WHAT DO WE KNOW ABOUT WINE AS AN ALTERNATIVE FINANCIAL ASSET

LE FUR Eric

INSEEC Business School, Bordeaux, France

LAREFI, Université Bordeaux IV, France

elefur@groupeinseec.com

FAYE Benoit

INSEEC Business School, Bordeaux, France

LAREFI, Université Bordeaux IV, France

bfaye@groupeinseec.com

CARDEBAT Jean-Marie

LAREFI, Université Bordeaux IV, France

jean-marie.cardebat@u-bordeaux4.fr

Abstract:

This article tries to characterize the wine market. The idea is whether these wines can represent assets credible alternative to traditional financial assets. We show that this trend is fashionable but it is probably premature. Indeed, the first part of our work shows that the analysis of actors and rules that govern this market, as well as the review of the academic literature, demonstrate the vagueness around this market: incomplete information, product heterogeneity, opacity of valuation rules. As many problems which confirm the efficiency absence in this market. In the second part, we prove this result empirically through a hedonic price analysis of the 5 first growths chateaux in Bordeaux (Haut-Brion, Lafitte Rothschild, Latour, Margaux, and Mouton Rothschild). Data are issued from 30 auction houses operating in six countries over the period from 2000 to 2012. We show notably that the place where the wines are exchanged significantly influences their prices. A systematic bias appears because the wines traded in Hong Kong are always more expensive. So, the market is not refereed. This reveals the inefficiency of the market and its immaturity. The fashion effect around the fine wines should not forget that this market is very shallow and unorganized which makes it more risky it appears under existing indices.

Key words: wine, finance, alternative assets, hedonic prices.

JEL code : G11, G12, G14

1. **Introduction**

During the 2000s, investing in wine became very fashionable. MASSET *et al*. (2012) point out the underlying reasons: on the one hand, the yields of these investments coupled with low correlations with traditional asset markets (stocks and bonds); on the other hand, a fad reinforced at the end of this decade because of vintages 2009 and 2010 deemed exceptional and highly rated by leading experts including Robert Parker. At the same time, the effect of Asian demand due in part to the elimination of customs duties in Hong Kong in February 2008 and the bubble on the Lafitte-Rothschild linked to the Chinese craze for this Chateau increased the attractiveness of wine as an alternative investment. From then on, we observed an increase in the number of investment funds specialized in wine and also in the number of price indices. The academic literature on the subject "Wine and Finance" developed as well. However, the characteristics of the wine market are actually relatively unknown and available information very incomplete. A few important elements show that we must remain very cautious concerning investment in wine: heterogeneity of academic studies, modes of indices calculation or composition and valuation of funds. With regard to the funds, the first problems have already arisen and we can legitimately wonder about opaque methods of valuation[1]. The purpose of this paper is therefore to develop a critical analysis of this fashionable investment and to show all the obstacles for an investor who wishes to integrate wine in an assets portfolio.

The idea of incorporating alternative assets such as "collectibles" in financial portfolios is not new. Indeed, academic literature has long dwelt on the motivations of investors to collect. One of them concerns the financial aspect. Even if this is not the main reason for the acquisition of collectibles, many collectors expect financial gain in return for their investment (BURTON and JACOBSEN, 1999) which can be considered as the main reason for collecting (PEARMAN *et al*., 1983; FORMANEK, 1991). For ANDERSON (1974), the main reasons for collecting are economic, collecting is

---

[1] See for example the article in the Financial Times of 30th September 2012 on the dubious valuation of Nobles Crus (Luxembourg fund).

thus a form of investment. However, STOLLER (1984) noted that, although collectors believe in their chances of financial gain, the market can be manipulated, for example through price guides or catalogs collection. There may also be market manipulation with a company artificially creating scarcity. This was the case for example with Swatch (LONG and SCHIFFMAN, 1997) or with Ty Inc. and the Beanie Baby (BURTON and JACOBSEN, 1999), a phenomenon that led to an over-saturation of the market (HOOD, 2006).

In response to the growing interest in wine as an asset class for investors, several academic studies have been conducted on the financial characteristics of the wine market. However, there have only been 31 papers devoted to this field since the first article of KRASKER (1979), 80% of these papers written over the last twelve years. Although there is a growing number of studies devoted to the profitability of the wine and the potential value to introduce it in a diversified portfolio, the academic research on this topic is still very far from what has already been done in particular in the arts field. We also note that some publications in academic journals prolong working papers or presentations at a conference, in such a way that only eight academic journals are concerned. Journal of Wine Economics with 4 publications is the only specialized review on wine to offer a few articles on wine and finance. The majority of papers are working papers (10 in all). 36 authors have written on the subject, FOGARTY being the most prolific with 6 publications followed by MASSET with 5 publications. With the exception of six wine professionals, the authors belong to universities or business schools, American (9), Swiss (4) Australian (3) French (3) German (1) and Irish (1). These studies are too limited in number to provide a detailed knowledge of the market.

In view of this lack of information, is the boom for wine as an alternative asset not dangerous? Favoring speculative behavior without any economic rationality? Is there a risk of creating phenomena of an ephemeral bubble? And ultimately tarnishing the image of fine wines supporting this speculation? The proliferation of indices, funds and researches on the return of this alternative investment can sometimes give the fallacious impression that we would be facing a market with

characteristics similar to those of a traditional financial asset market. But, this is not the case. In this paper, we show that several conditions are not met to make this market an efficient market. Much of the information is not immediately available, because divided between traders and merchants, notably actors in Bordeaux[2]. Information asymmetry between seller and buyer is the norm, as is the non-homogeneity of the products. Indices, such as academic studies or valuation methods of funds are founded from then on the basis of subsets of asymmetric information, distinct from each other and very incomplete. The auction data on which are based many researches are for example a very minority fraction of sales of fine wines on the secondary market. But even if one focuses on hammer auctions, we show in this paper from a hedonic price function on the basis of comprehensive data on all auction companies between 2000 and 2012 that significant price differences can intervene for the same wines[3] following the place of sales, suggesting that the market is not arbitrated[4]. To our knowledge, no work on a period so long has been carried out. Indeed, previous publications are usually based on one or a limited number of auction houses. After a review of the literature, we will show in the context of a hedonic price function, the impact of the place of sales on the price of wines. We conclude on the lack of experience and studies concerning the wine market and the dangers of associating wine as an alternative asset in a systematic way.

2. Review of the literature

Although little expanded, the academic literature has long studied the question of wine as an asset class with an attractive risk-return ratio in relation to the financial security of a portfolio. However, a more detailed analysis and extensive literature is required at this level and can focus on three questions:

- What is the return on an investment in the fine wine market?

- Is it worth investing in wine rather than in traditional assets?

---

[2] Most of the investments occur for fine Bordeaux wines.
[3] The five famous first growths: Haut-Brion, Lafitte-Rothschild, Latour, Margaux, and Mouton-Rothschild.
[4] For example, due to the importance of transaction costs (see MASSET *et al.*, 2012), the heterogeneity of tax rules or the lack of depth and structure of the market.

- Should wine considered as an alternative asset be incorporated to enhance the performance of traditional portfolios of financial assets?

Profitability of certain bottles is exceptional. The most spectacular margins were notably noted by SOKOLIN (1998). Studies on wine returns are mainly focused on Bordeaux wines and more specifically on the 5 first growths. Some studies compare the returns of Bordeaux with other regions (Australia, California, Spain, Italy and Rhone). However, in view of the results previously stated, no real trend is apparent concerning the supremacy of a wine compared to others in terms of returns. We might think that Bordeaux wines are more profitable given the importance of Bordeaux in the main wine indices and the composition of funds, but the facts do not confirm this belief. It is therefore legitimate to wonder about the heterogeneity of these results. The causes of this heterogeneity are multiple. First, the databases used are very different. They come mainly from auctions (The Chicago Wine Company, Annual Heublein Wine Auction Vintages, and Langton's investment classification), magazines (Wine Spectator) or brokers. Second, the selected vintages are also very heterogeneous. Many studies don't retain vintages prior to 1950 to avoid the antique effect, some dating back to 1893. Thirdly, the sample periods rarely exceed 15 years, but rather are around ten years and sometimes only have only a few years. Finally, we can note the methods and models used. The majority of papers are based on the repeat sales method, very little on the hedonic method. Data are often treated as time series, often little in panel.

In contrast with JAEGER (1981), FOGARTY (2006a, 2006b, 2006c) states that expensive Australian wines generally have a higher return than the cheaper wines, but this higher return is associated with a higher risk. This volatility is characteristic of collectibles (BURTON and JACOBSEN, 1999), which are also often cyclical (DI VITTORIO and GINSBURGH, 1996). BEIJER (2012) argues even that cheap wines have no interest in terms of investment. HADJ ALI and NAUGES (2003) show that returns of Bordeaux wines can be very important especially if we invest in wines *en primeur*. Indeed, Bordeaux wines generally increase in value between the time of the sale *en primeur* and their first quotation out *en primeur* market. However, CARDEBAT and FIGUET (2010) indicate that the five

premiers grands crus do not exhibit excessive returns, a result that is opposite to MASSET and HENDERSON (2010) who consider that the first growths and extraordinarily good wines rated by Robert Parker offer the best compromise in terms of returns. Several studies have been conducted on non-Bordeaux wines and show that Bordeaux wines have not the best returns. For example, FOGARTY (2006a, 2006b, 2006c) found that Australian wines have returns broadly comparable, if not superior, to those estimated by BURTON and JACOBSEN (2001) on Bordeaux wines. He also argues that Australian wines are more interesting because they benefit from a tax exemption (FOGARTY, 2007). Conversely, BEIJER (2012) found that Australian and American wines which represent only a small part of the total trade, provide lower returns. On their side, LUCEY and DEVINE (2011) find that Rhone wines have a higher performance than the Bordeaux wines: over the period 1996-2006, Hermitage La Chapelle gives an average annual return of 4.2% and a standard deviation of 12 %, Chapoutier Ermitage Le Pavillon (5% and 16.6%), Côte-Rôtie La Landonne (5.7% and 22.9%), Côte-Rôtie La Turque (9.1% and 21.6%), Château Beaucastel (1.6% and 14.7%) compared to the wines of Saint-Estèphe (-3.9% and 7.8%), Pauillac (2% and 13.2%), Saint-Julien (-1 , 8% and 17%), Pomerol (4.5 and 13.4%) and Saint-Emilion (5.9% and 19.2%). For BEIJER (2012), Bordeaux wines have lower returns than Spanish and Italian wines because they are more traded, more rare, thus reducing their illiquidity premium, even if from the middle of 2008, the indices of Bordeaux wines have fallen sharply in the wake of stock indices thus indicating their sensitivity to the crisis as other financial assets (MASSET and WEISSKOFT, 2010, 2011).

The second issue addressed in the literature, namely the comparison between the returns of financial assets and wine, is actually the oldest. Indeed, KRASKER (1979) conducted the first economic analysis from time series of the rate of return on the storage of wine. He analyzes 137 observations of red Bordeaux and California Cabernet Sauvignon over the period from 1973 to 1977 and found that the rate of return on wine is not significantly different from that of risk-free assets, i.e. U.S. Treasury Bonds that it outperformed of 0.64%. Two years later, in response to this article, JAEGER (1981) argues that the results of KRASKER are mistaken because they are based on a small

number of observations and a short period (coinciding with the oil crisis in the 1970s). Indeed, using the same methodology as KRASKER but over the period from 1969 to 1977, JAEGER found radically different results. She notes that with the same portfolio of wines than KRASKER, wine outperformed Treasuries by 16.6%. She explains this result in two ways: firstly, by the study period longer which reduces the negative impact of the 1973-1975 recession, and secondly, by lowering the cost of storage. On this last point, KRASKER (1979) estimated the cost of storage (endogenous) $ 16.60 per bottle per year while JAEGER (1981) was assumed it to be exogenous and equal to $ 0.45 per year. Most studies comparing the performance of the wine with those of Treasuries are agree on the outperformance of wine: which is the case for those who resort to Bordeaux wines (BURTON and JACOBSEN, 2001; JONES and STORCHMANN, 2001; HADJ ALI and NAUGES, 2003; SANNING et al., 2007; SANNING et al. 2008), Australian wines (BYRON and ASHENFELTER, 1995), the California wines (HAEGER and STORCHMANN, 2006) and indices combined Bordeaux-Rhone (DEVINE and LUCEY, 2011; U.S. DOTT, 2011). However, some studies have lower wine returns than U.S. Treasuries bonds: ASHENFELTER *et al.* (1995) with Bordeaux wines, WOOD and ANDERSON (2003, 2006) with Australian wines. Finally, LUCEY and DEVINE (2011), using the Sharpe ratio, show that all the Bordeaux appellations (except Saint-Emilion) realize a lower performance than the U.S. Treasury bonds to 5 years. The research also question returns of wine relative to stock indices, primarily the Dow Jones Average Index. Some studies show that wine indices outperform traditional assets, including the flagship index of The New York Stock exchange (DUTHY, 1986, BYRON and ASHENFELTER, 1995; KUMAR, 2005; MASSET and WEISSKOPF, 2010, 2011). All other studies find the opposite result (e.g., ASHENFELTER et al., 1995; BURTON and JACOBSEN, 2001; WOOD and ANDERSON, 2003, 2006; SANNING et al 2007, 2008; FOGARTY, 2010). Some studies also compare the performance of Bordeaux with the Russell 3000 index. They show that the Bordeaux wines systematically outperform the market index (MASSET *et al.*, 2010; MASSET and WEISSKOPF, 2010, 2011). Finally, all studies confirm that the risk associated with investing in wine as measured by the standard deviation is

lower than the DJIA, except KUMAR (2005) and DEVINE and LUCEY (2011). These authors show that if one considers the wines individually, then the risk is higher than the DJIA.

From then on, is there an interest to include wine in a portfolio, diversified or not? In other words, is there a low correlation of wine with other asset classes? This is the third and final question from the literature that we analyze here. A common belief believes that investing in wine has interesting features in terms of portfolio diversification, confirmed by academic studies (e.g. COFFMAN and NANCE, 2009; FOGARTY, 2010; MASSET and HENDERSON, 2010; MASSET *et al*. 2010). However, some academic studies indicate otherwise. For example, MOUGEOT and PERIGNON (2000) show that the wine is extremely volatile asset and therefore that a risk-averse investor has no interest in introduce wine in a diversified portfolio of assets. BURTON and JACOBSEN (2001) show that the introduction of fine wines in a diversified portfolio does not improve the profitability of the latter and only exceptional vintages like 1961 or 1982 beat the Dow Jones. For BEIJER (2012), the benefits of diversification of wine are optimum when they serve to hedge against the risk of holding public bonds. For other asset classes, the correlation coefficients are positive but weak with the wine, thus limiting the potential for diversification. Given the current high costs associated with transaction rebalancing a portfolio of investments in wine, an equally weighted portfolio of wines seems to be the best investment portfolio to own (FOGARTY, 2006b, 2006c).

Since JAEGER (1981) who believes that wine is an asset that must be introduced in a portfolio, many academic papers have confirmed this trend. FOGARTY (2007) for example shows that when the wine is included in the composition of the portfolio, the optimal portfolio has a quarterly return of 1.81% and a risk of 2.99%. To achieve this level of performance of portfolio without include wine in the portfolio, it requires accepting a quarterly risk of 3.23%. Thus, for the portfolio that maximizes the Sharpe ratio, the wine provides a gain in terms of risk reduction of 0.24% per quarter. Without wine in the portfolio, the return is to 1.77% and 3.18% risk. Therefore, for the portfolio that maximizes the Sharpe ratio, the wine provides a gain in terms of risk reduction of 0.17% per quarter.

SANNING et al. (2008) find a positive Jensen's alpha for the wine, so with a return higher than that predicted by the model. Using the CAPM and the Fama-French Three Factor Model, they find excess returns for wines and suggest a low correlation of wine with financial markets. However, the correlation between assets tends to increase during economic downturns. Thus, diversification tends to be less effective when it is most needed. FOGARTY (2010) and FOGARTY and JONES (2011) find that diversification benefit attributed to wine depends on the estimation method chosen. For example, the use of repeat sales method tends to overestimate returns. FOGARTY (2010) shows that the hybrid approach is the one that offers the greatest benefit in terms of portfolio diversification. More specifically, FOGARTY and SADLER (2012) state that the conclusion as to whether holding the wine offers an advantage in terms of diversification depends on the method used to estimate the wine returns, of the period, if raw data are used and the type of diversification test used. Finally, BALDI et al. (2010) analyze the relationship between the Global Wine Industry Share Price Index and Stock Market Composite Index returns and conclude that the wine returns have a slow speed of adjustment compared to equities and therefore act as a parachute, confirming the inclusion of wine in a portfolio.

From then on, a relative consensus appears to conclude that wine would be an interesting alternative for investors. However, the common point of all these analyzes remains the narrowness of their field of study. Indeed, they focus mostly on data from auctions, which represent a minority of total transactions and in addition they generally involve one or a very small number of these auction houses. In the context of an efficient market this situation wouldn't pose problem because a subset of the total information would be representative of the overall information. In other words, if the law of one price was respected on the fine wine market, so the study of a single market (Europe or USA, etc.) would be representative of the price dynamics in all markets. But, as we have said, given the type of asset, its heterogeneity, evaluation methods, etc., we can doubt a priori of the verification of this law. The following analysis will just return to this issue and focus on the impact on sales premises on the price dynamics to test the law of one price applied to the fine wine market.

3. An empirical analysis of the auction prices over the period 2000-2012: does the sale location matter?

3.1 Descriptive statistic on auction prices

The dataset consists in a panel of 79,661 observations. Each observation is the price of a couple "chateau-vintage" sold in one of the 30 auction houses considered over the period 2000-2012. As in Liv-ex 50 we took the 5 first growths: Lafitte Rothschild, Mouton Rothschild, Latour, Margaux and Haut Brion. The vintages considered are over the period from 1945 to 2008. Only 750ml bottles are collected. It represents a transaction volume of 662,652 bottles for a total value of USD 456,829,912. Prices reflect the price per bottle (in U.S. dollars) of a uniform lot of wine (same wine, vintage, and size) inclusive of the relevant buyer's premium for the auction house and location at the time but exclusive of sales taxes or VAT. Sales in currencies other than U.S. dollars are converted to U.S. dollars as of the date of the sale.

As well we consider 7 auction companies: Acker Merrall, Bonhams, Christie's, Edward Roberts International, Hart Davis, Morrell and Company, Sotheby's, and Zachy's. These companies operate in:

- 3 continents: Asia, North-America, and Europe,

- 6 countries: China, France, Switzerland, the UK, the USA, and the Netherlands

- 10 places: Genève, Hong-Kong, Paris, Amsterdam, New York, Chicago, Los Angeles, Bordeaux, San-Francisco, and London.

By combining companies and places, we identify 30 auction houses: Acker Merrall & Condit ; Bonhams and Butterfields ; Bonhams(Hong Kong and London), Christie's (Amsterdam, Geneva, Hong Kong, London, Los Angeles, New York Wines, Paris, South Kensington), Edward Roberts International (Chicago), Hart Davis Hart Wine Co. (Chicago), Morrell and Company, Fine Wine Auctions, Sotheby's (Hong Kong, London, New York), Zachy's Wine Auctions, Zachy's/Wally's, and Zachys-Christies.

Data are directly issued from these 30 auction houses which represent an exhaustive dataset on the 2000 decade. This worldwide dataset is necessary for exploring the location effect of sales on prices.

The transactions number for each chateau is given by graph 1. There is a predominance of the "two Rothschild" Lafitte and Mouton, but the distribution remains quite balanced between the 5 chateaux. However, the distribution of transactions by location and auction companies is not balanced.

There is a preponderance of the USA as the major trading location and especially New York. After the USA, the UK, with London, appears as an important place as well. China, with Hong-Kong, ranks third. That underlines the growing importance of China as a major market for fine wine. Turning to the auctions companies, Christie's and Sotheby's lead the market but are not alone: Zachy's and Acker Merrall & Condit are significant competitors on this market.

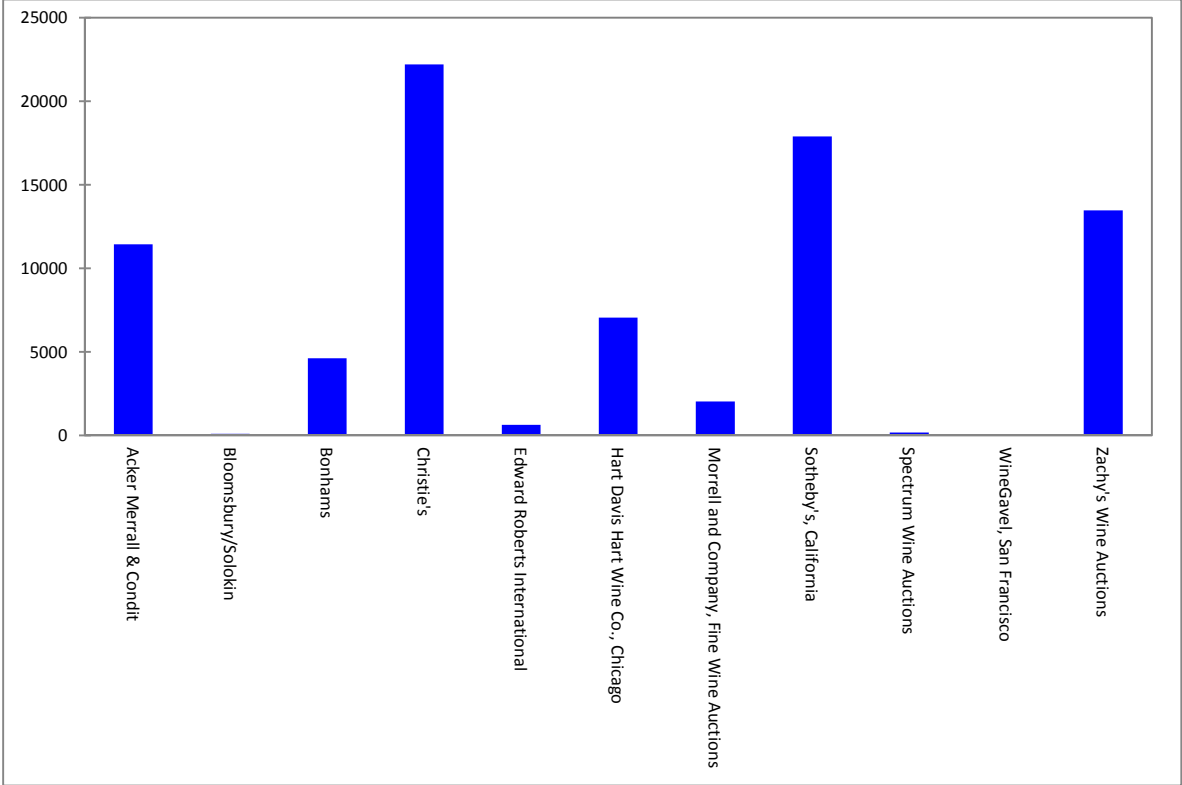Graph 1: transactions number by chateau on the whole period (2000-2012)
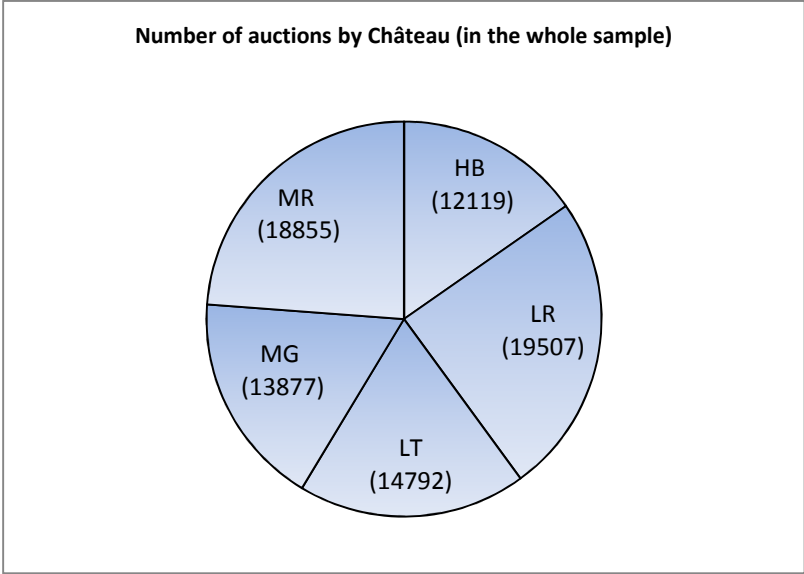
HB: Haut-Brion; LR: Lafitte Rothschild; LT: Latour; MG: Margaux; MR: Mouton Rothschild.
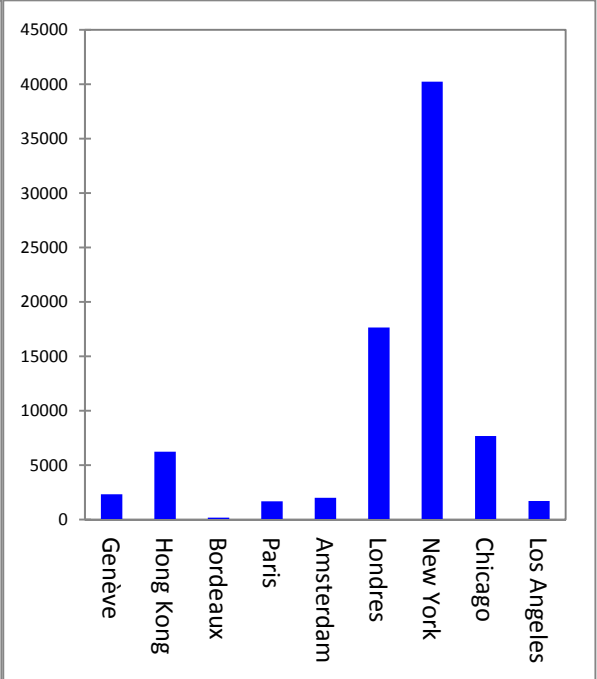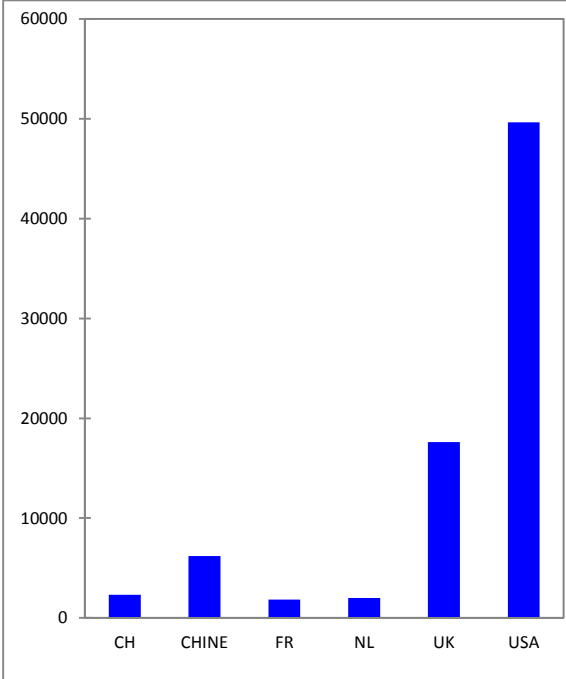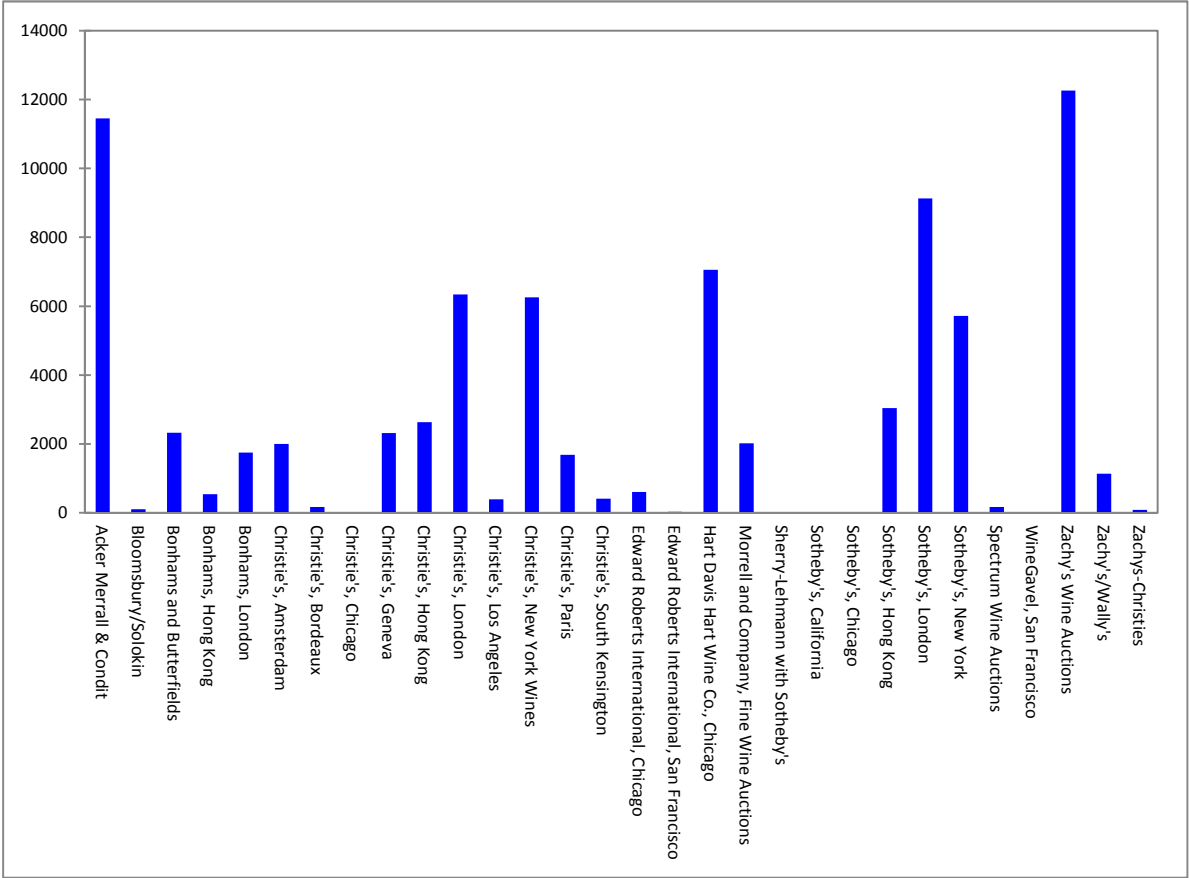
Graph 2: transactions number evolution by continent
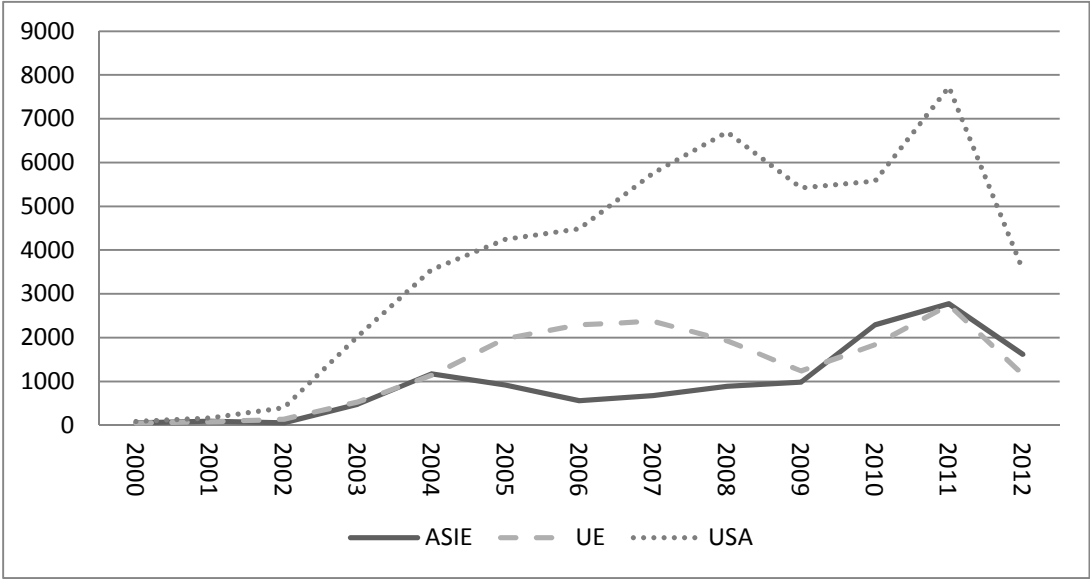
Graph 3: transactions number by auction companies on the whole period (2000-2012)

Graph 4: transactions number by location (auction houses, countries and places) on the whole period (2000-2012)

The distribution of the transactions by vintage is more problematic. As shown by graph 5, there is a concentration of the transactions on rare vintages. This situation raises the problem of the representativeness of certain sub-samples. Indeed, for a vintage like 1946, there are few transactions and then few couples of "chateau/vintage". Studying this vintage implies the potential risk to work with incomplete non representative samples. For example, this vintage should be traded in London but never in Hong-Kong or only one time; therefore some differences could appear in prices of a same "chateau/1946" but should not be representative. A price difference would be significant only if we compare sub-samples between places large enough.

Graph 5: transactions number by vintage on the whole period (2000-2012)
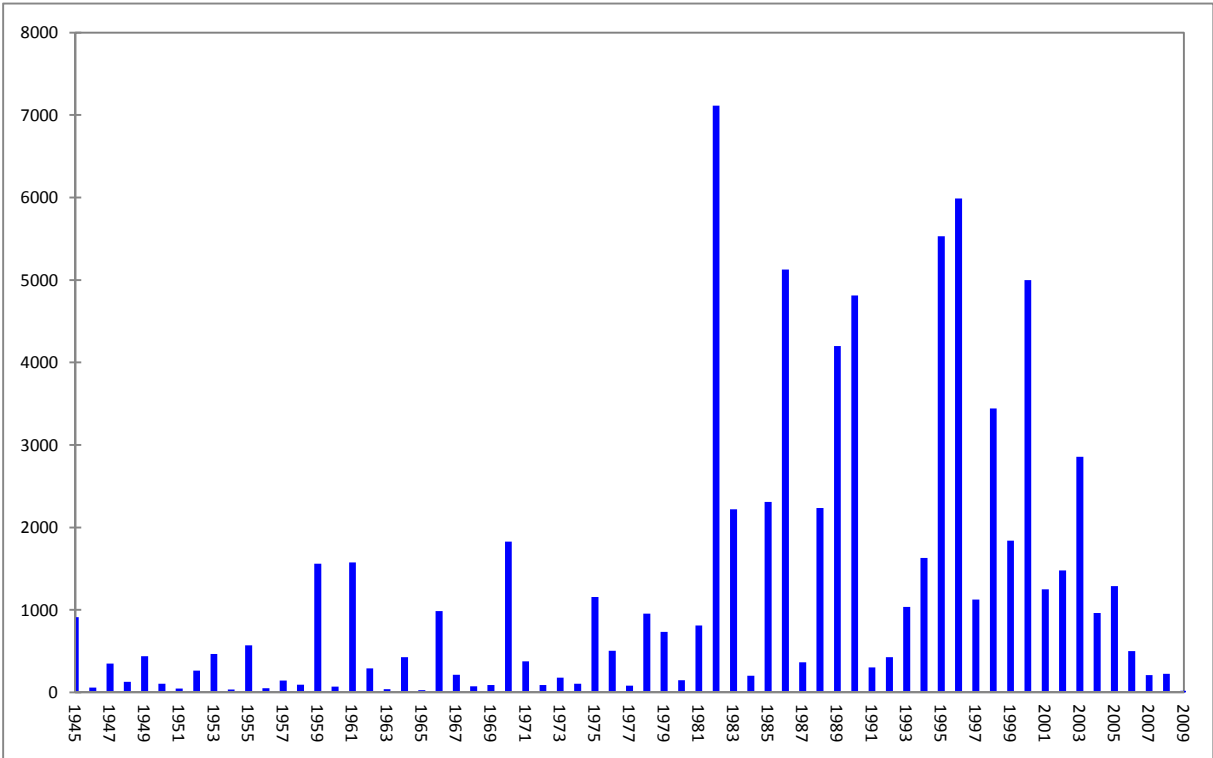
In order to avoid this problem of representativeness we have decided to partition the entire population of transactions according to the vintage with a Fischer algorithm in three classes. Table 4 exhibits the features of these 3 classes.

Table 1: the population partition according to vintages

Classes	1	2	3
Interval min-max	[18;1229[	[1229;3402[	[3402;7077]
Number of vintages	46	12	7
Frequency	0,708	0,185	0,108
Barycenter	381,087	2006,583	5363,000
Variance intra-class	130014,392	389015,720	887637,333
Vintages	Other vintages	1959, 1961, 1970, 1983, 1985, 1988, 1994, 1998, 1999, 2002, 2003, 2005	1982, 1986 1989, 1990 1995, 1996 2000

Before the 1982 vintage, there are only scarce transactions because stocks are rare. We can separate 2 periods: the antique (before 1982) and the contemporary (since 1982). We choose to take vintages in these 2 sub-periods, but only the most frequently traded vintages which ensure a high representativeness of sub-samples. Hence, we retain 11 vintages corresponding to the entire class 3 (table 1) and the 1945, 1949, 1959, 1961 vintages. This sub-sample represents 41,986 observations. Annex 1 at the end of the paper exposes some descriptive statistics about this sub-sample.

Furthermore, a hedonic function is a relation between differentiated goods prices and the quantities of characteristics contained in these goods (Triplett, 2004). Wine prices are then determined by factors like appellations, vintage, climatic conditions, expert opinions, reputation, etc. (e.g. LANDON and SMITH, 1998; OCZKOWSKI, 2001; CARDEBAT and FIGUET, 2004, 2009[5]). This hedonic analysis explains prices by the qualities and characteristics of the wines in a two-stage method. In the first stage of hedonic regression, a wine price is represented by hedonic price function. So the hedonic price of an additional unit of a particular factor is determined as the partial derivative of the hedonic price function with respect to this factor.

To run a hedonic analysis we then have to take into account quality variables. Because we consider much closed chateaux in terms of appellation (4 Medoc and one Pessac-Leognan), ranking (all first

---

[5] For a survey, see COSTANIGRO and MCCLUSKEY, 2011.

grands crus in the 1855 ranking), it is difficult to differentiate them according to the quality on objective variables. The only differentiation that occurs is on the name. Thus we will include as a differentiation variable the name of each chateau. Nevertheless, as usual in a hedonic analysis, it is possible to use the Parker Grade for these couple "chateau/vintage" as quality variable. Table 2 shows some descriptive statistics for the main variables included in the hedonic function.

Table 2: descriptive statistics for the main variables included in the hedonic function

Statistics	PARKER notes	Price/Btl ($)	Auction values
Numb. of obs.	41986	41986	41986
Median	96,000	698,370	4840,000
Sum	3943893,000	40398732,960	312303225,880
Mean	93,934	962,195	7438,271
Standard deviation (n)	6,390	1050,004	9339,374
Skewness (Fisher)	-1,193	6,428	5,868
Kurtosis (Fisher)	1,003	91,535	81,194

3.2 Econometric analysis: the hedonic price function with location effect

We first regress the simpler hedonic model with time fixed effect:

$$lnP_{it} = \alpha_t + lnGrade_{it} + lnNumb_{it} + Vintage_{it} + Chateau_{it} + \varepsilon_{it} \tag{1}$$

Where all quantitative variables are expressed in logarithm; P_{it} is the price of a couple "chateau/vintage" sold at date t (t=2000 to 2012); α_t is a time specific effect independent of individuals. Fixed time effects are included because of the growing demand for wine in the 2000 decade (see graph 2). The liberalization of the Hong Kong market in February 2008 has boosted the trade in this place. With a constant stock of fine wine the demand shock should imply a rising price since this date. $Numb_{it}$ is the number of bottles sold in a lot (1, 6 or 12 in most of the cases, with a predominance of single bottle sold). $Vintage_{it}$ is the vintage associated to each "chateau/vintage" couple. As ever said we consider the vintages: 1945, 1949, 1959, 1961, 1982, 1986, 1989, 1990, 1995, 1996, 2000. $Chateau_{it}$ represents the five chateaux studied in the previous section. Results of this hedonic function are reported in the model 1 (table 6).

The explanatory power of this model is quite good with a R^2 equals to 0.71.It confirms the strong impact of Robert Parker on the price. A 1% increase of the Parker Grade induces more than 3% of increase in the price of a wine. The number of bottled sold in a lot is significantly different from 0 but the impact is very low. The vintage effect is as usual: the more a wine is old, the more expensive it is. The coefficients associated to vintage from 1945 to 1961 are significantly (following a Wald test) higher than those from 1982 to 2000. Turning to chateau result, a Lafitte Rothschild effect appears. The coefficient for this Chateau is significantly higher than for others. Time period effects exhibit a higher price trend, especially in the end of the period. Years 2010, 11 and 12 are strongly associated to significant higher prices. This outcome is coherent with the growing Asian demand since 2008.

However the problem in this regression comes from the residual. Prices are extracted from several auction house, places and countries. These prices should be perfectly comparable for a same couple Chateau/vintage only if the law of one price was verified. In this case, information about the place (or country or auction house, etc.) where a wine would have been traded should not have any impact on the price of this wine. If these kind of geographic variables have some impact we can therefore reject the law of one price.

Moreover, an econometric problem arises if auction places or companies have some influence on prices. It means that the residual of equation (1) is not a white noise. Indeed, the residual can be written as follow:

$$\varepsilon_{it} = \theta_i + \gamma_{it} \tag{2}$$

Where θ_i is a specific individual effect independent of time and with γ_{it} the only random part of the error term. The period specific effect has been already taken into account in equation (1). But the presence of "geographic" specific effect has to be modeled in order to eliminate the "θ_i" bias.

Combining equation (1) and (2):

$$lnP_{it} = \alpha_t + \theta_i + lnGrade_{it} + lnNumb_{it} + Vintage_{it} + Chateau_{it} + \gamma_{it} \tag{3}$$

Where θ_i characterizes the location of the auction and the trading house without consideration of time. Several variables are used for θ_i: the company (for example Christie's), the city (called place in

what follows), the country, and the continent. The results of equation regressions (3) are shown in

the table 3 (model 2a to 2e):

Table 3: A hedonic model for auction prices 2000-2012

	Model 1	Model 2a Continent	Model 2b Countries	Model 2c Places	Model 2d Companies	Model 2e Auction Houses
Constant	-8.560912***	-8.568417***	-8.489245***	-8.491445***	-8.359518***	-8.344212***
Parker Grade (log)	3.072821***	3.066082***	3.042031***	3.042203***	2.987645***	3.011506***
Number of Bottles	0.029187***	0.021644***	0.014135***	0.014796***	0.020711***	0.004982
Vintage-1945	1.769280***	1.755845***	1.763853***	1.763178***	1.759458***	1.756846***
Vintage-1949	1.056011***	1.045431***	1.050929***	1.050106***	1.055519***	1.053411***
Vintage-1959	1.149979***	1.142371***	1.141768***	1.141544***	1.158164***	1.150525***
Vintage-1961	1.119613***	1.109986***	1.116009***	1.114904***	1.123924***	1.122407***
Vintage-1982	0.776652***	0.776618***	0.781094***	0.780886***	0.782167***	0.784797***
Vintage-1986	0.275723***	0.276977***	0.282222***	0.281981***	0.275693***	0.284887***
Vintage-1989	0.109318***	0.110197***	0.118618***	0.118552***	0.088639***	0.124319***
Vintage-1990	0.174832***	0.172431***	0.176164***	0.176416***	0.178572***	0.181192***
Vintage-1995	-0.253915***	-0.253804***	-0.252200***	-0.251562***	-0.249074***	-0.247386***
Vintage-2000	0.365846***	0.364694***	0.362290***	0.361828***	0.369027***	0.362070***
Haut Brion	0.038363***	0.040652***	0.038886***	0.038800***	0.022257***	0.036896***
Lafitte Rothschild	0.805915***	0.805535***	0.803244***	0.803560***	0.799828***	0.801496***
Latour	0.227381***	0.226794***	0.224189***	0.224394***	0.227897***	0.224487***
Margaux	0.062293***	0.063244***	0.061711***	0.061675***	0.063641***	0.062824***
Year-2001	-0.438564	-0.427190	-0.442568	-0.442988	-0.409089	-0.402135
Year-2002	-0.344996	-0.323779	-0.354904	-0.358399	-0.354425	-0.433565*
Year-2003	-0.239127	-0.237587	-0.247084	-0.248443	-0.234648	-0.316977
Year-2004	-0.135176	-0.138839	-0.142430	-0.144594	-0.135354	-0.217783
Year-2005	-0.037514	-0.015079	-0.017569	-0.019402	-0.014734	-0.068613
Year-2006	0.239212	0.266110	0.260331	0.259052	0.259605	0.205897
Year-2007	0.588331***	0.614700**	0.608724***	0.608690***	0.608970***	0.552318**
Year-2008	0.586515***	0.607155**	0.598560***	0.599082***	0.611294***	0.546388**
Year-2009	0.482474**	0.498738**	0.482999**	0.484686**	0.510408**	0.432686*
Year-2010	0.919022***	0.924074***	0.878305***	0.879383***	0.929826***	0.808488***
Year-2011	1.002154***	1.010362***	0.972126***	0.972816***	1.014641***	0.899310***
Year-2012	0.728450***	0.735157***	0.698212***	0.698728***	0.734772***	0.621949***
Asia		0.129568***				
America		0.027307***				

Switzerland		0.081795***			
China		0.342228***			
France		0.007626			
UK		0.054661***			
USA		0.087044***			
Genève			0.082379***		
Hong-Kong			0.341134***		
Paris			0.008780		
Amsterdam			0.055276***		
New York			0.090376***		
Chicago			0.066192***		
Los Angeles			0.119484***		
Acker Merrall & Condit				0.237170***	
Zachy's Wine Auctions				0.178000***	
Bonhams				0.072275***	
Christie's				0.175356***	
Hart Davis Hart Wine Co., Chicago				0.138963***	
Morrell and Company, Fine Wine Auctions				0.042054**	
Sotheby's				0.233477***	
Acker Merrall & Condit					0.220395***
Christie's, Hong Kong					0.486620***
Christie's, London					0.094927***
Christie's, Los Angeles					0.183802***
Christie's, New York Wines					0.113570***
Christie's, Paris					0.073122***
Christie's, South Kensington					-0.087569*
Edward Roberts International, Chicago					-0.072820***
Hart Davis Hart Wine Co., Chicago					0.151089***
Morrell and Company, Fine Wine Auctions					-0.007712
Sotheby's, Hong Kong					0.411651***

Sotheby's, London						0.161656***
Sotheby's, New York						0.189490***
Zachy's Wine Auctions						0.160870***
Zachy's/Wally's						0.175558***
Zachys-Christies						0.013202
Bonhams, Hong Kong						0.227288***
Bonhams, London						0.052086**
Christie's, Amsterdam						0.066185***
Christie's, Geneva						0.149352***
Observations	41986	41986	41986	41986	41986	41986
Adj. R^2	0.71	0.71	0.71	0.71	0.71	0.72

*** Significance at 1%, ** at 5%,* at 10%.

The general outcome resulting of table 3 is the influence of Asia on prices. Asia has a significant higher impact on price than Europe or USA (Wald test at 1%). This result is confirmed by the country and the place analyses (China and Hong-Kong signs are significantly higher than other). In Paris prices are significantly lower than elsewhere. These differences cannot be due to composition effect of the auctions. Thanks to the number of observations the wine composition of each sale is in average the same (same average price of a bottle in particular). For example Hong-Kong prices are not higher than Paris prices because of the presence in the first city of much rarer vintages (like 1945). The explanation of these differences has then to be found elsewhere.

Some companies (Morrell and Company, Fine Wine Auctions) have a significantly lower impact on prices, other companies (Acker Merrall & Condit, Sotheby's) have a stronger influence than all other companies (according to a series of Wald test at 1%). These outcomes should partly come from the results for auction houses which exhibit some significant volatility in the coefficients value. Some auction houses have a high influence on price (Sotheby's Hong Kong, Bonhams Hong Kong, and Christie's Hong Kong), others have a negative impact (e.g. Christie's South Kensington). That confirms the geographic bias existing in auction prices.

The Chinese / Hong-Kong[6] effect seems to be the major finding of this analysis. This geographical bias proves that the law of one price doesn't work and that there exist some arbitrage possibilities. This result is quite logic because the wine market is not well-organized like a standard financial market. A growing arbitrage activity between occident and Asian places should improve in the future the price convergence. However, to achieve the arbitrage of this special market the transaction cost will have to decrease. The bid-ask spread by now is variable between auction houses but always high[7]. It reduces the possible arbitrage benefits and opportunities.

---

[6] This market can be considered as a single market even if some restrictions still exist between H-K and the continental China.

[7] Masset et al. (2012) wrote: "When buying wine, those merchants usually take a commission of 20% to 25%. This number is comparable to the cumulated seller's commission and buyer's premium charged by auction houses. This provides a good estimate of the bid-ask spread on the wine market and suggests that wine trading is associated to substantial transaction costs."

Table 4: Distribution of VAT by place

Areas	Countries	State tax (%)	Local Tax (%)	Sum (VAT)
UE	NL	19	-	19
	CH	8	-	8
	FR (since 2000)	19,6	-	19,6
	UK	20	-	20
USA	NY	4	4,875	8,875
	LA	7,25	1,5	8,75
	SF	7,25	1,25	8,5
	Chicago	6,25	3,25	9,5
CHINA	Hong Kong			0

To complete our work we need to investigate deeply these transaction costs. Table 4 gives the VAT by place, but this information is not sufficient to assess transaction costs (transportations and insurance costs, accurate value of bid-ask spread for each auction houses, etc.). The lack of information we face about this topic is a serious limit of this work. We need to know if the arbitrage is not complete because of different transaction costs between places or because of the non-identification of arbitrage opportunities on an immature market.

3. Conclusion

This paper is a first investigation on what we know about fine wines market. Fine wines are more and more considered as interesting alternative assets. The aim of this paper was to evaluate the judicious aspect of this assertion. The review of the actors, indices, and academic literature reveal a complete lack of information and a great opacity. The empirical work based on a worldwide exhaustive dataset of auction sales shows with a hedonic function that systematic prices differences exist according to the sale locations. Prices are significantly higher in Hong-Kong than elsewhere in the world. However, at this stage an essential shortcoming appears because we cannot accurately evaluate the origin(s) of these systematic price gaps. Transaction cost is a serious candidate in this explanation, but we can abandon the hypothesis a non-arbitrage of this market (not due to transaction costs). We have to stay very careful in our conclusion. The law of one price is not respected on the fine wine market, but the reasons are not clearly established.

We then need to prolong our analysis, on one hand, with a deeper investigation of these costs. But, on the other hand, we can continue to explore our complete database in a traditional way. For instance in calculating a fine wine index for several portfolios (we can replicate as a benchmark the Liv-ex 50), in order to measure a composition effect. We can run a CAPM model as well to measure the alpha and beta of wines. All these studies will be done later, but at the beginning we wanted to scrutinize the general questions of "fine wines as alternative assets" as the first step of a general work program.

References

Anderson, R.C. (1974). Paintings as an investment. *Economic Inquiry*, 12, 13–26.

Ashenfelter, O., Ashmore, D. and Lalonde, R. (1995). Bordeaux wine vintage quality and the weather, *Chance,* 8, 7-13.

Beijer, Q. (2012). Château migraine or château riche? An empirical study on wine as a financial asset. *Working paper* n°124, American Association of Wine Economists, November.

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

Burton, B.J., and J.P. Jacobsen (2001). The rate of return on investment in wine, *Economic Inquiry* 39, 337-350.

Byron, R.P., and O. Ashenfelter (1995). Predicting the quality of an unborn Grange, *The Economic Record,* 71, 40-53.

Cardebat, J.-M. and Figuet J-M. (2004) What explains Bordeaux wines price?, Applied Economic Letters, 11(5), 293-296

Cardebat, J.-M. and Figuet J-M. (2009), Estimation of a hedonic price equation for Alsace, Beaujolais and Provence wines, Applied Economics Letters, 16(7-9), 921-927.

Cardebat, J.M. and J.M. Figuet (2010). Is Bordeaux wine an alternative financial asset? *5th International Academy of Wine Business Research Conference*, 8-10 Feb. 2010 Auckland (NZ).

Coffman B.A. and R.J. Nance (2009). Wine: The Illiquid Liquid Investment Asset. *Journal of Financial Planning*, Contributions, 61-70.

Costanigro, M. and McCluskey, J. J. (2011) Hedonic price analysis in food markets. In Lusk, J.L., Roosen, J., Shogren, J. F., The Oxford Handbook of the economics of food consumption and policy, Oxford University Press, 152-180

Devine, L. and B. Lucey (2011). Is wine a premier cru investment? *Working paper*.

Di Vittorio, A., and V. Ginsburgh (1996). Pricing red wines of Medoc vintages from 1949 to 1989 at Christie's auctions. *Journal de la Société Statistique de Paris*, 137, 19–49.

Duthy R. (1986). *The Successful Investor. A guide to Art, Wine, Antiques and other Growth Markets.* London: Collins.

Fogarty, J.J. (2006a). *Wine investment, pricing and substitutes*. Thesis, University of Western Australia.

Fogarty, J.J. (2006b). The Return to Australian Fine Wine and The Optimal Wine Portfolio. *Enometrics XIII*, VDQS.

Fogarty, J.J. (2006c). The return to Australian fine wine, *European Review of Agricultural Economics* 33, 542-561.

Fogarty, J.J. (2007). Rethinking wine investment in the UK and Australia, *Working paper*, The American Association of Wine Economists.

Fogarty, J.J. (2010). Wine investment and portfolio diversification gains. *Journal of Wine Economics*, 5(1), 119–131.

Fogarty, J.J. and C. Jones (2011). Return to Wine: A Comparison of the Hedonic, Repeat sales, and Hybrid Approaches, *Australian Economic Papers*, 50(4), 147-156.

Fogarty, J.J., and R. Sadler (2012). To Save or Savour: A Review of Wine Investment. *Working paper* n°1212, The University of Western Australia, School of Agricultural and Resource Economics.

Formanek, R. (1991). *Why they Collect: Collectors Reveal their Motivations*, in: To Have Possessions: A Handbook on Ownership and Property, Special Issue of Journal of Social Behavior and Personality. F.W. Rudmin, eds., 6, 275-286.

Hadj Ali, H. and C. Nauges (2003). Vente en primeur et investissement : une étude sur les grands crus de Bordeaux. *Economie et Prévision*, 159, 93-103.

Haeger, J.W., and K. Storchmann (2006). Prices of American Pinot Noir wines: climate, craftsmanship, critics, *Agricultural Economics* 35, 67-78.

Hood, D. (2006). Trash or treasure? *Money Sense*, 8(1), 49–51.

Jaeger, E. (1981). To save or savor: the rate of return to storing wine, *Journal of Political Economy* 89, 584-592.

Jones, G., and K.H. Storchmann (2001). Wine market prices and investment under uncertainty: an econometric model for Bordeaux Crus Classés, *Agricultural Economics* 26, 115-133.

Krasker, W.S. (1979). The rate of return to storing wines, *Journal of Political Economy* 87, 1363-1367.

Kumar, M. (2005), *Wine Investment for Portfolio Diversification*.

Landon, S. and Smith, CE. (1998) The use of quality and reputation indicators by consumers: the case of Bordeaux wine", Journal of Consumer Policy, 20, 289-323.

Long, M.M., and L.G. Schiffman (1997). Swatch Fever: An Allegory for Understanding the Paradox of Collecting. *Psychology and Marketing*, 14(5), 495-509.

Masset, P. and C. Henderson (2010). Wine as an Alternative Asset Class, *Journal of Wine Economics*, 5(1), 87-118.

Masset, P., C. Henderson, and J.P. Weisskopf (2010). Wine as an alternative asset class, *Working paper.*

Masset, P., and J.P. Weisskopf (2010). Raise your glass: wine investment and the financial crisis. American Association of Wine Economists, *AAWE Working Paper* No. 57.

Masset, P., and J.P. Weisskopf (2011). Raise your glass: wine investment and the financial crisis. *Conference VDQS-EuAWE*, Angers,

Masset, P., Weisskopf, J.P. and V. Deboccard (2012). A Study of the Evolution of High-End Wines in Switzerland (June 29, 2012). Available at SSRN: http://ssrn.com/abstract=2096164 or http://dx.doi.org/10.2139/ssrn.2096164.

Mougeot, N. and C. Pérignon (2000). How Do Illiquid Assets Improve Portfolio Performance? The Case of Bordeaux Wine, *Document de travail* HEC, Université de Lausanne.

Oczkowoski, E. (2001) Hedonic wine price function and measurement error, Economic Record, 239, 374-382.

Pearman, W.A., Schnabel, J., and A.K. Tomeh (1983). Rationalization and Antique Collecting. *Free Inquiry in Creative Sociology*, 11(1), 55-58.

Sanning, L.W., Shaffer, S., and J.M. Sharratt (2007). Alternative Investments: The Case of Wine. American Association of Wine Economists, *Working Paper*. 11.

Sanning, L.W., S. Shaffer and J.M. Sharratt (2008). Bordeaux wine as a Financial Investment, *Journal of Wine Economics* 3, 51-71.

Sokolin, W. (1998). *The Complete Wine Investor*. Collecting Wine for Pleasure and Profit. Rocklin, CA: Prima.

Stoler, M.A. (1984). The Economics of Collectibles Goods. *Journal of Cultural Economics*, 8:1, 91-104.

US DOTT, 2011. 'Daily treasury yield curve rates.' US Department of the Treasury, July 2011. http://www.treasury.gov/resource-center/data-chart-

Wood, D. and K. Anderson (2003). What Determines the Future Value on an Icon Wine? New Evidence from Australia. *Conference VDQS*.

Wood, D. and K. Anderson (2006). What Determines the Future Value on an Icon Wine? New Evidence from Australia. *Journal of Wine Economics*, 2, 125-140.
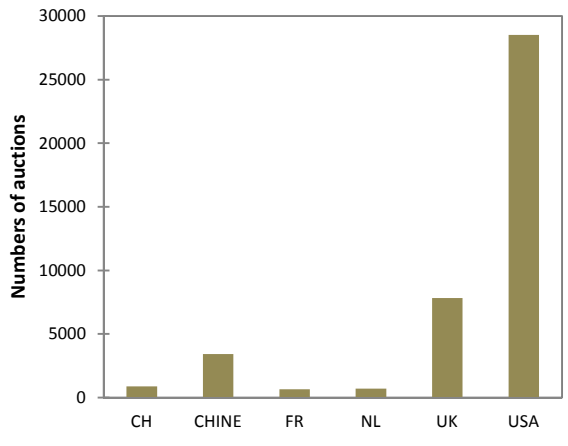
Annex 1: Descriptive statistic on the final sample (vintages: 1945, 1949, 1959, 1961, 1982, 1986, 1989, 1990, 1995, 1996, and 2000)
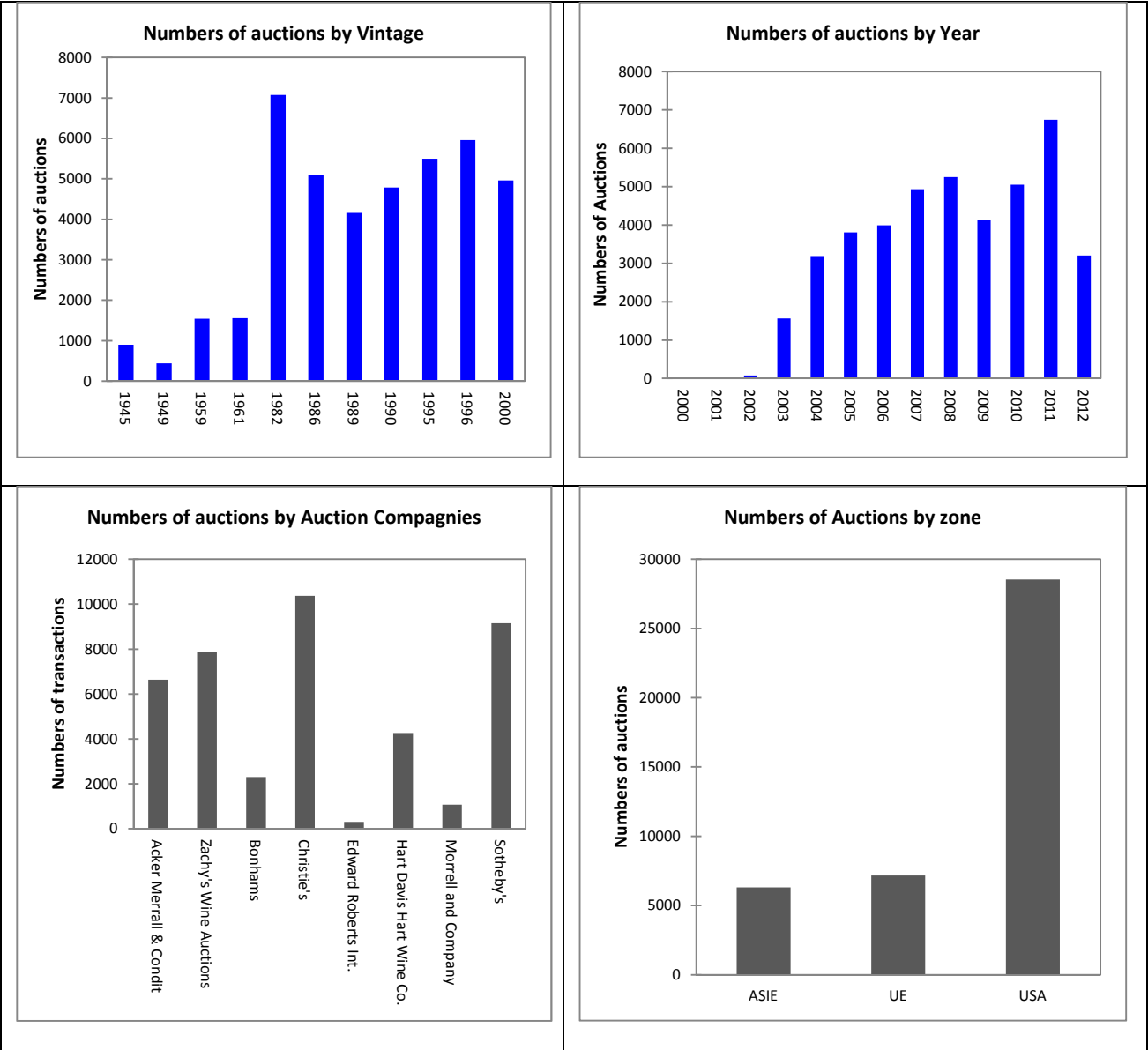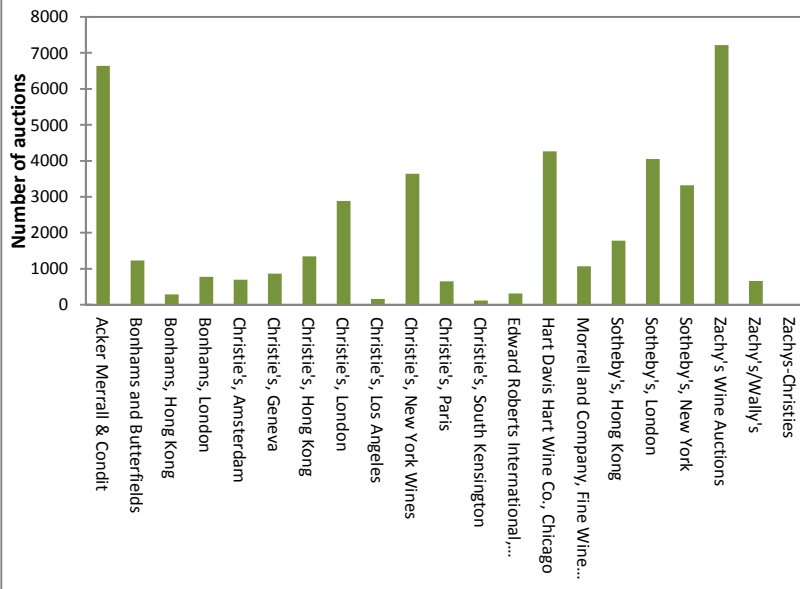
Numbers of auctions by places
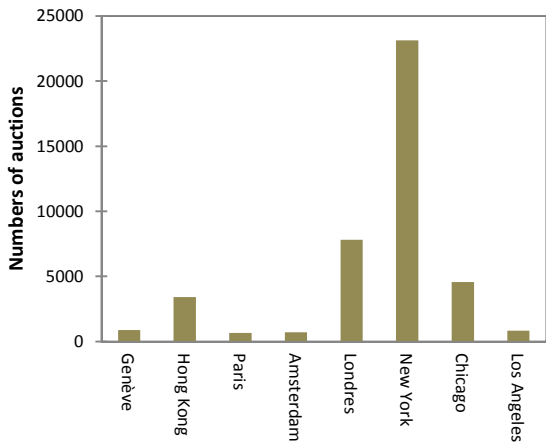
Number of auction by countries

Numbers of auction by auction Houses

Numbers of auctions by Château

HB 6657
LR 10008
LT 7523
MG 7694
MR 10104