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JÖNKÖPING UNIVERSITY

# INVESTMENT STUDY ON CHRISTIE'S CHINESE 20TH CENTURY ART

Master Thesis within Economics and Management of  
Entertainment and Arts Industries

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## **Abstract**

This thesis focuses on the blooming market of Chinese 20th Century Art. The study object is one category of Christie's Auction house, Chinese 20th Century Art, before 2009. Eight artists' auction results are selected to the dataset for the research. We find that the previous researches based on the collection of Western arts cannot explain the whole situation of Chinese 20<sup>th</sup> Century Art. It has speculative character as an invest option in global art market. And some factors would affect the price changing in the auction activities.

The Capital Asset Pricing Model is applied to study the investment condition of Chinese 20th Century Art as a capital asset. The result we get from our dataset presents that Chinese 20th Century Art is with high risks and high returns, which is quite different from the previous studies based on Western Artworks.

Regression analysis reveals that some factors do affect the rate of price changes. We find that young Chinese artists who born after 1950 achieve better sale results than older ones. Their artworks are always sold on high realized prices. In addition, the high price sale more often happened in the auction house of Hong Kong and the market of Chinese 20th Century Art is enlarging these years. The rate of price change is increasing by the sale year growing. The prices of the artworks are growing higher and higher recently. However, the findings above just explain parts of the price increasing. All the reasons for the price increasing are not clear in this thesis.

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# 1 Introduction

## 1.1 Overview and problems formulation

In the past decade, Chinese 20<sup>th</sup> Century Art, which catches the increasing interest regionally and globally, has enjoyed a remarkable growth in the auction market. In 2005, Christie's Hong Kong became the first international auction house which presented quality contemporary art from a combination of Asian nations. In 2008, Christie's Hong Kong also pioneered the inaugural evening sale for Chinese 20<sup>th</sup> Century Art, which attracted more concentrations on the category, Chinese 20<sup>th</sup> Century Art. In May 2008, Zeng Fanzhi's (1964- ) *Mask Series 1996 No.6* is sold for HK\$75,367,500 (US\$9,662,114), which is the "top-record" sale in Christie's among Chinese 20<sup>th</sup> century artists so far. On the same day, Yue Minjun's (1962- ) *Gweong-Gweong* and Liao Jichun's (1902-1976) *Garden* were bid respectively at the hammer prices HK\$54,087,500 (US\$6,934,018) and HK\$35,047,500 (US\$4,493,089). The popularity of auction sales reflects the notion that the art has become an asset class.

Baumol (1986) showed that the rate of return for investment of paintings was only 0.55% per year in the long run. Frey (2000), Heilbrun and Gray (2001) also estimated the rate of return on painting investments was in low level (Frey, 1.5%, Heilbrun and Gray, 4.5%). Such a low rate of return implies that the investors who bought a collection had to pay an opportunity cost of enjoying the paintings in high price. (Andersson and Andersson 2006) However, the researches on art investment are mostly based on Western Arts. Researchers collected the data of the master level artists from the mainstream auction houses in New York and London. Chanel, Gerard-Varet, and Ginsburgh (1994) summarize the test results of other researchers and concluded that the rates of returns varied greatly by sub periods and school.

## 1.2 Purpose

As a newly developing category, does the investment of Chinese 20<sup>th</sup> Century Art have any new characteristics differences from the previous studies? Can Western auction and investment theories explain the mechanism of it? To answer these questions, we collected the auction results from eight artists categorized in Chinese 20<sup>th</sup> Century Art according to the record of Christie's, who are all born after 1900. From the results we find some anti-conventional phenomenon in the auction sales of this category. There are large gaps between the estimated prices and realized

prices. In some cases, the realized price even exceeded the estimate price nearly ten times. However, as the study of Feldman and Reinhart (1996), in a mature market, the gap between the final bid and the true value of the object are lowered. In another word, the realized price will not exceed the estimated price too much. Is the large price-change of Chinese 20<sup>th</sup> Century art due to a non-rational decision or the bidders taking a fancy to the arts' value? What variables will affect this gap?

We assume that a number of variables would affect the prices increase. Whether it is true and how much affect each variable would bring to the rise of the price are the questions we are planning to test. The materials used and the size of the works are hypothesized to influence the price. Will these factors also affect the level of price increases? Works using materials that are easy to store will probably be sold at higher prices. And the works with larger size are probably sold at higher unit price. How much will the different locations of the auction houses affect the price rising? Does Hong Kong have a geographical-advantage from being close to Chinese art-producing places? The questions are examined in this thesis.

By comparing the artists who were born before 1950s to the ones after 1950s, different conditions will be presented to examine whether investing Chinese 20<sup>th</sup> Century paintings is a rational alternative or once speculation activity. Is this investment a more profitable option, comparing to investment in other capital assets? The constructive capital proposals are expected to be given out on what the investors should choose from the invest portfolio.

### **1.3 Limitation**

The dataset we have constructed is limited in observations. There are eight artists and the auction results only from Christie's. It is difficult to indicate the overall situation of the Chinese 20<sup>th</sup> Century Art completely, but just as a sample.

As the heterogeneous goods, the pricing system of the arts is complicated and difficult to be valued. Each of the artwork is unique, and the change of its value is irregular and unpredictable. Our study cannot cover all the affective factors to the price changing. For the study on capital portfolio, several capital assets investments are selected to construct the market security line. It is difficult to cover the all conditions of the whole market.

Based on the theoretical study, the academic survey can only explain the complicated reality partially. The practical art worlds are complex; they are globally scattered, constantly in flux, and typically operating independently of each other. (Becker, 1982) How much could the studies

interpret the situation of art industry from the economic is still problematic and we have no answer.

## **1.4 Structure**

This paper is organized as follows: Section 2 provides some basic information on Christie's and Chinese 20<sup>th</sup> Century Art. The previous studies on relevant topics are presented in Section 3. And we develop our study on the basis of the previous studies. Section 4 gives an overview of the theories used to analyze the topic. The overview of art market and the participators' interaction will be presented. Some knowledge on auction concepts will be also indicated in this part. The financial investment theory on Capital Asset Price Model (CAPM) and its application in arts investment are explained. Section 5 starts the empirical study. There are three parts in this section, the methodology used is devoted first; follow by the database we set up in detail; the final part will be the data test and the regression results. Section 6 concludes our paper, and provides suggestions for further research.

## 2 Background

### 2.1 Chinese 20<sup>th</sup> Century Art

#### 2.1.1 Overview on Chinese 20<sup>th</sup> Century Art

The 20th century is especially important when Chinese traditional art became transformed into modernistic styles. The artists of this period committed themselves to combine the advantages of Chinese and Western art. They applied the materials of Western oil paintings mixed with Chinese traditional ink paintings and other cultural elements. Due to complicated background of economy, politics, education and culture. Chinese 20th Century Art can be divided into four different stages. Here we list the development period of Chinese 20<sup>th</sup> Century Art. From the Table 2-1, we can clearly understand that there were important events in the Chinese local contemporary art, around 1980s, such as the “Star” Exhibition in 1979 and 85 New Wave etc, which innovated and broke the regulations on both the art concept and the expression, and showed a trend forwards freedom and openness, The arts forms were even more diverse after 1990, comparing to the propaganda use in service of politics before 1979.

Table 2-1 A Century of Art Development in China

Period Factors	1911 - 1949	1949-1978	1980s	1990- 2009
<b>Economy Model</b>	Dominated the coastal regions of China	Planned Economy	Market Economy	Market Economy at rapid economic development
<b>Arts Policy</b>	Acceptable of Western Art	“Art and literary works should serve for the politics” <sup>1</sup>	Release of the forbidden art and literature and critics thoughts	Market- oriented Art commercialized

<sup>1</sup> *Speech at the Forum of Art and Literature in Yan'an* by Mao Zedong(1942:5/2-23)

<b>Art Education</b>	Xujiahui Catholic Church created Tushan Wan Art Studio In Shanghai, political trend of thought to “Chinese learning for the essence, western learning for practical use”	Red Art: History Painting, Politics Propaganda painting, (of educated urban youth) go and work in the countryside or mountain areas	Starts to be free and open	Free, open, diverse
<b>Art Events</b>	Shanghai Oil Painting History: 17 Art Societies in 1914-1930	Purge	the “Star Exhibit” in 1979 “ ’85 New Wave”  China's New Art Post-1989	Internationalize-Venice Biennial
<b>Art Market</b>	Shanghai businessman  Guangdong Art Store	Art works belong to governmental art and craft business	Galley Industry	Galley Industry  Art Auction Industry  Auction Market

From 1990s, the China art auction industry started to grow, the first local Chinese auction company China Guardian Auctions Co. Ltd was founded in 1994. Ten years later, Christie’s opened the auction sale on the category of Chinese 20th Century Art in 2005; the Chinese arts became an investing option.

There is a widely accepted belief among the western arts collectors that Chinese artists struggled for the freedom of arts, on the background of despotism. This mind stimulates their interests to collect and invest on the Chinese contemporary arts.

### 2.1.2 Top 10 sales in Christie’s Auction House

Table 2-2 lists the top 10 sales of Chinese 20th Century Art in Christie’s. The top 10 sales range to six artists of which eight artists selected in our research dataset. Among these six artists, three are born before 1950s, and the other three are born after 1950s. From these ten records, we can find some phenomenon: almost all the sales happened in sales year of 2007 and 2008; the art media were all oil on canvas or oil on panel; the size of them were relatively large; the nine of top 10 sales were held in Christie’s Hong Kong. So, it seems that the high prices of sales have strong relationship with three aspects: year of sale, the art media of the works and the location of the auction houses. Further, whether the most obvious factors to sales price change found in the top



10 sales can be applied to explain the whole observations of our dataset; and whether the factors are the only effect factors. In our research, we plan to find the answers to these questions.

Table 2-2 Top 10 Sales in Christie’s on Chinese 20th Century Art, till 2009

Artists	Born	Time_Sale	Year_Art	Title of the art	style	Size(CM2)	Auction	Price Realized	Low Estimate	High Estimate
Zeng Fanzi	1964	200805	1996	Mask Series 1996 No. 6	oil on canvas diptych	72000	Hong Kong	9703490	1931235	3218725
Yue Minjun	1962	200805	1993	Gweong-Gweong	oil on canvas	45500	Hong Kong	6963712	on request	
Zao Wou-ki	1920	200811	1956	Hommage a Tou-Fou	oil on canvas	25350	Hong Kong	5892325	on request	
Liao Jichun	1902	200805	1970	Garden	oil on canvas	10556	Hong Kong	4512331	on request	
Wu Guanzhong	1919	200705	1973	Scenery of Northern China	oil on panel	11440	Hong Kong	4066793	on request	
Zhang Xiaogang	1958	200711	1993	Bloodline Series: Mother with Three Sons	oil on canvas	26811	New York	3961000	1800000	2200000
Zao Wou-ki	1920	200711	1956	Et la terre était sans forme	oil on canvas	32000	Hong Kong	3802408	1936875	2582500
Zao Wou-ki	1920	200705	1959	14. 12. 59	oil on canvas	21060	Hong Kong	3779242	641855	1026968
Zhang Xiaogang	1958	200811	1995	Bloodline: Big Family, No.2	oil on canvas	41400	Hong Kong	3424444	on request	
Zao Wou-ki	1920	200611	1958	Composition No.8	oil on canvas	16905	Hong Kong	3195971	451773	709929

## 2.2 Christie’s Auction House

Christie’s, the world's leading art business which held global auction and private sales. Founded in 1766 by James Christie, Christie's conducted the greatest auctions of the 18th, 19th and 20th centuries, and today remains a popular market place for unique and beautiful art. Christie’s is a name and place that speaks of extraordinary art, unparalleled service and expertise, as well as international glamour. Christie’s offers over 450 sales annually in over 80 categories, including all areas of fine and decorative arts, jewelries, photographs, collectibles, wine, and more. Prices range from \$200 to over \$80 million.

Prior to 1995, Sotheby’s and Christie’s, the world’s largest auction houses, were in fierce competition for consignments from sellers. In March 1995, this competition abruptly ended. Christie’s announced that it would charge sellers a fixed, non-negotiable commission on the sales price, and a month later Sotheby’s announced the same policies. (Ashenfelter & Graddy , 2005) From then on, the two largest auction houses always followed similar policies, which make the studies of one auction house possible and valid.

As a global company, the market strategy Christie’s conducts is resource to globally and sell locally. It has 57 offices in 32 countries and 10 salerooms around the world including London, New York, Paris, Geneva, Milan, Amsterdam, Dubai and Hong Kong. Christie’s leads the market with initiatives in growing geographic regions as well as categories and value ranges of sales.

In recent years, Hong Kong has become the most important auction center in Asia. Since the first sale in Hong Kong 1986, Christie's has become the leading international auction house in the region. Christie's Hong Kong was the first one who made the category: The Asian Contemporary and Chinese 20<sup>th</sup> Century Art, to present quality contemporary art from Asian nations. Chinese 20th Century Art have witnessed an extraordinary development following the rising importance of Asia on the global world stage, as well as the world's increasing fascination and interest in Asian art and culture. The art markets have experienced remarkable growth since the category began gaining popularity among collectors regionally and globally in the past decade.

### 3 Previous Studies

Bryan (1985) in his article compared the average annual rate of return and standard deviation in the paintings market between 1971 and 1984 against a sample of alternative investments. The result was that the rate of return in paintings was high over the sample period, relative to four major investment alternatives: gold, stocks, bonds, and housing.

The result of CAPMUI equation for all paintings showed an  $R^2$  of 0.56, which showed the CAPM can only explain the price of artworks partly. The author also surmised that the consumption value of art was one of the reasons people chose to invest in artworks.

Baumol(1986) tested the rate of return using the data of Reitlinger's artwork list. The result showed that, on the average, the purchase and subsequent resale of a painting brought an annual compounded rate of return of 0.55 percent in real terms. It is evidenced that this form of investment was quite risky. The article concluded that, the value of the art objects is unnatural; the prices of artworks are usually unpredictable; the investment on arts is more or less aimless. It is seen as the best-known empirical analysis of the value of the arts as an investment.

Frey and Pommerehne (1989) extended the data set by Baumol and examined a sample that covered over 350 years and concluded that painting investments yielded on average a 1.5 percent real return. The authors advised that individuals should be rational when doing an art investment decision. From then on, the researchers started to study the reasons why people invest on arts besides the financial motivation.

Mok, Ko, Woo, Kwok (1993) focused their study on Chinese modern painting investment. Here the Chinese modern artists are the ink and brush artists who were born in the Qing dynasty. The artworks dated from late 19<sup>th</sup> century and 20<sup>th</sup> century onwards. They got the result consistent with the studies on Western paintings. However, there are only 20 resold paintings during that period, the accuracy of the survey results are probably not so reliable.

Chanel, Gerardt and Ginsburgh (1993) constructed a price index for art markets and used the hedonic price estimation to get the returns of arts based on all sales. They (1994) used the hedonic regression technique to test the return of the paintings from all observations but not only the resale ones. The CAPM was applied then to calculate the systematic risk of the art market. They presented that the art market may well be predictable in the short run. Ginsburgh and Jeanfils (1995) continued the study on the international art market. They concluded that, in the long run, the returns for different art markets trend to be similar and there was no long-run

relation between art and stock market, although the finance market did have an impact on art market in short run.

2008 is the symbolic year when arts investment was facing a blooming increase. The media and public all thought highly of the art market. However, recent studies on arts investment also got similar results to previous empirical work that the artworks are not optimal invest alternative. Melnik and Plaut (1998) constructed a number of portfolio to test the data of “Art Market Research”. They proved that art cannot contribute to the performance of a well-diversified portfolio of financial asset. However, under “second-best” conditions, where the investor is constrained from investing in at least one class of assets, positive investment in art asset is in some cases optimal. When some sets of assets are removed from the portfolio, the art assets would replace in a sense the omitted asset class and be as a positive investment.

The latest study by Mandel (2009) further estimated the value of arts in the new perspectives to explain the art’s consumption characteristics. Mandel predicted a low and even negative risk premium for art by consumption-based capital asset pricing model. He concluded in the paper that “the price of art reflects not only the desire to smooth consumption over time as for any investment vehicle, but also the utility derived from its conspicuous consumption.”

In this thesis, the research will continue to study the returns of Chinese 20th Century Art. We select the observations from auction results of Christie's auction house. Eight artists' records are selected as sample to study the effective variables on the returns. To exceed the limitation of resold paintings, the observation covers the whole records of the eight artists in Christie's, due to the sample of the resold paintings only is too small. The Capital Asset Pricing Model will be applied to evaluate the invest situation of Chinese 20<sup>th</sup> Century Art by comparing to the other invest options, like bonds, bills and stocks. The Capital proposals are hopefully to be given out then.

## 4 Theoretical Framework

### 4.1 Art market study

#### 4.1.1 Production and consumption of the arts

Original art objects (paintings, pieces of sculpture, and other artifacts) are, as a generic commodity group, characterized by a set of attributes that distinguish them from all other goods. They are created only by individuals. Every unit of output is differentiated from every other unit of output, an extreme case of a heterogeneous commodity. For the work of artists no longer living, supply is fixed. Art works can be copied but not reproduced, in the sense that ultimately there is only one unique original of every work of art. Paintings and sculptures provide clear consumption benefits to purchasers through their utilitarian characteristics as durable private goods. (Throsby, 1994; Anderson, 2002)

Frey and Pommerehne (1989) report a price equation that could be interpreted as a reduced form of such a larger model, where the demand for artworks is explained by price, aesthetic quality, consumer income, financial market characteristics, and other variables, and supply is determined by prices and costs of production. The price is shown to be influenced significantly from the supply side by production costs and size and type of work, and from the demand side by consumer income, aesthetic evaluation, and rates of return on other assets. Because art works can be resold, and their prices may rise over time, they have the characteristics of financial assets, and as such may be sought as a hedge against inflation, as a store of wealth or as a source of speculative capital gain.

Throsby (1994) distinguished the arts through the utility functions of buyers. Art as decoration, providing immediate consumption services through its aesthetic qualities; and art as asset, art providing financial services through its potential for price appreciation. The “artistic” characteristics of works such as size, color, and other aesthetic values influence demand for art as decoration, the riskiness, expected rates of return, and other financial variables influence demand for art as asset.

The consumption of art challenges the conventional assumptions of homogeneous goods and services, completed learning of tastes, independence of choice among individuals. The new consumer theory suggests that tastes are similar between individuals. (Throsby, 1994) Furthermore, the relative consumption of the arts will rise over time, as experience, understanding and other human capital attributes associated with the arts are acquired. However,

the taste of individual still coexists of coherence and heterogeneity. The individual taste for the arts relies on both self-experience and social-affection.

#### 4.1.2 Markets and gatekeepers

The world of arts is a society with many barriers to cross. The gatekeepers may be the curators of museums, brokers of arts, consumers of arts, interest group and sponsors. Angela Grossmann (2009) claimed in her open letter that under the situation of gatekeeping of art, artists could congregate and express individually the diverse meanings of exclusion within the art world that they experience; or how and in which ways the art world denies independent creative expression.

The auction house provides a transaction market of artworks for the producers and consumers. As well, it plays the role as gatekeeper to control the entrance to this market. As a kind of agency of art transaction, the auction houses will charge the sellers' commissions and buyers' premiums. The experts of the auction house will give out a range of estimated price on the auctioned artworks. It is not the market free. The artworks that must reach a certain standard and level can be auctioned in the auction houses especially international ones. Entry into regular second-hand market normally only occurs after number of successful exhibitions in well-known galleries. Not all the artworks are able to entry into the auction market.

#### 4.1.3 Interaction among the participators in art auction market

The art worlds are globally scattered, constantly in flux, and typically operating independently from each other. The one globalized, all-encompassing art world does exist, but it does so as a myth; more accurately, there are multiplicities of intersecting, overlapping, self-similar art worlds, each expressing different views of the world as they see it. (Becker, 1982)

The markets for artworks can show evidence of information asymmetry, where the quality of goods is known to sellers but not to buyers. Therefore, the possibility of fakes or forgeries will exist. The expansion of the network of the arts market can promote the communication and transfer more information of transactions.

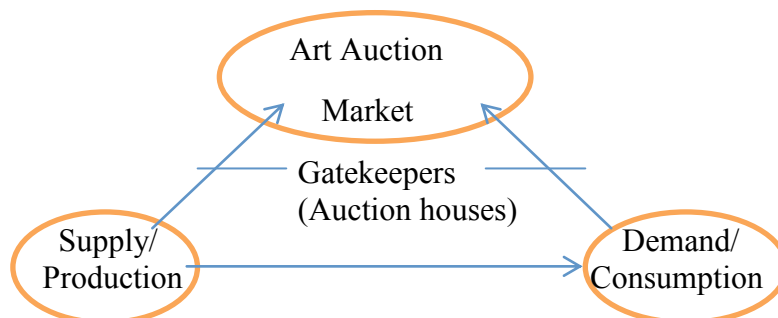


Figure 4-1, Interaction among sellers, buyers and gatekeepers in art auction market

As figure 4-1 shows, both the sellers and buyers meet the gatekeepers when accessing to the art auction market. In this link, besides the artists who are the primary producers, the collectors, galleries and investors would also become the suppliers of art works in the second-hand market. Also, they stand on the consumption side as the buyers of the market. At the same time, the sellers and buyers could turn into the gatekeepers of each other. There is no guarantee that the artworks could be sold once being bid in auction house. The buyers also have no assurance that they can obtain certain artworks they want. Not all the artworks and buyers can access into this market. Certain qualifications should be possessed.

## **4.2 Auction Concepts**

A structural change in the marketing of paintings or sculptures happens when such objects become part of the second-hand market, for example when they are being resold to collectors by brokers and auction houses such as Sotheby's and Christie's. In the market, the often speculative demand from collectors plays a substantial role in the determination of prices. The art object becomes a financial entity with an uncertain future value in the market as well as a current consumption value. (Andersson & Andersson, 2006, p.89)

### **4.2.1 Definition and Category**

As McAfee and McMillan (1987, p701) defined, "An auction is a market institution with an explicit set of rules determining resource allocation and prices on the basis of bids from the market participants." It is one kind of public sale when the value of the item is uncertain. An auction is typically treated as a single seller facing multiple buyers or a single buyer facing multiple sellers.

Here introduce two types of auctions, Dutch auction and English auction. Dutch auction also called descending-bid auction is one kind of sealed-bid auctions. The auctioneer calls an initial high price and gradually lowers the price until one bidder claims to accept the current price. The English auction is the converse of the former one with an ascending-bid form. The auctioneer begins with the lowest price acceptable, then the price is successively raised by customers until no one will raise the bid. Then the hammer is knocked down, and the item is sold to the highest bidder. The English auction is the most common form for selling goods, like antiques and artworks. Christie's and Sotheby's both adopt the English open outcry auction.

## **4.2.2 Auction pricing**

In the artwork auction, the auction house will give out a reserve price range called the estimate price. The low estimate price is the lowest acceptable price for the auctioneer. Estimate price is the main information the auctioneer provides before the auction. The realized price is the final hammer price, including 10 percent of the buyer's premium.

The value decides the price of the good. An item has a common value or a private value. The common value means all consumers have the same actual valuation to each item when they possess it (Klemperer, 1998); the private value means consumers place different valuation on the item after they purchase it. There is no pure common value item or pure private value item. Because of the private preference, the price of artworks is always uncertain. Woo (1995) claims that the valuation are mostly gained through socialization. As investment goods, the artworks must have similar value to each bidder. The value of the works of paintings is consistent with the judgment of their aesthetic quality, visual experience, the name of the artist, historical importance and so on. People who bid an artwork in high price always settle on its value in future. The longer a work has survived, the more likely it will survive longer. This kind of artwork is likely to have a higher price in the future than at present with fewer risks than the new work. (D'Souza & Prentice, 2002)

The biased estimates are mostly due to the information asymmetries. Louargand and McDaniel (1991) indicated the competition among the auction houses would make them to provide more information on the item before the auction begins, which would lead to more efficient price estimates. Feldman and Reinhart (1996) proved that, following the increasing amount of published information, the gap between the final bid and the "true" value of the object are lowered. Louargand and McDaniel (1991) also showed that there was no significant difference between the estimated and actual selling price according to the research on Sotheby's New York auction. Wilson (1977) argued the greater number of bidders may also be the one promotion to closer the realized prices to the actual value of the item.

## **4.3 CAPM - The Capital Asset Pricing Model**

### **4.3.1 Overview of the CAPM**

The Capital Asset Pricing Model (CAPM) was introduced by Jack Treynor (1961, 1962), William Sharp (1964), John Lintner (1965a, b) and Jan Mossin (1966) independently, builded on the earlier work of Harry Markowitz on diversification and modern portfolio theory. The CAPM is a



model of the relationship between risk and return. In finance and economics, it is used to determine a theoretically appropriate required rate of return of an asset, if that asset is to be added to an already well-diversified portfolio, given that asset's non-diversifiable risk (systematic risk). The model takes into account the asset's sensitivity to non-diversifiable risk, often represented by the estimated beta ( $\beta$ ) in the financial industry, as well as the expected return of the market and the expected return of a theoretical risk-free asset.

Systematic risks are market risks that cannot be diversified away, like interest rates, recessions and wars. Unsystematic risks, also known as "specific risk", are specific to individual stocks and can be diversified away as the investor increases the number of stocks in his or her portfolio. In another word, it represents the component of a stock's return that is not correlated with general market moves.

Sharp (1964) studied how the price risk results from basic influences of investor preferences then built a market equilibrium theory of asset prices under conditions of risk. It sheds considerable light on the relationship between the price of an asset and the various components of its overall risk. All efficient combinations will be perfectly correlated and a useful interpretation of the relationship between an individual asset's expected return and its risk.

The risks are resulting from swings in economic activity. Assets which are unaffected by changes in economic activity will return the pure interest rate; those which move with economic activity will promise appropriately higher expected rates of return.

#### **4.3.2 Assumptions of the model**

The CAPM allows corporate executives to identify the efficient portfolio (of risky asset) without having any knowledge of the expected return of each security. Instead, the model uses the actions of investors themselves as input. With this insight, it identifies the efficient portfolio as the market portfolio-the portfolio of all stocks and securities in the market. (Berk & DeMarzo, 2007)

In the book, they present three main assumptions that underlie the CAPM.

1. Investors can buy and sell all securities at competitive market prices (without incurring taxes or transactions costs) and can borrow and lend at the risk-free interest rate.
2. Investors hold only efficient portfolios of traded securities-portfolios that yield the maximum expected return for a given level of volatility.
3. Investors have homogeneous expectations regarding the volatilities, correlations, and

expected returns of securities.

### 4.3.3 The content of CAPM

The CAPM describes the required return on an asset as a function of its non-diversifiable or “beta” risk. The market portfolio is defined to have a beta 1.0. The riskless asset earns the risk free rate. The difference between the expected rate of return on the market portfolio and the risk-free rate is the market price of risk. The CAPM is represented by the line that describes the attainable combinations of expected return and beta risk by combining the market portfolio and the riskless asset. If the CAPM correctly describes investor behavior, then all market assets will offer risk and expected return combinations that plot on the line. Accordingly, the line is known as the Security Market Line (SML). Under the CAPM assumptions, the market portfolio is the efficient portfolio. Thus, if we plot individual securities according to their expected return and beta, the CAPM implies that they should all move forwards the SML.

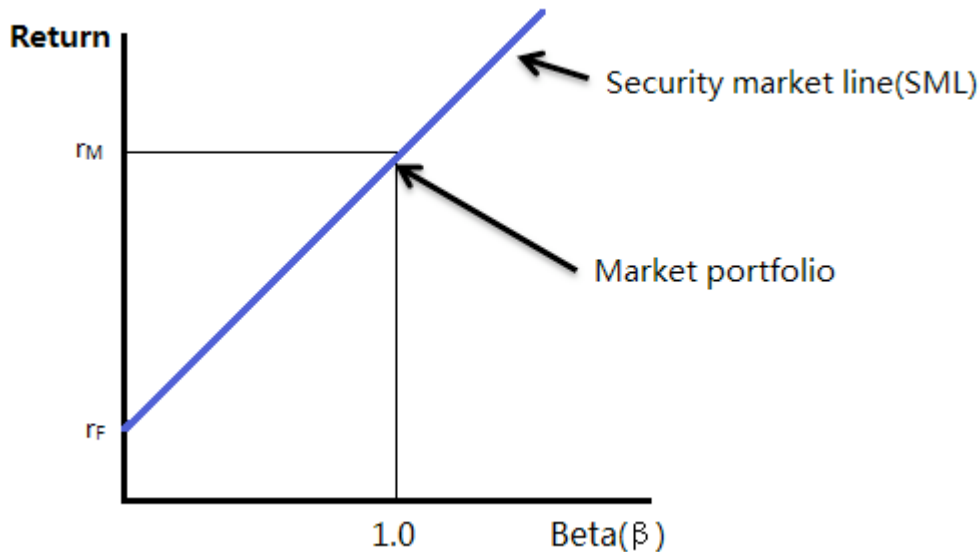


Figure 4-2 The Capital Asset Pricing Model

Figure 4-1 shows a plot of the relation between beta risk and expected return. Different portfolios, with different amounts of total risk, but equal amounts of beta risk, have the same expected return. Accordingly, all such portfolios plot at the same point in the figure). The sloping line in figure is known as the SML because all risky market assets must plot on the line. The result is a single price for bearing systematic risk. We refer to the difference between the expected return on the market portfolio and the return on a risk-free asset as the market risk premium.

The relationship represented graphically in figure is known as CAPM. The algebraic description of the CAPM is:

$$r_j = r_F + \beta_j(r_M - r_F) \quad (4-1)$$

In Equation 4-1,  $r_j$  is the return to investment object;  $r_F$  is the risk-free rate;  $r_M$  is the expected market return during the same period of time; the market risk premium is defined as  $r_M - r_F$ . The CAPM offers a measure of the risk premium on any risky asset,  $j$ , as  $\beta_j(r_M - r_F)$ , where  $\beta_j$  is the beta risk of the asset. As  $r_j$  and  $r_F$  are measured as per cent rates of change,  $\beta$  can also be interpreted as an elasticity.

The value of  $\beta_j$ , the beta risk of the  $j$ th asset, depends on its systematic risk. Specifically,  $\beta_j$  is measured as follows:

$$\beta_j = \frac{\text{cov}(r_j, r_M)}{\sigma_M^2} = \frac{\rho(r_j, r_M)\sigma_j}{\sigma_M} \quad (4-2)$$

In Equation 4-2,  $\text{cov}(r_j, r_M)$  is the covariance of holding-period returns of asset  $j$  with the market,  $\rho(r_j, r_M)$  is the correlation coefficient of holding-period returns between the asset and the market,  $\sigma_M^2$  is the variance of market returns, and  $\sigma_M$  and  $\sigma_j$  are the standard deviations of returns for the market and for asset  $j$ . Equations 4-1 and Equation 4-2 identify the information necessary for using the CAPM as means to estimate the required rate of return on an investment.

Given its focus on systematic risk, the CAPM is appropriate when investors are able to diversify at low cost. Clearly, the typical investors in new ventures (pension plans, endowment, and insurance companies) are able to do so. Public corporations may not be diversified, but the investors who own their shares are free to diversify their investments. Those investors should not require an increase in expected return for bearing under diversified risk. Other kinds of investors in new ventures may find diversification more difficult to achieve. In particular, private corporations and high-net-worth individuals may be compelled to hold portfolios that are not well diversified. If they must compete with investors who are well diversified, such investors cannot expect to be compensated for underdiversification. (J. Smith & R. Smith, 2004)

#### 4.3.4 Application on the CAPM

In practice, the CAPM is used to estimate a firm's cost of capital. We estimate stock betas in practice by regressing past stock returns of the market portfolio. There are three methods to

estimate the betas: the time horizon, the index used as the market portfolio, and the method used to extrapolate from past betas to future betas.

In addition to beta, risk-free interest rate and a risk-premium for the market index are required for estimating the cost of capital from the security market line.

#### **4.4 The application of CAPM in arts investment**

The market for art has enlarged rapidly. The auction sales attract more and more public attentions. The arts are studied as an investment alternative or a component in investment portfolio. The Capital Asset Pricing Model is a useful tool for testing the investment characteristics of artworks.

Bryan (1985) compared the average annual rate of return and standard deviation in the paintings market between 1971 and 1984 against a sample of alternative investments. The result was that the rate of return in paintings was high over the sample period, relative to four major investment alternatives: gold, stocks, bonds, and housing.

However, the limitation of the model in the art market analysis is due to the limited information for determining the magnitude of the consumption returns from art. The result of the test showed 56 percent of the variation in the painting the returns can be explained by the CAPM. The value that art provides in viewing pleasure is immeasurable.

The risks are expressed by the standard deviation of the returns, which means if the returns change unsteadily; the risks of the investment will turn high. The auction results on high return deals are the exceptional phenomenon. Capital lack, information asymmetry, speculation all could lead the invest failure and the market disruption. High transaction costs and accidental factors on pricing the arts also make it difficult to put through the deal.

We applied the data resourced from the Ecowin database to compare the returns and risks of art investment to the invest portfolio, from 1999 to 2009 in New York, London and Hong Kong. We suppose the government bonds invest as the risk-free investment, the mean of its returns we get from the database is about 4.2%. And the conditions of the stocks of the three markets are seen as the condition of market. The mean rate of return of the stocks is 15%, which is regarded as the market returns in our model. So we can build the equation and model diagram as follow:

$$r_j = 0.042 + \beta_j(0.15 - 0.042) \quad (4-3)$$

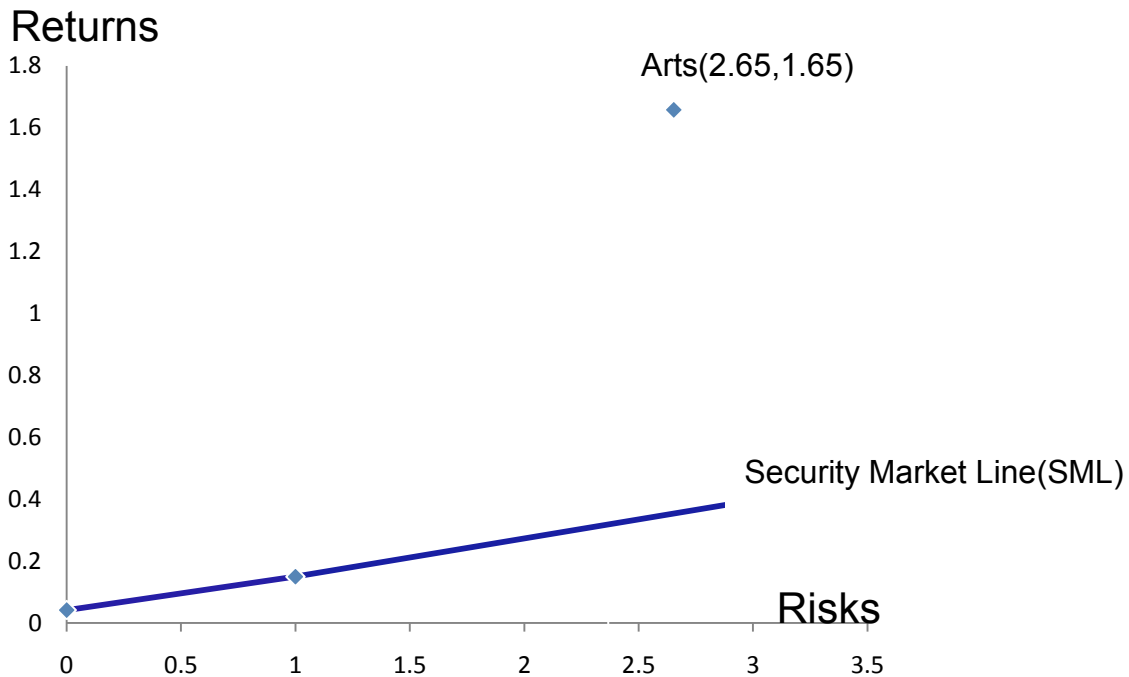


Figure 4-3 Application of Capital Asset Pricing Model

The returns of arts are obtained from the rate of price change, we calculated it with

$$\text{The rate of price change} = \text{realized price/estimated price} - 1 \quad (4-4)$$

The results are gotten from our database and signed on the diagram. It can be observed clearly from figure 4-3 that, with high returns and high risks, the coordinate of art investment is dispersed far away from the market security line. The arts investment is different from other common investments.

The Security Market Line (SML) shows the required return for each security as a function of its beta with the market. According to the CAPM, the market portfolio is efficient, which is equivalent to the required return equaling the expected return for every security. According to the CAPM, all stocks and portfolios should fall along the SML. (Jonathan & Peter, 2004) For the speculative market of artworks, it is dispersed far away from the MSL in short term run. However, as the CAPM presents, the returns of arts will decrease to the market security line in long-term run, though the period could probably be very long.

From the model application, we can get some conclusions on the conditions of art investment. It is possible to obtain the super high returns through the auctions of artworks, but the high risk is following together. The average investors without enough background knowledge and capital supports would face larger risks. Information asymmetry is one character of the art market. For

the average investors, the real value and the potential of value increasing are difficult to evaluate without expertise identification. Some information is hidden from the public. Though the auction houses are working hard on it to reveal more information on the artworks, it is still not enough for the public investors to make correct investment decisions. It is also due to the complicated property of the artwork itself. The change of the taste and fashion are difficult to forecast. The investors should be cautious when making an investment decision on Chinese 20<sup>th</sup> Century Art.

The empirical study will be applied to test what elements would affect this high level of return in the next part.

## 5 Empirical Studies

This part, the correlation matrix and the regression analysis are applied to test what elements would affect the returns of Chinese 20th Century Art. Eight Chinese 20th Century master artists born after 1900 are selected in the sample; the sale information is from the auction results recorded on Christie's official website<sup>2</sup>.

### 5.1 Data Description

Madeleine, Docclo and Ginsburgh (1994) claimed that paintings are typical heterogeneous goods. The reason is that the pricing system of the arts is complicated and the price of certain artwork is difficult to confirm. Each of the artwork is unique, and the change of its value is irregular and unpredictable. It is due to variable reasons, for instance, the changes of taste, fashion, the industry and the society.

The eight artists are selected in this database include well-known painters only. They are Zao Wou-ki, Wu Guanzhong, Zhang Xiaogang, Yun Gee, Zeng Fanzi, Yue Minjun, Liu Ye, and Chen Yifei. It probably can be seen as a good investment choice but can hardly be thought of representing Chinese painters in general.

The database covers the whole observation on the sales in Christie's of these eight artists. Several papers recommended using same painting sales for a more accurate comparison. However, this would reduce the number of observations by over 90% and there would be many months without a single transaction on record. The transactions of Chinese 20th Century Art are becoming active in just recent ten years. Ten-year is not exactly long-term run for the art investment. The cycle of the art investment is always long. The investors may keep the artworks more than ten years. The amount of the arts resold is limited. As well, the practical difficulties make it hard to search the resale works with changed information, translated titles, undistinguishable titles, like nude, still life, or untitled. Our research focused on the transactions held in Christie's, however the same works could probably be resold in another channels (other auction houses or galleries), which also makes the biases on studying the repeat sales only. Using all observations on sales provides more data and avoids the difficulty of searching for artworks which have been sold twice at least. For that, the information on all single sales is collected.

The whole dataset is from the auction results of Christie's. Big parts of the sales were happened in Christie's Hong Kong which was the first auction who opened the category on Chinese 20th

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<sup>2</sup> [www.christies.com](http://www.christies.com)

Century Art. The other primary auctions are in New York and London. We eliminated the observations of auction houses from Paris, Amsterdam and Taipei for the number of these observations' transaction records is too small to analyze with the statistic tool. It doesn't mean that the markets for Chinese 20th Century Art are limited in the three locations. We have no information on where the buyers come from. However, the art markets are international; the auction houses would cover more areas. There are no limitations for the investors to buy the artworks from all over the world. Without consideration the Chinese local and small scale auction houses and galleries, the sample could meet the selection bias for just an international case.

The observations include the information on the characteristics of the paintings, the year of the paintings finished, the date of the sales, sizes of the paintings, materials and types of the paintings, like oil on canvas or oil on board, ink or watercolor in Chinese traditional style, etching, lithograph and so on. Many previous regressions have broadly shared the same characteristics that the paintings, oil on canvas are always the most expensive. (Barre, Docclo and Ginsburgh, 1994)

The estimated prices of the auction arts are given out as a price range. The realized prices have included 10 percent of the buyer's premium, which could be seen as the transaction costs. We get the price differences from realized prices and estimated prices with the low estimated prices minus the realized prices. And the quotients of them will be used to calculate the rate of returns of the arts. All the currencies are unified with US dollars.

Several auctions with exceptional high hammer prices, its estimated prices are signed "on the request" but no numerical values. We removed the observations with this kind of estimated prices. For it would be unable to analyze the data in SPSS program.

Table 5-1 Frequencies of categorical and dummy variables

Variable		Frequency (number of objects)	Percent
Artists, Birth year	Zao Wou-ki, 1920	336	38.1
	Wu Guanzhong, 1919	231	26.2
	Zhang Xiaogang, 1958	85	9.6
	Yun Gee, 1906	39	4.4
	Zeng Fanzi, 1964	52	5.9



	Yue Minjun, 1962	49	5.6
	Liu Ye, 1964	44	5.0
	ChenYifei, 1946	45	5.1
Art media Category	Ink_color	143	16.2
	Gouache/water	63	7.2
	Oil_canvas	432	49.0
	Oil_Board	53	6.0
	Etching	53	6.0
	Lithograph	100	11.4
	Other	32	3.6
Auction houses	London	175	19.9
	New York	96	10.9
	Paris	32	3.6
	Hong Kong	577	65.5

Table 5-2 Descriptive Statistics for the dataset (Chinese 20th Century Art in Christie's)

	N	Minimum	Maximum	Sum	Mean	Std. Deviation
Year_Sale	881	1991	2010	1766163	2004.73	4.235
Size(CM2)	881	282,75	280000.00	7581962.79	8684.9517	16195.10103
Price Realized(US \$)	881	214	9703490	269073418	305418.18	633854.370
Low Estimate(US \$)	881	224	2066048	111122874	126132.66	229831.241
Rate of price changes till 2009 (%)	881	-.700	20.877	1463.267	1.66092	2.613108

Table 5-1 and Table 5-2 summarize the whole observations of our dataset. The total amount of observation is 881 from 8 Chinese 20th Century Artists in Christie's auction results.

As the table shows, Christie's' Hong Kong, London and New York are the main auction houses for Chinese 20th Century Art. Only the sales happened in Hong Kong auction house stand more than 65.5% of the whole results. The main art media is list in the table. Different materials with different costs and store methods will affect the values and prices of the artworks. Ink and gouache are always materials used in the Chinese traditional style paintings. Oil on canvas imported from western is expensive material of all. Furthermore, the art media option decides

the style of the artwork. The size of the painting is gotten by *length* × *width* of the painting. It not only affects the cost of the materials, but also displays the dimensions of the art.

## 5.2 Methodology

Multiple linear regression analysis is used in our data survey to study how much the elements will affect the rate of price change. The general form of a multiple regression equation for k independent variables is weighted sum:

$$Y = \beta_0 + \beta_1X_1 + \beta_2X_2 + \cdots + \beta_nX_n \quad (5-1)$$

The equation, Y is the predicted score on the dependent variables, each  $X_i$  is one of the independent variables,  $\beta_0$  is the intercept (the value of Y when all of the  $X_i=0$ ), and each  $\beta_i$ ( $i=1$  to k) is a standardized regression coefficient indicating the relative importance of the corresponding independent variable in determining the predicted value of the dependent variable. Regression analysis calculates the intercept and regression coefficients so as to provide the best-fitting linear equation according to the least-squares criterion, that is, such that the sum of the squared deviations of the predicted scores from the observed scores is minimized to give the most accurate prediction.

## 5.3 Hypotheses

We supposed several variables would affect the prices changing. Whether it is true and how much each variable would affect the rising in value is expected to test. The variables we hypothesize would be effective are artists, the year of birth, the year of sale, the size and the materials of the paintings and the location of the auction houses.

Different artists with different styles would produce the different results of sales. For the Chinese 20th Century Art invest, the reputation of a painter would probably plays an important role in the purchases and price increasing.

We found the artists born after 1950s are the ones just are active in China art industry. They are the force of Chinese Contemporary Arts. Of course, their performances are more uncertain and difficult to predict. Yet, the artists before 1950s with traditional styles, the quantity and quality of their works are both relative stabilization. It is hypothesized that the art sales of the artists born after 1950s have more unstable factors affect the sale results.

The materials used and the size of the works will influence the price. Furthermore, whether will they affect the level of the price increasing? The works using the materials easy to store will be sold in higher price. And the larger works are probably with unit price higher.

Hong Kong is the center of Asian art market. New York and London are the two main art transaction centers in the world. How much will the different locations affect the price rising? Does Hong Kong have the geo-advantage because it is closed to Chinese art-producing place? We hypothesize the different locations of the auction houses have strong relationship to the sale result of the arts.

## 5.4 Correlation

Correlation Matrix is the initial step to compute whether the items we selected have significant correlations. If there are no significant correlations between these items, then they are unrelated and that we would not expect them to form one or more factors for conduction a factor analysis. The correlation matrix for these items, together with their significance levels, is presented in Appendix 1.

As for the correlation between dependent and independent variables, the independent variables, *Zhang Xiaogang, Zeng Fanzhi, Yue Minjun, later 1950, Oil\_canvas/Oil\_Board, Hong Kong* present positive correlation with rate of price change.

Additionally the following correlations have statistical significance:

*Wu Guanzhong, Yun Gee, Chen Yifei* did good job in *Hong Kong* Auction house. *Yun Gee, Zeng Fanzhi, Yue Minjun, Chen Yifei* did better job with the materials oil. And *Zao Wou-ki* has more artworks in forms of *Lithographs or etchings*; *Wu Guanzhong* born 1919 has more artworks finished with Chinese traditional materials or styles, like *Ink\_color or Gouache/water*.

As the correlation, we divide the artists into two groups by their birth year. One is the artists born before 1950, the artists who born after 1950 are included in the other group. The dummy variable (born) after 1950 is set as an independent variable for the regression analysis below.

## 5.5 Estimates

The database is put into the SPSS program to analyze how the variables effect the prices changes of the Chinese 20th Century Art. We establish as Dependent Variable: the rate of price change as *realized price/estimated price-1*.

$$\text{The rate of price change} = \text{realized price/estimated price} - 1 \quad (5-2)$$

The independent variables, (born) after 1950 , Year sale, Oil/Oil Board London and Hong Kong are imported into the program for the regression analysis. We get the coefficient of determination, which is shown as  $R=.386$ , and the  $R^2 =.149$ . The coefficient of determination  $R^2$  is the proportion of variance in the dependent variable that is explained by the model, and it is near 15 per cent in this case. It suggests that about 15 percent of the variance in rate of price change for Chinese 20th Century Art of Christie's in our research is explained by the independent variables that we examined.

In Table 5-3, we estimate the auction price changes; it provides values from which you can build the regression equation or model. The unstandardized *B* coefficients for each of the independent variables are given first, with their standard errors, and then the standardized coefficients or beta weights are given with their *t* values and significance levels.

In Table 5-3, we get a positive *B* value of born after 1950, 1.757, which illustrates the fact that the artists born after 1950s get positive value on the auction results of the rate of price change. For the normal auction activities, it is usual that the realized prices would not exceed the estimated prices too much, following the market information opened more and the investors turning more rational. Andersson and Andersson (2006) distinguished the art markets from dead and living artists. The supplies of the dead artists are fixed or decreased. An increase in demand will lead to an increase in price. For the living artists, they probably increase the supply of the similar style artworks as a response to the increased price. As well, the larger supplies will lead to price decrease. However, for the Chinese 20<sup>th</sup> Century Art, especially for the artists born after 1950s, they do not follow the regulations but present more active and changeable characters. They always got the realized price much higher than the estimated price.

Table 5-3 Auction Price Changes Estimates

Model	Unstandardized Coefficients		t	Sig	Collinearity Statistics	
	B	Std. Error			Tolerance	VIF
(Constant)	-143.080	40.962	-3.493	.001		
Born after 1950	1.757	.202	8.705	.000	.844	1.185
Hong Kong	.944	.239	3.958	.000	.516	1.939
London	-.141	.279	-.506	.613	.536	1.866
Year_Sale	.072	.020	3.506	.000	.887	1.127
Oil_canvas/Oil_Board	.123	.172	.714	.475	.909	1.100

Dependent Variable: Rate of price change

The sale year of the auction got the *B* value with **+.072**; the auction held more recently got better sale results, though the factor does not affect the results too much. The art market for Chinese

20<sup>th</sup> Century Art is just growing up. It expanded largely after 2005 the Christie's Hong Kong held the year sale on this category. Especially in 2007 and 2008, the market bloomed quickly.

From the regression results, we can also observe that Hong Kong auction house do achieve higher record in Chinese 20<sup>th</sup> Century Art sale than other auction house. The geographical-advantage do play important role in getting better results. The Chinese arts market is mature in Hong Kong. However, for the other auction houses, there is no significant relationship on which auction house it is to hold the sale.

The variables on materials of the artworks also did not achieve a significance level of  $p < .05$ .

Taking the variables in descending order of their standardized regression coefficients to report the results of multiple regression, the equation is as follows:

$$\begin{aligned} \text{Rate of Price Change} = \\ -143.08 + 1.757\text{Born after 1950} + .072\text{Year\_Sale} + .944\text{Hong Kong} \end{aligned} \quad (5-3)$$

From the equation we can find that some of the independent variables have a significant *negative* effect on Rate of Price Change. But it is also noticed that many independent variables did not achieve a significance level of  $p < .05$  according to the  $t$  test, and so their coefficients may be attributed to chance.

## 6 Conclusion

The artistic style of Chinese 20<sup>th</sup> Century Art is unique from the others either forms ever before. The market is emerging but immature. Few investors have enough experience in the area. We could say, with limited information and knowledge, the Chinese 20<sup>th</sup> Century Art investment, as a new and special category, is more opportunistic. The regulation of the transaction prices changing is flexible and uncertain. The law to invest on Western arts and the knowledge on the art investment cannot be used directly on the Chinese 20<sup>th</sup> Century Art investment.

The Capital Asset Pricing Model we built illustrates that both of the rate of returns and risks of Chinese 20<sup>th</sup> Century Art are obviously much higher than other capital investments. The high level of return is the main reason why the large capital assets are attracted into the art market from the other capital markets, especially in the background of monetary crisis recent years.

The empirical study is applied to test what elements would affect the high level of return. The correlation and regression analysis are run to test which variables and how much will they affect the rate of price change. From the data analysis, we find that the younger artists who born after 1950s always get higher price increasing than the older artists who born before 1950s. As well, Hong Kong auction house do obtain more attentions and higher achievement on the sale of Chinese 20<sup>th</sup> Century Art.

However, the statistic results of the multiple regressions present the unconfirmed elements which can affect the price changing of the artworks. Many variables did not get significance lever of  $p < .05$  according to the  $t$  test. The effective factors are not so obvious. The accidental factors of profits add the risks of this invest. These add the hardness to predict the future trend of the price changing for the artworks.

In conclusion, the investment on Chinese 20<sup>th</sup> Century Art is different from the common capital investment, which is not suitable for average investors without certain knowledge on this field. There are gatekeepers to entry.

For the future studies, the database is looked forward to covering more observations to make the statistical results more precise and reasonable. Our dataset was just up to the year of 2009. When we are just writing this article, the spring sales 2010 took good news that the result of Chinese arts made the new highest record in history. The real causes of the rising are expect to find out. Are there any reasons behind appearance will forecast the blooming this time? It would be a new subject to study on.

Comparing to the other capital investments, the arts market is too small for the number of investors and the amount to total capital. It makes the unbalance of the Capital Asset Pricing Model. How much could the model explain the conditions of art invest is expected to test.

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## Appendix 1: Correlations matrix

	Zao Wou-ki	Wu Guanzhong	Zhang Xiaogang	Yun Gee	Zeng Fanzi	Yue Minjun	Liu Ye	Chen Yifei	later 1950	Year_Sale	Size(CM2)	Ink_color/Gouache/water	Oil_canvas/Oil_Board	Lithograph/Etching/Other	London	New York	Paris	Hong Kong	Price Realized	Rate of price change
Zao Wou-ki	1																			
Wu Guanzhong	-,468**	1																		
Zhang Xiaogang	-,257**	-,195**	1																	
Yun Gee	-,169**	-,128**	-,070*	1																
Zeng Fanzi	-,197**	-,149**	-,082*	-,054	1															
Yue Minjun	-,191**	-,145**	-,079*	-,052	-,061	1														
Liu Ye	-,180**	-,137**	-,075*	-,049	-,057	-,056	1													
Chen Yifei	-,182**	-,138**	-,076*	-,050	-,058	-,056	-,053	1												
later 1950	-,467**	-,354**	,550**	-,128**	,421**	,408**	,386**	-,138**	1											
Year_Sale	0,043	-,350**	,183**	0,061	,145**	,125**	,128**	-,110**	,329**	1										
Size(CM2)	-,031	-,169**	0,020	-,068*	,196**	,188**	0,011	0,028	,223**	,075*	1									
Ink_color/Gouache/water	-,164**	,591**	-,161**	-,093**	-,116**	-,134**	-,127**	-,128**	-,303**	-,244**	-,146**	1								
Oil_canvas/Oil_Board	-,117**	-,250**	0,056	,172**	,168**	,110**	0,019	,210**	,194**	0,045	,215**	-,613**	1							
Lithograph/Etching/Other	,318**	-,307**	,105**	-,111**	-,082*	-,028	,112**	-,120**	,068*	,195**	-,109**	-,284**	-,571**	1						
London	,294**	-,290**	0,020	-,093**	0,008	0,041	0,056	-,116**	,067*	0,011	0,021	-,141**	-,145**	,323**	1					
New York	,123**	-,200**	,219**	-,075*	-,026	0,026	-,013	-,081*	,140**	0,044	-,049	-,166**	-,131**	,338**	-,174**	1				
Paris	,222**	-,116**	-,043	-,012	-,049	-,047	-,045	-,045	-,102**	,124**	-,046	0,036	0,005	-,055	-,097**	-,068*	1			
Hong Kong	-,418**	,422**	-,143**	,133**	0,020	-,022	-,020	,168**	-,107**	-,076*	0,031	,209**	,208**	-,470**	-,680**	-,474**	-,267**	1		
Price Realized	-,058	-,131**	,111**	-,045	,149**	,116**	-,010	0,014	,210**	,220**	,413**	-,199**	,352**	-,220**	-,110**	-,044	-,023	,133**	1	
Rate of price change	-,143**	-,112**	,087**	-,085*	,257**	,217**	0,018	-,016	,318**	,201**	0,018	-,081*	,125**	-,071*	-,121**	-,059	-,032	,151**	,217**	1

\*\* . Correlation is significant at the 0.01 level (2-tailed).

\* . Correlation is significant at the 0.05 level (2-tailed).

