Determinants of Prices and Sales Rates in the New Zealand Secondary Art Market, 1988-2011

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Abstract The economics of the New Zealand art market is unstudied, perhaps due to its isolation and small size. Further, given late European colonisation, monetised art production in the Western canon only began in the mid-nineteenth century. These features suggest not only a coherent national market, but also a laboratory for examining art markets. Prices realised at auction were estimated against artwork characteristics and state of the market for 27,365 artworks by artists associated with New Zealand. Other artworks, which are only a small proportion of the New Zealand art market are ignored. Potential sample selection bias created by those works that go unsold at auction as reserve price not reached in bidding) was corrected using the Heckit method. This involved estimation of an equation explaining works "bought in". In the absence of known reserve prices and auction house estimates, special attention is paid to explaining the "buy-in" rate in terms of information in the market for each artist - the greater the information, the more likely it is that reserve prices would be accurate, increasing the probability of a sale. It is also argued that auction house selling strategies would play a role in determining the "buy-in" rate. The empirical results of the estimation are presented and the impact of sample selection correction is considered.

Key Words Buy-in, selection bias, hedonic pricing

JEL Classifications C35, G11, D44 (Market Structure and Pricing - Auctions)

1 Introduction

The New Zealand art market (re-sale at auction) is analysed using the hedonic pricing model. As indicated, there are significant reasons for examining the New Zealand art market, most being related to both its short history and its isolation. This suggests it may be natural laboratory for examining such markets.

As the New Zealand art market is relatively unknown a little historical background is in order. The New Zealand secondary art-market (largely sales of artworks by owners rather than sales by the artists or their agents of works not previously on the market) uses art auctions as its vehicle. Although art auctions appeared in NZ in the nineteenth century, it was only in the late twentieth century that they appear to have become an established method of sales that continues throughout the year rather than sporadically. This is not surprising given that the stock of paintings would be too small to ensure a consistent enough flow to establish a re-sale market. Sales were often through exhibitions by art societies in the main urban centres, including a good number of amateur artists and also a greater number of female artists than is usually represented in art sales. As an indication of the late start, Canterbury College School of Art (www.fina.canterbury.ac.nz - founded 1882) was the first in New Zealand. The Otago Art Society was the first such society formed (1876) in Dunedin". The market of consumers was also small with a total population of only 967,000 in 1900 and 1,429,700 in 1926. The present population is approximately 4.5 million, the size of a medium sized city in many countries with established, stable art markets. This suggests that in restricting works to domiciled artists, the market will not create historical or contemporary NZ artists fetching astronomical prices, so avoiding the potential estimation distortions arising from this.

In part because of the small size and isolation of the market, thick (size of) market effects on the saleability of artworks are considered potentially important. Commodities in a thick market are more liquid than those in less thick markets and are more readily accepted. Generally the concept of thickness is used in conjunction with relatively homogeneous commodities, and refer to the size of the market as a whole. Here the term is applied to works by a specific artist, given the heterogeneity exhibited by artworks as a whole. This is not the same as a reputational (quality) effect, as this would apply solely to price. The number of artworks sold by each artist over the entire sample period is used as a proxy for thickness of the market for their artworks as opposed to those of other artists. So artworks with a thin market are less liquid and more difficult to sell. The sellers may choose to hold onto these artworks with expectations of attracting higher prices in the future (Gavazza 2008, House and Ozdenoren, 2008). Price for artworks also depends on quantity but more on the supply at each auction. The price of a particular artwork is expected to diminish with higher availability on the day of auction. This is the first paper that incorporates both thickness of markets (a longer run consideration) and supply (short-run) conditions in modelling art prices and art indices.

The use of the count of artworks is also used to partially overcome a problem that is faced by the data set for this study. With over one thousand artists represented in the data set, and especially since many only have one artwork appearing throughout the entire study period, it is impossible to use dummy variables meaningfully to represent individual artists. This problem will become increasingly important in art price economics as larger and larger data sets are employed.

Non-random selection of artworks in the estimation of the relationship between auction prices and its characteristics to produce an art market index could give rise to model specification error and bias. Artworks that do not reach the reserve price and are not sold at auctions are widely known in the art market as buy-ins. Past research on modelling art price dynamics or art price indices overwhelmingly encompass only artworks sold at auctions. Excluding buy-ins introduces a potential selection bias (based on non-randomly selected samples) and so can produce misleading ordinary least squares, OLS, estimates. Heckman (1979) treated the selection bias as a specification error and introduced a consistent estimation method to take account of the censored sample specification error. This involves a two-stage estimation method to correct for non-randomly selected samples. Collins et al. (2007) explore the sample selection bias in a sample of artworks by painters categorised as Symbolists.

The remainder of the paper is structured as follows. Section 2 provides a critique of selection bias and computation of art market price indices. Data and hypotheses are dealt with in section 3. Section 4 presents the methodology incorporating selection bias. The empirical results are presented in Section 5. Conclusions are discussed in Section 6.

2 Background on Art Market Indices and Empirical Analyses

A body of quantitative techniques such as the naïve/average art index method; repeat-sales index method; hedonic price index method and risk, return and portfolio analysis has been widely used to measure and explore the pricing trends of secondary art markets. Predominantly, these studies estimate art price indices from auction prices and in turn calculate returns for portfolio analyses.

One of the earlier techniques, the naïve art index method, tracks the changing value of a fixed basket of paintings (Stein, 1977; Candela and Scorcu, 1997). The repeat-sales index method follows the changes in value of resold paintings. One major advantage of the repeat-sales method is that it is parsimonious and does not include the quality characteristics of artworks. This method is greatly disadvantaged by the limited number of observations as artworks are infrequently resold (Anderson 1974; Baumol, 1986; Frey and Pommerehne, 1989; Buelens and Ginsburgh, 1993; Goetzmann, 1993; Pesando and Shum, 2008; Locatelli

Biey and Zanolla, 1999; Mei and Moses, 2002; among others). In the hedonic price index method, all sales (including repeat-sales) are considered as single sales for which the objective features such as name of the painter, size of painting, medium of execution, etc. are recorded (de la Barre et al., 1994; Chanel et al., 1994; Czujack, 1997; Angello and Pierce, 1996; Higgs and Worthington, 2005; Renneboog and Spaenjers, 2011; Higgs, 2012; Higgs and Forster, 2014; among others). A clear advantage of the hedonic price method is that all auction data are used. The main disadvantage is that often only a few characteristics of each painting are gathered together in any given dataset (usually auction records). In terms of portfolio analysis, the Markowitz method is used to analyse risk, return and portfolio diversification (Renneboog and Van Houtte, 2002; Worthington and Higgs, 2004; Renneboog and Spaenjers, 2013; Higgs, 2012, among others). So far these studies only considered artworks sold at auctions and completely ignore all buy-ins and ultimately over-estimating of art price indices and/or portfolio analyses.

To address the problem of buy-ins, Collins et al. (2007) use the Heckman two-stage process to calculate a price index for symbolist painters spanning the period 1990 to 2001. The results show that the estimated sample selection bias coefficient is significant and therefore supports the Heckman selection bias process yet there is no significant difference between the OLS and Heckman art price indices.

This paper attempts to extend on past studies by including all artworks offered at auction houses including buy-ins in the New Zealand art market. This completeness of information may produce unbiased and consistent estimates and produce more reliable art price indices.

3 Data

The data set comprises 27,365 individual auction sales between 1988 quarter one and 2011 Quarter four. These sales represent all paintings sold and unsold at auctions over this period. The works are by 1,661 New Zealand artists that either born or lived mostly in New Zealand. Only the reputation of 20 artists is included in the empirical modelling and they are selected on the highest price achieved at auctions. This data set captures the longest time period and continuous spectrum of art movements and genres. Thus the works are intended to be highly heterogeneous with respect to period, subject matter, genre and medium. The records of all sales of all individual artists' works in the seven New Zealand auction houses are collected from the Australian Art Sales Digest (2013). The data were then aggregated into quarters. Almost all these transactions are secondary sales consigned by domestic owners. Their reasons for consignment are not known. The price variable is the auction hammer price plus the buyer's premium, being 10 to 30 percent above the hammer price depending on the auction house. The premium is included as it increases the purchasers' outlay and is different between auction houses. Hammer price alone would be misleading. Pessando and Shum (1999), Locatelli Biey and Zanola (1999), Zanola (2007), Higgs (2012) and Higgs and Forster (2014) also include premium to the hammer price.

4 Model Specification and Descriptive Statistics

The majority of research on modelling art price dynamics or art price indices involves only artworks sold at auctions. By excluding buy-ins, this will introduce a selection bias based on non-randomly selected samples, and this will produce misleading OLS estimators. Heckman (1979) threated the selection bias as a specification error and introduced a consistent estimation method to take account of the censored specification error. This involves a two-stage estimation method to correct for non-randomly selected samples. This model is called the Heckman two-stage or Heckit model.

In the first stage, the selection bias equation can be specified as the probability of artworks being sold or unsold or a probit regression of the form:

$$\mathrm{SLD}_i = Z_i\gamma + u_i \tag{1}$$

where SLD indicates sale of artworks ($SLD_i = 1$ if the artwork has been sold and $SLD_i = 0$ otherwise), Z_i is a vector of regressors that explain if an artwork sells or remains unsold, γ is a vector of unknown parameters and u_i is a vector of random errors with $E(u_i) = 0$ and $E(u_i^2) = 1$. Equation (1) yields results that can be used to predict the probability of sale of artworks for each artist.

In the second stage, the art price equation is corrected for self-selection by incorporating a transformation of these predicted individual probabilities as an additional explanatory variable. The art price equation may be specified as:

$$\mathrm{PCE}_i = X_i\beta + \varepsilon_i \tag{2}$$

where PCE_i denotes the logarithm of the price of artwork i for only artworks that have been sold at auctions, β is a vector of shadow prices, X_i is a matrix of regressors that illustrate the characteristics of each artwork and ε_i is a vector of random errors with $E(\varepsilon_i) = 0$, $E(\varepsilon_i^2) = \sigma_\varepsilon^2$

and $E(\varepsilon_i u_i) = \rho\sigma_\varepsilon$ and are jointly normally distributed. Z_i is a matrix of regressors which shares common characteristics as X_i. The conditional expectation of price given artworks that have been sold is defined as:

$$E[PCE_i | X_i, SLD_i = 1] = X_i\beta + E[\varepsilon_i | X_i, SLD_i = 1] = X_i\beta + \rho\sigma_\varepsilon\lambda(Z_i\gamma) \qquad (3)$$

where ρ is the correlation between unobserved determinants of propensity to sell artworks and unobserved determinants of price offers and λ is the inverse Mills ratio evaluated at $Z_i\gamma$. The inclusion of the sample selection can be viewed as a form of omitted variable bias, conditional on both X_i and λ and this modifies the sample as if it is randomly selected. The art price equation can be estimated by replacing λ with the Probit estimates from the first stage and including it as an additional explanatory variable in the linear regression estimation of the art price equation. Restricting $\sigma > 0$, λ can only be zero if $\rho = 0$, so testing the null that the coefficient on λ is zero is equivalent to testing for sample selectivity. The selection bias is present if $\rho = 0$ is rejected.

The dependent variable for the selection bias equation (1) is a dummy variable representing whether the artwork is sold or not sold, SLD, with SLD equals to 1 if sold and 0 elsewhere. The dependent variable for the art price equation (2) is the logged price paid by the successful bidder. The price is defined by the auction hammer price plus buyer's premium. The buyer's premia are included as these differ from period to period and, most importantly, from auction house to house (Pessando and Shum, 1999; Locatelli Biey and Zanola, 1999, Higgs, 2012; Higgs and Forster, 2014).

The matrix of characteristic regressors for the art price equation encompasses four groups. The first group relates to the artists, including each artist's name. An artist's name serves as a surrogate quality variable and to some degree with subject matter and genre. Twenty artists are included where these artists have commanded the highest prices for their artworks. Binary dummy variables link each artist to a work, with artists not included in the top 20 as the reference category. Thus, in the New Zealand canon, artists such as Colin McCahon, Charles Goldie, Frances Hodgkins and Gordon Walters should have a positive impact on price compared to the reference category. If an artist is dead (DTH) or alive (ALV) at the time of the auction of each of his or her works requires dummy variables: DTH = 1 if deceased and DTH = 0 elsewhere; ALV = 1 if alive and ALV = 0 otherwise; UKN = 1 if the date of birth or death is unknown and UNK = 0 elsewhere with UNK as the reference category. The estimated coefficient on DTH is expected to be positive, and to have a higher value than the estimated coefficient on ALV. The role of death in determining an artist's prices has been studied elsewhere (e.g. Ekelund et. al., 2000; Higgs and Worthington, 2005; Ursprung and Wiermann, 2008; Renneboog and Spaenjers, 2013, Higgs and Forster, 2014 and among others). Of the 1661 artists, 907 (54.6 percent) died prior to or during the study period, 654 (39.4 percent) are alive at its end and 100 (6 percent) with unknown birth or death dates. The explanatory variable, COUNT, represents thickness of the art market as measured by the number of artworks offered by a given artist over the entire study period. This variable is a proxy for thickness of the market in a specific artist's work and is therefore an experiential/informational variable. In this sense the greater the thickness of the market for an artist the less the risk in purchasing the artist.

The second group of explanatory variables is the physical characteristics of the works. The media employed are acrylic (ACR), charcoal (CHA), crayon (CRA), etching (ETC), gouache (GCH), lithography (LTH), pastel (PAS), pencil (PEN), oil (OIL) and watercolour (WCO). They are treated as dummy variables, the reference category being 'all other media', including mixed media (MIX). Oil is expected to have the largest positive impact on price, followed by its substitute, acrylic, both having characteristics of durability, permanency and colour-fastness. Etching and lithography, allow editioning of copies of the same image, creating a lack of uniqueness and so should have estimated negative coefficients. More ephemeral and fugitive media, i.e. charcoal, crayon, gouache, lithographs, pastels, pencil and watercolour are expected to have a negative impact upon price. In addition, these media are usually rendered on paper and are more prone to deterioration, and can be rendered more quickly and in greater numbers of works than oils and acrylics. Nonetheless, the largest group of works sold is oils (80.14 percent), then acrylics (12.85 percent) and mixed media (4.30 percent). Physical characteristics also include the dimensions of the artworks. Size is usually represented as surface area (ARE), defined by ARE = height × width and area squared (ASQ). The inclusion of a quadratic is that as size increases so will price, but as size further increases it becomes difficult for most houses to accommodate them. Thus the expected signs are positive for ARE and negative for ASQ (see Anderson, 1974; de la Barre et al., 1994; Agnello and Pierce, 1996; Czujack, 1997; Locatelli Biey and Zanola, 1999 and Renneboog and Spaenjers, 2013). As well as ARE and ASQ other measures are used to explore the impacts of an artwork's dimensions on its price. The basic measure of dimensions as shape is the ratio of height (H) to width (W), with the variable HDW = H/W. Two dummy variables representing the major orientations, portrait (POR) and landscape (LAN), such that if HDW >

1 then for that artwork POR = 1 and POR = 0 otherwise and if HDW < 1 for any artwork then for that artwork LAN = 1 and LAN = 0 otherwise, square works being the reference category. Assuming that the demand for landscapes is the mainstay of the New Zealand art market the estimated coefficient on LAN is expected to be positive, and to have a higher value than the estimated coefficient on POR. Thus it is being assumed that dummy variables LAN and POR act partly as highly aggregate proxies for the subject matter of the works (see Higgs and Forster, 2014).

The final set of explanatory variables incorporate the sales characteristics of the work. The first of these are dummy variables identifying in which of the six major auction houses the sale took place: that is, Art+Object (ARO), Cordy's (COR), Dunbar Sloane (DUN), International Art Centre (IAC), Watson's Auctioneers (WAT) and Webb's (WEB). The reference category is an online auction house, FishersOnlineArt.com (OTH). During the sample period, the largest number of works was sold through Dunbar Sloane (DUN), followed by Webb's (WEB) and then International Art Centre (IAC). A variable which represents the number of works offered at each auction house at an auction (WOA) is also included to take account of the supply of artworks at each auction. As the number of artworks in a sale increases, the greater the short-run supply and the price of artworks is expected to fall. The final set of sales characteristics categorises the quarter and year when the work is sold. This consists of eighty quarterly dummy variables spanning 1992 quarter one to 2011 quarter four with works prior to 1991 quarter four as the reference category. There are insufficient data from 1988 to 1991 to construct a continuous quarterly price index over this period.

The two matrices of regressors, X_i for the price equation and Z_i for the selection bias equation contain common variables. As long as at least one of the variables in the selection equation is not included in the price equation, then the Heckman selection bias model can be estimated (Sartori, 2003). The explanatory variable Art+Object (ARO) has been excluded from the selection equation.

<TABLE 1 HERE>

Table 1 also presents sample maximums, means and standard deviations for price, means and standard deviations for area and height divided by width (HDW) and the number of works sold per artist for twenty artists. These artists were chosen as they commanded the highest price during the sample period. Colin McCahon, Charles Goldie, Frances Hodgkins and Gordon Walters achieved the highest prices of \$640,000, \$530,000 \$410,000 and

$380,000 respectively. In terms of area, only one out of 20 artists (5 percent) produced artworks that on average exceeded one square metre. The majority of these artworks were created to grace walls of domestic houses as opposed to art galleries. According to HDW, twelve out of twenty artists produced on average more portraits as compared to landscapes. This is suggestive of an argument that landscape is practised more by the conventional NZ artist, and less so by the more outstanding artists.

<FIGURE 1 HERE>

Figure 1 illustrates the orientation defined by HDW = H/W where H = height and W = width of all 27,365 artworks in the data set. It is noted that the measurements are for the external dimensions of the works, rather than the dimensions of the subject matter. Where HDW < 1 the works are described as 'landscape' oriented, although landscape need not be the subject matter. Where HDW > 1 works are 'portrait' oriented, although portraiture need not be the subject matter. Where H/W = 1 the work is 'square', so the frequency for 'square' works is necessarily at a point and not an interval. Figure 1 exhibits three major modes, suggesting the outcome of artists' conscious choices. The modality of the square works also suggests conscious choices by artists. Of the works in the data set 61.69% were landscape oriented, 32.74% were portrait oriented and 5.57% were exactly square. In addition, the frequency distribution of the portrait dimensions is far less peaked than that for landscape. Higgs and Forster (2014) produced a similar graph for HDW for artworks by 70 Australian artists and suggested that "these elements reflect the preferences of artists, but they may also reflect the influence of the market on artists".

<TABLE 2 HERE>

5 Empirical results

The empirical results for the OLS and Heckit models are presented in Table 2. The estimated coefficients; standard errors and p-values are detailed in columns 2 to 4 for the OLS model, and columns 5 to 7 for the Heckit model.

To test for multicollinearity, variance inflation factors are calculated (not shown). As a rule of thumb, a variance inflation factor (VIF) significantly greater than ten indicates the presence of harmful collinearity. Among the explanatory variables the VIFs exceed ten are for living status such as DTH and ALV and also in the auction houses such as DUC, IAC and WEB. The estimated parameters for both models appear sensible in terms of both the precision of the estimates and the anticipated signs on the coefficients. This suggests that multicollinearity, while present, is not too serious a problem.

On terms of goodness of fit, the Heckit model adjusted R^2 of 0.5503 is higher than the OLS adjusted R^2 of 0.4380. In addition, the selection bias criterion test of the null hypothesis $\rho = 0$ is rejected with $\rho = 0.6659$ and p-value = 0.0000. Since the null hypothesis of no selection bias is rejected, this suggests that selection bias exits in the model. In brief, the discussion of the estimated coefficients for the price equation is only presented for the Heckit model.

The impact of the artists on prices conformed to expectations based on knowledge of the New Zealand art market. All artist dummy variables are significant at the 1% level. The estimated coefficients of 19 artists are positive suggesting that these artists have a positive impact on art prices in relation to the excluded 1641 artists as reference. Only Charles Blomfield has a negative impact on art prices. The negative impact on price of Blomfiled's artwork could be the result of multiple productions of the same artwork which detracted the value of his artworks. The highest average prices are achieved by Francis Hodgkins, Charles Goldie, Colin McCahon, Gottfried Lindauer and Charles Barraud. The estimated coefficient for works by artists who are dead at the time of auction (DTH) is positive (0.9068), while artists who are alive at the time of auction (ALV) is also positive (0.7878), and both statistically significant at the 1% level. This suggests that deceased artists can command higher prices. The measure of thickness of the art market is positive (0.0051) and significant at the 1% level of significance. Although this was not the reasoning behind the inclusion of thickness of an individual artist's market it suggests that this also increases prices as well as saleability.

Consistent with expectations works in oil (OIL) are the most valued and have a positive impact on price. This classifies that oil is the most sought after medium with its durable quality, and is therefore more likely to command higher prices. Acrylic, as a relatively modern alternative, also fetches high prices at auction, along with pen (PEN) and gouache (GCH). The more affordable media are etchings (ETC), lithograph (LTH), water colour (WCO) and crayon (CRA). Higgs (2012) and Higgs and Forster (2014) find similar impact of medium on price in the Australian art market.

Other physical characteristics included in the regression model are the size of the work. These are the area of the work in square metres (ARE) and its nonlinear component, area squared (ASQ). The positive sign of the area coefficient (0.0373) and the negative sign of its squared term (-0.0039) indicate that New Zealand art prices first tend to increase with size, then decrease as the paintings become too large and difficult to house. The price-maximising size for artworks is 4.78 square metres. By comparison, Agnello and Pierce (1996) found the price-maximising size for American artists' work to be 6.53 square metres while de la Barre et al. (1994) calculated this optimal size to be 5.89 square metres for Old Masters and 1.70 square metres for Modern and Contemporary European works, Higgs and Worthington (2005) estimated the optimal size for Australian Modern and Contemporary artwork to be 6.70 square metres and Higgs and Forster (2014) estimated the optimal size of 5.25 square metres. In terms of dimensions, the estimated coefficients for landscape (LAN) and portrait (POR) are respectively -0.2925 and -0.1532 and are significant at the 1% level. The negative coefficients on LAN and POR indicate that portrait dimensioned works are preferred to landscape and both dimensioned works are less preferred to square works. These results do not conform to expectations. The conflicting results may be due to the impact of multicollinearity or the choice of the twenty artists with predominately portrait works to represent the reputation of artworks. Contrary to these findings, Higgs and Forster (2014) find that landscape dimensioned works are preferred to portrait and square works.

The final set of variables relates to the sale characteristics of the works. Art+Object (ARO), Dunbar Sloane (DUN), International Art Centre (IAC) and Webb's (WEB) increase the standard price over other auction houses while Cordy's (COR) and Watson's Auctioneers (WAT) are associated with systematically lower auction prices. These results are relative to the reference category, FishersOnlineArt.com (OTH). This strongly suggests that the top four auction houses can exercise market power luring owners of works by well-known artists to sell their works. The explanatory variable, availability of artworks at each auction (WOA), is a proxy for the supply of artworks. The estimated coefficient of WOA is negative (-0.0024) and significant at the 0.01 level of significance. This conforms to theoretical expectation that as short-run supply increases, price will decrease.

Table 3 presents the nominal quarterly art price indices. The nominal New Zealand art indices using the OLS and Heckit methods are calculated as $100e^{\beta t}$ spanning the first quarter 1992 to the fourth quarter 2011. The price trend of the OLS price indices appears to be higher than the Heckit price indices. A dependent sample t test is conducted to determine if there is a significant difference between the two price indices. The t calculated is 16.0937 with a p-value of 0.0000. This suggests that the null hypothesis of no difference between the two series is rejected and therefore we can conclude that there is a significant difference between the two art price index series.

<TABLE 3 HERE>

Plots of the trends of the New Zealand art price indices by OLS method (APIOLS) and Heckit method (APIHECK) are illustrated in Figure 2. The two series follow a similar trend. The estimated art price index appears to be strongly cyclical with peaks in 2001 quarter two, 2004 quarter one and 2006 quarter one and troughs in 1993 quarter two, 1994 quarter two, 1996 quarter two and 2010 quarter two. There is evidence that the New Zealand art bear market began in 1992 and continued until 2002 and thereafter continued to decline until 2011 quarter 4. During the global financial crisis (GFC), the New Zealand art market followed most global art markets with down turns in 2009 quarter two and 2010 quarter two. As a comparison, Higgs (2012) find the Australian art market experienced sharp downturns during the GFC.

<FIGURE 2 HERE>

Table 4 compares the risk and returns on the New Zealand art market based on the OLS and Heckit price indices over three periods: the entire period, the period prior to the GFC or prior to 2007 quarter four and the period after the GFC from 2008 quarter one to 2011 quarter four. There are significant differences between the average returns for the two methods over the three periods. The uppermost panel of Table 4 presents the risk and returns for the two art price indices over the entire sample period. During this period the arithmetic average Heckit art return of 0.2799% is lower than the average OLS return of 0.7238%. The Heckit returns are slightly more volatile than the OLS with respective standard deviations of 36.0321% and 32.6732%. As a comparison, Higgs (2012) using quarterly data from 1986 to 2009 found the average returns of the Australian art market to be 1.1731% with a standard deviation of 17.3477%. The next-to-uppermost panel of Table 4 shows the risk and returns covering the period prior to the GFC. The average returns for the Heckit and OLS art indices are 0.4767% and 0.8201% with the respective standard deviations being 34.5673% and 30.2853%. The lowermost panel of Table 4 presents the risk and returns after the GFC, the average Heckit returns plunged by 0.4949% whereas the OLS did not follow the same trend with an average upturn of 0.3450%. Over this period the Heckit and OLS art returns are more volatile than the other periods with a standard deviation of 42.5619% and 41.9514% respectively. After the GFC, the Heckit average returns conform to global art market trends as compare to that of the OLS. Higgs (2012) find a downturn in the average Australian art returns of 5.8548% with a standard deviation of 20.8675% over the GFC. It is important to note that the Australian returns may be overestimated by ignoring selection bias. In sum, the average New Zealand Heckit returns for the entire period and the period prior to the GFC are approximately halved as compared to the OLS. There is a marked difference between the Heckit and OLS average returns after the GFC. It is at present not clear what explains this great difference with use of the Heckit selection bias model. However, it does stand as an entirely understandable result.

<TABLE 4 HERE>

6 Concluding Remarks

The analysis of the results is not yet fully complete, but some findings appear novel, while others are consistent with the results of earlier studies. In summary this study includes all artworks sold and unsold or “buy-ins” (unsold items whose hammer prices have not met the sellers’ reserve prices) in the New Zealand art market over the period 1988 to 2011. This study employs two methods the OLS and Heckit selection bias models to construct quarterly New Zealand art price indices from 1992 quarter one to 2001 quarter four. Previous studies almost in their entirety ignore selection bias as data for buy-ins were not readily available. The empirical findings produce evidence of selection bias existing and substantially affecting economic interpretations of results.

The New Zealand Heckit and OLS art price indices follow almost exactly the same trend and timing of fluctuations but, as should be expected, the Heckit art price index is found to be significantly lower than the OLS art price index: it is always lower. This suggests that previous studies with calculated art price indices and returns to art purchases that ignored buy-ins are potentially unreliable and/or biased. Average returns are calculated from the two art price indices for the entire period, the period prior to the GFC and after the GFC. The average Heckit returns are significantly lower than the OLS average returns across all three periods. After the GFC the average Heckit art return for NZ is negative, as opposed to a positive return based upon OLS estimates. Although strictly speaking just for New Zealand, these findings make a contribution in tracking the movement of the art prices and financial returns on this market that has not been previously explored.

This paper considers the distribution (of the dimensions) of works in the sample. Certainly the distribution of the works constrains the choices that can be made by potential purchasers. It also reflects aspects of the supply side in that it represents choices made both by artists in production of works and by owners in consigning those works to auction. The complexity of the sample distribution (of dimensions) also indicates not only a more cautious interpretation of the present results, but for the mass of previous research where the sample distribution has not been noted. Of specific interest is the higher proportion of works that adhere to ‘landscape’ dimensions (Height < Width), and the number that adhere to a strictly square format (H = W).

Market efficiency has been explored by including the thick market effects for individual artists and the impact of the short-run supply of artworks to any given individual auction market. While not having a strong influence on price or saleability, these results are statistically significant. While the use of count also obviated the need for including unique dummy for all individual artists, significant artists were included individually. To a degree this is arbitrary and a limitation in this modelling is the choice of the highest price to nominate the 20 artists to represent the reputation of artworks. A future option is to consider the 20 artists with the highest representation (count) in auctions.

There are many interesting opportunities to expand upon this work. One possibility is to examine the inter-relationship between the New Zealand art market and that of other financial markets. The impacts of the GFC noted above suggest that some macro-financial variables, if not macroeconomic variables may be of importance. This also will allow more sophisticated methods of exploring the interrelationships between these markets.

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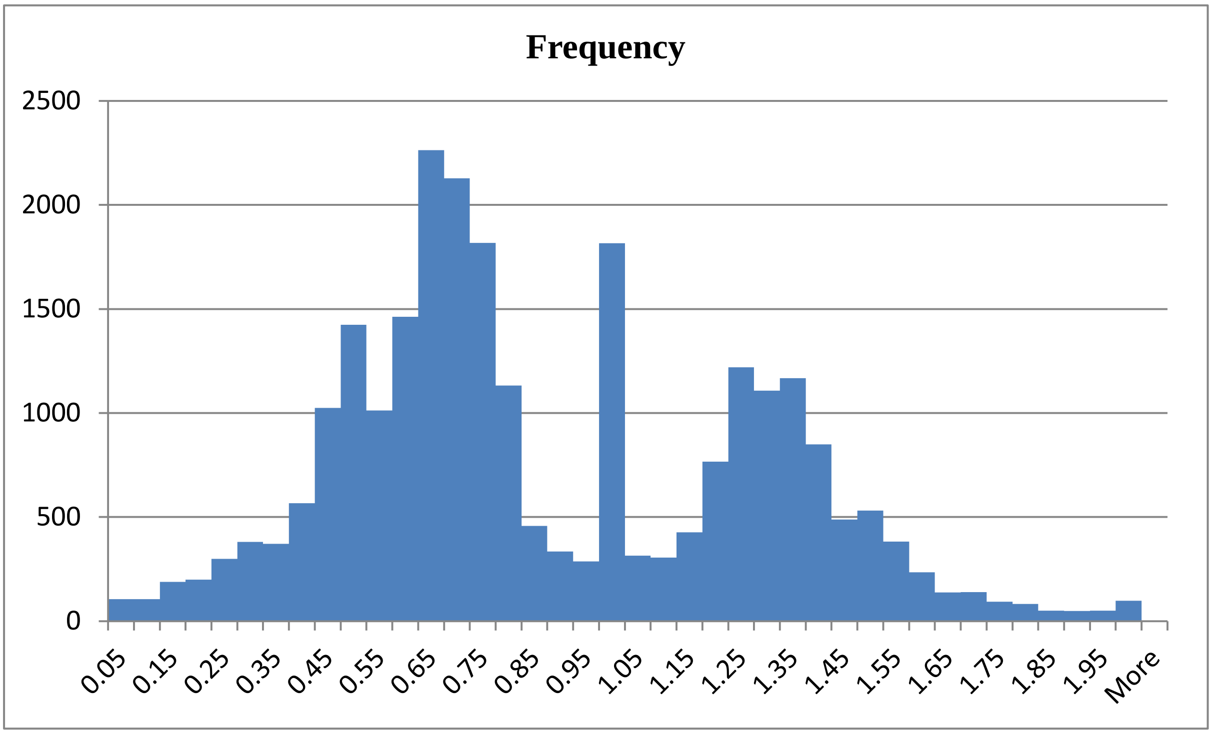
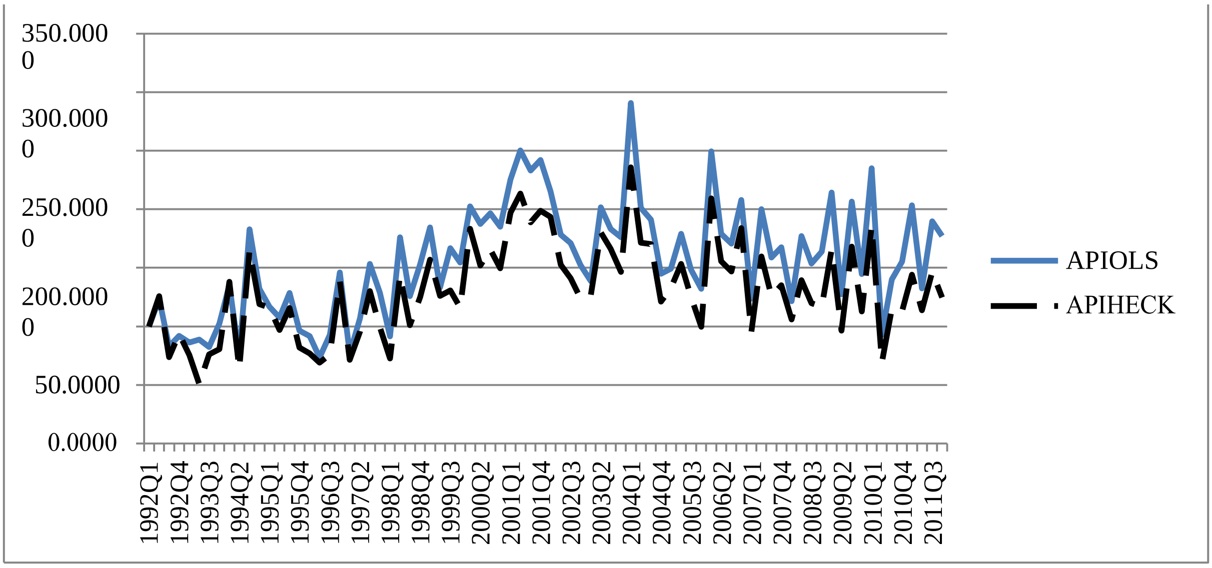


Fig. 1 Frequency distribution of height divided by width

Fig. 2 Graph of OLS and Heckit price indices from 1992 quarter one to 2011 quarter four



APIOLS is OLS Art Price Index and APIHECK is Heckit Art Price Index.

Table 1

					Price			Area (Height ´ Width in M^2)		HDW		
Surname	First Name	Code	Born	Died	Maximum	Mean	Standard deviation	Mean	Standard deviation	Mean	Standard deviation	Count
Barraud	Charles Decimus	BARC	1822	1897	$200,000	$23,770.15	59767.52	0.4340	0.3584	0.6832	0.0833	13
Binney	Donald	BIND	1940	-	$270,000	$37,798.58	62281.22	0.6752	0.5379	1.2100	0.4248	75
Blomfield	Charles	BLOC	1848	1926	$180,000	$7,009.39	1.49E+04	0.1839	0.1319	0.7664	0.3036	525
Bullmore	Edward	BULE	1933	1978	$180,000	$12,755.38	25462.82	0.6829	0.7440	1.0182	0.4359	43
Chevalier	Nicholas	CHEN	1828	1902	$350,000	$42,741.67	115566	0.7484	1.8148	0.8545	0.3056	9
Cotton	Shane	COTS	1964	-	$225,000	$15,930.50	33576.49	0.8852	1.2881	1.1653	1.9607	134
Fomison	Anthony Leslie (Tony)	FOMA	1939	1990	$150,000	$21,313.10	32140.3	0.3151	0.3665	1.1991	0.8390	156
Goldie	Charles Frederick	GOLC	1870	1947	$530,000	$95,024.29	115570.2	0.1353	0.1772	1.2081	0.2042	136
Hammond	William (Bill)	HAMW	1947	-	$290,000	$41,760.28	69864.11	1.1908	2.3233	1.0602	0.5600	138
Hanly	James Patrick (Pat)	HANJ	1932	2004	$160,000	$16,741.02	30163.37	0.5598	0.4351	0.9984	0.2799	181
Hodgkins	Frances Mary	HODF	1919	2004	$410,000	$157,745.50	158746.4	0.3681	0.1128	0.9714	0.1871	11
Hotere	Ralph	HOTR	1931	-	$280,000	$29,697.64	57883.64	0.7929	1.2343	1.3351	0.5443	186
Illingworth	Michael H.	ILLM	1832	1988	$212,386	$28,914.79	4.56E+04	0.3543	0.2800	1.0703	0.2591	80
Lindauer	Gottfried	LING	1839	1926	$180,000	$34,228.29	42147.59	0.4345	0.1883	1.2399	0.1323	68
McCahon	Colin John	MCCC	1919	1987	$640,000	$69,935.69	111277.1	0.4774	0.6259	1.1608	0.4602	155
Page	Evelyn	PAGE	1899	1993	$190,000	$19,371.03	38146.04	0.1734	0.1087	0.9107	0.2899	96
Smither	Michael Duncan	SMIM	1939	-	$155,000	$11,813.63	22907	0.5304	0.5751	0.9970	0.4434	305
Steele	Louis John	STEL	1843	1918	$270,000	$18,219.18	58494.36	0.2315	0.3907	0.9619	0.4357	27
Walters	Gordon	WALG	1919	1995	$380,000	$26,723.01	74496.11	0.4969	0.3553	1.1769	0.2278	44
Watkins	Kennett	WATK	1847	1933	$160,000	$22,924.00	61904.23	0.4686	0.3660	0.9370	0.4800	8
Total						$4,799.54	20180.36	0.5036	1.2955	1.1986	19.7640	27365

Table 2 The empirical results

	OLS			Heckit		
Variable	Estimated Coefficient	Standard Error	p-value	Estimated Coefficient	Standard Error	p-value
CON	5.8008	0.1803	0.0000	5.2860	0.1967	0.0000
BARC	3.3741	0.4146	0.0000	3.0319	0.5080	0.0000
BIND	2.6292	0.1476	0.0000	2.7759	0.1830	0.0000
BLOC	-0.7711	0.0651	0.0000	-0.8313	0.0819	0.0000
BULE	2.2192	0.3340	0.0000	1.9283	0.2960	0.0000
CHEN	2.6602	0.6754	0.0001	2.2585	0.6553	0.0006
COTS	1.6898	0.0839	0.0000	1.7665	0.1475	0.0000
FOMA	2.4907	0.0981	0.0000	2.3776	0.1449	0.0000
GOLC	3.6220	0.1033	0.0000	3.7570	0.1349	0.0000
HAMW	2.6705	0.1230	0.0000	2.6528	0.1494	0.0000
HANJ	1.7792	0.1068	0.0000	1.6953	0.1328	0.0000
HODF	5.2438	0.2222	0.0000	5.2939	0.4851	0.0000
HOTR	2.1321	0.1297	0.0000	2.0218	0.1316	0.0000
ILLM	2.2519	0.1523	0.0000	2.3302	0.1808	0.0000
LING	3.0142	0.1428	0.0000	3.1000	0.1940	0.0000
MCCC	3.2352	0.0827	0.0000	3.3255	0.1343	0.0000
PAGE	2.5861	0.1245	0.0000	2.5205	0.1682	0.0000
SMIM	0.5498	0.0875	0.0000	0.5102	0.0982	0.0000
STEL	1.7328	0.3842	0.0000	1.5885	0.3280	0.0000
WALG	3.1313	0.2253	0.0000	2.9252	0.2906	0.0000
WATK	1.5562	1.7285	0.3680	0.9182	0.7573	0.2253
DTH	0.9692	0.0968	0.0000	0.9068	0.1126	0.0000
ALV	0.8551	0.0975	0.0000	0.7878	0.1126	0.0000
COUNT	0.0048	0.0001	0.0000	0.0051	0.0001	0.0000
ACR	-0.0263	0.0752	0.7269	-0.0221	0.0755	0.7694
CHA	-0.5574	0.7687	0.4684	-0.3748	0.6979	0.5912
CRA	-0.8913	0.1828	0.0000	-0.8667	0.9603	0.3668
ETC	-0.7041	0.4793	0.1419	-0.5922	0.6846	0.3871
GCH	0.0627	0.2585	0.8084	-0.2093	0.3486	0.5483
LTH	-0.7787	0.3666	0.0337	-0.6348	0.7817	0.4168
MIX	-0.2911	0.0809	0.0003	-0.2861	0.0853	0.0008
OIL	-0.0086	0.0705	0.9027	0.0140	0.0716	0.8448
PAS	-0.5235	0.3352	0.1184	-0.5095	0.3474	0.1426
PEN	-0.0155	0.5902	0.9790	-0.1429	0.4544	0.7532
WCO	-0.8947	0.2475	0.0003	-0.6800	0.3406	0.0459
ARE	0.0426	0.0057	0.0000	0.0373	0.0014	0.0000
ASQ	-0.0044	0.0009	0.0000	-0.0039	0.0002	0.0000
POR	-0.1618	0.0445	0.0003	-0.1532	0.0472	0.0012
LAN	-0.3244	0.0439	0.0000	-0.2925	0.0463	0.0000
ARO	0.7099	0.1247	0.0000	0.7060	0.1254	0.0000
COR	-0.8248	0.1311	0.0000	-0.6861	0.1370	0.0000
DUN	0.0679	0.1224	0.5792	0.2158	0.1238	0.0814
IAC	0.2014	0.1155	0.0813	0.5055	0.1191	0.0000

	OLS			Heckit		
Variable	Estimated Coefficient	Standard Error	p-value	Estimated Coefficient	Standard Error	p-value
WAT	-0.1396	0.1225	0.2543	-0.1493	0.1245	0.2304
WEB	0.2571	0.1157	0.0263	0.2334	0.1177	0.0475
WOA	-0.0027	0.0001	0.0000	-0.0024	0.0001	0.0000
1992Q1	0.1314	0.1872	0.4826	0.2245	0.2027	0.2679
1992Q2	0.3421	0.1698	0.0440	0.4550	0.2002	0.0230
1992Q3	-0.0534	0.1719	0.7560	-0.0808	0.1882	0.6675
1992Q4	0.0481	0.1685	0.7752	0.1584	0.1878	0.3991
1993Q1	-0.0170	0.1194	0.8865	-0.0551	0.1328	0.6780
1993Q2	0.0114	0.2176	0.9581	-0.4541	0.2083	0.0293
1993Q3	-0.0626	0.1534	0.6832	-0.0484	0.1952	0.8043
1993Q4	0.1539	0.1312	0.2408	0.0075	0.1455	0.9587
1994Q1	0.4344	0.1291	0.0008	0.5482	0.1370	0.0001
1994Q2	-0.1680	0.1300	0.1963	-0.2259	0.1468	0.1240
1994Q3	0.7350	0.1118	0.0000	0.7258	0.1278	0.0000
1994Q4	0.4102	0.1177	0.0005	0.3988	0.1250	0.0014
1995Q1	0.2873	0.1233	0.0199	0.3742	0.1451	0.0099
1995Q2	0.2048	0.1046	0.0502	0.1924	0.1183	0.1040
1995Q3	0.3820	0.1177	0.0012	0.3700	0.1339	0.0057
1995Q4	0.0936	0.1052	0.3736	0.0243	0.1179	0.8367
1996Q1	0.0454	0.1551	0.7698	-0.0354	0.1609	0.8260
1996Q2	-0.1777	0.1200	0.1385	-0.1440	0.1308	0.2710
1996Q3	0.0576	0.0999	0.5642	-0.0526	0.1159	0.6499
1996Q4	0.5107	0.0982	0.0000	0.5518	0.1153	0.0000
1997Q1	-0.1347	0.1662	0.4175	-0.1091	0.2156	0.6127
1997Q2	0.2004	0.0970	0.0390	0.1775	0.1150	0.1226
1997Q3	0.5598	0.1047	0.0000	0.4876	0.1166	0.0000
1997Q4	0.3846	0.1175	0.0011	0.2187	0.1252	0.0807
1998Q1	0.0435	0.1351	0.7472	-0.0959	0.1683	0.5689
1998Q2	0.6976	0.1197	0.0000	0.5885	0.1286	0.0000
1998Q3	0.3618	0.1017	0.0004	0.2344	0.1153	0.0421
1998Q4	0.5580	0.1054	0.0000	0.4481	0.1149	0.0001
1999Q1	0.7435	0.1233	0.0000	0.6748	0.1537	0.0000
1999Q2	0.4174	0.1238	0.0007	0.4557	0.1266	0.0003
1999Q3	0.6422	0.0933	0.0000	0.4925	0.1035	0.0000
1999Q4	0.5672	0.1106	0.0000	0.3735	0.1245	0.0027
2000Q1	0.8372	0.1304	0.0000	0.8308	0.1541	0.0000
2000Q2	0.7598	0.1175	0.0000	0.6428	0.1267	0.0000
2000Q3	0.8078	0.0973	0.0000	0.7291	0.1089	0.0000
2000Q4	0.7474	0.1015	0.0000	0.6275	0.1094	0.0000
2001Q1	0.9447	0.1276	0.0000	0.9034	0.1625	0.0000
2001Q2	1.0495	0.1067	0.0000	0.9830	0.1128	0.0000
2001Q3	0.9779	0.1064	0.0000	0.8599	0.1131	0.0000
2001Q4	1.0155	0.0967	0.0000	0.9109	0.1106	0.0000
2002Q1	0.8987	0.1175	0.0000	0.8845	0.1509	0.0000
2002Q2	0.7092	0.1147	0.0000	0.6464	0.1154	0.0000

	OLS			Heckit		
Variable	Estimated Coefficient	Standard Error	p-value	Estimated Coefficient	Standard Error	p-value
2002Q3	0.6685	0.1018	0.0000	0.5698	0.1070	0.0000
2002Q4	0.5517	0.1028	0.0000	0.4386	0.1125	0.0001
2003Q1	0.4581	0.1173	0.0001	0.4617	0.1325	0.0005
2003Q2	0.8338	0.1099	0.0000	0.8136	0.1138	0.0000
2003Q3	0.7359	0.0935	0.0000	0.7322	0.1013	0.0000
2003Q4	0.6974	0.0885	0.0000	0.6072	0.0995	0.0000
2004Q1	1.1988	0.1105	0.0000	1.0829	0.1293	0.0000
2004Q2	0.8298	0.0954	0.0000	0.7634	0.1038	0.0000
2004Q3	0.7792	0.0864	0.0000	0.7570	0.0989	0.0000
2004Q4	0.5033	0.0902	0.0000	0.4171	0.0995	0.0000
2005Q1	0.5329	0.1099	0.0000	0.5072	0.1339	0.0002
2005Q2	0.7136	0.0966	0.0000	0.6518	0.1009	0.0000
2005Q3	0.5276	0.0971	0.0000	0.4506	0.1044	0.0000
2005Q4	0.4094	0.0914	0.0000	0.2197	0.1018	0.0309
2006Q1	1.0452	0.1243	0.0000	0.9636	0.1245	0.0000
2006Q2	0.7139	0.0938	0.0000	0.6659	0.1024	0.0000
2006Q3	0.6653	0.0863	0.0000	0.6095	0.1035	0.0000
2006Q4	0.8637	0.0914	0.0000	0.8338	0.1066	0.0000
2007Q1	0.3436	0.1097	0.0017	0.1725	0.1279	0.1773
2007Q2	0.8257	0.0873	0.0000	0.6918	0.1000	0.0000
2007Q3	0.5945	0.0949	0.0000	0.4533	0.1100	0.0000
2007Q4	0.6483	0.0879	0.0000	0.5248	0.1011	0.0000
2008Q1	0.3255	0.1244	0.0089	0.2832	0.1347	0.0355
2008Q2	0.7002	0.0850	0.0000	0.5572	0.1021	0.0000
2008Q3	0.5610	0.0872	0.0000	0.4065	0.1041	0.0001
2008Q4	0.6255	0.0857	0.0000	0.3800	0.1073	0.0004
2009Q1	0.8928	0.1048	0.0000	0.7299	0.1409	0.0000
2009Q2	0.3749	0.0892	0.0000	0.1866	0.1119	0.0954
2009Q3	0.8579	0.0874	0.0000	0.7449	0.1039	0.0000
2009Q4	0.5018	0.0913	0.0000	0.3441	0.1039	0.0009
2010Q1	0.9865	0.1072	0.0000	0.8431	0.1297	0.0000
2010Q2	0.0572	0.0985	0.5612	-0.1396	0.1130	0.2165
2010Q3	0.4679	0.0846	0.0000	0.3627	0.1008	0.0003
2010Q4	0.5712	0.0971	0.0000	0.3470	0.1106	0.0017
2011Q1	0.8410	0.1263	0.0000	0.5895	0.1382	0.0000
2011Q2	0.4119	0.0914	0.0000	0.3551	0.1148	0.0020
2011Q3	0.7718	0.0929	0.0000	0.6069	0.1076	0.0000
2011Q4	0.7034	0.0864	0.0000	0.4456	0.1070	0.0000
σ				1.4215	0.0154	0.0000
ρ				0.6659	0.0238	0.0000
R^2	0.4415			0.5503		
Adjusted R^2	0.4380			0.5483		

Table 3 OLS and Heckit price indices

Year	APIOLS	APIHECK	Year	APIOLS	APIHECK	Year	APIOLS	APIHECK	Year	APIOLS	APIHECK	Year	APIOLS	APIHECK
1992Q1	100.0000	100.0000	1996Q1	91.7596	77.1129	2000Q1	202.5434	183.3581	2004Q1	290.7853	235.9418	2008Q1	121.4066	106.0401
1992Q2	123.4388	125.9153	1996Q2	73.4101	69.1787	2000Q2	187.4434	151.9267	2004Q2	201.0485	171.4005	2008Q2	177.0877	139.4631
1992Q3	83.1212	73.6852	1996Q3	92.8902	75.7961	2000Q3	196.6537	165.6205	2004Q3	191.1150	170.3154	2008Q3	153.6345	119.9555
1992Q4	92.0006	93.6009	1996Q4	146.1216	138.7157	2000Q4	185.1322	149.6304	2004Q4	145.0408	121.2352	2008Q4	163.8727	116.8187
1993Q1	86.2077	75.6051	1997Q1	76.6356	71.6295	2001Q1	225.5126	197.1745	2005Q1	149.4007	132.6655	2009Q1	214.1328	165.7675
1993Q2	88.6833	50.7324	1997Q2	107.1425	95.4101	2001Q2	250.4279	213.5118	2005Q2	178.9902	153.3027	2009Q2	127.5385	96.2758
1993Q3	82.3646	76.1177	1997Q3	153.4685	130.0867	2001Q3	233.1442	188.7760	2005Q3	148.6049	125.3706	2009Q3	206.7574	168.2669
1993Q4	102.2711	80.4939	1997Q4	128.8137	99.4170	2001Q4	242.0657	198.6545	2005Q4	132.0400	99.5165	2009Q4	144.8040	112.6995
1994Q1	135.3797	138.2230	1998Q1	91.5854	72.5841	2002Q1	215.3938	193.4817	2006Q1	249.3911	209.4027	2010Q1	235.1156	185.6355
1994Q2	74.1310	63.7358	1998Q2	176.1427	143.9022	2002Q2	178.2078	152.4771	2006Q2	179.0523	155.4819	2010Q2	92.8278	69.4777
1994Q3	182.8540	165.0904	1998Q3	125.9008	100.9911	2002Q3	171.0947	141.2318	2006Q3	170.5510	146.9553	2010Q3	139.9654	114.8152
1994Q4	132.1564	119.0439	1998Q4	153.1982	125.0509	2002Q4	152.2379	123.8704	2006Q4	207.9834	183.9030	2010Q4	155.2223	113.0237
1995Q1	116.8636	116.1437	1999Q1	184.4210	156.8751	2003Q1	138.6280	126.7705	2007Q1	123.6302	94.9288	2011Q1	203.2426	144.0432
1995Q2	107.6185	96.8350	1999Q2	133.1106	126.0055	2003Q2	201.8478	180.2403	2007Q2	200.1969	159.5718	2011Q2	132.3503	113.9441
1995Q3	128.4718	115.6645	1999Q3	166.6501	130.7377	2003Q3	183.0386	166.1384	2007Q3	158.8635	125.7093	2011Q3	189.6818	146.5769
1995Q4	96.2950	81.8549	1999Q4	154.6164	116.0702	2003Q4	176.1238	146.6171	2007Q4	167.6384	135.0262	2011Q4	177.1511	124.7467

APIOLS is OLS art price index and APIHECK is Heckit art price index.

Table 4 Summary of statistics of OLS and Heckit art returns

	OLS Returns	Heckit Returns
Period	Entire	
Mean	0.7238	0.2799
Standard Deviation	32.6732	36.0321
Minimum	-92.9331	-98.2779
Maximum	90.2854	95.1747
Count	79	79
Period	Up to 2007 Q4	
Mean	0.8201	0.4767
Standard Deviation	30.2853	34.5673
Minimum	-64.5377	-77.4122
Maximum	90.2854	95.1747
Count	63	63
Period	GFC 2008 Q1 onwards	
Mean	0.3450	-0.4949
Standard Deviation	41.9514	42.5619
Minimum	-92.9331	-98.2779
Maximum	48.4696	55.8334
Count	16	16