested that the market leader will not respond strategically to any $\mu > 0$, to preserve the credibility of its pricing. However, this restriction does not apply to any $\delta > 0$, since its scale advantages should allow it to match the market follower's discount offer to the seller, and thereby retain the seller. As such, for the market follower any $\delta > 0$ will be strictly dominated by $\delta = 0$, since there is no gain to be realized from offering a discount under conditions where the market leader responds strategically by discounting its commission.

To illustrate, consider the extensive form representation of the strategic interaction between market leader and market follower illustrated in Figure 1. Once the market leader has set P, Q, the follower has to choose whether or not to compete on commission discount, i.e. between $\delta > 0$ and $\delta = 0$. If the follower chooses $\delta = 0$, there is no further strategic response from the market leader, the market leader will retain the unambiguous dominant market share - for the sake of illustration we employ the $0.75 : 0.25$ split we observe empirically in the South African market. If the follower chooses $\delta > 0$, the market leader has to choose whether to respond by itself offering a discount ($\delta > 0$), or whether remain inert ($\delta = 0$). Where there is no countervailing discount offered, the market leader will lose some market share - for the sake of illustration we employ a $0.5 : 0.5$ split between the two auction houses. If the market leader does set $\delta > 0$, it retains market share, and we retain the $0.75 : 0.25$ split that protects the market leader dominance. It is clear that for the market leader $\delta > 0$ dominates $\delta = 0$, hence eliminating

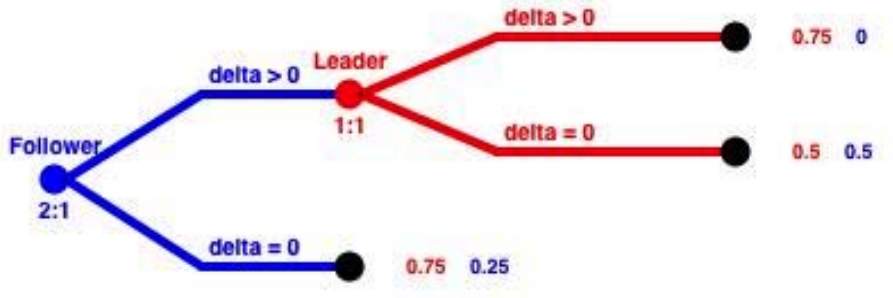


Figure 1:

$\delta > 0$ as a means of gaining market share for the follower.[12]

Hence the only competitive response the market follower has is to offer a mark-up of anticipated auction prices over that offered by the market leader, setting $\mu > 0$.

Raising the projected price of the art work above that implied by hedonic pricing, $\widetilde{P} > P(S)$, as suggested above, given our assumption that $dm(P)/dP < 0$, will lower the anticipated likelihood of the art work being sold. Rational sellers will anticipate this impact. Why then would they deem the inflated price of any potential interest? The reason rests in the fact that, leaving aside the possibility of a reduced commission, now the seller faces:

$$E(P) = \begin{cases} E(P) = m(P)P - m(P)\mathbb{Q}(P) & if\ E(P) \geq E\left(\widetilde{P}\right) \\ E\left(\widetilde{P}\right) = m\left(\widetilde{P}\right)\widetilde{P} - m\left(\widetilde{P}\right)\mathbb{Q}\left(\widetilde{P}\right) & if\ E(P) < E\left(\widetilde{P}\right) \end{cases} \tag{6}$$

such that the higher price may offset the negative impact the raised price has on the probability of a sale.

[12]Empirically, this is borne out by the South African evidence. Official seller's commissions to auction houses and buyer's premia are symmetrical between the two auction houses. Thus SWC imposes a 12% buyer's premium and seller's commission for any art work above ZAR12,000, and a 15% buyer's premium and seller's commission for any art work below ZAR12,000. By contrast, SC imposes a 12% buyer's premium and seller's commission for any art work above ZAR10,000, and a 15% buyer's premium and seller's commission for any art work below ZAR10,000. The difference between ZAR12,000 and ZAR10,000 is less than US$200, confirming the effective equivalence of the costing structure of the two auction houses.

Market Leader

Under profit maximizing behavior on the part of the auction houses, market conduct now follows. For the market leader, the profit function under (3) provides the single FOC:

$$\begin{aligned} \frac{dE\left(\Pi_L\right)}{dP} &= \frac{dm\left(P\right)}{dP}\mathbb{Q}\left(P\right) + m\left(P\right)\frac{d\mathbb{Q}\left(P\right)}{dP} - \frac{dC\left(P\right)}{dP} = 0 \\ \Longrightarrow \mathbb{Q}_L^*\left(P^*\right) &= \frac{\frac{dC(P)}{dP} - m\left(P\right)\frac{d\mathbb{Q}(P)}{dP}}{\frac{dm(P)}{dP}} \end{aligned} \tag{7}$$

where Π_L, $\mathbb{Q}_L^*$, denote the profit and profit maximizing sales commission of the market leading auction house respectively.

Note that this implies that the optimal revenue from commissions, $\mathbb{Q}_L^*\left(P\right) > 0$, only if $\frac{dC(P)}{dP} - m\left(P\right)\frac{d\mathbb{Q}(P)}{dP} < 0$, given our assumptions that $d\mathbb{Q}\left(P\right)/dP > 0$, $dm\left(P\right)/dP < 0$, $dC\left(P\right)/dP > 0$. Thus the requirement of a positive value for the commission revenue stream amounts to a minimum probability requirement, $m^*\left(P\right)$, that:

$$\frac{dC\left(P\right)/dP}{d\mathbb{Q}\left(P\right)/dP} < m^*\left(P\right) \leq 1 \tag{8}$$

In effect, the anticipated positive commission revenue stream will materialize only if (a.) the auction house moderates its price estimate sufficiently to raise the probability of a sale $m\left(P\right)$ above the minimum probability requirement, and/or (b.) moderates the extent to which it allows costs of auctions to be dependent on price, thereby forcing $\left(dC\left(P\right)/dP\right) \to 0$.[13,14]

Market Follower

For the market following auction house, given (4) and (5), the baseline profit function (3) is modified to:

$$E\left(\Pi_F\right) = m\left(\widetilde{P}\right)\widetilde{\mathbb{Q}}\left(\widetilde{P}\right) - C\left(\widetilde{P}\right) = m\left(\left(1+\mu\right)P\right)\left(1-\delta\right)\mathbb{Q}\left(\left(1+\mu\right)P\right) - C\left(\left(1+\mu\right)P\right) \tag{9}$$

where Π_F denotes the market follower's profit.

[13] To illustrate, for a simple linear structure, in which $E\left(\Pi\right) = m\left(P\right)\rho P - \chi P$, $0 < \rho, \chi \leq 1$, with ρ and χ denoting the proportion of the price chareged as commission and incurred as cost by the auction house respectively, the requirement would be that $\frac{\chi}{\rho} < m\left(P\right) \leq 1$.

[14] In the limit, if the auction house is able to realize $dC\left(P\right)/dP = 0$, under our assumption structure it would have strictly:

$$\mathbb{Q}^*\left(P\right) = \frac{-m\left(P\right)\frac{d\mathbb{Q}(P)}{dP}}{\frac{dm(P)}{dP}} > 0$$

For the market follower P is determined by the market leader. The only decision variables of the market follower are the mark-up of price over the hedonic price, μ, and the commission discount, δ. The result is that the market follower faces two FOCs.

In the case of price, the decision problem is symmetrical to that of the leader:

$$\begin{aligned} \frac{dE\left(\Pi_F\right)}{d\mu} &= 0 \qquad (10) \\ &= \left(\frac{\partial m\left(\widetilde{P}\right)}{\partial \widetilde{P}}\right)\left(\frac{\partial \widetilde{P}}{\partial \mu}\right)\widetilde{\mathbb{Q}}\left(\widetilde{P}\right) + m\left(\widetilde{P}\right)\left(\frac{\partial \mathbb{Q}\left(\widetilde{P}\right)}{\partial \widetilde{P}}\right)\left(\frac{\partial \widetilde{P}}{\partial \mu}\right) - \left(\frac{\partial C\left(\widetilde{P}\right)}{\partial \widetilde{P}}\right)\left(\frac{\partial \widetilde{P}}{\partial \mu}\right) \end{aligned}$$

Under substitution from (4), (5), this allows us to solve for:

$$\mathbb{Q}_F^*\left(\widetilde{P}\right) = \frac{\left(\frac{1}{(1-\delta)}\right)\left(\frac{\partial C\left(\widetilde{P}\right)}{\partial \widetilde{P}}\right) - m\left(\widetilde{P}\right)\left(\frac{\partial \mathbb{Q}\left(\widetilde{P}\right)}{\partial \widetilde{P}}\right)}{\left(\frac{\partial m\left(\widetilde{P}\right)}{\partial \widetilde{P}}\right)} \qquad (11)$$

where $\mathbb{Q}_F^*$, denotes the follower's profit maximizing sales commission. As for the market leader, under the same assumptions, $\partial \mathbb{Q}\left(\widetilde{P}\right)/\partial \widetilde{P} > 0$, $\partial m\left(\widetilde{P}\right)/\partial \widetilde{P} < 0$, $\partial C\left(\widetilde{P}\right)/\partial \widetilde{P} > 0$, the requirement that optimal revenue from commissions, $\mathbb{Q}_F^*\left(\widetilde{P}\right) > 0$, generates a symmetrical minimum probability condition, $m^*\left(\widetilde{P}\right)$, such that:

$$\left(\frac{1}{(1-\delta)}\right)\left(\frac{\partial C\left(\widetilde{P}\right)/\partial \widetilde{P}}{\partial \mathbb{Q}\left(\widetilde{P}\right)/\partial \widetilde{P}}\right) < m^*\left(\widetilde{P}\right) \leq 1 \qquad (12)$$

with the implication that the auction house is required to moderate the mark-up of price over hedonic pricing, and reduce dependence of cost on price, as is the case for the market leader.

Note that in principle, if the market follower does offer a discount on its commission, since $(1/(1-\delta)) > 1$, this raises the minimum probability condition for a positive revenue stream, thereby *reducing* the capacity of the market follower to offer inflated prices above that of the market leader. This reinforces the earlier dominance of the $\delta = 0$ over the $\delta > 0$ strategy result.

But consider the case where the market follower does not offer any commission discount, such that $\delta = 0$, the case we have suggested is the likely outcome given that $\delta = 0$ dominates $\delta > 0$. Then relative to the market leader, the minimum probability condition for the market follower can be both

	$\frac{\partial C^2\left(\widetilde{P}\right)}{\partial \widetilde{P}^2} > 0$	$\frac{\partial C^2\left(\widetilde{P}\right)}{\partial \widetilde{P}^2} < 0$
$\frac{\partial \widetilde{\mathbb{Q}}^2\left(\widetilde{P}\right)}{\partial \widetilde{P}^2} > 0$	$m^*\left(\widetilde{P}\right) > m^*(P),\ if\ \frac{\partial C^2\left(\widetilde{P}\right)}{\partial \widetilde{P}^2} > \frac{\partial \widetilde{\mathbb{Q}}^2\left(\widetilde{P}\right)}{\partial \widetilde{P}^2}$ $m^*\left(\widetilde{P}\right) < m^*(P),\ if\ \frac{\partial C^2\left(\widetilde{P}\right)}{\partial \widetilde{P}^2} < \frac{\partial \widetilde{\mathbb{Q}}^2\left(\widetilde{P}\right)}{\partial \widetilde{P}^2}$	$m^*\left(\widetilde{P}\right) < m^*(P)$
$\frac{\partial \widetilde{\mathbb{Q}}^2\left(\widetilde{P}\right)}{\partial \widetilde{P}^2} < 0$	$m^*\left(\widetilde{P}\right) > m^*(P)$	$m^*\left(\widetilde{P}\right) > m^*(P),\ if\ \frac{\partial C^2\left(\widetilde{P}\right)}{\partial \widetilde{P}^2} > \frac{\partial \widetilde{\mathbb{Q}}^2\left(\widetilde{P}\right)}{\partial \widetilde{P}^2}$ $m^*\left(\widetilde{P}\right) < m^*(P),\ if\ \frac{\partial C^2\left(\widetilde{P}\right)}{\partial \widetilde{P}^2} < \frac{\partial \widetilde{\mathbb{Q}}^2\left(\widetilde{P}\right)}{\partial \widetilde{P}^2}$

Table 1: Comparison of Market Leader and Follower Minimum Probability Conditions

more or less binding than for the market leader, depending on the relative rate of increase of marginal cost, $\partial C\left(\widetilde{P}\right)/\partial \widetilde{P}$, and marginal revenue, $\partial \mathbb{Q}\left(\widetilde{P}\right)/\partial \widetilde{P}$. Table 1 illustrates on condition that $\widetilde{P} > P$ as specified by (4).

Modeling Approach

In terms of our model, it is logically feasible that either of $m^*\left(\widetilde{P}\right) > m^*(P)$ or $m^*\left(\widetilde{P}\right) < m^*(P)$ may hold. Our descriptive evidence has already established, however, that the buy-in rate of the market follower (SWC) is greater than that of the market leader, indicating that it is the $m^*\left(\widetilde{P}\right) < m^*(P)$ case that emerges for the South African art market (recall the evidence of Table 1).

Since empirically for the South African case the commission structure is also effectively identical across the auction houses, as our model implies it should be, the implication is thus that the market follower provides more aggressive price estimates to sellers than does the market leader. Thus the empirical prediction we must test for our model is that $\widetilde{P} > P(S)$, such that in (4), $\mu > 0$.

We approach this task by means of two distinct empirical strategies. In the first we test directly whether there exists a distinct relationship between realized hammer price of auctioned (and sold) art work, and the price estimate provided by the auction house. In the second, we employ an indirect approach, using hedonic price estimations, to infer the counterfactual price estimates that both auction houses *would have* offered on the art work that was in fact auctioned by the rival auction house.

In both instances, the expectation is that the market follower provides more aggressive price estimates than the market leader. Thus the realized hammer price should be a smaller proportion of the price estimate for the market follower than for the market leader. Under the indirect test, the market follower should provide higher hedonic price estimates of the art works the market leader auctioned; while

the market leader should provide lower hedonic price estimates of the art works the market follower auctioned.

The Direct Test

The first is given by the direct prediction of our theoretical framework, that the market follower should overprice in its art valuations relative to the market leader. One test of this is to test for the relationship between the realized hammer price and the mean value of the art work valuation provided by the auction house, by means of:

$$\begin{aligned} P_i &= \alpha_0 + \sum_{h=1}^{2} \alpha_h P^e_{i,h} + \sum_{h=1}^{2} \beta_h \widetilde{P}^e_{i,h} + \varepsilon_{i,h},\ h \in \{SC, SWC\} \\ & \quad where \\ \widetilde{P}^e_{i,h} &= \frac{\left(P^e_{i,h,\max} - P^e_{i,h,\min}\right)}{P^e_{i,h,\max}} \end{aligned} \tag{13}$$

where P_i denotes the hammer price for art work i, $P^e_{i,h}$ denotes the mean price estimate of art work i auctioned by auction house h, and $\widetilde{P}^e_{i,h}$ the price differential between the upper ($P^e_{i,h,\max}$) and lower ($P^e_{i,h,\min}$) bound price estimates provided by the auction house h, normalized on the upper bound valuation of the art work. We estimate under both a zero and non-zero restriction on the $\beta_{i,h}$.

In terms of our theoretical priors, our expectation is that $\alpha_{SC} > \alpha_{SWC}$, given that the market follower should overprice in its art valuations.

While we are agnostic on the relative magnitudes of the β_h, note that where buyers respond negatively to price uncertainty, $\beta_h < 0$.[15]

[15]Note that the reported roles of experts and their estimate price varies in the literature. Abowd and Ashenfelter's (1988) work on impressionist art through the period of 1980 to 1982 finds that auctioneers' price estimates are far better predictors of prices than hedonic models. Beggs and Graddy (1997) study impressionist and contemporary art through the period of 1980 to 1994, and find systematic overestimation on recently executed works of art and underestimation on paintings that have longer lives. Ashenfelter et al. (2001) use the same database with Beggs and Graddy (1997) on impressionist and contemporary art, but obtain different findings. Their research examines whether the spread between high and low estimate is an indication of auctioneer's uncertainty or reflects the seller's wish to set a high reserve price. Conversely, Mei and Moses (2002) argue that auctioneers strategically set estimates in order to increase realized prices. Their research uses American, impressionist and old masters art auction data from 1950 to 2002. This paper uses a hybrid approach, setting the average auction house estimate, and the difference between high and low auction house estimates normalized on the high estimate as two independent variables to test the influence of expert estimates on auction prices.

Indirect Test

Specification (13) provides a direct test of the predictions of our model. It suffers from a counterfactual limitation: in the absence of repeat sales of the same art work by different auction houses, any art work sold by a given auction house does not have valuation data from the alternative auction house, precluding a one-on-one comparison of the valuations provided by the two auction houses. We can approximate such a comparison, however, by using hedonic price equations loading on art work characteristics.[16] By estimating the hedonic price equation for each auction house, we are able to infer the estimated price any auction house would have provided on any art work of specified characteristics, even if it was not in fact offered at auction by the auction house.

The hedonic pricing approach attempts to identify the most relevant explanatory variables for determining art prices, based on the characteristics of the art work itself. The approach is to gather price data on art sales across time, generally from auction sales, and to regress the price of each work on a set of observable characteristics of the painting, such as the artist, the size of the painting, its medium and material. The estimated coefficients can be interpreted as the "shadow prices" of each attribute.[17]

To establish the plausibility of the hedonic pricing framework for the South African art market, we

[16]Note that the literature has identified a number of alternative approaches to art work valuation. The most common art price indices are based on expert judgment, for example Sotheby's index. For each auction lot, experts give a low and high estimate, representing expert opinion about the range in which the lot might be sold at auction, which also generally serve as the basis of the reserve price for the art work. Generally estimates are based on the examination of an item and recent auction records of comparable pieces. A second common approach to an art price index is the repeated sales method. It calculates changes in the sales price of the same piece of art over time. (Housing market analysts use the same approach - see the widely cited Case-Shiller index.) The weakness of the approach is that it requires either high frequency of sales of identical pieces of art, or very long time horizons over which data is collected. While some art piece might be offered for sale at relatively high frequency, others such as "Triptych 1969" by Francis Bacon may not be offered at all in a single decade. Goetzmann (1993), Locatelli-Biey and Zanola (1999), Mei and Moses (2002), Pesando and Shum (1999) conduct researches on art auction returns using the repeated regression approach because it overcomes the disadvantages of the hedonic pricing approach at the expense of discarding non-repeated sales data. In our data set, limited observation of repeated sales in our sample time frame limits the usefulness of the repeated sales approach. According to authors specializing in repeated sales analysis, the repeated sales method should not be used for time frames of less than 20 years, unless the number of repeated sales is large. Although there are a number of repeated sales in our data set, the total volume of repeated sales was too small to run repeated-sales regression. Hence, this paper chooses the hedonic price approach to study the price mechanism in the SA art market. An advantage of the relatively short time span covered by our data, is that it obviates any concern that changes in prices are simply a reflection of changing tastes and preferences on the part of buyers. Given that our data are derived between 2009 to 2013, public taste and market evaluation of artworks should remain stable for the four-year period of the study.

[17]The hedonic price methodology was originally used in agricultural economics. Waugh (1928) first published his paper on how vegetable prices are influenced by quality factors. Chanel et al. (1994, 1996), Chanel (1995), and Gerard-Varet (1995) discuss the use of hedonic models to construct art price indexes - also see Ashenfelter and Graddy (2003). Chanel et al (1996) compare results from repeated sale and hedonic approaches, indicating that both approaches yield estimates of real rates of return in art assets over long intervals that are the same magnitude. The regressions therefore render similar estimate prices.

begin with the estimation of the hedonic price of an art work as function of an array of descriptive characteristics, a basket of economic determinants, and an error term. The hedonic regression approach makes it possible to identify the most relevant explanatory variables for determining art prices. This provides us with the following specification:

$$P_i = \alpha_0 + \sum_{j=1}^{m} \alpha_j X_j + \sum_{k=1}^{n} \beta_k Y_k + \sum_{l=1}^{p} \gamma_l Z_l + \varepsilon_i \tag{14}$$

where P_i denotes the hammer price of the $i'th$ art work including the buyer's premium, the X_i denote the range of art work characteristics that we control for, the Y_k denotes the range of "marketing" interventions we are able to control for, the Z_k denotes the range of economic conditions we control for, and ε_i is a Gaussian error term. The α_i therefore denote the implicit prices of the characteristics X_i. We estimate under zero and non-zero restrictions of the β_k, γ_l, vectors.

We then consider:

$$P^e_{i,h} = \alpha_0 + \sum_{j=1}^{m} \alpha_{j,h} X_j + \sum_{k=1}^{n} \beta_{k,h} Y_k + \sum_{l=1}^{p} \gamma_{l,h} Z_l + \varepsilon_i,\ h \in \{SC, SWC\} \tag{15}$$

where as above $P^e_{i,h}$ denotes the mean price estimate of art work i auctioned by auction house h, as the hedonic model of price estimates for the two auction houses. Our theoretical model predicts that:

$$\begin{aligned} P^e_{i,SC}\left(X_{j,SWC}, Y_{k,SWC}\right) &< P^e_{i,SWC}\left(X_{j,SWC}, Y_{k,SWC}\right) \\ P^e_{i,SC}\left(X_{j,SC}, Y_{k,SC}\right) &< P^e_{i,SWC}\left(X_{j,SC}, Y_{k,SC}\right) \end{aligned} \tag{16}$$

i.e. that the hedonic price estimate of SC should lie below that of SWC, irrespective of whether the auction houses are provided with the details of the art works that SC markets, or those that SWC markets. Note that the association would hold for all work presented for auction, rather than sold art work, since for the latter the prevailing market valuation of the work would bind, hiding any overvaluation that the SWC market follower may be pricing into its evaluations.

Data

Our data set consists of prices and characteristics of 7553 art works created by South African artists presented for auction by the two largest South African art auction houses - SC and SWC - over the 2009-13 period. Of these 5329 sold, while the remainder were bought in. The focus of the present analysis is

exclusively on South African fine art.[18] All data items were hand coded by hand using the catalogue of all the fine art auctions that take place in Cape Town and Johannesburg between 2009 and 2013.

Our direct analysis employs only the 5329 sold auction lot information. The indirect test employs all 7553 lot records, both sold and unsold.

We use hammer price including the buyer's premium to measure the market value of artworks faced by buyers. Price estimates of the lots are provided directly by the catalogued data of the art auction houses. These estimates are produced by art experts and are in the form of a low and high estimated price.[19] If the hammer price is below the reserve price, the sale does not occur and the auction house announces this fact. The practice is now common in all major auction houses after a New York State law was passed in the 1980s requiring full disclosure of no sales. From the 7553 artworks auctioned in our data set, about 70% were sold and 30% were "bought in" by the art auction house.

In addition, each auction lot item includes a portfolio of information, such as the biographical information of the artist (the name, birth, death, age), the size of the art object, the date of signature if signed, the material, the theme, the commercial packaging, and other sale information.

The independent variables of our analysis are categorized into seven groups.

First, we employ economic variables. Art can be considered to be a substitute for financial assets, utilized for the intertemporal transfer of value. For this reason, economic conditions plausibly influence the prices realized in art auctions. For this reason, we control for a range of variables that capture conditions in financial markets, and prevailing macroeconomic conditions.[20] Variables we include in estimation are gross domestic product (GDP) as a proxy for the overall state of the South African economy; both the Dow Jones Index and Johannesburg stock market index as proxies for returns on domestic and international financial markets; the interest rate as a proxy for the macroeconomic policy environment; the inflation rate as a proxy for pressure on nominal price conditions in the economy; and the nominal rand-dollar exchange rate as a proxy of exchange rate risk. These variables constitute the Z_l vector in

[18] Both SC and SWC also present international artists' work for auction - though this a very small proportion of their sales in terms of both number of lots, and the share of market value.

[19] The minimum expected price is generally viewed as being systematically related to the seller's undisclosed reserve price. Ashenfelter and Graddy (2003) argue that the rule of thumb for art auctions seems to be that the reserve price is 80% of the minimum price estimated by the auction house.

[20] Detailed discussions of the rate of return in art markets and its association with asset markets (amongst other variables) is available in Goetzmann et al (2011), Reneboog and Spaenjers (2013, 2014), Taylor and Coleman (2011), Kraeussl and Logher (2010), Seckin and Atukeren (2006) and Candela and Scorcu (1997).

specification (14) and (15).

Second, we include a range of variables that capture how art works are presented in the auction house catalogues. These categorical variables include whether the art work appears on the cover of a pre-sale catalogue (denoted $Cover$), whether the catalogue specifies whether the art work was exhibiting in important shows (denoted $Exhibited$), and whether the catalogue specifies whether the art work was illustrated in relevant art literature (denoted $Illustrated$), or discussed in relevant art literature (denoted $Literature$). These variables constitute the Y_k vector in specification (14) and (15).

In addition, we consider a range of variables that constitute the characteristics of the art work itself, and hence fall into the X_j vector in specification (14) and (15).

Our data set identifies 584 separate artists whose work has been presented at auction. Of the 584 artists presented at auction, 102 did not report sales. Of the 482 artists with recorded sales, 355 recorded less than 10 sales, 102 sales of between 10 and 50 works, and only 25 artists had sales of 50 or more works.

We control only for the 482 artists with recorded sales. In our estimations we control for the identity of artists,[21] their living status (alive, dead), their year of birth as well of death (if deceased), and the age of the artist at the time of the auction.[22]

To maintain parsimony of specification, we do not control for all 482 artist identities separately in the reported regression results for estimations that include only sold auction lots. Instead, we separate artists into three distinct groups. First Tier artists, include the 25 artists for whom more than 50 works have been sold in the market, and we control for these artists with individual categorical variables identifying their performance in the market (we denote these by individual artist names). The artists are individually identified in Table 2. Second tier artists are those for whom between 10 and 50 works have been sold. Third tier artists are those for whom less than 10 works have been sold. For both second and third tier artists we do not control for artists individually, but simply include a collective categorical variable for all second, and all third tier artists, denoted $Tier2$ and $Tier3$ respectively. Since all artist variables are categorical, we employ Stanley Pinker (for whom we have exactly 50 sales records in our data) as the

[21] Use of artist identity may capture not only an inherent market value that may be associated with specific artists, but may serve as an indirect control for the likely style and subject of the work - see the discussion in Grampp (1989).

[22] For decesaed artists, the recorded age is the age at the time of death. Higgs and Worthington (2005) suggest that the price of an artwork is often expected to increase once an artist has died when all other variables keep constant.

reference category. Of course, where estimation includes all lots presented for auction (sold and bought in), all 584 artists are included in the specification. Artists who are unsold are classified as $Tier3$.

We also consider a range of direct physical characteristics of the art works. Specifically, we consider the size of the art work (height, width, depth, diameter, if applicable) by means of its area (or volume), denoted $Area$. We also allow for the possibility of a non-linear association between size and price by including a non-linear transform of $Area$.[23] In addition, we also control for whether the artwork is signed, numbered or dated, by three categorical variables denoted $Signed$, $Numbered$, $Dated$.

Moreover, we control for the medium of the art work. Art works are classified in terms of 12 categorical variables: Oil, Water Proof Pigment, Watercolor, Water Soluble Pigment, Mixed Media, Diverse Media, Ceramic, Dish, Sculpture, Print, Photo, and Others.[24] Variable denotation directly reflects the categorization. In estimation, Dish serves as the reference category.

The last set of controls under the X_j vector is given by the theme of the art work. Again, we classify art works in terms of 7 thematic contents: Portrait, Nude, Figures, Miniature, Landscape, Abstract, and Illustration/Advertisement/Cartoon. Variable denotation directly reflects the labelling, except for Illustration/Advertisement/Cartoon, which we denote by $IllAdCar$. The reference category is Landscape for specifications including only sold auction lots, and Abstract for specifications that include all auction lots (sold and bought in).

Finally, our data records information on expert evaluation of the art works at auction. Six expert estimate related variables are employed. $EstAve$ refers to the average of the estimated low and estimated high price reported in the pre-sale catalogues ($P^e_{i,h}$ in our notation above). $EstDiffProp$ denotes the difference between the high and low expert estimates, normalized on the high price ($\widetilde{P}^e_{i,h}$ in our notation above). $EstAve\_h$, $EstDiffProp\_h$ refer to these two variables for the h'th auction house, where $h = \{SC, SWC\}$.

[23] Bigger may be better, but for private buyers there may be a limit to the size of art work that can be reasonably accommodated.

[24] Note that this classification is directly the reported classification of the auction house catalogues. Accuracy of specification is therefore contingent on the accuracy and consistency of auction house classification.

Results

Direct Test

We report the results of estimating specification (13) in Table 3.

INSERT TABLE 3 ABOUT HERE.

Our findings are consistent with the predictions of our model. Specifically, we find that for the full market data in our sample, $\alpha_{SC} = 1.12$, suggesting that the actual hammer price realized at auction lies above the mean price estimate provided by SC. By contrast, for the full market data $\alpha_{SWC} = 0.78$, so that the realized hammer price lies below the mean price estimate provided by SWC. This is consistent with the prediction of our theoretical model, suggesting that SWC will be more aggressive in its price evaluations relative to the actual market value of art work relative to SC.

In our market hedonic price mode reported below, we find evidence for a strong market segmentation - see Figure 9 below. This segmentation is in terms of a market for art work that falls below ZAR1 million in terms of realized hammer price, which we refer to as the "Bottom" market. The second is a mid-valued market, referred to as "Middle" henceforth for art work that realizes a hammer price between ZAR 1 and 3 million. Finally, a top-end market, referred to as "Top," is for works of art that realize a hammer price above ZAR 3 million.

In repeating our estimation of specification (13) for the three market segments, the predictions of our theoretical model are consistently confirmed. In each instance we find that $\alpha_{SC} > \alpha_{SWC}$. What is more, as we move from the Bottom to Middle and Top market segments, the $(\alpha_{SC} - \alpha_{SWC})$ differential increases in magnitude, in the sense that the α_{SWC} coefficient ceases to be statistically significant.[25]

This finding suggests not only that the market follower has the more aggressive price estimation strategy, but that it ceases to be a reliable indicator of price in the Middle and Top market segments.

The Hedonic Pricing Model

Here we consider the results of estimating specification (14). Purpose of these estimations is to establish a hedonic pricing framework on sold art work, to guide the hedonic estimations under the indirect test of our model. This reliability test of the hedonic framework is of added significance since the indirect test is

[25]Tests of parameter equivalence further confirm the differences between the art auction house price estimates in relation to hammer prices.

on the association between art house price estimations, rather than realized hammer price. A framework based on actual market prices is a useful reference point. Results are reported in Table 4.

INSERT TABLE 4 ABOUT HERE.

The first notable result is that the variables controlling for the presentation of art work by the auction houses (the Y_k vector of specification (14)) exert a strong influence on the hammer price of art works. The $Cover$, $Exhibited$, and the $Literature$ variables all report positive and statistically significant (at the 1% level) impacts on price. Only the $Illustrated$ variable proves statistically insignificant. The implication is that, controlling for other price determinants, appearance on the cover of the pre-sale catalogue is associated with a ZAR1.5 million price premium, having a note indicating that the art work was exhibited has a ZAR219 thousand price premium, and having a note indicating reference to the work in the art literature generates a ZAR263 thousand price premium over art works that have none of the special mentions in the pre-sale catalogues. The inference is immediate, and strong. The presentation of the art work in the pre-sale catalogue stands in strong association with an art work's price, especially cover appearances, though both exhibition appearances and literature references also add significantly to anticipated price.[26]

In a market with significant information asymmetries on the part of buyers as to the fundamental artistic value of the work on auction, catalogue cover illustration, and the recognition of artists and their work in the art literature appear to be serving as signalling devices for buyers in the search for quality.

Second, size does matter. Larger is better, though within limits. Note that the linear term incorporating $Area$ is positive and statistically significant, while the nonlinear term $Area^2$ is negative and statistically significant. The inference is that the area of an art work that would maximize the auction price would occur at approximately $21000cm^2$, which corresponds to a painting of approximately $145cm$ square. The finding confirms our prior that while larger art works raise the anticipated market price, but that the significant role of private buyers also limits the size of art works that are of interest to the market.

Third, medium of presentation matters. Relative to the reference category $Dish$, Oils command a ZAR76 thousand market price premium, while Diverse Media and Prints generate a ZAR47 and ZAR93 thousand market price discount respectively. While all other media of presentation do not differ from

[26]The inference is of course not of causality - the appearance on the cover or in illustration may be due to the significance and hence value of the art work, rendering the variable endogenous.

the reference category statistically significantly, note that Watercolors, Ceramics, Sculptures, and Photos report price premia, and Water Proof Pigment, Water Soluble Pigment, Mixed Media, and Others report price discounts.

Fourth, the thematic focus of an art work also matters. Relative to the Landscape reference category, Portraits and Still Lifes report statistically significant positive price premia of ZAR151 thousand and ZAR131 thousand respectively. While all other thematic categories do not report statistically significant differences in market prices from Landscapes, nonetheless Nudes, Figures, Miniatures and Abstracts report positive price premia relative to Landscapes, and only the $IllAdCar$ category a price discount.

Fifth, the identity of an artist matters also, but once the presentation of the art work in the pre-sale estimate has been controlled for, less than the priors from the literature might suggest. Specifically, relative to our reference category of Stanley Pinker, only Stern with a price premium of approximately ZAR2 million, and J.H.Pierneef with a premium of ZAR287 thousand show statistically significant variation, including the $Tier2$ and $Tier3$ artist categories.

However, note the impact on the artist identifiers where we drop the variables that control for the pre-sale auction house catalogue presentation of the auction lots - reported in Column 1 of Table 4. Eliminating the influence of the marketing of the auction lots, reveals strong statistically significant differences between the expected prices realized by artists. Again relative to the reference category provided by Stanley Pinker, the only artist with a statistically significant positive price premium is Stern (ZAR2.1 million),[27] though J.H.Pierneef (ZAR122 thousand) and W.Kentridge (ZAR14 thousand) report statistically insignificant premia. A number of artists report statistically significant[28] and insignificant[29] price discounts relative to Pinker. These results suggest the hierarchical price ordering of artists reported in Figure 8.

INSERT FIGURE 8 ABOUT HERE.

The implication of the contrasting results of Columns 1 and 2 of Table 4, is that while there appears to be a strong stratification of the market across artists, this stratification disappears once the pre-sale

[27]The implication is that Irma Stern is the one South African artist who has fully realized the transition from the secondary to the international market level.

[28]These include M.J.de Jongh, P. van Heerden, E.S.Boyley, C.Coetzee, T.J.McCaw, P.H.Naude, A.Rose-Innes, A.H.Boshoff, K.Bakker, W.H.Coetzer, C.A.Büchner, J.P.Meintjies, J.E.A.Volschenk, and $Tier2$ and $Tier3$ artists.

[29]These include W.W.Battiss, G.J.Boonzaier, C.E.F.Skotnes, R.G.Hodgins, M.F.E.Sumner, N.C.Catherine, M.C.L.van Esche, P.van der Westhuizen and E.D.Villa.

catalogue marketing is controlled for. In effect, the market's artist stratification is a reflection of the art literature's assessment of the merits of the pool of artists active in South Africa, as represented by the auction houses in their marketing. These results are consistent with a relatively immature art market in South Africa, that relies substantially on expert signals on the quality of the art work on offer. That the $adj - R^2$ of the estimation rises from 0.25 to 0.36 on inclusion of the catalogue presentation variables between Column 1 and 2 of Table 4 suggests that a principal source of such guidance emanates from the cataloguing of the auction houses.[30]

Finally, in Column 3 of Table 4, we report results from a specification that incorporates the set of variables that control for economic conditions. Note that the results reported for the Column 2 baseline regression remain entirely unaffected. None of the economic variables prove to be statistically significant.

The immediate inference might appear to be that the South African art market does not contain investment behavior. However, this result does not prove robust. With respect to the majority of the market, the inference cannot be dismissed. However, the market is strongly segmented, and pricing behavior that is responsive to economic fundamentals that is consistent with investor responses does become evident in some segments of the market.

In Figure 9 we illustrate the cross plot of actual realized hammer prices (incorporating the buyer's premium) against the conditional mean values implied by the estimation reported in Column 2 of Table 4. What is immediately evident from the plot is that the art market is segmented into three distinct sub-markets.

INSERT FIGURE 9 ABOUT HERE

The first sub-market is evident for art work priced below ZAR 1 million on the hedonic conditional mean value valuation. The second applies to art work ranging from ZAR1 to 3 million on the hedonic conditional mean value valuation. Thirdly, there is a distinct market above ZAR 3 million on the hedonic conditional mean value valuation. These are the market segments already referenced in Table 4.

[30] Note also that a range of characteristics of art works do not prove to be statistically significant. The date of death and age of the artist, as well as whether the art work is signed dated and numbered all are statistically insignificant with respect to the hammer price realized in auction. $Death$ and $Dated$ do become statistically significant when the auction house marketing variables are dropped from estimation - with more recently deceased artists carrying a lower price. Again this suggests that the market may rely strongly on the signalling contained in the presentation of the art work in pre-sale catalogues in assessing value.

INSERT TABLE 5 ABOUT HERE

In Table 5 we therefore report a reestimation of the hedonic specification in equation (14), segmenting the market into the three distinct price ranges. Column 1 reports the whole market results; Column 2 results for art work in the sub-ZAR1 million range, Column 3 for the ZAR1 - 3 million range, and Column 4 for the above ZAR 3 million range.[31] Given the thinness of the market for the ZAR1 - 3 million range, and above ZAR 3 million ranges, degrees of freedom preclude the inclusion of all our independent variables in estimation. Since a number of variables do not have any records in these two market segments (particularly a wide array of individual artists do not show auction records above the ZAR1 million mark), it is these variables that are dropped in Columns 3 and 4.

The two lower market segments continue to show no statistically significant association with the economic variables included in our study. For the market above ZAR3 million a set of associations does emerge, however. Specifically, GDP is statistically significantly and positively associated with realized hammer price, as is the Dow Jones market index. By contrast, the Johannesburg stock exchange index is negatively and statistically significantly associated with the hammer price. The inference is thus that an expansion of GDP leads to increased demand for art in the highest price range in the market. What is more, the impact is strong, as is shown by the implied elasticity of the GDP coefficient values against a range of GDP and hammer price values reported in Figure 10. The elasticity values range from 2.8% for "high" art prices (ZAR22 million) and low GDP values, to 24.3% for "low" art prices (ZAR3 million) and high GDP values. Thus the elasticity declines with rising art prices, and rises with rising GDP values.[32]

INSERT FIGURE 10 ABOUT HERE

The stock market index coefficients imply that high-end art market prices move pro-cyclically with off-shore equity markets, and counter-cyclically with domestic equity markets. The implication is that the art market, at least at the top end, serves as an alternative to off-shore investment hedging. Art serves as a form of risk diversification,[33] whose importance increases as returns on domestic financial markets

[31]While the three segments in the market appear clearly delineated, we also experimented with a range of alternative classifications. In particular, we used a six-fold classification of art works below ZAR20 thousand, art works from ZAR20 thousand through ZAR100 thousand, ZAR1100 to ZAR500 thousand, ZAR500 thousand through ZAR1 million, ZAR1 million through ZAR3 million, and art works above ZAR3 million. Results are not materially affected.

[32]Given the small sample size of the top end market, not too great a significance should be attached to the elasticity values.

[33]Note that our results are consistent with those reported in Taylor and Coleman (2011) for Australian Aboriginal art, the Chinese and Indian markets as reported in Kraeussl and Logher (2010), and the Turkish market as reported in Seckin and Atukeren (2006).

decline. The significance of the financial asset market variables only in the high-end market would also be consistent with the perception that the highest ranked South African art trades on international markets, rather than the domestic market alone, thereby attracting international buyers and financial investors diversifying risk on international financial markets. Again, as Figures 11 and 12 illustrate for the Dow Jones and JSE markets respectively, the implied sensitivity of prices as measured by elasticities across market values are large - though the caveat regarding sample size and hence the precision of the estimated coefficients remains.

INSERT FIGURES 11 AND 12 ABOUT HERE

Note that in the below ZAR 1 million market, differentiation amongst the individual artists becomes more distinct than in the market as a whole. Figure 13 reports the conditional mean value of realized auction prices for the top 25 artists by number under the below ZAR 1 million market. What emerges is that the price differences between artists prove stronger and more statistically significant in the bottom end of the market (with the exception of Stern). From Figure 13, one might also infer a reference group of six artists (Stern, Kentridge, Pierneef, Pinker, Skotnes and Van Essche), with three market bands below them, ZAR 50 - ZAR 100 thousand below the reference group benchmark, ZAR 100 - ZAR 120 thousand below them, and more than ZAR 120 thousand below.

INSERT FIGURE 13 ABOUT HERE

A second feature that emerges from a contrast of the bottom market and the market as a whole, is that $Watercolor$ and $Sculpture$ gain increased prominence amongst art media, while $Print$ has less of a price discount (it halves). In addition, amongst the thematic focus areas of the art work $Figures$, $Miniatures$ and $Abstract$ works gain increased prominence in the sense that they are statistically significantly higher than the excluded $Landscape$ category, perhaps consistent with a new and younger buyer group entering the market.

Indirect Test

Here we turn to an examination of the counterfactual pricing evidence derived from the estimation of specification (15). Again we use hedonic price estimations, employing the mean price estimate provided by the auction houses rather than the realized hammer price. We report results for the estimations in Table 6.

INSERT TABLE 6 ABOUT HERE.

In column (1) of Table 6 we report the hedonic price estimation linking SWC price estimates to the work it presents for auction, irrespective of whether the work was sold or not. Column (2) of Table 6 repeats for SC. Note that the analysis is for all work presented for auction, not just sold art work.

Our interest does not lie in the hedonic estimations themselves. Instead, we employ the derived coefficient values in order to examine the counterfactual question of what value SC would have generated in its price estimations if presented with the art works that SWC in fact presented for auction; and vice versa. If the priors generated by our theoretical framework are correct, then we should find that the SC hedonic pricing mechanism generates *lower* price estimates for the art work valued and presented for auction by SWC. Conversely, we should find that SWC generates *higher* price estimates for the art work valued and presented for auction by SWC. Recall the expectations that were specified in (16).

This is precisely what we find. Consider the summary evidence of Table 7.

INSERT TABLE 7 ABOUT HERE.

We employ the hedonic price relationship estimated in column (1) of Table 6 for SC, to provide counterfactual price estimates for the SC auction house, using the art work that was in fact presented for auction by the SWC market follower. We report results in column (1) of Table 7. The resultant average price computed across all 3803 art works presented for auction by SWC, is ZAR95,852 (mean), which lies below the ZAR139,869 (mean) value obtained from the SWC actual recorded price evaluation, or the ZAR174,968 (mean) value obtained from the SWC hedonic price evaluation. This confirms the theoretical expectation that $P^e_{i,SC}\left(X_{j,SWC}, Y_{k,SWC}\right) < P^e_{i,SWC}\left(X_{j,SWC}, Y_{k,SWC}\right)$.

Symmetrically, we employ the hedonic price relationship estimated in column (2) of Table 6 for SWC, to provide counterfactual price estimates for the SWC auction house, using the art work that was in fact presented for auction by the SC market leader. We report results in column (1) of Table 7. The resultant average price computed across all 3751 art works presented for auction by SC, is ZAR505,161 (mean), which lies well above the ZAR164,401 (mean) value obtained from the SWC actual recorded price evaluation, or the ZAR164,275 (mean) value obtained from the SWC hedonic price evaluation. This confirms the theoretical expectation that $P^e_{i,SC}\left(X_{j,SC}, Y_{k,SC}\right) < P^e_{i,SWC}\left(X_{j,SC}, Y_{k,SC}\right)$.

It is worth noting, that for sold art works, the market discipline on prices is evident. Where we repeat

the exercise of inferred counterfactual prices on sold art works alone, the overvaluation of the SWC market follower disappears - and in fact shows that the market follower generates *lower* prices than the market leader in art works that in fact sell - see the evidence reported in column (2) of Table 7. This is consistent with the theoretical model's expectations that the market follower uses overvaluation to attract lots for presentation at auction, at the expense a higher buy-in rate at auction.

Conclusions and Evaluation

This paper analyzed the strategic interaction of art auction houses in the fine art market in South Africa. Core prediction of our theoretical model is that the market leader provides price estimates prior to the sale, that are closely related to the realized sale price of the art work. By contrast, the market follower is forced to systematically over-value art work it offers for auction, at the cost of a significantly higher buy-in rate than the market leader.

Our empirical analysis confirms the prediction of the theory by means of a direct and an indirect test. The direct test refers to the test for the relationship between the realized hammer price and the art work pre-auction evaluation provided by the auction house. We found that the market follower has clearly over-evaluated prices compared to the market leader.

The indirect test employs the hedonic price relationship between the estimated art work prices provided by an art auction house, and a wide rang of characteristics of each art work. This hedonic relationship is used to generate the counterfactual estimated prices for each art auction house, for the art work that is presented for auction by the rival auction house, and is then compared against the actual price estimates of the rival auction house. We find that the market leader's hedonic pricing relationship applied to art work offered for auction by the market follower, generates lower prices on average than the estimates of the market follower. Conversely, the market follower's hedonic pricing relationship applied to art work offered for auction by the market leader, generates higher prices on average than the estimates of the market leader. This confirms the theoretical expectations we derive.

References and Notes

1. Abowd, J. and Ashenfelter, O. (1988) Art Auctions: Prices indices and sale rates for impressionist and contemporary pictures, mimeo, Economics Dept,. Princeton U.

2. Ashenfelter, O. (1989) How auctions work for wine and art, *Journal of Economic Perspectives*, 3, 23–36.

3. Ashenfelter, O. and Graddy, K. (2003) Auctions and the price of art, *Journal of Economic Literature*, 41, 763–87.

4. Ashenfelter, O. and Graddy, K. (2011) Sale Rates and Price Movements in Art Auctions, *American Economic Review*, 101(3), 212-6.

5. Ashenfelter, O., Graddy, K., and Stevens, M. (2002) An empirical study of sales rates and prices in Impressionist and Contemporary Art auctions, mimeo, Department of Economics, Oxford University.

6. Baumol, W. (1986) Unnatural value or art investment as a floating crap game, *American Economic Review*, 76, 10–15.

7. Bauwens , L, and Ginsburg, V., 2000, Art Experts and Auctions: Are Pre-sale Estimates Unbiased and Fully Informative?, *Recherches Économiques de Louvain*, 66(2), 131-44.

8. Beggs, A. and Graddy, K. (1997) Declining values and the afternoon effect: evidence from art auctions, *Rand Journal of Economics*, 23, 544–65.

9. Buelens, N. and Ginsburgh, V. (1993) Revisiting Baumol's art investment as floating crap game, *European Economic Review*, 37, 1351–71.

10. Burton, B. and Jacobsen, J. (1999) Measuring returns on investments in collectibles, *Journal of Economic Perspectives*, 13, 193–212.

11. Candela, G., and Scorcu, A.E., (1997) A Price Index for Art Market Auctions: An Application to the Italian Market of Modern and Contemporary Oil Paintings, *Journal of Cultural Economics*, 21(3), 175-196.

12. Chanel, O. (1995) Is art market behavior predictable? *European Economic Review*, 39, 519–27.

13. Chanel, O., Gérard-Varet, L., and Ginsburgh, V. (1994) Prices and returns on paintings: an exercise on how to price the priceless, *Geneva Papers on Risk and Insurance Theory*, 19, 7–21.

14. Chanel, O., Gérard-Varet, L., and Ginsburgh, V. (1996) The relevance of hedonic price indexes: the case of paintings, *Journal of Cultural Economics*, 20, 1–24.

15. Chow, G. (1967) Technological change and the demand for computers, *American Economic Review*, 57, 1117–30.

16. Court, A. (1939) Hedonic price indexes with automotive examples, in The Dynamics of Automobile Demand, General Motors Corporation, 99–117.

17. de la Barre, M., Docclo, S., and Ginsburgh, V. (1994) Returns of Impressionist, modern and contemporary European paintings, 1962–1991, *Annales d'Economie and Statistique*, 35, 143–81.

18. Edwards, S. (2004) The economics of Latin American art: creativity patterns and rates of return, *Economía*, Spring, 1–35.

19. Ekelund, R., Ressler, R., and Watson, J. (1998) Estimates, bias and 'No Sales' in Latin American art auctions, 1977–1996, *Journal of Cultural Economics*, 22, 33–42.

20. Ekelund, R., Ressler, R., and Watson, J. (2000) 'The 'Death-Effect' in art prices: a demand-side exploration, *Journal of Cultural Economics*, 24, 283–300.

21. Fama, E. (1965) Random Walks in Stock Market Prices, *Financial Analysts Journal*, 21(5), 55–59.

22. Frey, B. and Pommerehne, W. (1989) *Muses and Markets: Explorations in the Economics of the Arts*, Basil Blackwell, Oxford.

23. Frey, B. and Eichenberger, R. (1995) On the rate of return in the art market: survey and evaluation, *European Economic Review*, 39, 528–37.

24. Galenson, D. and Weinberg, B. (2000) Age and the quality of work: the case of modern American painters, *Journal of Political Economy*, 108, 761–77.

25. Gerard-Varet, L. (1995) On pricing the priceless: comments on the economics of the visual art market, *European Economic Review*, 39, 509–18.

26. Ginsburgh, V. and van Ours, J. (2007) How to organize sequential auctions: results of a natural experiment by Christie's, *Oxford Economic Papers*, 59, 1–15.

27. Goetzmann, W. (1993) Accounting for taste: art and the financial markets over three centuries, *American Economic Review*, 83, 1370–76.

28. Goetzmann, W., Renneboog, L., and Spaenjers, C., (2011). Art and Money, *American Economic Review*, 101(3), 222-26.

29. Grampp, D. (1989). *Pricing the priceless. Art, artists and economics*. New York: Basic Books, Inc.

30. Higgs, H., and Worthington, A. (2005). Financial return and price determinants in the Australian art market, 1973–2003. *The Economic Record*, 81, 113–123.

31. Hulten, C. (2003) Price hedonics: a critical review, *FRBNY Economic Policy Review*, Federal Reserve Bank of New York, September, 1–15.

32. Klemperer, P. (2004) *Auctions: Theory and Practice*, Princeton University Press, Princeton, NJ.

33. Kraeussl, R., and Logher, R., (2010) Emerging Art Markets, *Emerging Markets Review,* 11(4), 301-318.

34. McAndrew, C., Smith, J.L., and Thompson, R., (2014) The Impact of Reserve Prices on the Perceived Bias of Expert Appraisals of Fine Art, *Journal Of Applied Econometrics*, 27(2), 235-252.

35. Mei, J. and Moses, M. (2002) Art as an investment and the underperformance of masterpieces, *American Economic Review*, 92, 1656–68.

36. Mei, J. and Moses, M. (2005) Vested interests and biased price estimates: evidence from an auction market, *Journal of Finance*, 60, 2409–36.

37. Milgrom, P, and Weber, R., 1982, A Theory of Auctions and Competitive Bidding, *Econometrica*, 50(5), 1089-122.

38. Morgan, P.B., and Shy, O. (2014) Undercut-Proof Equilibria With Multiple Firms, Mimeo: State University of New York at Buffalo.

39. Nerlove, M. (1995) Hedonic price functions and the measurement of preferences: the case of Swedish wine consumers, *European Economic Review*, 39, 1697–1716.

40. Pesando, J. (1993) Art as an investment: the market for modern prints, *American Economic Review*, 83, 1075–89.

41. Renneboog, L.D.R., and Spaenjers, C., (2013) Buying Beauty: On Prices and Returns in the Art Market, *Management Science*, 59(1) 36-53.

42. Renneboog, L.D.R., and Spaenjers, C., (2014) Investment Returns and Economic Fundamentals in International Art Markets, CEPR Discussion Paper 2014-018.

43. Rengers, M. and Velthuis, O. (2002) Determinants of prices for contemporary art in Dutch galleries, 1992–1998, *Journal of Cultural Economics*, 26, 1–28.

44. Sagot-Duvauroux, D. (2003) Art prices, in R. Towse (ed.) *A Handbook of Cultural Economics*, Edward Elgar, Cheltenham, 57–63.

45. Seckin, A., and Atukeren, E., (2006) Art and the Economy: A First Look at the Market for Paintings in Turkey, *Economics Bulletin*, 26(3), 1-13.

46. Schonfeld, S. and Reinstaller, A. (2007) The effects of gallery and artist reputation on prices in the primary market for art: a note, *Journal of Cultural Economics*, 31, 143–53.

47. Taylor, D., and Coleman, L., (2011) Price Determinants of Aboriginal Art, and Its Role as an Alternative Asset Class, *Journal Of Banking And Finance*, 35(6) 1519-1529.

48. Throsby, D. (1994) The production and consumption of the arts: a view of cultural economics, *Journal of Economic Literature*, 32, 1–29.

49. Triplett, J. (2004) Handbook on hedonic indexes and quality adjustments in price indexes: special application to information technology products, STI Working Paper 2004/9, OECD, Paris.

50. C. (2002) Canadian versus American art: what pays off and why, *Journal of Cultural Economics*, 26, 203–16.

Figures and Tables

Table 1: The South African Art Market

	Strauss & Co	Stephan Welz & Co	Total
Art Work Presented for Auction:			
Total Estimated Value	612,342,700	531,083,200	1,143,416,900
Number	3,751	3,802	7,533
Mean Value	163,248	139,685	151,387
Median Value	40,000	14,000	25,000
Variance	5.21×10^{11}	2.40×10^{13}	1.24×10^{13}
Standard Deviation	721,948	4,902,580	3,515,133
Art Work Sold at Auction:			
Total Value	586,468,891	119,227,166	705,696,057
Number	2,946	2,399	5,345
Mean Value	199,140	49,699	132,053
Median Value	44,560	15,680	28,964
Variance	7.33×10^{11}	2.56×10^{10}	4.21×10^{11}
Standard Deviation	856,401	160,130	648,962

Note: Values are in South African Rand (ZAR)
Source: Own data collection from auctions, 2009 - 2013.

Table 2: Principal South African Artists at Auction

(1)		(2)	
Ranking in Number		**Ranking in Value (ZAR)**	
Battiss, W.W.	172	Stern, Irma	191,994,082
Pierneef, J.H.	147	Pierneef, J.H.	54,057,195
Boonzaier, G.J.	142	Preller, A.	28,351,046
De Jongh, M.J.	99	Laubser, Maggie	25,855,537
Kentridge, W.J.	94	Battiss, W.W.	17,589,558
Skotnes, C.E.F.	86	Kentridge, W.J.	17,212,052
Stern, Irma	76	Wenning, P.W.F.	16,747,396
Hodgins, R.G.	75	Skotnes, C.E.F.	16,583,494
Laubser, Maggie	74	Pinker, S.F.	12,363,648
Sumner, M.F.E.	73	Van Wouw, A.	12,293,910
VanHeerden, P.	73	Van Essche, M.C.L.	10,833,474
Boyley, E.S.	70	Sumner, M.F.E.	10,291,257
Coetzer, W.H.	70	Boonzaier, G.J.	9,983,796
Naude, P.H.	68	Hodgins, R.G.	9,979,309
Coetzee, C.	67	Naude, P.H.	9,968,253
Catherine, N.C.	65	Villa, E.D.	6,751,302
McCaw, T.J.	64	Rose-Innes, A.	6,410,483
Rose-Innes, A.	63	Kibel, W.	5,991,833
Van Essche, M.C.L.	61	Sekoto, G.	5,752,026
Boshoff, A.H.	60	Sithole, L.T.	5,554,460
Villa, E.D.	56	Meintjes, J.P.	5,483,585
Volschenk, J.E.A.	56	Tretchikoff, V.G.	5,323,160
Meintjes, J.P.	55	Boshoff, A.H.	5,204,236
Büchner, C.A.	54	Laubscher, F.B.H.	5,124,628
Pinker, S.F.	50	Lock, F.	4,859,340
Van Der Westhuizen, P.	48	Welz, J.M.F.	4,824,195
Krige, F.	46	Pemba, G.M.M.	4,795,130
Timlin, W.M.	46	Kumalo, S.A.	4,100,373
Claerhout, F.M.	43	Coetzee, C.	3,627,285
De Jongh, G.C.	43	Catherine, N.C.	3,586,680
Mayer, E.K.E.	43	Clarke, P.	3,429,238
Domsaitis, P.	40	Oerder, F.D.	3,319,728
Preller, A.	40	Krige, F.	3,301,645

Table 3: Direct Test

Expert Estimate and Hammer Price, 2009-2013								
	(1)		(2)		(3)		(4)	
	Full Market		Bottom		Middle		Top	
	HammerP	HammerP	HammerP	HammerP	HammerP	HammerP	HammerP	HammerP
EstAve	1.101***		0.924***		0.379***		0.780***	
	(173.92)		(116.44)		(4.53)		(6.55)	
EstDiffProp	-119070.4*		-54458.9***		169721.7		-14984153.4	
	(-2.10)		(-3.57)		(0.19)		(-1.64)	
EstAve_SC		1.115***		0.995***		0.450***		0.779***
		(173.44)		(107.56)		(4.52)		(6.47)
EstAve_SWC		0.780***		0.700***		0.257		-0.514
		(27.49)		(49.33)		(1.71)		(-0.67)
EstDiffProp_SC		-178916.6**		-101970.1***		-81202.2		-13548721.8
		(-3.19)		(-6.83)		(-0.09)		(-1.43)
EstDiffProp_SWC		-218211.5***		-115581.7***		82134.4		0
		(-3.59)		(-7.21)		(0.06)		(.)
Constant	46059.1**	74283.2***	29190.2***	45640.7***	1167780.1***	1190279.3***	7023773.3*	6711936.6*
	(2.77)	(4.43)	(6.45)	(10.18)	(4.27)	(4.29)	(2.59)	(2.41)
N	5059	5059	4974	4974	59	59	26	26
R	0.86	0.86	0.73	0.75	0.24	0.25	0.66	0.65
F-test of parameter equivalence								
EstAve_SC= = EstAve_SWC	-	133.38*** [0.00]	-	309.22*** [0.00]	-	1.18 [0.28]	-	3.02* [0.10]

*** denotes significance at 1% level of significance
** denotes significance at 5% level of significance
* denotes significance at 10% level of significance
Figures in round parentheses denote t-statistics
Figures in square parentheses denote probability values

Table 4: Hedonic Price Estimations – Sold Art Work

Hedonic Price Model, SA Fine Art, 2009-2013			
	(1)	**(2)**	**(3)**
	Hammer_Plus	Hammer_Plus	Hammer_Plus
Battiss_WW	-113794.6	25500.8	27610.4
	(-1.41)	(0.34)	(0.37)
Pierneef_JH	121832.3	286823.3***	287899.7***
	(1.47)	(3.69)	(3.70)
Boonzaier_GJ	-145081.1	63854.0	66374.0
	(-1.74)	(0.82)	(0.85)
deJongh_MJ	-332459.0***	-26118.4	-24352.7
	(-3.69)	(-0.31)	(-0.29)
Kentridge_WJ	14455.4	124434.7	123510.8
	(0.15)	(1.39)	(1.38)
Skotnes_CEF	-106896.6	99378.4	98930.7
	(-1.15)	(1.14)	(1.14)
Hodgins_RG	-176614.1	-25643.3	-21531.9
	(-1.81)	(-0.28)	(-0.24)
Stern_Irma	2103283.9***	1939112.9***	1938016.6***
	(22.44)	(22.07)	(22.05)
VanHeerden_P	-266755.4**	-9289.3	-6887.5
	(-2.81)	(-0.10)	(-0.08)
Sumner_MFE	-135439.9	9353.7	6325.0
	(-1.43)	(0.11)	(0.07)
Boyley_ES	-251509.9**	-19458.5	-18202.9
	(-2.62)	(-0.22)	(-0.20)
Coetzee_C	-280289.7**	-36568.3	-36225.8
	(-2.83)	(-0.40)	(-0.39)
McCaw_TJ	-343384.2***	-72713.1	-70783.3
	(-3.51)	(-0.79)	(-0.77)
Naude_PH	-204040.0*	17140.7	20132.5
	(-2.07)	(0.19)	(0.22)
Innes_AR	-221818.6*	28710.0	29773.7
	(-2.25)	(0.31)	(0.32)
Catherine_NC	-180423.0	33629.3	39621.3
	(-1.77)	(0.35)	(0.42)
VanEssche_MCL	-188384.5	14983.2	12850.2
	(-1.90)	(0.16)	(0.14)
Boshoff_AH	-217961.6*	6532.0	12062.1
	(-2.16)	(0.07)	(0.13)
Baker_K	-305226.2**	-45990.8	-41719.0
	(-2.99)	(-0.48)	(-0.43)
Coetzer_WH	-320175.7**	-47018.6	-43057.5
	(-3.20)	(-0.50)	(-0.46)
Buchner_CA	-343694.0***	-81163.7	-79264.4

	(-3.37)	(-0.85)	(-0.83)
Meintjes_JP	-339096.1**	-141783.9	-139609.7
	(-3.26)	(-1.46)	(-1.44)
Volschenk_JEA	-360072.1***	-25060.4	-20342.2
	(-3.47)	(-0.26)	(-0.21)
VanDerW_P	-201080.7	16247.6	23549.3
	(-1.90)	(0.16)	(0.24)
Villa_ED	-209163.9	12530.4	19552.1
	(-1.80)	(0.12)	(0.18)
Tier 2	-237695.8***	-9213.3	-6466.7
	(-3.52)	(-0.14)	(-0.10)
Tier 3	-285848.5***	-47691.5	-43980.1
	(-4.07)	(-0.72)	(-0.66)
Death	-2124.8***	-737.5	-700.3
	(-4.88)	(-1.81)	(-1.70)
Age	-730.6	-266.0	-327.5
	(-0.96)	(-0.38)	(-0.46)
Height	847.0	558.6	602.3
	(1.44)	(1.02)	(1.10)
Area	31.98***	22.89***	22.45***
	(5.03)	(3.88)	(3.80)
Area_2	-0.000801***	-0.000546***	-0.000543***
	(-5.23)	(-3.85)	(-3.83)
Signed	28423.5	12786.0	32468.8
	(0.90)	(0.44)	(1.03)
Dated	47029.6*	20855.2	17543.4
	(2.52)	(1.20)	(1.00)
Numbered	35194.9	45563.3	43514.9
	(0.90)	(1.26)	(1.21)
Oil	122444.6***	76912.6**	78371.0**
	(4.23)	(2.87)	(2.91)
WaterProof	13380.0	-20832.8	-15848.9
	(0.24)	(-0.40)	(-0.30)
Watercolor	14853.2	26178.1	26077.1
	(0.41)	(0.77)	(0.77)
WaterSolutable	-98128.6	-88289.1	-85766.6
	(-1.90)	(-1.85)	(-1.80)
MixedMedia	-33195.1	-22242.6	-20368.8
	(-0.76)	(-0.55)	(-0.51)
DiverseMedia	-56441.3**	-47404.7*	-46390.7*
	(-2.65)	(-2.41)	(-2.35)
Ceramic	57588.9	88874.4	91198.8
	(0.10)	(0.17)	(0.17)
Sculp	117424.6*	6891.5	6360.1
	(2.51)	(0.16)	(0.15)
Print	-93018.3*	-92811.1*	-91679.8*
	(-2.34)	(-2.52)	(-2.49)
Photo	46791.3	22004.3	-10709.8

	(0.08)	(0.04)	(-0.02)
Others	-30696.5	-68237.4	-64450.0
	(-0.37)	(-0.90)	(-0.85)
Portrait	206655.9***	150818.5***	150735.4***
	(5.65)	(4.46)	(4.45)
Still_Life	165048.3***	131123.2***	127728.1***
	(4.92)	(4.23)	(4.11)
Nude	9270.9	14992.3	15329.2
	(0.13)	(0.23)	(0.23)
Figures	38403.6	22170.3	22958.8
	(1.65)	(1.03)	(1.05)
Miniature	99354.8	137285.7	137664.6
	(1.23)	(1.84)	(1.83)
Abstract	33619.3	19185.6	17161.5
	(1.07)	(0.66)	(0.58)
IllustrationsAdCartoon	7052.8	-23202.3	-24637.5
	(0.09)	(-0.31)	(-0.33)
Exhibited		219462.6***	218466.7***
		(5.03)	(4.98)
Literature		263385.2***	263319.4***
		(6.77)	(6.75)
Illustrated		-21805.6	-17063.6
		(-0.97)	(-0.64)
Cover		1489129.4***	1490023.4***
		(25.54)	(25.49)
GDP			0.719
			(0.84)
InflationRate			-1690816.1
			(-1.49)
DJIA			2.017
			(0.11)
R			9314.4
			(0.57)
JSE			-5.182
			(-0.78)
Strauss			-5097.3
			(-0.25)
Constant	4326538.0***	1375318.9	1148837.1
	(5.13)	(1.74)	(1.36)
N	5006	5006	5006
R^2	0.25	0.36	0.37

*** denotes significance at 1% level of significance
** denotes significance at 5% level of significance
* denotes significance at 10% level of significance
Figures in round parentheses denote t-statistics

Table 5: Hedonic Price Estimations – Market Segmentation

South African Art Market Prices at Auction, 2009 - 2013				
	(1)	(2)	(3)	(4)
	Hammer P Total	Hammer P Bottom	Hammer P Middle	Hammer P Top
GDP	0.689	-0.0816	-1.872	164.8*
	(0.82)	(-0.48)	(-0.17)	(2.57)
InflationRate	-1661932.3	-81574.9	-11433176	-201379082.9
	(-1.47)	(-0.36)	(-0.84)	(-1.91)
DJIA	0.983	-3.462	287.5	12364.8*
	(0.05)	(-0.94)	(0.67)	(3.00)
R	10314.0	1439.2	119994.2	-1046487.5
	(0.64)	(0.44)	(0.51)	(-0.66)
JSE	-4.617	1.447	-66.64	-3013.2*
	(-0.70)	(1.09)	(-0.51)	(-2.56)
Strauss	-930.1	23584.0***	545859.3	6295276.7
	(-0.05)	(5.84)	(1.30)	(1.79)
Battiss_WW	23750.4	-82509.4***	84273.4	
	(0.32)	(-5.34)	(0.13)	
Pierneef_JH	283425.1***	2268.1	-417693.6	18493971.4*
	(3.66)	(0.14)	(-0.79)	(2.71)
Boonzaier_GJ	65315.3	-60110.3***		
	(0.84)	(-3.79)		
deJongh_MJ	-26457.1	-142016.6***		
	(-0.31)	(-8.21)		
Kentridge_WJ	117866.5	14794.4	-587857.3	
	(1.33)	(0.82)	(-0.27)	
Skotnes_CEF	89751.4	-21516.9	-1256148.3	
	(1.04)	(-1.21)	(-0.82)	
Hodgins_RG	-19144.5	-58017.2**	-1566582.6	
	(-0.21)	(-3.19)	(-0.76)	
Stern_Irma	1937324.7***	3506.0	507040.4	9870068.3*
	(22.16)	(0.17)	(0.92)	(2.25)
VanHeerden_P	-9829.4	-119420.0***		
	(-0.11)	(-6.64)		
Sumner_MFE	8779.0	-72444.8***	229743.0	
	(0.10)	(-4.01)	(0.34)	
Boyley_ES	-18487.6	-118548.8***		
	(-0.21)	(-6.50)		
Coetzee_C	-35668.3	-117826.0***		
	(-0.39)	(-6.30)		
McCaw_TJ	-70261.3	-131257.2***		
	(-0.77)	(-7.07)		
Naude_PH	18274.6	-62505.7***	335788.7	
	(0.20)	(-3.33)	(0.40)	
Innes_AR	31221.1	-61323.1**		
	(0.34)	(-3.29)		
Catherine_NC	33448.3	-92098.1***		
	(0.36)	(-4.83)		
VanEssche_MCL	11772.6	-26631.3		
	(0.13)	(-1.42)		
Boshoff_AH	6265.8	-79864.9***		
	(0.07)	(-4.20)		
Baker_K	-43783.1	-147384.3***		
	(-0.46)	(-7.58)		
Coetzer_WH	-45447.7	-137762.9***		
	(-0.49)	(-7.27)		
Buchner_CA	-79968.0	-131774.3***		
	(-0.84)	(-6.82)		
Meintjes_JP	-140531.8	-119479.5***		
	(-1.46)	(-6.10)		
Volschenk_JEA	-21955.1	-135725.0***		
	(-0.23)	(-6.90)		
VanDerWESTHUIZEN_P	20576.0	-97304.6***		
	(0.21)	(-4.89)		
Villa_ED	12443.5	-103645.8***		
	(0.12)	(-4.99)		
Tier 2	-6627.1	-102200.5***	-15290.6	
	(-0.10)	(-7.75)	(-0.03)	

Tier 3	-43881.4	-133518.4***		
	(-0.67)	(-9.80)		
Death	-628.4	-614.8***	9403.7	840932.8*
	(-1.54)	(-7.50)	(0.89)	(3.16)
Age	-420.9	-112.9		
	(-0.60)	(-0.80)		
Area	26.46***	11.26***	-151.1	5028.1*
	(6.76)	(14.24)	(-0.75)	(2.67)
Area_2	-0.000574***	-0.000208***	0.00835	-0.344
	(-4.29)	(-7.75)	(0.61)	(-2.18)
Signed	28073.9	-774.0		
	(0.91)	(-0.12)		
Dated	16683.7	8974.3*		
	(0.96)	(2.56)		
Numbered	41565.9	-13954.2*		
	(1.18)	(-1.98)		
Oil	71791.0**	24857.1***	-131644.6	
	(2.71)	(4.68)	(-0.31)	
WaterProof	-22278.1	13229.5		
	(-0.43)	(1.27)		
Watercolor	19652.8	-25004.2***		
	(0.59)	(-3.73)		
WaterSolutable	-89212.0	16529.5	-541135.3	
	(-1.88)	(1.73)	(-0.75)	
MixedMedia	-25643.9	-11393.7		
	(-0.64)	(-1.43)		
DiverseMedia	-49702.8*	-15073.1***		
	(-2.56)	(-3.87)		
Ceramic	-422.9	-65871.7		
	(-0.00)	(-1.61)		
Sculp	24232.3	44531.9***	-285762.9	
	(0.59)	(5.43)	(-0.44)	
Print	-95123.6**	-44740.2***		
	(-2.65)	(-6.23)		
Photo	-22524.9	25197.3		
	(-0.04)	(0.24)		
Others	-70394.7	4847.4		
	(-0.94)	(0.32)		
Exhibited	216810.7***	49047.4***	539950.7	2797715.3
	(5.00)	(5.47)	(1.61)	(1.49)
Literature	257749.3***	78219.8***	-203968.2	
	(6.76)	(9.80)	(-0.86)	
Illustrated	-15907.6	7410.7	395295.8	
	(-0.60)	(1.39)	(0.55)	
Cover	1498441.1***	322694.3***	-20576.7	-585325.9
	(25.91)	(21.25)	(-0.09)	(-0.46)
Portrait	151977.5***	20276.8**	-845382.5	11173792.0**
	(4.54)	(2.98)	(-1.68)	(3.53)
Still_Life	130385.1***	13678.9*	-247278.9	4702947.9
	(4.23)	(2.18)	(-0.65)	(2.15)
Nude	16731.6	16504.9		
	(0.26)	(1.25)		
Figures	26187.8	26087.6***		
	(1.22)	(6.03)		
Miniature	127877.8	33950.1*		
	(1.73)	(2.29)		
Abstract	17862.5	11905.2*	392058.3	
	(0.61)	(2.04)	(0.70)	
IllusAdCart	-24171.1	-9177.0		
	(-0.32)	(-0.62)		
constant	1036001.1	1348920.7***	-17590268	-1.78e+09**
	(1.24)	(8.01)	(-0.79)	(-3.42)
N	5062	4977	59	26
R	0.36	0.32	0.48	0.80

*** denotes significance at 1% level of significance
** denotes significance at 5% level of significance
* denotes significance at 10% level of significance
Figures in round parentheses denote t-statistics

Table 6: Hedonic Price Estimations for Indirect Test

Hedonic Regression Results, 2009-2013		
	(1)	(2)
	Welz EstAve	Strauss EstAve
Battiss_WW	-166674.8	-129168.4
	(-0.12)	(-1.49)
Boonzaier_GJ	-143255.7	-117488.1
	(-0.10)	(-1.26)
Pierneef_JH	-52315.4	258248.4**
	(-0.03)	(2.73)
Skotnes_CEF	-488533.9	-15316.8
	(-0.27)	(-0.16)
Sumner_MFE	-14925.4	-129921.3
	(-0.01)	(-1.33)
Laubser_Maggie	-241554.7	-135933.9
	(-0.16)	(-1.32)
deJongh_MJ	-403866.4	-176043.8
	(-0.27)	(-1.42)
Naude_PH	-341670.7	-156768.7
	(-0.20)	(-1.43)
McCaw_TJ	-442166.8	-234320.2*
	(-0.29)	(-2.06)
Stern_Irma	18246112.6***	1945558.6***
	(9.87)	(18.58)
Hodgins_RG	-254712.2	-176846.5
	(-0.16)	(-1.72)
Coetzer_WH	-410495.1	-203809.6
	(-0.25)	(-1.89)
VanHeerden_P	-396012.9	-174093.7
	(-0.17)	(-1.73)
Boyley_ES	-399570.5	-182371.0
	(-0.26)	(-1.50)
Claerhout_FM	-335825.3	-159366.1
	(-0.22)	(-1.36)
Krige_F	-286586.7	-171943.5
	(-0.20)	(-1.05)
VanEssche_MCL	-217193.2	-155233.8
	(-0.13)	(-1.36)
Innes_AR	-138332.4	-128657.2
	(-0.08)	(-1.16)
Baker_K	-578973.9	-223576.5
	(-0.40)	(-0.74)
Coetzee_C	-396976.2	-185858.9
	(-0.22)	(-1.53)
Catherine_NC	-219443.5	-89312.7
	(-0.14)	(-0.76)
Bchner_CA	-479107.2	-211073.8
	(-0.27)	(-1.80)
Villa_ED	-208550.2	-96886.7

	(-0.07)	(-0.89)
Boshoff_AH	-371928.7	-151274.5
	(-0.22)	(-1.16)
Meintjes_JP	-383276.4	-238932.5*
	(-0.18)	(-2.15)
Tier2	-343775.7	-142147.7
	(-0.28)	(-1.91)
Tier3	-360559.0	-173067.4*
	(-0.30)	(-2.24)
Death	-1517.6	92.22
	(-0.26)	(0.18)
Age	-133.9	-88.27
	(-0.12)	(-0.47)
Signed	133653.4	-6865.0
	(0.24)	(-0.15)
Dated	73555.0	10709.9
	(0.29)	(0.45)
Numbered	41945.5	34990.9
	(0.08)	(0.75)
Oil	232459.3	128507.0***
	(0.52)	(3.64)
WaterProofOiltexturedpigmen	137778.3	52653.8
	(0.22)	(0.70)
Watercolor	-143921.6	70383.8
	(-0.27)	(1.54)
WaterSolutableWatercolortextu	-128754.4	-201371.7**
	(-0.18)	(-2.81)
MixedMedia	-150385.6	-4710.2
	(-0.25)	(-0.09)
DiverseMediaStickmediumwith	-201035.5	-63130.2*
	(-0.60)	(-2.56)
Sculp	80074.0	15942.2
	(0.12)	(0.34)
Print	-143790.9	-76211.7
	(-0.25)	(-1.57)
Photo	66115.8	28890.9
	(0.04)	(0.09)
Others	-6565.5	-54962.2
	(-0.01)	(-0.54)
Exhibited	-550054.8	124166.6**
	(-0.47)	(2.68)
Literature	417483.8	169897.9***
	(0.43)	(4.20)
Illustrated	-213304.4	105548.7
	(-0.82)	(0.31)
Cover	-1664104.9	1389281.1***
	(-1.09)	(22.28)
Still_Life	-253434.7	-18066.9
	(-0.49)	(-0.39)
Nude	-461939.8	-31696.9
	(-0.55)	(-0.33)

Figures	-131168.6	-81015.1*
	(-0.38)	(-2.55)
portrait	316234.9	-145871.3
	(0.16)	(-1.11)
Miniature	-68429.3	-44948.0
	(-0.09)	(-0.10)
Landscape	-206807.1	-92366.5**
	(-0.60)	(-2.62)
IllustrationsAdCartoon	-18183.2	-110341.6
	(-0.02)	(-1.10)
Constant	3410981.7	12604.4
	(0.29)	(0.01)
N	3154	3423
R	0.08	0.31

*** denotes significance at 1% level of significance
** denotes significance at 5% level of significance
* denotes significance at 10% level of significance
Figures in round parentheses denote t-statistics

Table 7: Indirect Test

Empirical Analysis results of Market Leader and Follower Model					
Strauss & Co. (SC) Welz & Co. (SWC)		Total		Sold	
		Mean	Median	Mean	Median
SC on SC	Hedonic	164275	77177	160922	58066
	Estimate	164401	40000	160972	40000
SC on SWC	Hedonic	95852	76340	54352	35237
SWC on SWC	Hedonic	174968	66066	45190	35671
	Estimate	139869	14000	45192	12750
SWC on SC	Hedonic	505161	189413	-254996	-302253

Figure 1: Total South African Art Sales

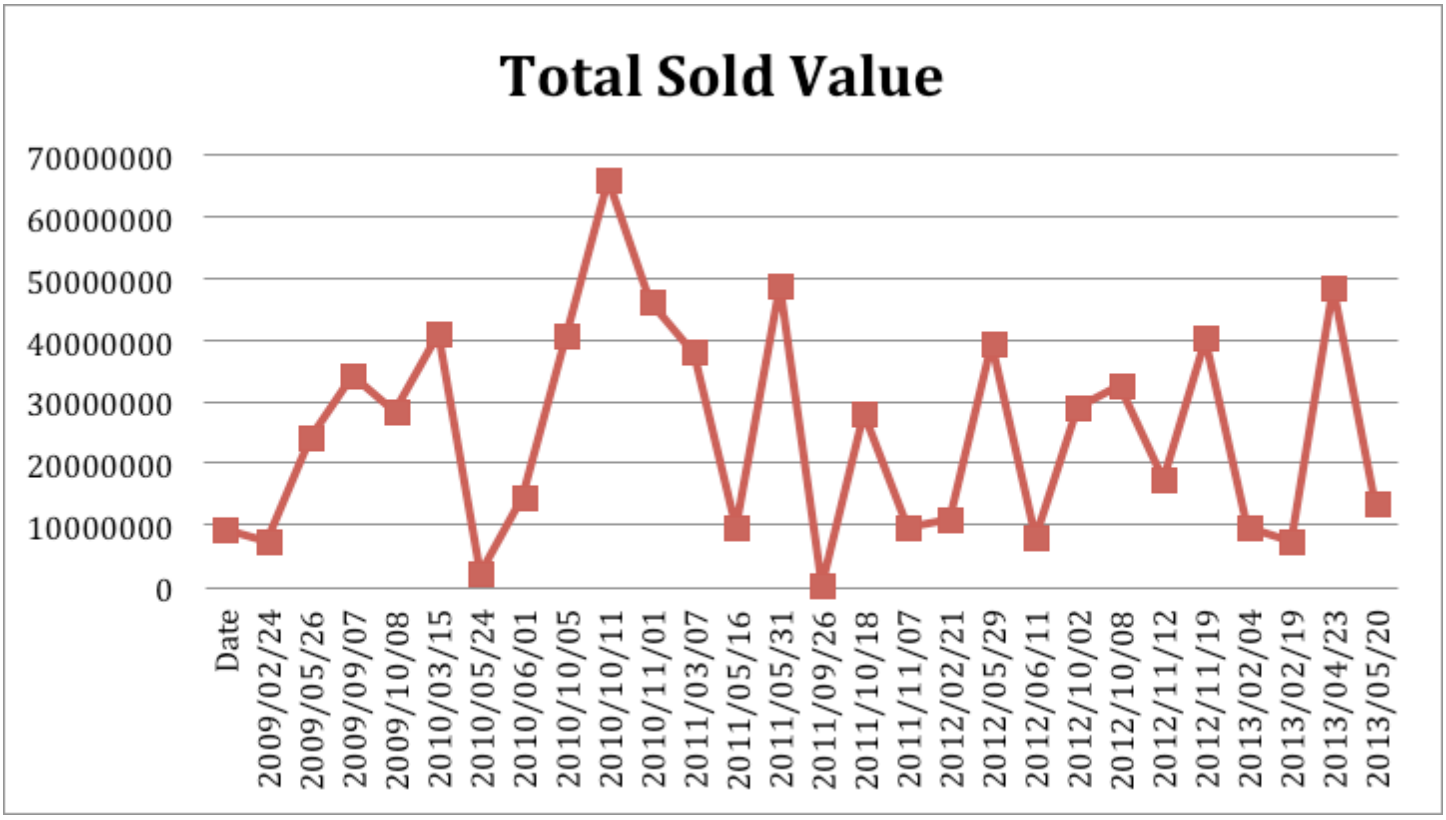


Figure 2: Strauss and Co Mean and Median Art Sales

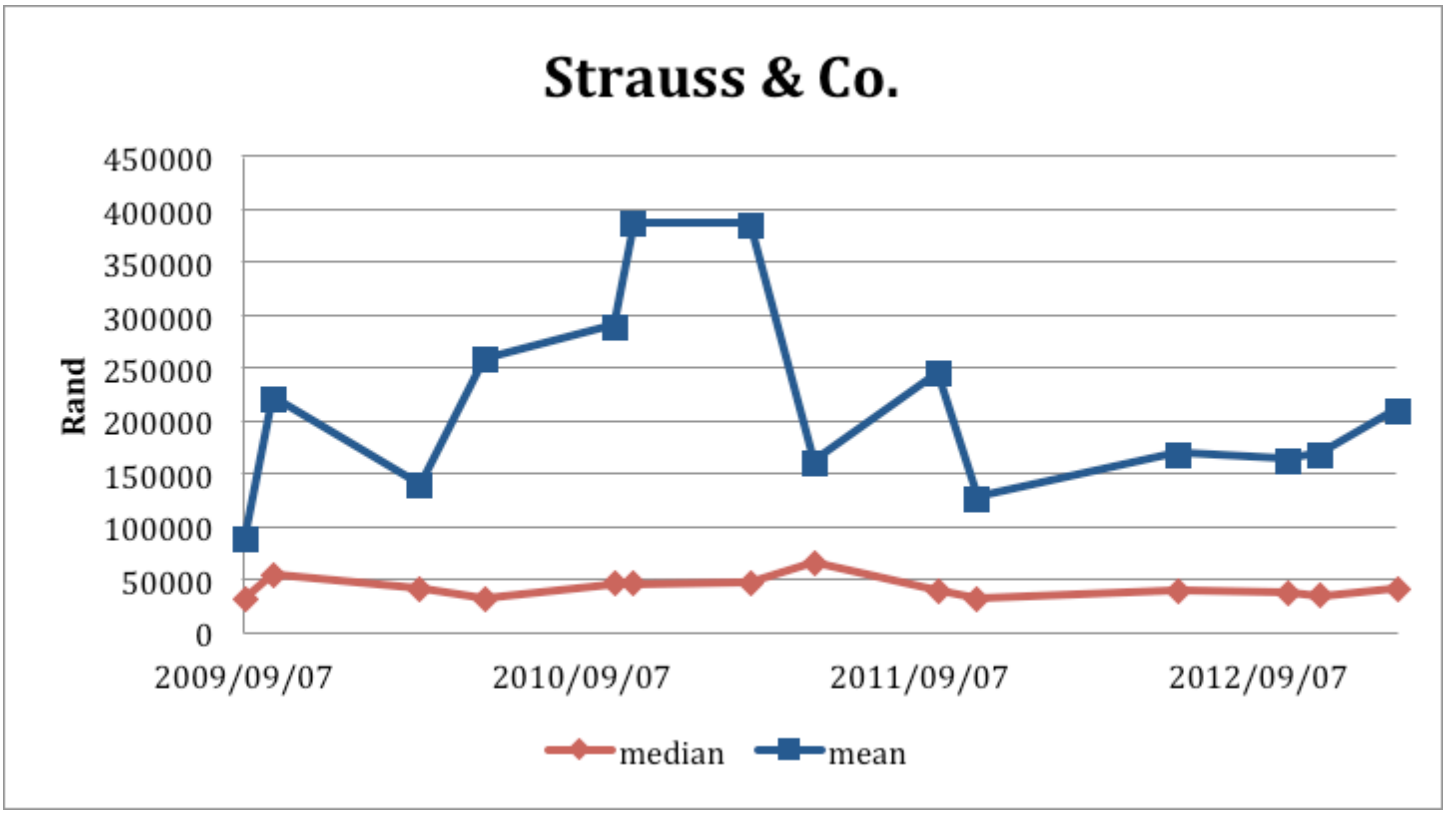


Figure 3: Stephan Welz and Co Mean and Median Art Sales

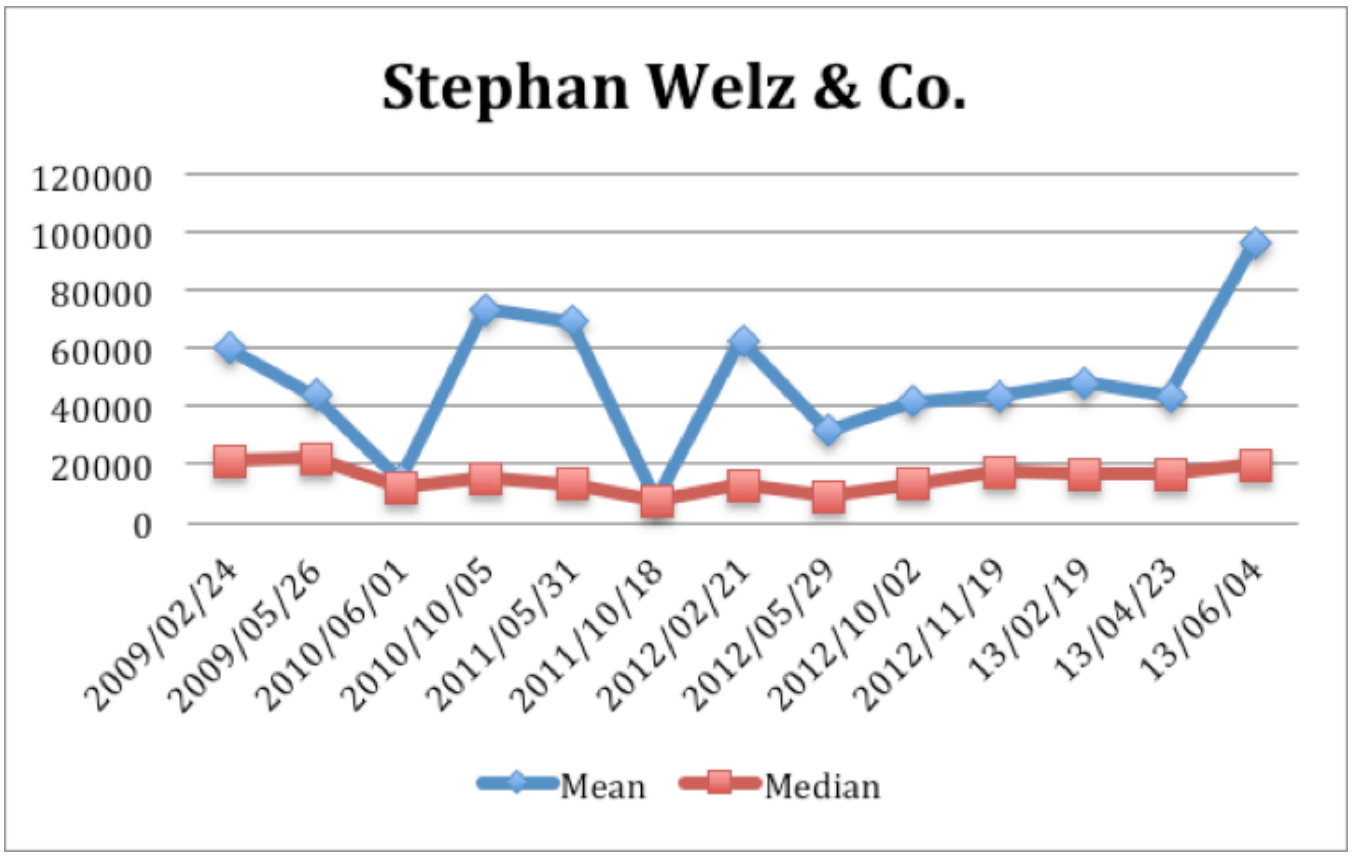


Figure 4: Strauss and Co Total Art Sales

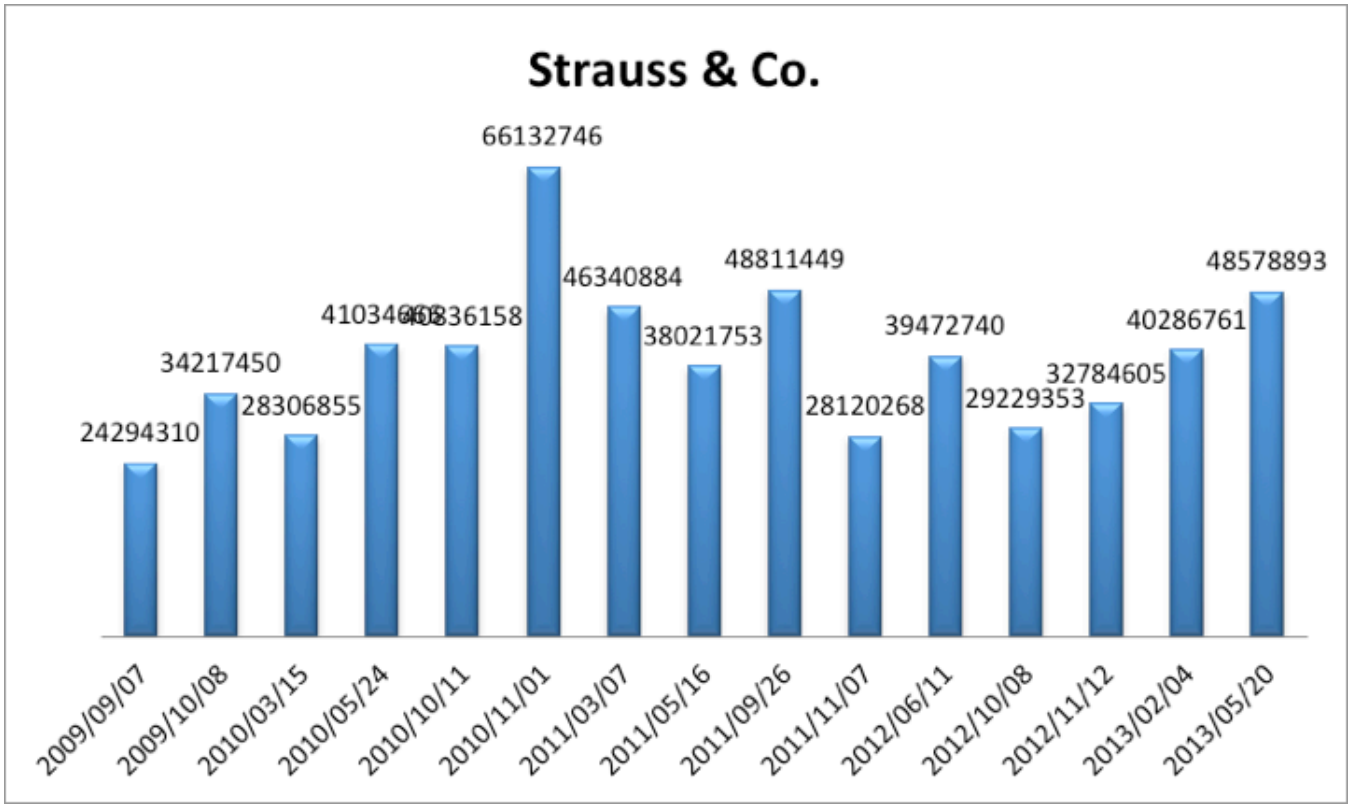


Figure 5: Stephan Welz and Co Total Art Sales

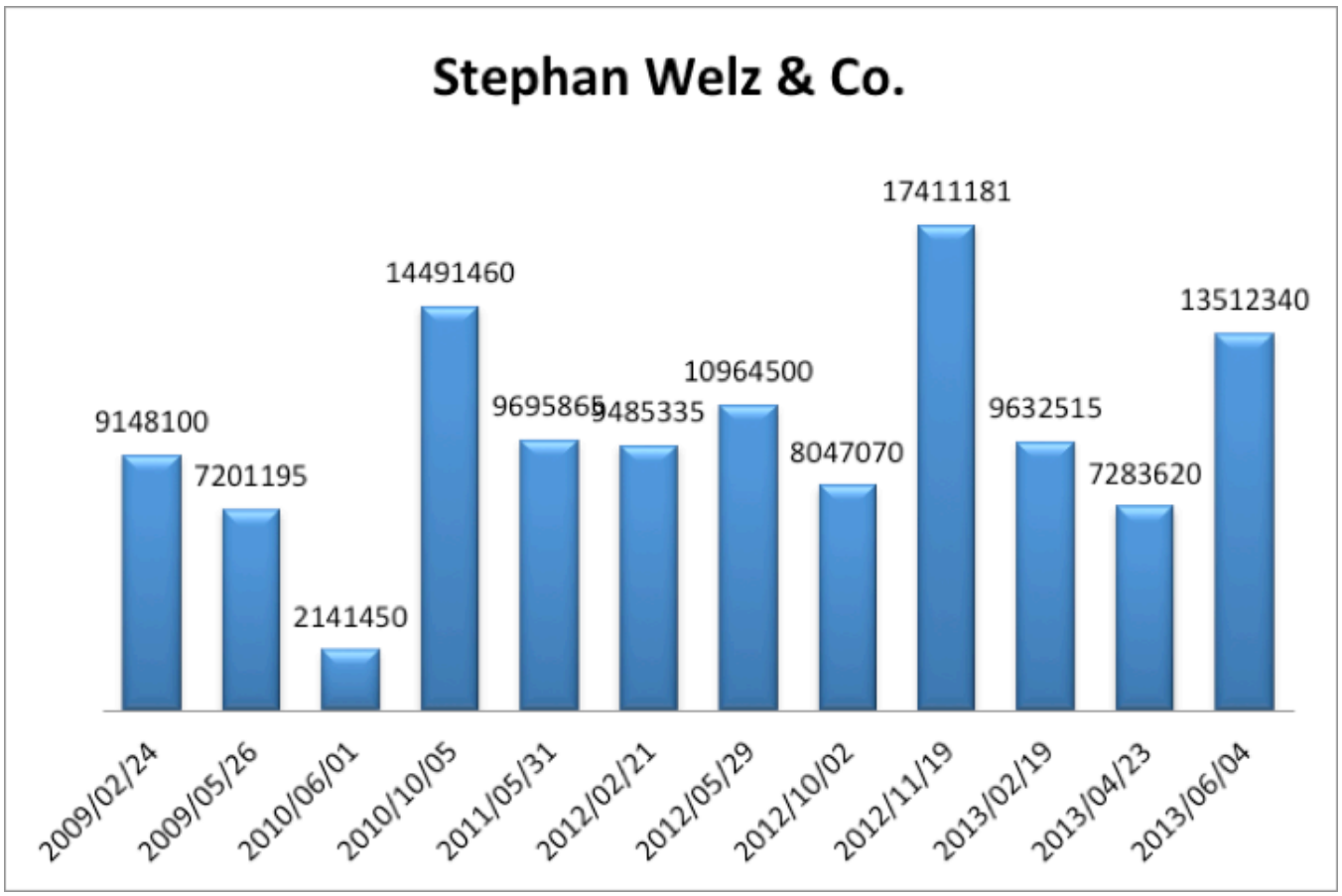


Figure 6: Number of Art Auction Lots Offered for Sale

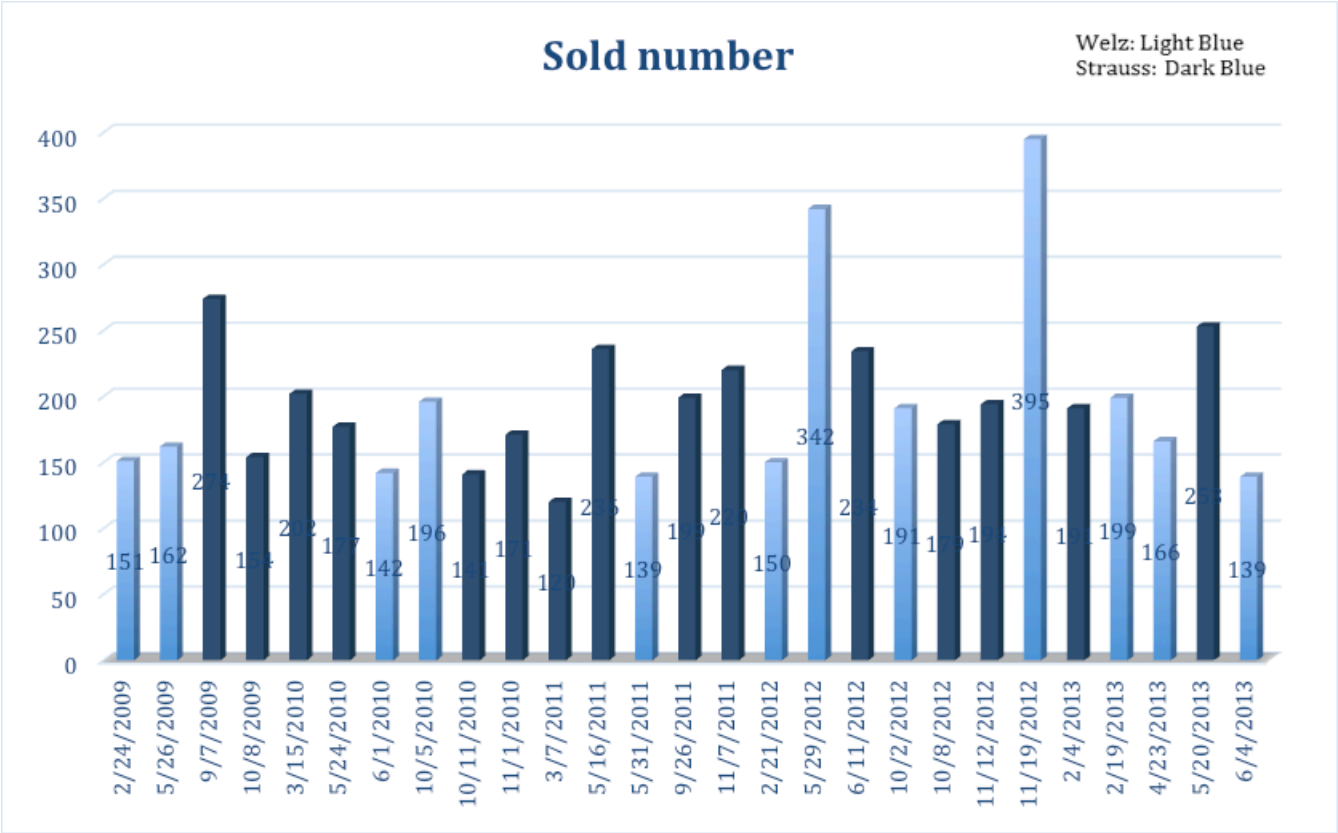


Figure 7: Ratio of Sold Art Auction Lots to Total Auction Lots Offered for Sale

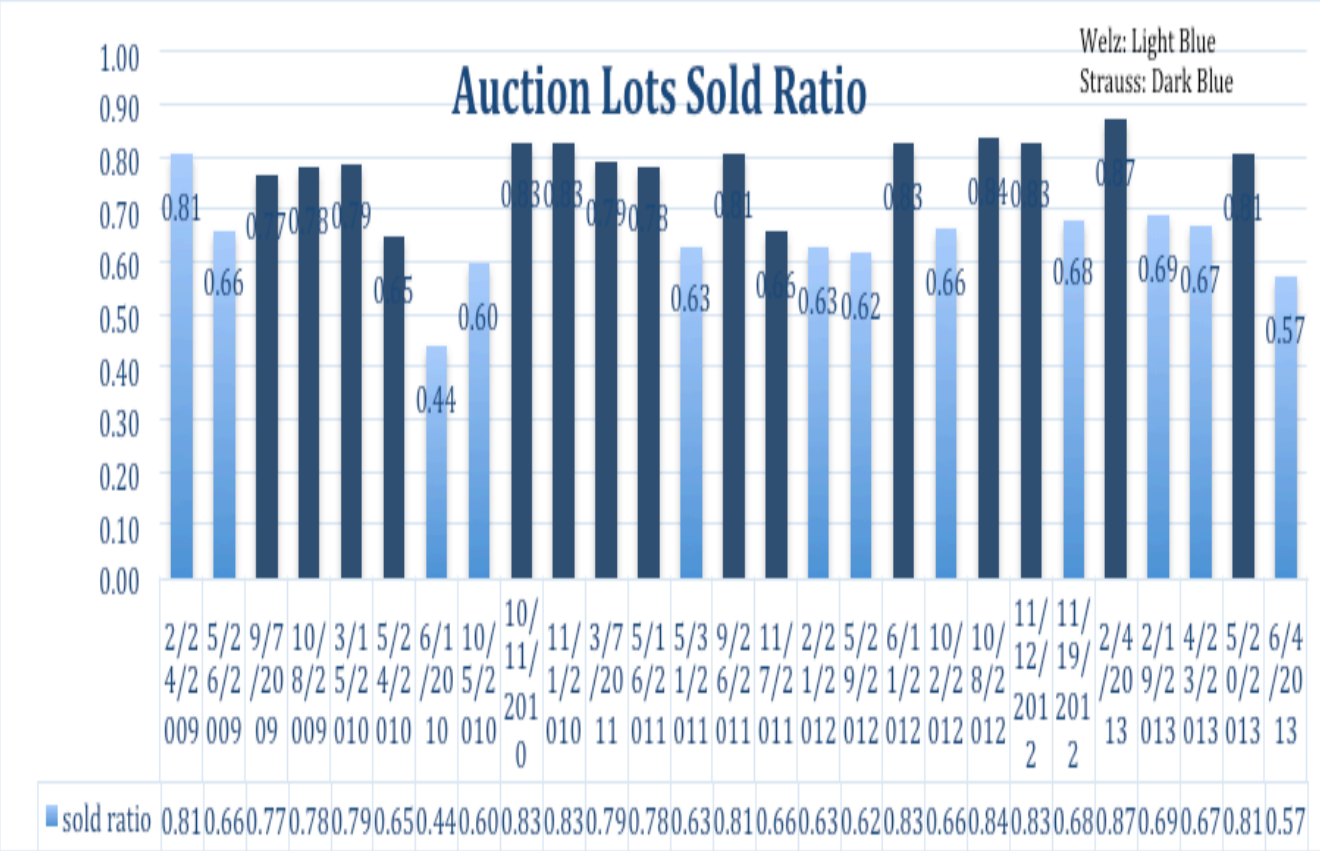


Figure 8:

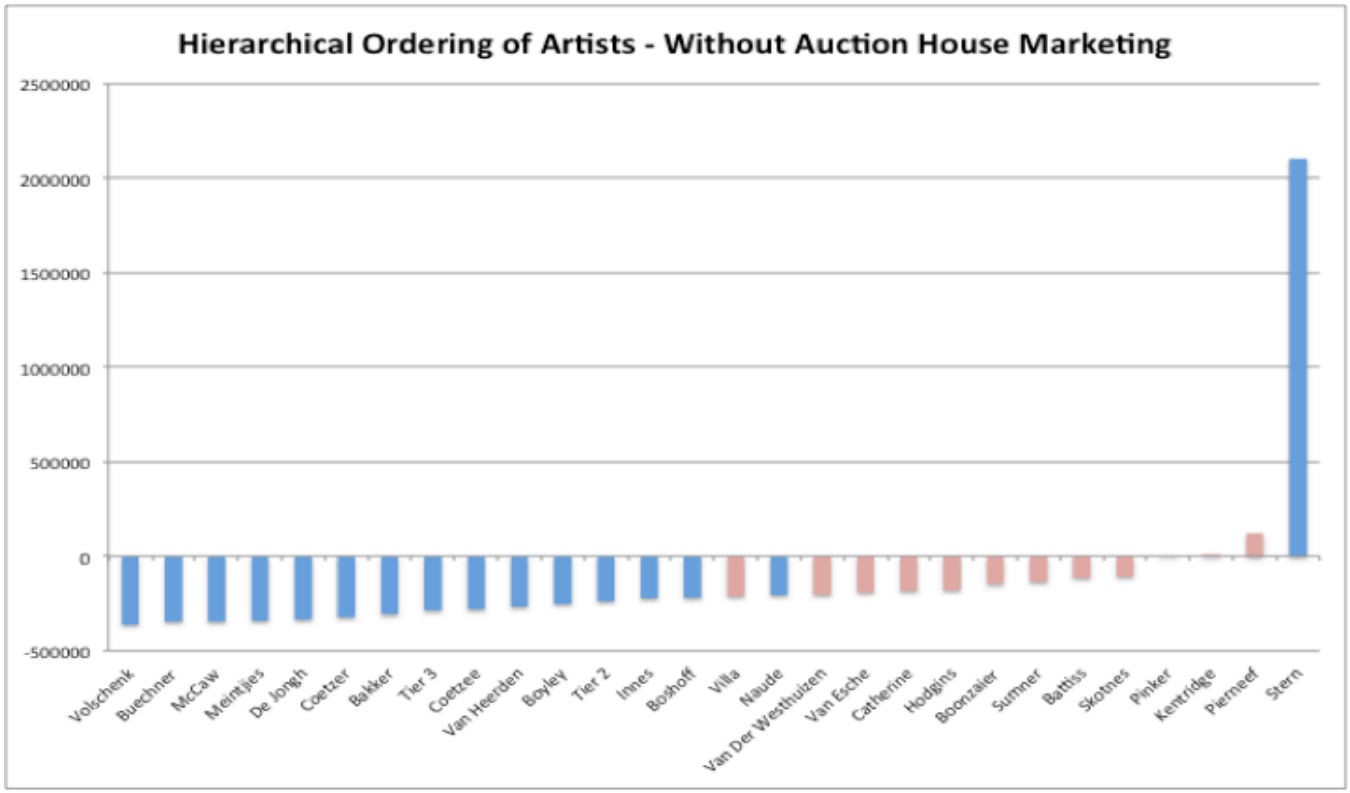


Figure 9: Market Segmentation

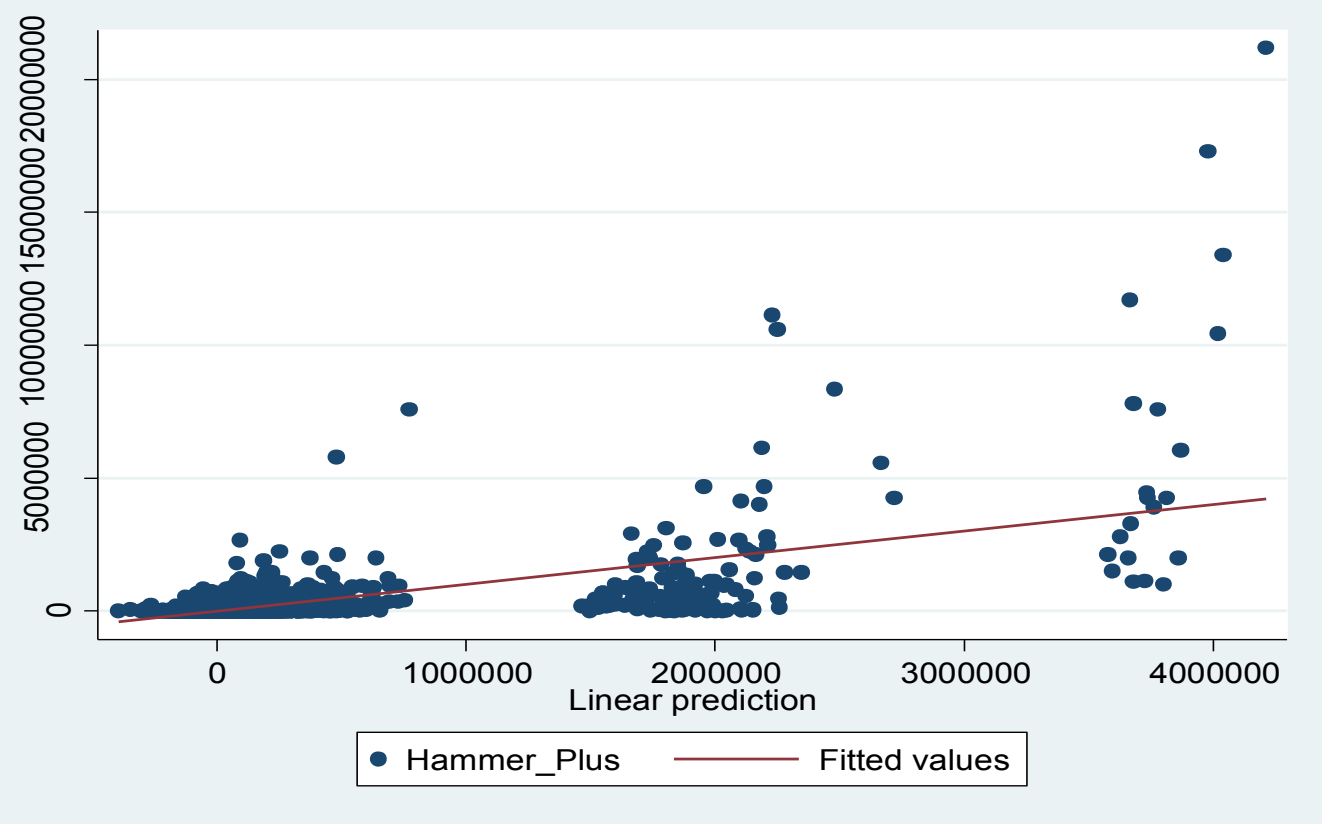


Figure 10: Implied Elasticities 1: GDP

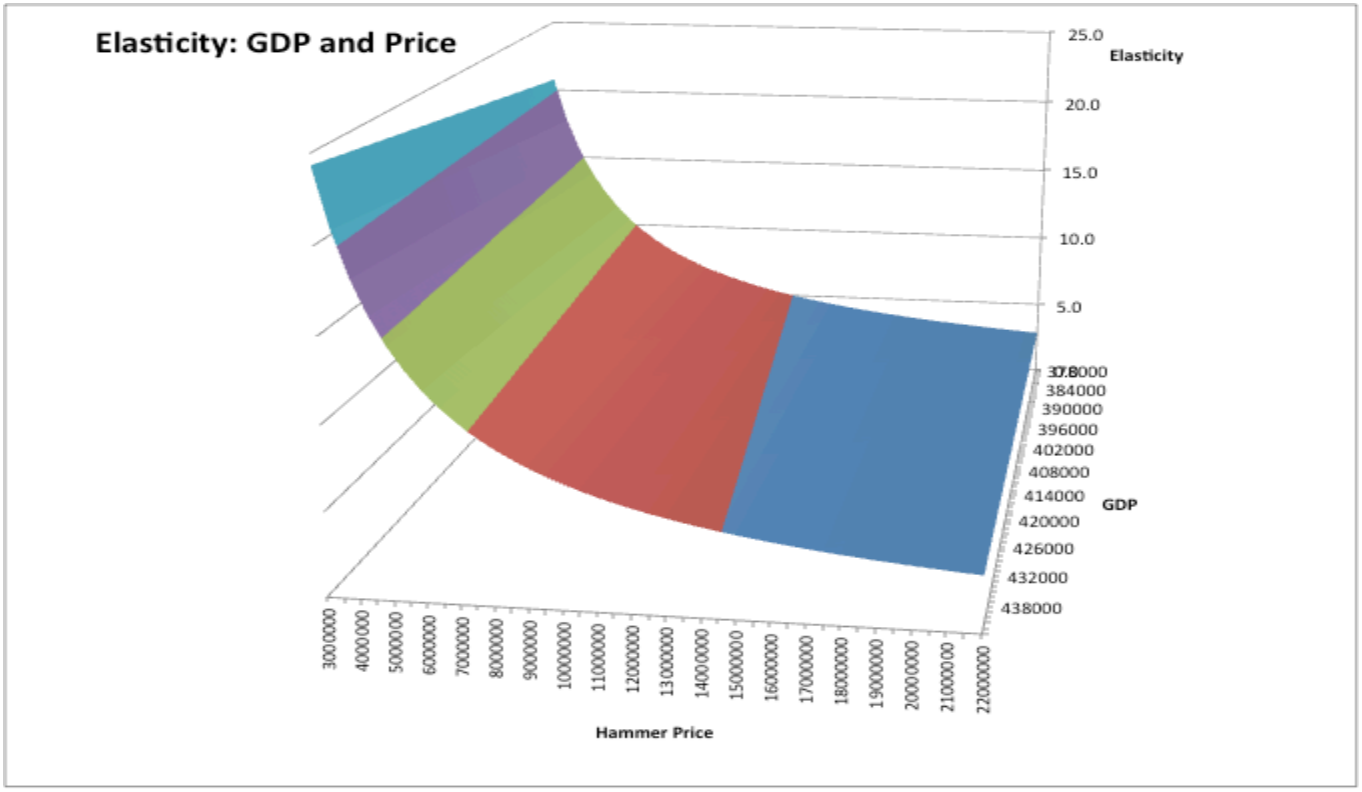


Figure 11: Implied Elasticities 2: Dow Jones

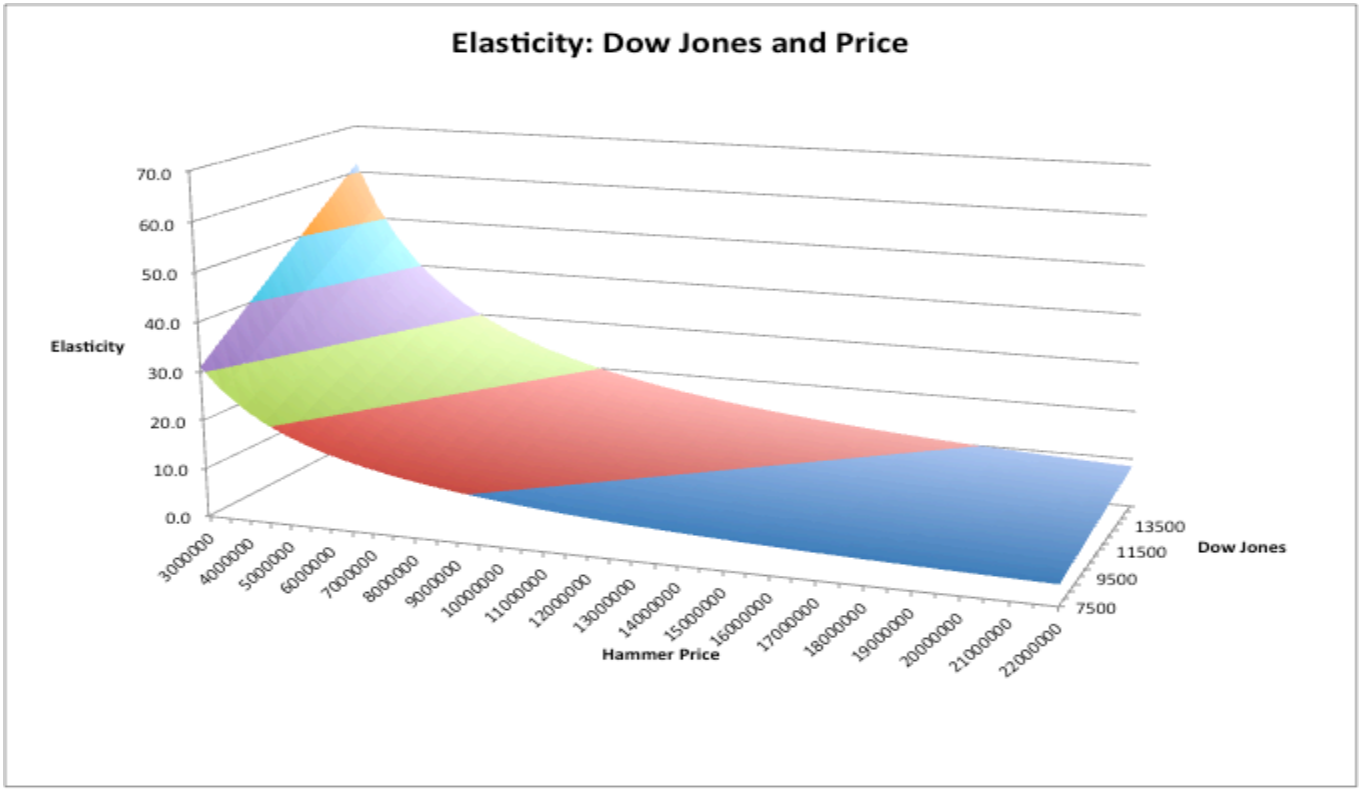


Figure 12: Implied Elasticities 3: JSE

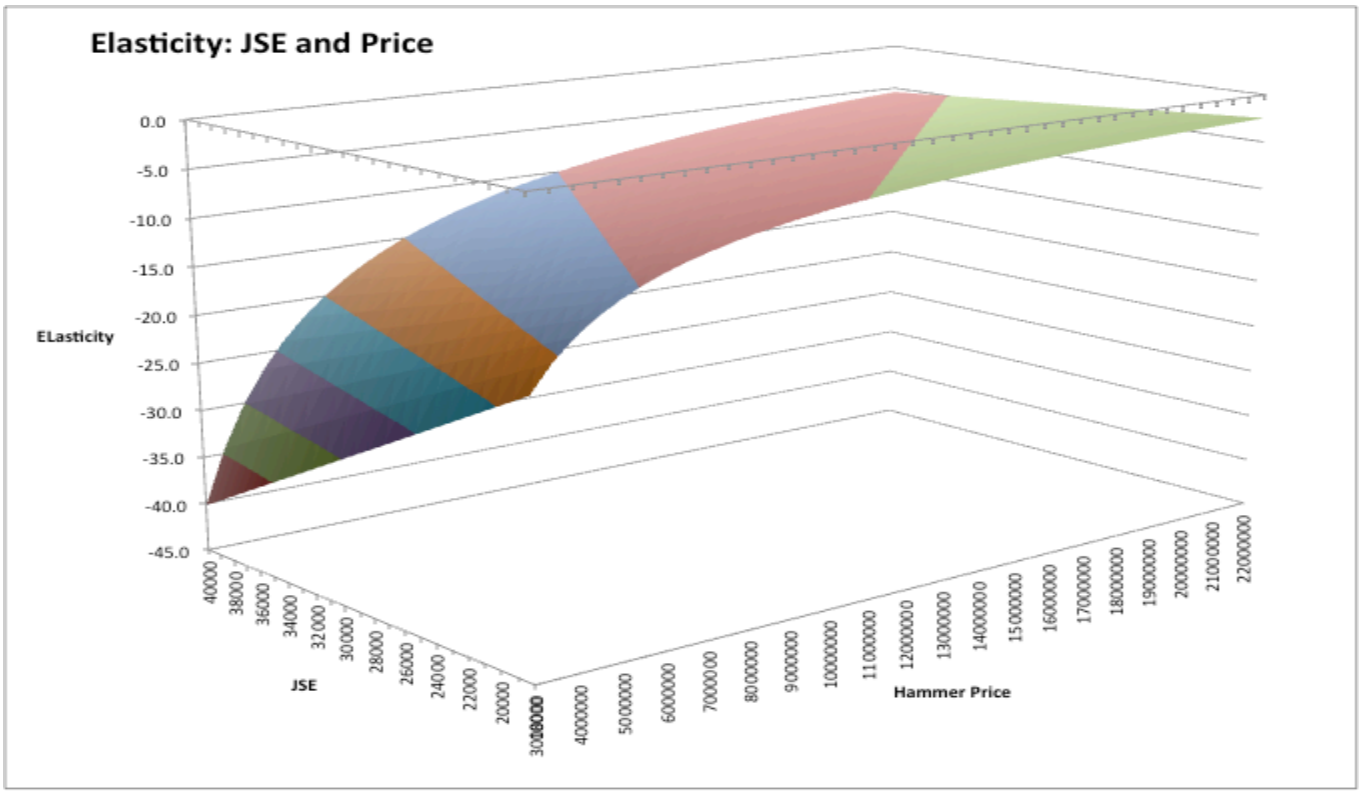
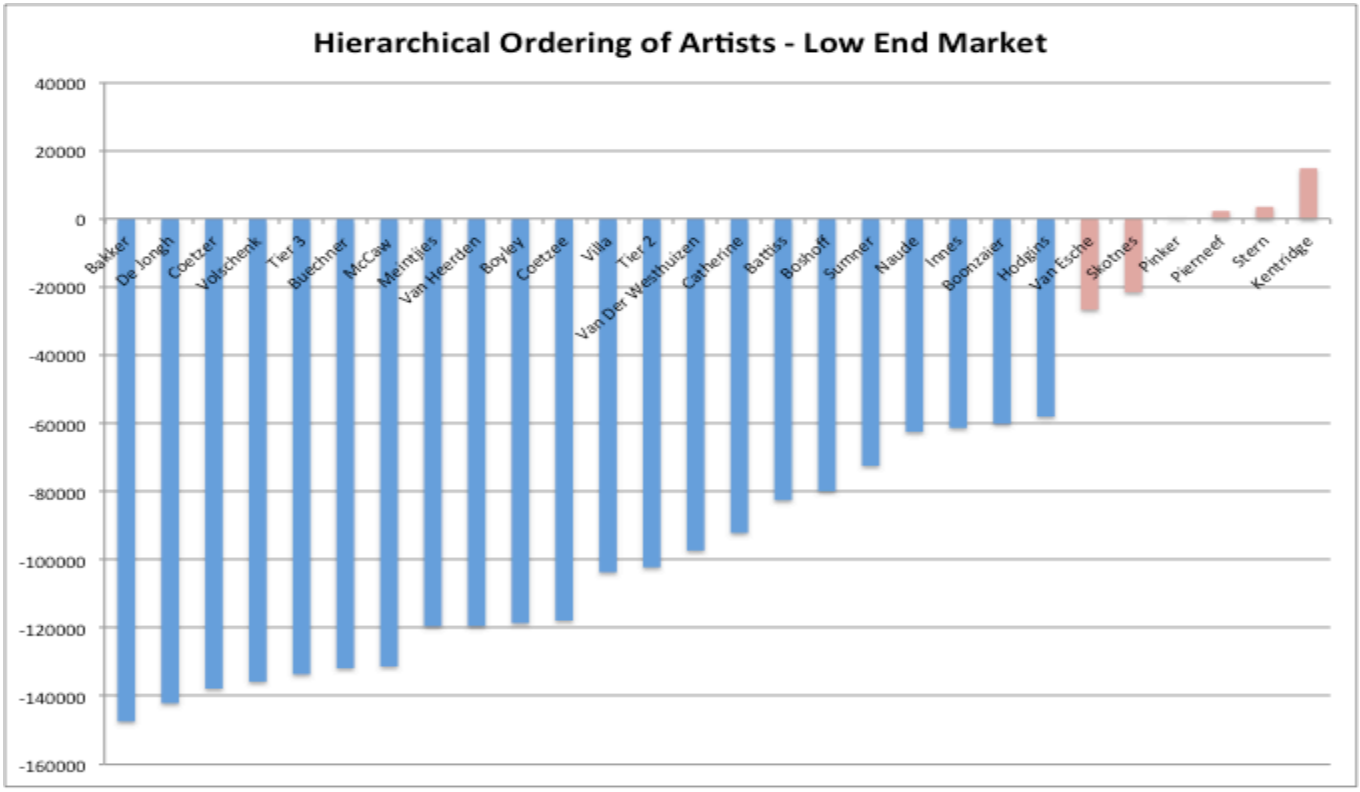


Figure 13:


Hierarchical Ordering of Artists - Low End Market
40000
20000
0
-20000
-40000
-60000
-80000
-100000
-120000
-140000
-160000
Bakker
De Jongh
Coetzer
Volschenk
Tier 3
Buechner
McCaw
Meintjies
Van Heerden
Boyley
Coetzee
Villa
Tier 2
Van Der Westhuizen
Catherine
Battiss
Boshoff
Sumner
Naude
Innes
Boonzaier
Hodgins
Van Esche
Skotnes
Pinker
Pierneef
Stern
Kentridge