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# Going Global: Markups and Product Quality in the Chinese Art Market

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**Abstract**

We analyze two reasons for export prices to be different across markets — namely, quality differentiation and variable markups — and attempt to parse their relative importance and some of their underlying drivers. To overcome the substantial measurement issues in this task, we consider a particular industry as a special case: Chinese fine art. The simplicity of the supply-side of art vis-à-vis marginal cost and the wealth of data on its quality characteristics make it possible to separately identify the markup and quality components of international relative prices for Chinese artwork. Through this lens, we trace the process of growth and internationalization of Chinese art since the year 2000 and uncover a rich set of facts. We find strong support for quality sorting into international markets at both the level of artist and artwork, as well as substantial markup differences across destinations. Using a structural model of endogenous quality choice by Feenstra and Romalis (2012), we argue that much of the international quality premium is driven by specific distribution costs (whether physical or informational), rather than destination-specific preferences for quality.

Keywords: international prices, quality differentiation, art auction

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# 1. Introduction

It is well-documented that exporters often set different prices for similar products across destination countries. This observation has generated intense interest in the drivers of these price differences, with the idea that they will abet our understanding of export success as well as of the international transmission of shocks. In this paper, we focus on two reasons for export prices to be different across markets, namely quality differentiation and variable markups over marginal cost, and attempt to parse them empirically.

We build on recent work highlighting the role of quality differentiation and markup variation in explaining export price patterns. In a representative paper on quality differentiation, Manova and Zhang (2012) document the firm-level pricing behavior of Chinese exporters. They find that firms with higher prices in a given destination have higher export revenues, suggesting that product quality is a dominant determinant of export sales rather than low prices. They also find that for a given firm, prices vary across destinations in a manner which suggests sending different quality levels to different markets. In a separate body of research, the role of a firm's markup over its marginal cost of production has been emphasized as a means for firms to tailor prices to specific markets. Often the size of the markup is thought of as a function of destination characteristics such as market size and the level of competition, among other factors. One prominent example of this type of variable markup in the context of a monopolistically competitive industry is Melitz and Ottaviano (2008).

The problem we address is that, even at the frontier of data availability (i.e., a census of firm- and product-level prices and sales volume by export destination), it is difficult to make unqualified statements about the importance of either product quality or markups in explaining international trade patterns. The first issue has to do with measurement. The basic identification problem is that only two pieces of data are typically observed, export prices and quantities, which are each influenced by a multitude of factors including the

export's quality level, marginal cost and markup. This quandary has led researchers to try to estimate either product quality or markups at a high level of abstraction,[1] often ignoring the influence of one factor on the other. A second issue is that, even with a clean measure of product quality in hand, the underlying determinants of quality choice are also unidentified. An exporter may choose to ship higher quality varieties to a given destination due to demand factors, such as the importing consumers' preferences for quality, or supply factors such as the costs of producing or shipping. Our objectives are to take preliminary steps to separately identify quality and markups across markets and to investigate the determinants of quality sorting by destination.

To fix ideas, we shall consider a particular industry as a special case: the international auction market for Chinese fine art. Our analysis will center on the price of Chinese artworks sold outside of mainland China versus those sold within. This industry is well-suited to our purposes for a few reasons. First, quality characteristics of each artwork, such as physical traits, measures of authenticity, proxies for provenance, and characteristics of the auction transaction, are observed. This allows us to measure and control for many different quality characteristics of each artwork and to compare prices across markets on an apples-to-apples basis. Second, isolating the markup component of price is greatly abetted by the fact that the relationship between marginal cost and price for artworks can be summarized by observable data. The auction market for fine art is largely a secondary market, and therefore the concept of the marginal cost of an artwork has to do, if anything, with an artwork's former sale price.[2] We attempt to control for that in our empirical work and, as such, what is

[1] An indicative example of this practice is the measurement of trade quality. Several authors have suggested measures that use information on inputs or quantities, in addition to prices, to better identify product quality. For example, Brambilla, Lederman, and Porto (2012) utilize the concentration of skilled and unskilled workers within a firm. Hallak and Schott (2011), Khandelwal (2010), and Gervais (2012) use the trade balance, import market share and export quantity, respectively, conditional on price and other controls as a measure of quality. In spite of these advances, though, the influence of variable markups on prices is rarely explicitly taken into account.

[2] An alternative, more familiar, definition of marginal cost is as a production cost, variation in which we do not believe has an appreciable influence on art auction prices. On one hand, the artists of many works sold at auctions are no longer alive, which distorts the relationship between supply factors and output prices.

being captured in our measures of price differences across markets comes close to being a pure measure of markup differences.

Third, in addition to observing quality and markups, Chinese art is an industry that has recently undergone a transition from autarky to exporting. Auction-quality artworks produced by Chinese artists were until lately only sold at auction houses in mainland China. Beginning in the late 1990s and early 2000s, however, the share of Chinese artworks sold at auction houses outside of mainland China began to rise steadily, going from 2.7 percent of the total number of sales in the early 2000s to a peak of 9.2 percent in 2007. And fourth, the scale of the Chinese art market make it at least plausible to gather information about *all* auction sales since 2000 and to say something about the market as a whole. Accordingly, we have assembled an almost comprehensive census of auction transaction prices for Chinese artworks over this period. All in all, the dataset includes information on over 1 million artworks put up for auction.

With this long list of sales data, we uncover a rich set of facts describing the international pricing of Chinese art, beginning with the unconditional international price premium and telescoping into quality adjusted estimates and estimates conditional on certain characteristics of the artwork and auction transaction. The results can be summarized as follows: (i) internationally sold artworks and the domestic artworks of internationally selling artists have much higher average prices than those of artists selling only domestically; (ii) for internationally selling artists, international works have a higher price than their domestic works; (iii) most of (i) and (ii) is explained by quality differences between internationally sold artworks and those sold domestically; (iv) after controlling for quality differences, internationally sold artworks still have a significantly higher price than domestic artworks; and (v) the inter-

On the other, for contemporary and classical artists alike, the market structure is such that marginal cost plays a relatively small role in price setting because of the high degree of differentiation among artworks. Our identifying assumption is that the elasticity of prices to production cost is zero, which is a clear difference between art and other industries (where marginal cost is a more important determinant of price).

national price premium is most pronounced for auctions taking place in the United States and United Kingdom, for contemporary art, and for artists with the highest number of international sales.

The fact that international sales have higher price and higher quality than domestic sales (i.e., results (i), (ii) and (iii)) is closely related to the literature on quality sorting in international trade. Perhaps the closest antecedent among those papers is Crozet, Head, and Mayer (2012), in which the quality of French wine is observed to be higher for firms exporting to more destinations, at higher prices, and for firms selling larger quantities in each destination; these correlations support trade theories in which firms sort into export markets according to their output quality.

Our work also provides a measure of export quality and supports the finding of quality sorting, but makes several other additional contributions. First, in the case of art, prices are higher for international sales because of higher markups and not higher marginal cost, which differs from the common practice of modeling output quality as a function of input cost.[3] Specifying that higher output quality requires higher marginal cost is an intuitive and reasonable assumption, but it is not the only way in which product quality might influence patterns of trade prices. Our results demonstrate an important interaction between markups and quality.

Second, albeit for only one specific industry, we provide a quantification of the relative contributions of quality and markups to export prices. Recent studies, such as Manova and Zhang (2012), Bastos and Silva (2010), Brambilla, Lederman, and Porto (2012) and Kneller and Yu (2008), each find that average export prices of a given product vary sys-

[3]For instance, Kugler and Verhoogen (2012) model endogenous improvement in the quality of labor, capital and output, given firm productivity, and find a correlation between plant size and both output and input prices. Other papers relating output quality to explicit costs include: Baldwin and Harrigan (2011), Johnson (2012), Bastos and Silva (2010), Crozet, Head and Mayer (2012), Fernandes and Paunov (2009), Hallak and Sivadasan (2011), Mandel (2009), Iacovone and Javorcik (2008), Verhoogen (2008) and Sutton (2007).

tematically across destinations, in some instances even within the same exporting firm. The fact that prices are a function of destination characteristics suggests that exporters are able to price discriminate by adjusting their quality and/or markups. Building on those results, we show that quality dominates (non-quality-related) markups in the determination of the international price premium for Chinese art (result (iii)). We also demonstrate that the *quality-adjusted* markup differences across markets are still large in absolute terms (result (iv)).

Third, the joint estimation of quality and markups provides some hints as to the drivers of quality sorting. The supply-side story that we have in mind is the Alchian-Allen (1964) effect, or the idea that exporters "ship the good apples out." Alchian and Allen's conjecture was that any specific cost applied to an export, such as a flat transport cost or per unit tariff, would shift demand towards higher-priced, higher-quality varieties by lowering their relative price. Previous studies finding support for this mechanism of quality sorting include Hummels and Skiba (2004) and Lugovskyy and Skiba (2010). The quality sorting we find for Chinese art is consistent with Alchian-Allen, though it probably does not reflect the cost structure of physical transportation. It could be that there are other specific costs to developing an international fine art, such as those associated with establishing an artist's brand or acquiring information, which explain the quality premium on international sales. Quality sorting may also be driven by demand-side factors such as differential preferences for quality across markets. These factors have been emphasized by Hallak (2006), Feenstra and Romalis (2012) and Lugovskyy and Skiba (2010), where the preference for quality is modeled as an increasing function of importer income. To see which effect (i.e., specific costs a la Alchian-Allen or preferences for quality) is more prominent in our data, we adapt the formulation of Feenstra and Romalis (2012) and derive a structural interpretation of the international quality premium. We find that the quality premium for Chinese art largely reflects specific costs, especially in the early years of international sales.

Finally, we use the depth of the dataset to further analyze quality and markup discrimination across markets. It turns out that the price and quality premia are quite sensitive to the region where the auction is located, the medium and period of the artwork, and the degree of internationalization of the artist (result (v)). These findings are related to the modeling of international trade prices with variable markups. In a model with linear demand, Melitz and Ottaviano (2008) show that exporter markups and average productivity are an endogenous function of market size and the degree of trade integration, with larger and more integrated countries characterized by higher average productivity and lower average markups. This is the opposite of our result that larger art markets (i.e., US and UK) and highly internationalized artists have relatively high markups even after controlling for quality. These results are yet another indication that there are potentially important forces above and beyond productivity differences that drive wedges in international prices.

The paper proceeds as follows. The next section describes the evolution of the Chinese fine art market over the past decade, as well as the details of the dataset. Section 3 describes our empirical specification and results, including a structural interpretation of quality sorting. Section 4 concludes.

# 2. The Market for Chinese Art

## 2.1. Data

Our point of departure is a highly detailed list of the auction sales of Chinese artists sold anywhere in the world. We obtain these data from www.artron.net, one of the largest online databases covering auctions of Chinese artworks and antiques. Our dataset contains catalogue information from 6,978 individual auctions that took place in 424 auction houses in China (including Hong Kong, Macau and Taiwan) between May 1994 to September 2011,

totaling 1,994,178 individual lots and over RMB 200 billion in sales turnover. In addition, the dataset includes another 165 auctions selling works of Chinese art and antiques held at 16 auction houses outside of greater China, totaling 39,830 individual lots and over RMB 11 billion in sales turnover.

Artron aggregates detailed information on each auction, including the name of the auction house, the time of auction, the ordering of items within an auction, the low and high auction-house estimated prices for each item, whether the item was sold, and how much it was sold for. In addition, the dataset contains information on the characteristics of each artwork, including the title, the classification of the artwork (calligraphy, paintings, jewelry, furniture, etc.), its size and medium, the artist, the time period in which the work was produced, and any proof of the authenticity of the work provided by the seller. Previous studies of art auctions have identified most of the aforementioned characteristics as relevant factors in determining art prices. For instance, art prices tend to correlate positively with: the size of the work, the presence of the artist's signature or other signs of authenticity, the prestige of the work's provenance, and the rarity in terms of its medium, style or subject matter. Moreover, oil paintings tend to sell for higher prices than other materials.

In terms of the characteristics of the artist, the price of artworks tends to be positively correlated with: the historical significance of the artist, the participation of the artist in major exhibitions, the prestige of the gallery that represents the artist, the popularity of the subject matter that the artist specializes in at the time of auction, and whether the artwork was produced during the best period of the artist's career. The nationality of the artist and the artistic style that the artist identifies with may also be important drivers of price. Lastly, the features of the auction itself, including the prestige of the auction house, the location of the sale, the time of the sale, the ordering of the lots, among others, are important determinants of sales prices. Some studies, such as Ashenfelter and Graddy (2003) and Mei and Moses (2002), have found that the estimated price range provided by auction houses

have an anchoring effect on buyers and hence a positive influence on hammer prices. Our measures of artwork quality, defined below, controls for many of these price-determining characteristics.

In this paper, we focus our attention on some of the largest artwork type classifications: calligraphy, classical-style paintings, and oil paintings. These segments together account for 1,234,338 individual lots, over RMB 134 billion in sales and 63.7% of the total sales turnover recorded by Artron. Among the 1,234,338 lots, the database does not report a sales price for 540,948 lots, which is an indication that those items went up for auction but were not sold. These observations are removed from our sample for our baseline specification. In addition, another 10,206 lots are removed because they do not have information on the artist of the work. Finally, in the resulting 683,184 lots, we focus on the 679,317 lots that were auctioned on or after January 1, 2000, due to the relative sparsity of coverage prior to 2000; there are only 644 lots sold per year on average in our sample pre-2000, compared with an average of 56,610 lots per year afterwards. The average number of auction houses in the database is only 3 pre-2000, compared with 77 auction houses thereafter.

## 2.2. Market Overview - Volume

The past decade has witnessed a boom in the market for Chinese art, which has mirrored the boom in China's overall economy. Sales revenue from domestic auctions, defined as sales in mainland China, went from RMB 96.7 million in 2000 to RMB 32.1 billion in 2010, a compound annual growth rate of 79 percent. At 2013 values of the renminbi of 6.2 per dollar, sales grew from $15.6 million to $5.2 billion over that period. The increase was driven by both quantities and prices of Chinese art sold at auction. On the quantity side, the number of works sold at domestic auctions houses increased from 2,218 in 2000 to 48,480 in 2010, a compound annual growth rate of 49 percent. The initial low level and rapid subsequent

growth of Chinese art sales indicate that the 2000s represented the birth of this market as a major auction category. More broadly, China's domestic market for all types of art (Chinese or foreign) also underwent dramatic growth over this period. According to Artprice's 2011 annual "Art Market Trends" report, Beijing represented 27% of global auction revenues for the year and finished ahead of New York and London as the leading marketplace for art in terms of revenue.

We will pay special attention to the international aspect of this market expansion. Figure 1 (drawn from the data in Table 1) shows the growth of domestic and international sales over the period 2000 through mid-2011, where international sales are defined as those outside of mainland China.[4] Values for both series were low and flat through 2003, when they each began to accelerate. Domestic sales shot up to almost RMB 10 billion by 2005 and accelerated dramatically again in 2008-11. Note that we only observe sales through mid-2011; with data through the rest of the year, 2011 would have been, quite literally, off of the chart. International sales grew steadily through 2007 before being dented by the financial crisis in 2008-9. All in all, the value of international sales went from RMB 83 million in 2000 to RMB 3.5 billion in 2010, a compound annual growth rate of 46 percent.

Table 1 provides more detail on the geographic composition of Chinese art sales. The majority of artworks by Chinese artists were auctioned in mainland China, which accounted for over 89% of the total sales turnover and 97% of the number of works sold in our sample. In particular, the largest domestic auction houses were concentrated in Beijing, accounting for over 71% of the total sales and 62% of the total number of works sold. The largest foreign-operated auction houses, Sotheby's and Christie's, auctioned the majority of their portfolio of Chinese artworks in Hong Kong, which accounted for 9% of overall sales and 2% in terms of the number of works sold.

[4]We treat Hong Kong as part of the international market because Hong Kong's free-port status results in low taxes, zero tariffs on art, mild regulatory burden, and banking secrecy, which makes it significantly different from the mainland art market.

The summary statistics hightly several distinctions between the nature of domestic and international transactions. First, the type of artist sold internationally tended to be quite different from that which sold only domestically, as illustrated in Table 2. We note that it is only a relatively small subset of artists, about 14 percent, sold internationally, and that those artists accounted for a disproportionate share of overall sales volume. We define domestic-only artists as those who never had their works auction outside mainland China during our sample period, whereas international artists are those with at least one international sale. As show in Panel A of Table 2, there are a total of 41,812 individual artists in our sample, of which 5,881 are international. However, the median number of works sold is much higher for international artists, at 7, relative to domestic-only artists, at 1. Figure 2 shows the cumulative number of domestic-only versus international artists in each year. The majority of Chinese artists never sold outside of mainland China, accounting for 58% to 87% of all artists in a given year. Even for international artists, 29% to 43% in a given year are those who have auctioned internationally only once. Finally, Table 3 compares the works of international artists sold at auctions in mainland China versus their works sold in international markets. It is evident that the majority of works by international artists are auctioned in mainland China, totaling over RMB 101 billion in sales, or 85% of their total turnover.

A second dimension of the international nature of art transactions reflects the composition of auction houses, acting as intermediaries in art transactions, that have sold Chinese art. Panel C of Table 1 illustrates that mainland intermediaries grew very quickly in the 2000s, going from 6 to 128. Moreover, this growth was relatively consistent among Beijing, Shanghai and other locations. These observations are somewhat surprising in light of the fact that revenues are remain highly concentrated in China's two flagship auction houses, China Guardian and Poly International Auction.[5] In contrast, international sales took place

[5]To be sure, Guardian and Poly have played a key role in the rise of the Chinese art market. China Guardian started business in Beijing in 1993 and operates on a private business model similar to Sotheby's

at a much smaller number of auction houses, concentrated in Hong Kong, New York and London.

## 2.3. Market Overview - Prices

We now turn to art prices across markets. The top panel of Figure 3 shows the average price level of internationally sold artworks relative to those of artists sold only domestically. Since we observe all of the works of all artists, we are able to define a third category of artwork as the domestic sales of artists that have sold internationally at some point during the sample. The international sales have a price level substantially higher than domestic sales; the average price of works sold in mainland China is RMB 173,170, compared with an average of RMB 531,667 for works sold in the international markets. The artworks of domestic-only artists have the lowest average price level, while the domestic sales of internationally-sold artists carve an intermediate path in between international and domestic-only. The bottom panel indexes each series to its level in 2000 to gauge the relative growth rates of prices. International sales, in spite of their high levels and almost doubling through 2011, grew the slowest while domestic sales, led by the domestic sales of international artists, grew the fastest. In summary, the unconditional average price of international sales was substantially higher than domestic sales during the 2000s, but domestic prices were catching up.

One additional characterization of art prices in each market is their variance, shown in panel E of Table 1. We note that there is a very high degree of price dispersion in all markets, with the overall standard deviation of prices equivalent to a 184 percent deviation

and Christie's. It leads the mainland auction houses with $901.8 million, about 8 percent of the world's auction sales revenue in 2011. Poly was founded in 2005 and also saw its share of global auction revenue grow to 8% in 2011. Both auction houses now rank third and fourth in the global auction market, next to Sotheby's and Christie's whose combined global market share has fallen from 73% to 47% in just ten years, according to "Art Market Trends 2011". As a measure of the growth in the Chinese market, even smaller auction houses, such as Beijing Hanhai and Beijing Council, ranked among the top ten auction houses in the world in terms of revenue in 2011.

from their geometric mean. At the beginning of the sample, the variance of international sales is below the variance of domestic sales, though this changes over time as increasing price dispersion in Hong Kong pulls the international standard deviation above the domestic one.

## 2.4. Other factors

One shortcoming of using auction prices is that they may abstract from certain factors that directly influence the relative price of international sales. We examined two such factors, physical transportation costs and the buyer's premium (i.e., fee) charged by the auction houses, but expect these to have quantitatively small effects on our measure of the international price premium. As far as shipping, these costs should not substantially alter the relative price of international transactions; anecdotes suggest that most artworks auctioned outside China are not exported from China directly before the sale.[6] Exceptions are primarily modern and contemporary artworks. For that group of artworks, however, shipping costs are typically a *de minimus* share of the final auction price. It also turns out that the buyer's premium is not substantially different in mainland versus internationally for the main auction houses in our sample. For example, at Christie's the standard buyer's premium is 25% for a sale price of up to $75,000, 20% for an auction price between $75,000 and $1.5 million, and 12% for a price larger than $1.5 million.[7] By way of comparison, at the top two Chinese auction houses, Poly and Guardian, the buyer's premium ranges between 10-25%.[8] Notwithstanding some heterogeneity in these fees across lots, as they may be subject to negotiation or a more granular sliding scale by value, the range of fees appears

[6] Artworks dating prior to the 19th century and which are auctioned in the international market had likely been taken out of mainland China before the foundation of the People's Republic of China in 1949.

[7] `http://www.christies.com/features/guides/buying-guide/related-information/buyers-premium`

[8] See Poly's website: `http://en.polypm.com.cn/english/pmgz.php`, and China Guardian's website (in Chinese): `http://www.cguardian.com/tabid/68/Default.aspx`

roughly similar across markets.

There are several other well-documented shortcomings to analyzing art markets using auction data. First, industry reports suggest that auctions account for less than 50% of the artworks transacted in the market, with the rest taking place in private galleries and through dealers. However, since the dealer market is highly segmented and not transparent, it is difficult to obtain comparable data. Second, as Goetzmann (1993) argues, auction data have inherent survivorship bias as only works that do not fall out of fashion or are acquired by museums and major private collectors appear on the auction market. A similar bias may arise if auction houses select only the works of the highest calibre to put up for sale. Third, other factors that we do not observe in our dataset may be influencing the price of artworks. For example, the characteristics of buyers (e.g., motivation, valuation, art historical knowledge, information set) can potentially be significant drivers of prices. Pommerehne and Feld (1997) argue that public museums often purchase artworks at above-average prices because they tend to target works whose calibre and historical significance are often not in question. As a result, such works have lower risk and require a higher premium. Finally, many external forces are at play. Renneboog and Spaenjers (2012) identify economic growth, disposable income (inequality) and lagged equity returns as important determinants of art prices. The regulatory structure of a market is also important. As pointed out by Plattner (1996), the tax benefits associated with donations to cultural institutions in the US may play a role in the selection of artworks bought at auction.

# 3. The International Price Premium

In this section, we document the average price and quality of internationally selling artworks and internationally selling artists (including their domestic sales) relative to those of artists that only sold in mainland China. The framework used is the hedonic regression. The

marginal values of each artwork characteristic and transaction characteristic are estimated, including physical characteristics, auction house estimates and proxies for authenticity or provenance, among others. Whether the artwork was sold domestically (i.e., at auction in mainland China) or internationally (i.e., outside of mainland China) enters as an additional characteristic in the hedonic regression, and will be our gauge of the relative markup on international transactions. Further, we will consider two different measures of this international price premium. In the first, we do not control for the influence of all of an artwork's quality characteristics described above; this will be our measure of the unconditional international price premium. In the second, we do control for those characteristics. The difference between the international price premium that does not control for quality and that which does is our estimate of how quality influences international prices (i.e., it is an international quality premium). Finally, we also assess the effect of being an internationally sold artist on the price and quality premia of that artist's domestic sales.

## 3.1. Baseline

In our baseline model, the log price of a given artwork for sale, $\ln p^i_{ct}$, is a function of whether the work is sold internationally, $Intl\_Intl$, whether it is the domestic work of an internationally selling artist, $Dom\_Intl$, a vector of quality characteristics $Z$, and a full set of semi-annual fixed effects:

$$\ln p^i_{ct} = \alpha + \beta_0 Intl\_Intl + \beta_1 Dom\_Intl + \sum_{c=1}^{m} \beta_{2,c}\, Z_c + \sum_{t=1}^{n} \beta_{3,t}\, year_t + \varepsilon^i_{ct} \qquad (1)$$

The average difference in price between international and domestic artists is estimated by the coefficients $\beta_0$ and $\beta_1$: $\beta_0$ is the price of internationally sold artworks relative to those of artists only selling domestically, while $\beta_1$ is the price of domestically sold artworks of internationally selling artists relative to those of artists only selling domestically. The

quality characteristics contained in the vector $Z$ include: the type of artwork, the period it was produced, its size, among others listed in the Appendix A.

An important additional quality characteristic is the pre-sale auction house estimate of the artworks value which is a range composed of a low estimate and a high estimate, and which we include as part of $Z$. The pre-sale range of estimates captures a wide array of value-determining characteristics which are otherwise difficult to measure, including the significance of the artist and artwork, the value from being sold at a particular auction house and even geographic characteristics. It is also well-documented the low estimate tends to be closely related to the seller's reserve price below which the item fails to sell at auction. We exploit this fact in two ways. First, in our baseline, the low estimate is a control variable which additionally captures variation in prices due to the seller's reserve. To the extent that the seller's reserve price is related to the past sale price of an artwork, the low estimate serves as a control for the artwork's cost basis. Second, since models of international trade featuring imperfect competition stress the role of the firms as price setters, in the following section we will examine the robustness of the results using the low estimate as the dependent variable.

Given the inclusiveness of the pre-auction estimate variable in terms of its informational content, we do not include artist dummy variables in our baseline specification. We shall introduce those later on as a robustness check to control for unobserved artist characteristics. We note, however, the fact that auction house estimates may reflect the value of being an internationally sold artist, and hence might be collinear with $\beta_0$ and $\beta_1$. Such a correlation (and the implied inclusive definition of quality) would imply that $\beta_0$ and $\beta_1$ are conservative estimates of the true underlying international price premium. We do not include fixed effects for auction houses given their collinearity with the geographically defined international dummy variables. And finally, the semi-annual fixed effects control for general trends in the prices of Chinese fine art across all markets.

Our baseline results are shown in Table 4. The first column shows the unconditional price premium commanded by internationally selling artists, that is, *without* controlling on the quality characteristics of each artwork. It is evident that internationally selling artists have much higher prices than domestically selling artists and, further, that this result is driven by both the international and domestic sales of the internationally selling artists. International sales have the rather large price premium of 155 percent while the domestic sales of internationally selling artists have a price premium of 100 percent. It is immediate that prices of international sales are about 50 percent higher than the domestic sales of internationally selling artists.

The second column reports results from a similar regression, though this time the quality controls (including auction house pre-sale estimates) are added to the right-hand side of the equation. We can interpret the price premium for international artworks in this regression as a 'quality-adjusted' premium since it takes into account the composition of works sold in each market. It is evident that the premium for both internationally sold works and the domestic works of internationally selling artists goes down considerably when quality differences are accounted for, as the estimates drop to 28.5 percent and 14.8 percent, respectively. That said, apples-to-apples price differences of almost 30 percent still indicate a substantial amount of international price dispersion. We take this to mean that the markup charged in the international market is substantially higher than in the domestic market. Moreover, the markup charged for internationally selling artist in the domestic market is larger than for the rest of the domestic market. There could be various reasons for this latter observation, such as some type of anchoring or signaling mechanism orthogonal to measured quality characteristics which drives up the markups of the domestic artworks of international artists.

One can interpret the difference between the unconditional estimates in the first column and the quality-adjusted estimates in the second column as the influence of quality composition on international art prices; this difference is shown in the third column en-

titled 'international quality premium.' Reading across the first row, the results indicate that internationally selling artworks are 155 percent more expensive than those of domestic artists, with 127 percent of this premium due to the fact that internationally sold artworks have higher-valued quality characteristics. We also observe that most (over 85 percent) of the premium for the domestic works of internationally selling artists is due to quality differences, as implied by the estimates in the second row.

Overall, the results in Table 4 suggest a high degree of quality sorting into export markets: (i) artists with higher quality artworks select into selling internationally, and (ii) the higher quality works of those artists are the ones that sell internationally. The first of these statements is supported by the fact that the international quality premium is positive for both international artworks and domestic works of international artists. The fact that all types of sales of international artists have higher quality implies that, on average, the quality of internationally selling artists is higher than that of domestically selling artists. The second statement is illustrated by the relatively large premium for international works. In summary, a sufficient condition for these two statements to be true is:

$$\text{International quality premium (intl.)} > \text{International quality premium (dom.)} > 0$$

which holds in our baseline in Table 4, as well as in the balance of robustness checks presented in the next section.

The pattern of quality and markup sorting also holds over time during this period, as shown in Figure 4 on an annual basis. However, the magnitude of the quality premium and the quality-adjusted premium have distinct dynamics. The quality premium was very high at the beginning of the period, reaching a peak of 412 percent in 2001, before falling steadily to less than 100 percent in 2007 and ticking up thereafter. In contrast, the quality-adjusted price premium grew steadily through 2007, going from 9 percent to 45 percent before falling

back to 13 percent in 2010.

## 3.2. Robustness

To gauge the robustness of the international price and quality premia in the baseline model, there are several alternate specifications that we explore. First, we return to the notion that auction sales prices may systematically differ from the reserve price of the seller. This could be introducing bias into the measures of the international premium due to the use of auction *transaction* prices in the baseline regression; to the extent that transaction prices deviate from reserve prices either more or less in international transactions than domestic ones, the international premium would reflect that difference in prices. Table 5 shows the resulting estimates of (1) where we have substituted the transaction price on the left-hand side with the low estimate (a proxy for the seller's reserve price). Since the low estimate was previously used as a quality control variable, the specification in Table 5 also adds artist fixed effects for the top 300 artists by physical sales volume into the quality-adjusted international premium specification. The results are broadly in line with our baseline, though the unconditional price premium falls somewhat for both international sales and domestic sales of international artists and the quality-adjusted estimates rise. Importantly, as before, the quality premium indicates both across artist and within artist sorting into international sales.

In Table 6, we address the possibility that there is selection bias in our baseline sample of artworks which only included those that consummated a sale at auction (and did not include lots put up for auction that failed to sell). This concern is not a trivial one as roughly one third of our 1.1 million observation sample does not have a transaction price, indicating that these works did not end up being sold. Building on our specification using the low estimate as the dependent variable, we proceed to run the regression over all lots brought up for auction. The estimates shown in Table 6 are minimally different from those in Table

5, indicating that even if there are systematic pricing differences between sold and unsold artworks at auction, they do not manifest themselves across geographic auction locations.

In Table 7, we consider whether the churning of artists in the sample had an appreciable influence on the international premia. Given the rapid growth in the number of domestic artists documented above (see Figure 2) there may be concern that the composition of artists is changing in such a way that amplifies the price differences across markets. For example, if the new domestic entrants are of relatively low price and quality, it would create the appearance of relatively high quality international and incumbent domestic artists. We test this possibility by reverting to auction transaction prices on the left-hand side and holding the composition of artists in the year 2000 constant over subsequent periods. Table 7 shows that doings so, despite dropping roughly half of the sample, has little effect on the international price and quality premia of internationally sold artworks. The domestic-international premia decline somewhat but are qualitatively similar to the baseline.

Next we examine the international price and quality premia in particular destination markets. To do so, we divide the international cohort into two groups: Honk Kong/Macau/Taiwan and US/UK/Other, which roughly divides the world into the broader Asian market and the rest of the world, respectively. Table 8 shows regression estimates for the US/UK/Other group of auction locations. It is immediately apparent that the premia for international works, both unconditional and quality-adjusted, is much larger than for the overall sample. Artworks sold in the US/UK/Other fetched over three times more than works sold in mainland China. Again, the majority of this difference (i.e., 283 percent of the 331 percent premium) is accounted for by the higher quality of the international sales, and even controlling for quality there is a large price premium of about 50 percent. Interestingly, the domestic sales of international artists have virtually the same price and quality premia as the overall sample, indicating that there is nothing in particular about selling in US/UK/Other that allows internationally selling artists to charge more in mainland China.

Tables 9 and 10 duplicate the analysis for the different subgroups of medium and period, respectively. Among the media, both the international price premium and quality premium are higher for oil paintings than for classical-style paintings and calligraphy, though the quality-adjusted premium is roughly the same for each medium. That is, while quality sorting seems to be stronger for oil paintings, the quality-adjusted markup is about the same for all media. Much the same pattern holds for contemporary versus non-contemporary art, which is in part by construction since contemporary art is less likely to be classical-style or calligraphy.

Finally, Table 11 decomposes the price and quality premia by degree of internationalization, which is proxied by the number of international sales for a given artist. As shown in Figure 2, the number of artists with very few international sales is not trivial; by 2011, over half of the cumulative number of international sales were by artists who only sold a single painting abroad over the period. This distinction turns out to be quite meaningful for the international premia, as the top quartile of artists by number of international sales have substantially higher relative price and quality than the bottom quartile. For the most internationalized artists, the selection of high quality artists into international markets is also the strongest, as evidenced by the relatively close estimates of the quality premium of international versus domestic works of international artists. In other words, the artists with the highest quality works sell more works abroad, but at a similar quality and price level to their domestic sales.

## 3.3. A Structural Model of Quality Sorting

Having shown evidence for quality and markup differentials inside versus outside of China, in this section we attempt to rationalize the results through the lens of theories that give rise to quality sorting. To uncover the drivers of the quality premium, we shall follow the structural

approach of Feenstra and Romalis (2012) and adapt their model of endogenous quality choice. Their framework features specific transport costs and non-homothetic preferences for quality, a structure that allows for the identification of the quality component of average export prices in the trade data. Given that we observe relative trade quality from our empirical estimates, we shall invert their model equations to identify the parameters governing specific costs and preferences for quality.

On the preferences side, demand in a country $k$ is in the form of the following expenditure function:

$$E^k = E(p_1^k/z_1^{\alpha^k}, ..., p_n^k/z_n^{\alpha^k}, U^k)$$

which is defined over $n$ varieties with price $p$ and quality level $z$. The parameter $\alpha$ amplifies quality's effect on quality-adjusted prices exponentially and indicates the preference for quality of country $k$ consumers. Since $E^k$ is a function of the country's utility, it follows that richer countries with higher consumption levels spend more on all available import varieties. Similarly, countries with higher levels of $\alpha$ tilt their expenditure towards higher quality varieties. In Feenstra and Romalis (2012), this expenditure function is specialized to the following "non-homothetic" CES function:

$$E^k = U^k \left[ \int_i (p_i^k/z_i^{\alpha^k})^{(1-\sigma)} di \right]^{\frac{1}{(1-\sigma)}}$$

which scales the constant elasticity aggregator (with elasticity $\sigma$) by country $k$'s level of utility.

On the production side, sellers simultaneously choose the level of quality and the landed

price to maximize the following expression for profit given destination demand $Q_i^k$:[9]

$$\max_{p_i^k, z_i^k} \left\{ p_i^k - \tau_i^k \frac{c_i(z_i^k, w_i, \varphi_i) + T_i^k}{z_i^{\alpha^k}} \right\} \frac{Q_i^k}{tar_i^k}$$

The difference between landed prices and those at the factory gate are transport and tariff costs, which appear in this expression as a specific cost $T_i^k$, an iceburg cost $\tau_i^k$ and an ad-valorem tariff $tar_i^k$. Profits also reflect the variable cost of a variety, denoted $c_i(z_i^k, w_i, \varphi_i)$, which is a function of quality as well as input prices and productivity. As discussed above, since auctions are largely secondary market transactions, it is difficult to apply the notion of production to them in a literal sense. Therefore we will proceed by implicitly normalizing $w_i/\varphi_i = 1$, which purges the resulting expressions for price and quality of productivity and wages.[10]

The seller's problem gives rise to two first order conditions for export price and quality:

$$p_i^k = T_i^k \left( \frac{1}{1 - \alpha^k \theta} \right) \left( \frac{\sigma}{\sigma - 1} \right) \tag{2}$$

$$z_i^k = \left[ T_i^k \left( \frac{\alpha^k \theta}{1 - \alpha^k \theta} \right) \right]^{\theta} \tag{3}$$

Price is a function of the specific cost, the quality valuation parameter, the elasticity of substitution among varieties and $\theta$, which is a parameter between 0 and 1 necessary to ensure diminishing returns to the production of quality and a corresponding interior solution for quality and prices in the model. From our empirical work above we have estimates of the price and quality of international sales relative to those of domestic sales (i.e., $p_i^k/p_i^0$ and

[9] At this point, we depart somewhat from the notation in Feenstra and Romalis (2012). First, we do not adopt firm-level subscripts for two reasons: (i) since our focus will not be on firm-specific (in our empirics, artist-specific) variation in costs, we abstract from firm level heterogeneity in productivity and inputs, and (ii) we have in mind an application where each firm/artist has many varieties on the market, and so the exposition is clearest modeling individual varieties, not firms. Second, for simplicity and ease of interpretation, we do not track the factory gate prices of sellers.

[10] In Feenstra and Romalis (2012), productivity and wages also cancel out of aggregate export prices but for a different reason. See footnote 8 in their paper.

$z_i^k/z_i^0$ where 0 denotes a domestic sale). Equations (2) and (3) thus compose a system of two equations in 4 unknowns $(T_i^k, \alpha^k, \sigma, \theta)$. Our final identifying assumption is that $\sigma$ is the same across markets.

Dividing each expression by its value for domestic sales, taking logs and rearranging yields a closed form expression for the relative preference for quality across destinations:

$$\ln\left(\frac{\widehat{\alpha^k}}{\alpha^0}\right) = \ln\left(\frac{p^k}{p^0}\right) - \frac{1}{\theta}\ln\left(\frac{z^k}{z^0}\right) \tag{4}$$

Interestingly, for values of $\theta$ close to 1, a sufficient statistic for the relative preference for quality is the quality-adjusted international price premium (i.e., $\ln\left(p^k/p^0\right) - \ln\left(z^k/z^0\right)$). In other words, countries with a strong preference for quality have higher markups, *above and beyond* those being paid for imports of higher quality. The intuition for this result is that sellers internalize consumers' preference for quality and increase their prices to high-valuation markets by even more than the premium implied by the quality-inclusive price. Due to the non-linearity of the logged first order conditions with respect to $\alpha$, it is difficult to solve directly for $T^k/T^0$. That said, Equation (4) already attaches an implicit value to the importance of specific costs; holding $\sigma$ and $\theta$ constant, changes in the price premium over time above those accounted for by the quality-adjusted price are being driven by changes in the relative specific cost.

With this decomposition in mind, we return to our time series estimates of the international price and quality premia in Figure 4. Equation (4) implies that the low and relatively stable value of the quality-adjusted price premium implies a similarly modest and stable role of relative preferences for quality in driving the international price premium. Given this measure of relative preferences, it therefore must be an the specific costs that are behind the heights of the international quality premium in the early portion of the sample. The dynamics of the price premium tend to support this story: In the early years when information

about Chinese artists was relatively scarce outside of China and the specific cost of acquiring that information was great, the relative quality of international sales was very high. Then, as the international community of art buyers better acquainted itself with Chinese art, these costs began to fall and so did the relative quality of international sales. All the while, preferences for quality also contributed to prices at relatively high levels outside of China, albeit relatively modestly. The dynamics of the estimated preference for quality implies that international taste for Chinese art grew steadily relative to mainland China over the first part of the sample, and then tapered off in the more recent years. This latter change may indicate that Chinese preferences for quality have increased in line with the recent burgeoning of the domestic market.

# 4. Conclusion

This paper takes preliminary steps in identifying the drivers of quality and markup heterogeneity across international markets. Our study of the Chinese art market suggests that product quality exerts a considerable influence on international price differences, operating through higher markups. The results also shed light on the dynamic nature of product quality over the course of an international marketï¿½s inception. We find that the international quality premium was particularly high as sales were first being made abroad and tapered off thereafter, an indication that the per unit costs associated with purchasing Chinese art outside of China were initially high but declining. Relative preferences for quality also appear to contribute to the quality premium, albeit less so than specific costs and in a more stable manner over time.

Chinese art may also be a useful lens through which to view other open issues in international pricing. For example, a particularity to art auctions is that all sales take place through intermediaries (i.e., the auction houses) as opposed to directly between buyers and

sellers. Indeed, we do not actually observe who either transacting party is, but only that a transaction occurred at the intermediating firm. While our analysis accounts to some extent for the influence of auction intermediaries on prices, through auction house controls and auction house estimates in the hedonic regression, there is much more to be said about the role of intermediaries at both distributing goods and services internationally and creating value.

Finally, we acknowledge that art, as a cultural export, is at best an analogy for international trade in more standard types of goods. That said, art bears a resemblance to manufactured goods in certain respects that warrant further investigation. For instance, total auction sales value across artists appears to be distributed following a power law, which is a hallmark of the firm size distribution and a highly cited fact in the international trade literature. Whereas for standard manufactures this distribution is often taken as evidence of a firm productivity distribution with a fat right tail, it must be other factors either on the supply-side or demand-side which generate this pattern of sales for art. This similarity with manufactures may also imply more general applicability of lessons gleaned from the art market.

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# Appendix

## A. Control Variables for the Quality of Artworks

The quality control variables used in the hedonic regressions are listed below.

1. The type of artwork

   We identify whether the artwork is an oil painting, an ink or watercolor painting in the classical style, or a work of calligraphy.

2. The period in which the artwork is produced

   For each artwork where the information on the time period in which it was produced is available, we classify it into one of four periods: Pre-1840, Late Qing Dynasty (1840-1910), Republican period (1911-1948), and Contemporary period (Post-1949).

3. The order in which the item is sold at auction

   Given evidences of the declining-price anomaly found in art auctions (Beggs and Graddy (1997)), we identify the order in which items are put on sale in each auction. Dummy variables are created indicating in which quintile each item was auctioned.

4. The size of the artwork

   Consistent with existing literature on Hedonic Regressions, we include measures of the artwork's height (cm), width (cm), height-squared ($cm^2$), width-squared ($cm^2$), and total surface area ($cm^2$).

5. The medium of the artwork

   We include in the regression dummy variables indicating whether the artwork is of the following medium: Acrylic, Ink, Oil, Tempera, On Canvas, On Panel, On Paper, On Silk, or On Xuan Paper.

6. The authenticity and provenance of artwork

   We construct dummy variables based on the presence of other features of artwork, including 1) whether the work was signed, 2) whether the work was stamped by the artist or subsequent collectors, 3) whether the work was inscribed, 4) whether the work was titled, 5) whether the work is dated, 6) whether there is any evidence of authenticity of the work, including statements signed by art history experts, 7) whether the work took part in major exhibitions, 8) whether the work was included in major publications, and 9) whether the work has significant provenance.

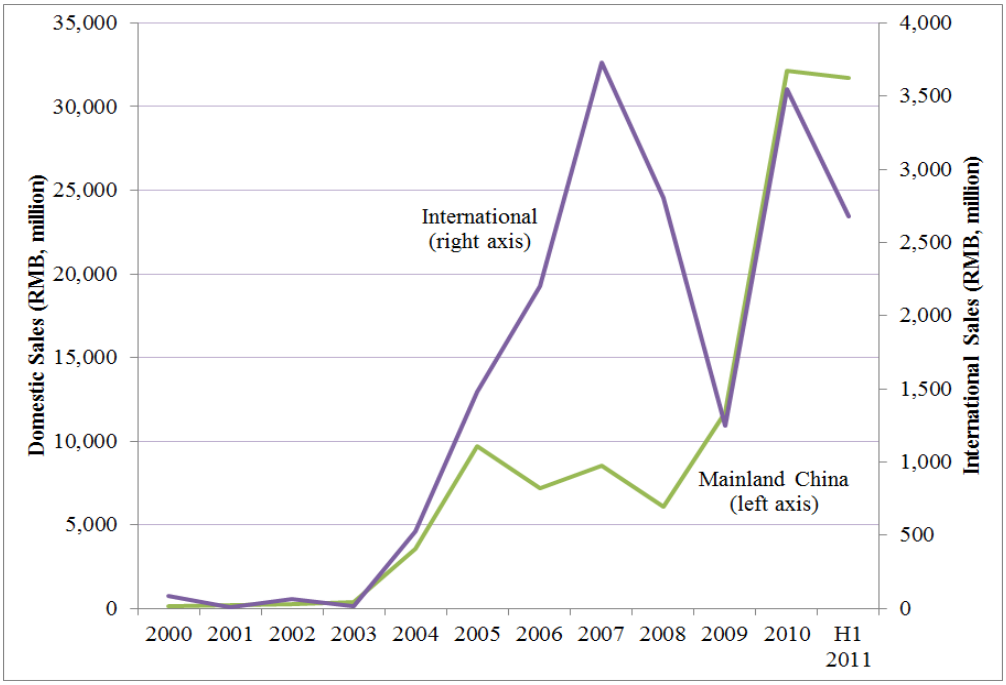



Figure 1: **Domestic and International Sales Outstanding of Chinese Artworks in Calligraphy and Paintings**. Domestic sales include all revenue from auctions houses in mainland China, while international sales include revenues from auction houses out of mainland China.

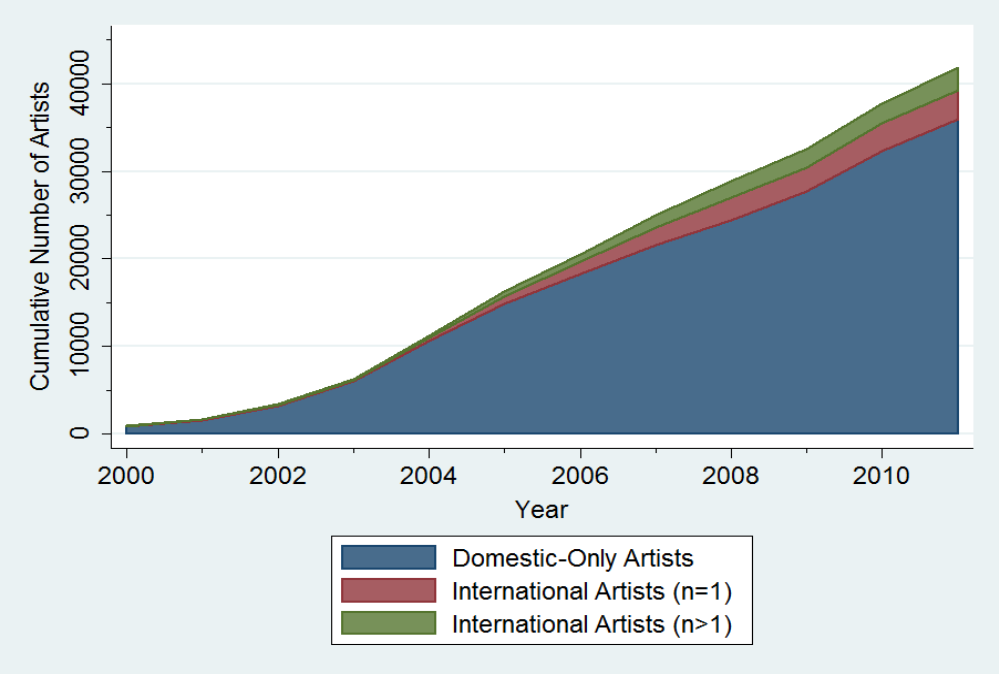
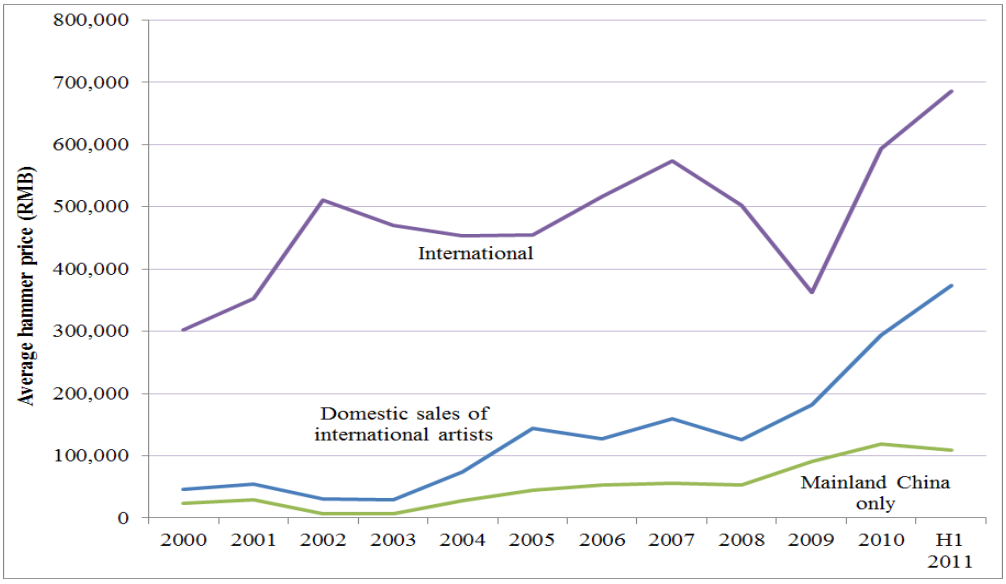



Figure 2: **Cumulative Number of Domestic-only and International Artists**. This figure shows the cumulative number of artists in our database at the end of each calendar year. Artists are grouped based on the total number of works sold outside mainland China up to the end of each year. Domestic-only artists never have works auctioned in the international market, whereas international artists have $n(n > 0)$ works sold internationally.

A. Level




B. Growth

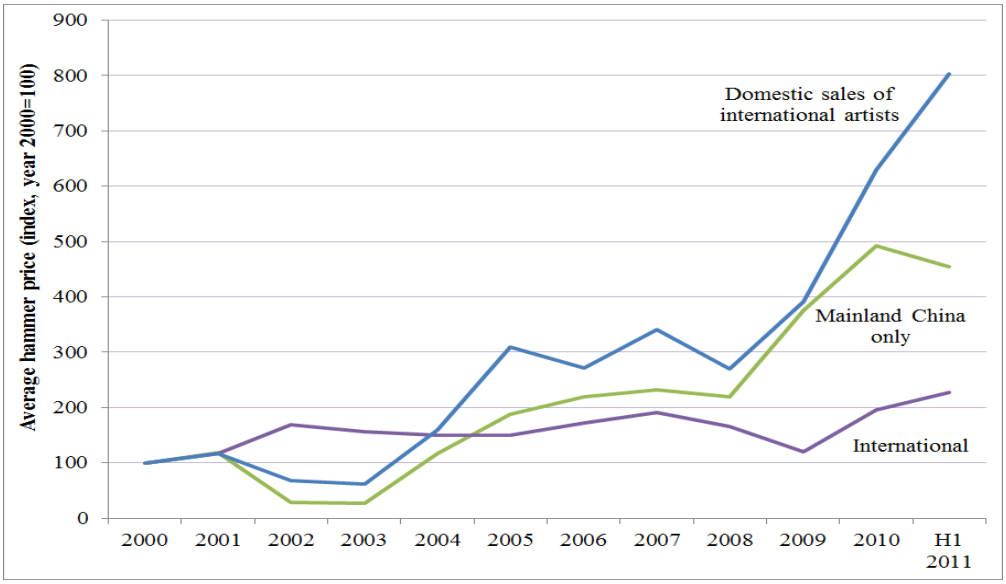



Figure 3: **Hammer Price of Domestic-only and International Chinese Artists**. Panel A shows the average hammer price and Panel B shows the growth of average hammer price based on the level of 2000 (Index2000=100). Domestic-only Chinese artists never have works auctioned in the international market, whereas international artists have works sold internationally.

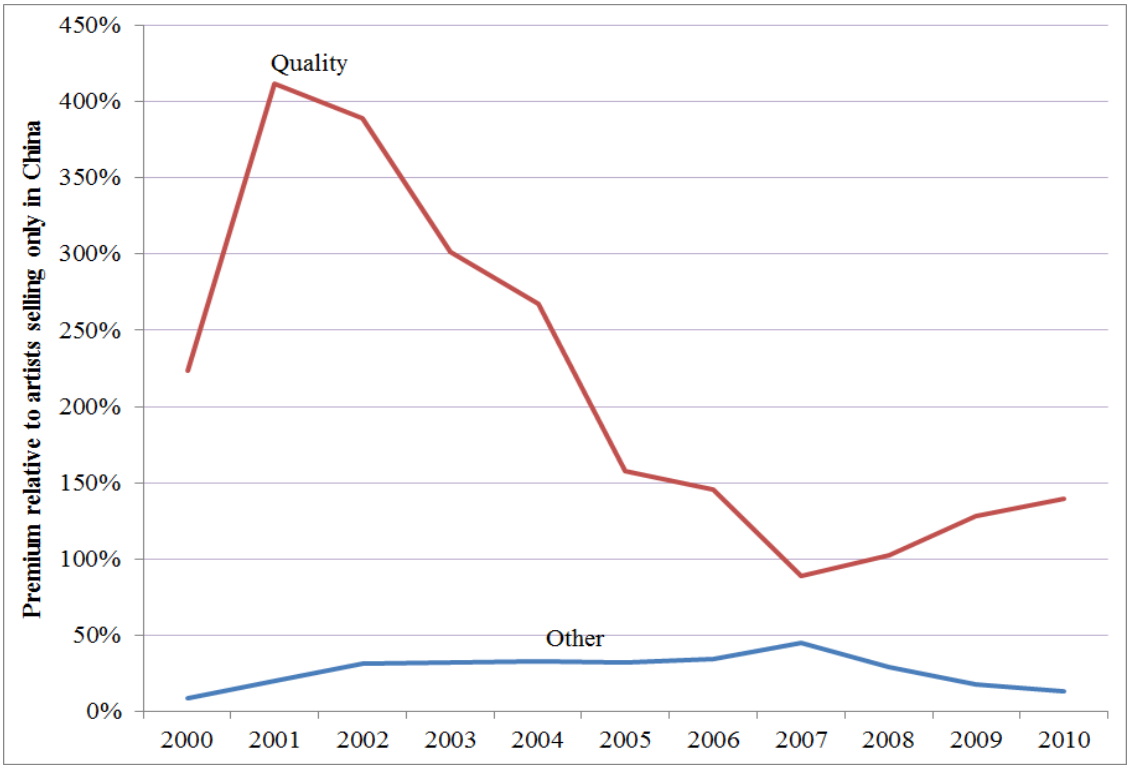



Figure 4: **The Evolution of International Premium decomposed into Quality and Markup**. The decomposition of international premium is based on equation (1).

## Table 1: Auction Results by Location

This table reports auction results of Chinese art during 2000 - 2011 in the domestic and international market. We categorize the domestic market as Beijing, Shanghai, and others; we categorize the international market as Hong Kong, Macau, Taiwan (HMT), United Kingdom (UK), United States (US) and others.

Panel A: Total Sales (RMB Million)

| | Domestic | | | | International | | | | | Total |
|---|---|---|---|---|---|---|---|---|---|---|
| | Beijing | Shanghai | Other | Subtotal | HMT | UK | US | Other | Subtotal | |
| 2000 | 81.1 | 0.5 | 15.1 | 96.7 | 82.7 | - | - | - | 82.7 | 179.4 |
| 2001 | 164.4 | 26.0 | 17.7 | 208.0 | 7.3 | - | - | - | 7.3 | 215.4 |
| 2002 | 114.0 | 88.6 | 26.2 | 228.8 | 66.9 | - | - | - | 66.9 | 295.8 |
| 2003 | 201.0 | 148.8 | 44.8 | 394.5 | 16.9 | - | - | - | 16.9 | 411.4 |
| 2004 | 2,206.5 | 848.5 | 525.0 | 3,580.0 | 528.4 | - | - | - | 528.4 | 4,108.3 |
| 2005 | 6,298.2 | 1,977.0 | 1,439.4 | 9,714.7 | 1,468.0 | - | 8.9 | 4.9 | 1,481.8 | 11,196.5 |
| 2006 | 4,760.3 | 763.0 | 1,675.7 | 7,198.9 | 2,024.7 | - | 177.1 | - | 2,201.8 | 9,400.7 |
| 2007 | 5,833.2 | 985.2 | 1,728.2 | 8,546.7 | 3,189.7 | 45.0 | 493.7 | - | 3,728.4 | 12,275.0 |
| 2008 | 3,957.2 | 786.5 | 1,330.5 | 6,074.2 | 2,343.6 | 278.9 | 184.6 | - | 2,807.1 | 8,881.4 |
| 2009 | 8,333.2 | 1,312.7 | 2,100.3 | 11,746.1 | 1,177.2 | 21.4 | 33.4 | 14.6 | 1,246.7 | 12,992.8 |
| 2010 | 22,138.9 | 4,120.0 | 5,878.4 | 32,137.3 | 3,497.6 | 13.6 | 19.5 | 17.5 | 3,548.2 | 35,685.5 |
| 2011 | 21,157.9 | 3,278.8 | 7,284.7 | 31,721.4 | 2,655.1 | - | 14.1 | 5.7 | 2,675.0 | 34,396.4 |
| Total | 75,245.8 | 14,335.5 | 22,066.0 | 111,647.3 | 17,058.3 | 359.0 | 931.3 | 42.7 | 18,391.3 | 130,038.6 |

Panel B: Total Number of Works Sold

| | Domestic | | | | International | | | | | Total |
|---|---|---|---|---|---|---|---|---|---|---|
| | Beijing | Shanghai | Other | Subtotal | HMT | UK | US | Other | Subtotal | |
| 2000 | 1,881 | 32 | 305 | 2,218 | 274 | - | - | - | 274 | 2,492 |
| 2001 | 2,512 | 902 | 639 | 4,053 | 6 | - | - | - | 6 | 4,059 |
| 2002 | 5,429 | 1,975 | 1,145 | 8,549 | 131 | - | - | - | 131 | 8,680 |
| 2003 | 9,296 | 5,545 | 1,939 | 16,780 | 81 | - | - | - | 81 | 16,861 |
| 2004 | 24,893 | 17,777 | 11,654 | 54,324 | 1,166 | - | - | - | 1,166 | 55,490 |
| 2005 | 33,919 | 22,318 | 20,320 | 76,557 | 3,192 | - | 14 | 66 | 3,272 | 79,829 |
| 2006 | 35,221 | 7,886 | 23,295 | 66,402 | 4,043 | - | 215 | - | 4,258 | 70,660 |
| 2007 | 35,012 | 8,126 | 20,841 | 63,979 | 6,051 | 87 | 354 | - | 6,492 | 70,471 |
| 2008 | 30,227 | 8,900 | 16,961 | 56,088 | 5,273 | 86 | 233 | - | 5,592 | 61,680 |
| 2009 | 38,672 | 12,930 | 20,292 | 71,894 | 3,317 | 20 | 37 | 64 | 3,438 | 75,332 |
| 2010 | 63,945 | 20,218 | 39,355 | 123,518 | 5,872 | 25 | 33 | 52 | 5,982 | 129,500 |
| 2011 | 48,910 | 14,674 | 36,780 | 100,364 | 3,838 | - | 35 | 26 | 3,899 | 104,263 |
| Total | 329,917 | 121,283 | 193,526 | 644,726 | 33,244 | 218 | 921 | 208 | 34,591 | 679,317 |

Panel C: Number of Auction Houses

| | Domestic | | | | International | | | | | Total |
|---|---|---|---|---|---|---|---|---|---|---|
| | Beijing | Shanghai | Other | Subtotal | HMT | UK | US | Other | Subtotal | |
| 2000 | 3 | 1 | 2 | 6 | 2 | 0 | 0 | 0 | 2 | 8 |
| 2001 | 5 | 3 | 4 | 12 | 1 | 0 | 0 | 0 | 1 | 13 |
| 2002 | 5 | 7 | 5 | 17 | 2 | 0 | 0 | 0 | 2 | 19 |
| 2003 | 6 | 9 | 8 | 23 | 2 | 0 | 0 | 0 | 2 | 25 |
| 2004 | 9 | 15 | 18 | 42 | 4 | 0 | 0 | 0 | 4 | 46 |
| 2005 | 23 | 18 | 27 | 68 | 5 | 1 | 0 | 1 | 7 | 75 |
| 2006 | 39 | 17 | 43 | 99 | 8 | 1 | 0 | 0 | 9 | 108 |
| 2007 | 37 | 12 | 44 | 93 | 12 | 1 | 2 | 0 | 15 | 108 |
| 2008 | 39 | 14 | 42 | 95 | 13 | 3 | 2 | 0 | 18 | 113 |
| 2009 | 32 | 13 | 41 | 86 | 13 | 3 | 2 | 1 | 19 | 105 |
| 2010 | 51 | 21 | 56 | 128 | 14 | 2 | 2 | 2 | 20 | 148 |
| 2011 | 52 | 19 | 71 | 142 | 13 | 2 | 0 | 1 | 16 | 158 |

Panel D: Average Sales Price per Work (RMB)

| | Domestic | | | | International | | | | | Total |
|---|---|---|---|---|---|---|---|---|---|---|
| | Beijing | Shanghai | Other | Subtotal | HMT | UK | US | Other | Subtotal | |
| 2000 | 43,120 | 15,044 | 49,458 | 43,587 | 301,960 | - | - | - | 301,960 | 71,996 |
| 2001 | 65,436 | 28,770 | 27,678 | 51,323 | 1,224,521 | - | - | - | 1,224,521 | 53,057 |
| 2002 | 20,996 | 44,863 | 22,908 | 26,766 | 510,929 | - | - | - | 510,929 | 34,073 |
| 2003 | 21,620 | 26,831 | 23,099 | 23,513 | 208,592 | - | - | - | 208,592 | 24,402 |
| 2004 | 88,638 | 47,733 | 45,045 | 65,900 | 453,150 | - | - | - | 453,150 | 74,038 |
| 2005 | 185,683 | 88,584 | 70,838 | 126,894 | 459,914 | - | 632,474 | 74,432 | 452,877 | 140,256 |
| 2006 | 135,156 | 96,749 | 71,932 | 108,414 | 500,798 | - | 823,653 | - | 517,100 | 133,042 |
| 2007 | 166,607 | 121,239 | 82,925 | 133,586 | 527,135 | 517,103 | 1,394,573 | - | 574,300 | 174,185 |
| 2008 | 130,916 | 88,375 | 78,446 | 108,298 | 444,452 | 3,243,351 | 792,377 | - | 501,993 | 143,991 |
| 2009 | 215,483 | 101,524 | 103,501 | 163,381 | 354,906 | 1,070,826 | 903,964 | 227,888 | 362,615 | 172,474 |
| 2010 | 346,218 | 203,777 | 149,369 | 260,183 | 595,636 | 545,415 | 590,545 | 336,774 | 593,147 | 275,564 |
| 2011 | 432,588 | 223,442 | 198,062 | 316,063 | 691,805 | - | 402,190 | 220,452 | 686,062 | 329,900 |
| Total | 228,075 | 118,199 | 114,021 | 173,170 | 513,124 | 1,646,642 | 1,011,134 | 205,488 | 531,677 | 191,425 |

Panel E: Standard Deviation of Log Sales Price per Work (RMB)

| | Domestic | | | | International | | | | | Total |
|---|---|---|---|---|---|---|---|---|---|---|
| | Beijing | Shanghai | Other | Subtotal | HMT | UK | US | Other | Subtotal | |
| 2000 | 1.30 | 0.98 | 0.98 | 1.27 | 1.21 | N/A | N/A | N/A | 1.21 | 1.39 |
| 2001 | 1.14 | 1.22 | 1.02 | 1.21 | 0.88 | N/A | N/A | N/A | 0.88 | 1.22 |
| 2002 | 1.60 | 1.28 | 0.96 | 1.55 | 1.22 | N/A | N/A | N/A | 1.22 | 1.60 |
| 2003 | 1.59 | 1.29 | 1.49 | 1.54 | 1.29 | N/A | N/A | N/A | 1.29 | 1.54 |
| 2004 | 1.72 | 1.27 | 1.40 | 1.52 | 1.79 | N/A | N/A | N/A | 1.79 | 1.56 |
| 2005 | 1.72 | 1.44 | 1.58 | 1.65 | 2.16 | 1.49 | N/A | 1.51 | 2.16 | 1.68 |
| 2006 | 1.63 | 1.49 | 1.51 | 1.60 | 1.97 | 1.18 | N/A | N/A | 1.97 | 1.65 |
| 2007 | 1.75 | 1.60 | 1.49 | 1.66 | 2.36 | 1.30 | 1.15 | N/A | 2.36 | 1.75 |
| 2008 | 1.77 | 1.65 | 1.47 | 1.67 | 2.24 | 1.24 | 1.18 | N/A | 2.28 | 1.75 |
| 2009 | 1.87 | 1.74 | 1.58 | 1.78 | 2.04 | 1.46 | 1.58 | 1.01 | 2.04 | 1.79 |
| 2010 | 2.05 | 1.73 | 1.60 | 1.86 | 2.15 | 1.30 | 1.65 | 1.18 | 2.15 | 1.88 |
| 2011 | 1.96 | 1.80 | 1.63 | 1.83 | 2.17 | 1.92 | N/A | 1.13 | 2.17 | 1.84 |

Table 2: Number of Works Sold and Average Sales Price by Artist

This table presents summary statistics on the number of works sold and the average sales price by Chinese artists. We classify artists by whether they have sold works in the international market. Domestic-Only artists have zero works sold in the international market, whereas international artists have at least one work sold internationally. The sample period is from 2000 to 2011.

Panel A: Number of Artist

| Total | Domestic-Only Artists | International Artists |
|---|---|---|
| 41,812 | 35,931 | 5,881 |

Panel B: Number of Works Sold per Artist

| | All Artists | Domestic-Only Artists | International Artists |
|---|---|---|---|
| Mean | 16 | 4 | 92 |
| Median | 1 | 1 | 7 |
| Std Dev | 147 | 12 | 381 |
| Min | 1 | 1 | 1 |
| Max | 9,145 | 598 | 9,145 |

Panel C: Average Sales Price per Work Sold (RMB)

| | All Artists | Domestic-Only Artists | International Artists |
|---|---|---|---|
| Mean | 67,422 | 55,694 | 139,078 |
| Median | 10,450 | 8,960 | 25,888 |
| Std Dev | 816,015 | 837,008 | 669,312 |
| Min | 100 | 100 | 115 |
| Max | 109,000,000 | 109,000,000 | 39,100,000 |

Table 3: Number of Works Sold and Average Sales Price by International Artist

This table compares the auction results of domestic works and international works by international Chinese artists, who have at least one work sold internationally.

| | A. Total Sales (RMB Million) | | B. Total Number of Works Sold | | C. Average Sales Price(RMB) | |
|---|---|---|---|---|---|---|
| | Domestic Works | Int'l Works | Domestic Works | Int'l Works | Domestic Works | Int'l Works |
| 2000 | 89.4 | 82.7 | 1,915 | 274 | 46,659 | 301,960 |
| 2001 | 193.8 | 7.3 | 3,558 | 6 | 54,469 | 1,224,521 |
| 2002 | 217.7 | 66.9 | 6,945 | 131 | 31,346 | 510,929 |
| 2003 | 368.4 | 16.9 | 12,758 | 81 | 28,880 | 208,592 |
| 2004 | 3,305.7 | 528.4 | 44,571 | 1,166 | 74,168 | 453,150 |
| 2005 | 9,107.9 | 1,481.2 | 63,193 | 3,256 | 144,128 | 454,929 |
| 2006 | 6,324.1 | 2,201.8 | 49,859 | 4,258 | 126,840 | 517,100 |
| 2007 | 7,660.3 | 3,728.4 | 48,110 | 6,492 | 159,224 | 574,300 |
| 2008 | 5,361.4 | 2,807.1 | 42,606 | 5,592 | 125,836 | 501,993 |
| 2009 | 10,412.4 | 1,246.7 | 57,143 | 3,438 | 182,217 | 362,615 |
| 2010 | 29,316.4 | 3,548.2 | 99,745 | 5,982 | 293,913 | 593,147 |
| 2011 | 29,304.2 | 2,675.0 | 78,293 | 3,899 | 374,289 | 686,062 |
| Total | 101,661.6 | 18,390.7 | 508,696 | 34,575 | 199,847 | 531,907 |

Table 4: International Price Premium and Quality Premium

| | International Price Premium | Quality-Adj. Intl Price Premium | International Quality Premium |
|---|---|---|---|
| International Dummies | | | |
| International works of international artists | **1.552** | **0.285** | **1.267** |
| | (0.013) | (0.004) | (0.013) |
| Domestic works of international artists | **1.001** | **0.148** | **0.852** |
| | (0.005) | (0.002) | (0.005) |
| Time Dummies | Included | Included | |
| Quality Control | Not Included | Included | |
| Log Estimated Price | Not Included | Included | |
| Artist Dummies | Not Included | Not Included | |
| Constant | **9.164** | **1.195** | |
| | (0.062) | (0.018) | Number of Observations |
| Number of Observations | 679,317 | 608,909 | |
| R-square | 0.096 | 0.872 | |

Table 5: Baseline Regression with Low-end Estimated Value on the LHS, Only Sold Works

| | International Price Premium | Quality-Adj. Intl Price Premium | International Quality Premium |
|---|---|---|---|
| International Dummies | | | |
| International works of international artists | **1.252** | **0.387** | **0.865** |
| | (0.013) | (0.010) | (0.016) |
| Domestic works of international artists | **0.831** | **0.475** | **0.355** |
| | (0.005) | (0.005) | (0.008) |
| Time Dummies | Included | Included | |
| Quality Variables | Not Included | Included | |
| Log Estimated Price | Not Included | Not Included | |
| Artist Dummies for the Top 300 Artists (Based on # of Works Sold) | Not Included | Included | |
| Constant | **9.010** | **5.595** | |
| | (0.061) | (0.056) | Number of Observations |
| Number of Observations | 634,350 | 608,909 | |
| R-square | 0.060 | 0.456 | |

Table 6: Baseline Regression with Low-end Estimated Value on the LHS, Including Unsold Works

| | International Price Premium | Quality-Adj. Intl Price Premium | International Quality Premium |
|---|---|---|---|
| International Dummies | | | |
| International works of international artists | **1.212** | **0.477** | **0.735** |
| | (0.010) | (0.008) | (0.012) |
| Domestic works of international artists | **0.746** | **0.430** | **0.316** |
| | (0.004) | (0.004) | (0.006) |
| Time Dummies | Included | Included | |
| Quality Variables | Not Included | Included | |
| Log Estimated Price | Not Included | Not Included | |
| Artist Dummies for the Top 300 Artists (Based on # of Works Sold) | Not Included | Included | |
| Constant | **8.855** | **5.788** | |
| | (0.033) | (0.035) | Number of Observations |
| Number of Observations | 1,128,390 | 1,084,115 | |
| R-square | 0.052 | 0.401 | |

Table 7: Balanced Panel of Artists

This table shows baseline regression results for all works by artists who were present in the dataset in the year 2000

| | International Price Premium | Quality-Adj. Intl Price Premium | International Quality Premium |
|---|---|---|---|
| International Dummies | | | |
| International works of international artists | **1.519** | **0.297** | **1.221** |
| | (0.026) | (0.010) | (0.028) |
| Domestic works of international artists | **0.711** | **0.116** | **0.594** |
| | (0.021) | (0.009) | (0.022) |
| Time Dummies | Included | Included | |
| Quality Variables | Not Included | Included | |
| Log Estimated Price | Not Included | Included | |
| Artist Dummies | Not Included | Not Included | |
| Constant | **9.307** | **1.151** | |
| | (0.061) | (0.020) | Number of Observations |
| Number of Observations | 367,816 | 337,712 | |
| R-square | 0.051 | 0.871 | |

Table 8: International Premium when International Destinations Excluding HK/Macau/Taiwan

| | International Price Premium | Quality-Adj. Intl Price Premium | International Quality Premium |
|---|---|---|---|
| International Dummies | | | |
| International works of international artists | **3.311** | **0.483** | **2.828** |
| | (0.042) | (0.021) | (0.047) |
| Domestic works of international artists | **1.001** | **0.153** | **0.848** |
| | (0.005) | (0.002) | (0.005) |
| Time Dummies | Included | Included | |
| Quality Control | Not Included | Included | |
| Log Estimated Price | Not Included | Included | |
| Artist Dummies | Not Included | Not Included | |
| Constant | **8.424** | **1.165** | |
| | (0.069) | (0.022) | Number of Observations |
| Number of Observations | 646,073 | 577,345 | |
| R-square | 0.100 | 0.870 | |

Table 9: International Premium by Classification of Artwork

| **Calligraphy** | International Price Premium | Quality-Adj. Intl Price Premium | International Quality Premium |
|---|---|---|---|
| International Dummies | | | |
| International works of international artists | **0.793** | **0.299** | **0.495** |
| | (0.027) | (0.013) | (0.030) |
| Domestic works of international artists | **1.150** | **0.174** | **0.976** |
| | (0.010) | (0.005) | (0.011) |
| Time Dummies | Included | Included | |
| Quality Control | Not Included | Included | |
| Log Estimated Price | Not Included | Included | |
| Artist Dummies | Not Included | Not Included | |
| Constant | **8.310** | **1.216** | |
| | (0.167) | (0.054) | Number of Observations |
| Number of Observations | 136,314 | 122,549 | |
| R-square | 0.139 | 0.817 | |

| **Classical-style Painting** | International Price Premium | Quality-Adj. Intl Price Premium | International Quality Premium |
|---|---|---|---|
| International Dummies | | | |
| International works of international artists | **1.308** | **0.256** | **1.052** |
| | (0.016) | (0.006) | (0.016) |
| Domestic works of international artists | **1.116** | **0.142** | **0.975** |
| | (0.006) | (0.003) | (0.006) |
| Time Dummies | Included | Included | |
| Quality Control | Not Included | Included | |
| Log Estimated Price | Not Included | Included | |
| Artist Dummies | Not Included | Not Included | |
| Constant | **9.223** | **1.172** | |
| | (0.080) | (0.022) | Number of Observations |
| Number of Observations | 500,814 | 445,729 | |
| R-square | 0.100 | 0.872 | |

| **Oil Painting** | International Price Premium | Quality-Adj. Intl Price Premium | International Quality Premium |
|---|---|---|---|
| International Dummies | | | |
| International works of international artists | **1.726** | **0.281** | **1.445** |
| | (0.021) | (0.008) | (0.022) |
| Domestic works of international artists | **1.205** | **0.097** | **1.108** |
| | (0.015) | (0.005) | (0.016) |
| Time Dummies | Included | Included | |
| Quality Control | Not Included | Included | |
| Log Estimated Price | Not Included | Included | |
| Artist Dummies | Not Included | Not Included | |
| Constant | **9.825** | **0.098** | |
| | (0.110) | (0.045) | Number of Observations |
| Number of Observations | 42,189 | 40,631 | |
| R-square | 0.220 | 0.922 | |

Table 10: International Premium for Contemporary vs Non-Contemporary Artworks

| **Contemporary (Post-1949)** | International Price Premium | Quality-Adj. Intl Price Premium | International Quality Premium |
|---|---|---|---|
| International Dummies | | | |
| International works of international artists | **2.109** | **0.285** | **1.824** |
| | (0.019) | (0.004) | (0.019) |
| Domestic works of international artists | **0.883** | **0.148** | **0.734** |
| | (0.009) | (0.002) | (0.010) |
| Time Dummies | Included | Included | |
| Quality Variables | Not Included | Included | |
| Log Estimated Price | Not Included | Included | |
| Artist Dummies | Not Included | Not Included | |
| Constant | **9.984** | **1.195** | |
| | (0.087) | (0.018) | Number of Observations |
| Number of Observations | 148,676 | 608,909 | |
| R-square | 0.117 | 0.872 | |

| **Non-Contemporary (Pre-1949)** | International Price Premium | Quality-Adj. Intl Price Premium | International Quality Premium |
|---|---|---|---|
| International Dummies | | | |
| International works of international artists | **1.188** | **0.231** | **0.956** |
| | (0.015) | (0.005) | (0.016) |
| Domestic works of international artists | **1.050** | **0.141** | **0.908** |
| | (0.005) | (0.003) | (0.006) |
| Time Dummies | Included | Included | |
| Quality Variables | Not Included | Included | |
| Log Estimated Price | Not Included | Included | |
| Artist Dummies | Not Included | Not Included | |
| Constant | **8.872** | **1.254** | |
| | (0.075) | (0.021) | Number of Observations |
| Number of Observations | 530,641 | 465,527 | |
| R-square | 0.097 | 0.860 | |

Table 11: International Premium by Artists' Degree of Internationalization

| **Most Internationalized Quartile** | International Price Premium | Quality-Adj. Intl Price Premium | International Quality Premium |
|---|---|---|---|
| International Dummies | | | |
| International works of international artists | **2.584** | **0.415** | **2.169** |
| | (0.024) | (0.009) | (0.025) |
| Domestic works of international artists | **2.140** | **0.260** | **1.881** |
| | (0.008) | (0.005) | (0.009) |
| Time Dummies | Included | Included | |
| Quality Variables | Not Included | Included | |
| Log Estimated Price | Not Included | Included | |
| Artist Dummies | Not Included | Not Included | |
| Constant | **9.075** | **1.222** | |
| | (0.075) | (0.029) | Number of Observations |
| Number of Observations | 216,442 | 190,135 | |
| R-square | 0.305 | 0.907 | |

| **Least Internationalized Quartile** | International Price Premium | Quality-Adj. Intl Price Premium | International Quality Premium |
|---|---|---|---|
| International Dummies | | | |
| International works of international artists | **0.268** | **0.164** | **0.104** |
| | (0.021) | (0.008) | (0.023) |
| Domestic works of international artists | **0.428** | **0.103** | **0.326** |
| | (0.006) | (0.003) | (0.006) |
| Time Dummies | Included | Included | |
| Quality Variables | Not Included | Included | |
| Log Estimated Price | Not Included | Included | |
| Artist Dummies | Not Included | Not Included | |
| Constant | **9.008** | **1.424** | |
| | (0.096) | (0.030) | Number of Observations |
| Number of Observations | 291,307 | 252,251 | |
| R-square | 0.072 | 0.841 | |