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## Fair re-valuation of wine as an investment

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# Fair re-valuation of wine as an investment

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# Fair re-valuation of wine as an investment

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## Abstract

The prices of wine is a key topic for market participants interested in valuing their stock, including dealers, restaurants or consumers who may be interested in optimizing their purchases. As a closely related issue, re-valuation is the need to regularly update the value of a stock. This need is especially met by fund managers in the growing industry of wine as an investment. In this case, fair-value measurement is compulsory by law. We briefly review methods available to funds and introduce a new quantitative method aimed at meeting IFRS 13 compliance for fair valuation. Using auction data, we apply our method to compute current fair value of a basket of wines.

*Keywords:* IFRS13, hedonic regression, repeated sales, wine investment

*JEL classification:* **C14, C43, M40, G12**

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# 1 Introduction

Although consumers generally hold bottles of wine in view of drinking it, some hold it also for the investment it may represent. Recent literature has highlighted the direct benefits of wine investment and the positive diversification effects wine can offer to a portfolio of standard assets (see Sanning et al., 2008 or Fogarty, 2010). Indeed, wine shares many characteristics with other agricultural goods considered as investments, not least an active auction market that offers transparency and liquidity to market participants. Wine funds in particular have industrialized the art of speculating in wine, offering the possibility to actively invest in this alternative asset.

Measuring performance of wine investment funds is needed to properly compute performance fees of managers, assess fair value of a share in the fund, and, more generally, provide accurate reporting to all stakeholders involved. Traditional valuation of physical assets by independent appraisers is slowly rendered obsolete by increasing access to data and automation capabilities. Furthermore, the growing level of stocks held by wine funds makes a regular “manual” valuation if not impossible, at least very difficult to achieve. As a consequence, the adoption of IFRS 13 (effective since January 2013) by regulated wine funds requires significant changes to traditional procedures for determining fair value. To the contrary of stocks and bonds, a wine bottle does not yield any coupon or dividend, and unlike other conspicuous assets such as art that perpetually yield aesthetic dividends (Baumol, 1986), wine cannot be consumed without destroying its value. For the same reason, cash-flows cannot be obtained from renting, or leasing bottles of wine, so that any type of net-present-value valuation cannot be applied. This research addresses the question of valuation of wine in the context of wine funds valued in going-concern and that are subject to IAS-IFRS regulation. We first review the existing literature on quantitative methods for wine valuation and application of IAS-IFRS in the wine industry.

Valuation of wine generally relates to the application of hedonic regression. Hedonic regression was popularized by Rosen (1974) who suggested that consumers pay a marginal price for each characteristic of a given good with the sum of these implicit prices consisting in the observed market price. Golan and Shalit (1993) applied hedonic regression to assess impact of characteristics of Israeli wines on prices. They created a pricing system based on grape variety. Oczkowski (1994) focused on Australian wines and included new variables, such as vintage and region. Nerlove (1995) rather regresses quantity sold on price and quality attributes, since supply of varieties may not be exogeneously determined. Using data on Bordeaux wines, Combris et al. (2003) included in the hedonic regression not only the information appearing on the label of the bottle, but also the sensory characteristics of the wine. They showed that the market price is mainly determined by objective characteristics. Yoo et al. (2011) use hedonic regression

to price wines supplied in British Columbia.

Priilaid and van Rensburgh (2012) identify four categories of explanatory variables: objective (such as vintage or geographical location), sensory (for instance taste, bouquet), climatic and chemical wine characteristics (concentration in sugar and alcohol). They use a hedonic regression methodology to assess consumer prices in the South African market.

The question of IAS-IFRS compliance in agricultural markets is discussed by Marsh and Fischer (2013). The authors mention that wine, as a processed product, is typically excluded from IAS 41 for agriculture. Azevedo (2007) precisely focuses on the impact of IAS 41 in the viticulture industry. The author highlights that fair value can be determined based on the price of active market when it exists but in the case of the wine-growing industry, this exercise is rendered difficult by heterogeneity of wines accross regions. The author suggests valuing an agricultural stock of wines by expressing it in litres of wine. Bohusova et al. (2013) review possibilites for SMEs active in the wine growing industry to properly implement provisions in an IFRS framework for wines as biological assets.

The remainder of the paper is organized as follows. Section 2 presents the current environment and methods presently used by some wine funds. Section 3 introduces a new methodology to estimate returns of a fund using either the hedonic or repeated-sales approach. We then illustrate the method using 100 different types of bottles between January and September 2012. The last section concludes.

## 2 Current environment

Since 2005, compliance with IAS-IFRS is compulsory for all investment vehicles quoted on European stock exchanges, including wine funds. Furthermore, the recent European directive 2011/61/EU on Alternative Investment Fund Managers (AIFM) highlights a growing interest by supranational bodies to improve transparency in the market of alternative strategies, including funds that used to be less regulated. “IFRS 13 Fair Value Measurement” has become effective in January 2013. In this framework, fair-value is defined as “*the price that would be received to sell an asset or paid to transfer a liability in an orderly transaction between market participants at the measurement date*”. For non-financial assets, the selected valuation method must be appropriate for the measurement consistent with their “highest and best use”. While this notion makes sense for physical assets such as real estate or machinery (that can be rented or exploited), the “highest and best use” of a stock held by a wine fund is limited to store it in a well-tempered cellar or wine-refridgerator. As a consequence, the fair-value of a wine stock must necesseraly rely on [IFRS 13:24]: it should correspond to a transaction taking place in the principal market for

the asset or liability or, in the absence of a principal market, in the most advantageous market for the asset or liability. Since there is no centralized, or principal, market for wine, the most advantageous market is defined as the one that maximizes the amount that would be received to sell the asset after taking into account transaction costs and transport costs ([IFRS 13:A1]).

Wine funds currently implement various methods to value their stocks. Table 1 presents some funds of wine as an investment and which valuation they use, if published. None of the funds appears to use a historical cost approach, where inventories are valued at acquisition price. On the contrary, several funds already rely on a market approach to value their stocks, even

Table 1: List of wine investment funds.

Name	Location	Valuation
The wine investment fund	Bermuda	Liv-ex system
Nobles Crus	Luxemburg	Average of dealers and auction prices
The vintage wine fund	Cayman Islands	Auction data and independent valuation
Wine Growth Fund	Luxemburg	Unknown
Lunzer Wine Fund	British Virgin Islands	Liv-ex system and independent valuation
Curzon Cap Fine Wine Geared Growth Fund	Guernsey	Unknown
SPL Fine Wine NR2 IC Ltd	Guernsey	Unknown
Patrimoine Grands Crus	France	Liv-ex system

though IFRS 13 compliance is not obvious in that case. Interestingly, some funds seem to use the “Liv-ex” valuation methodology promoted by the Liv-ex, an internet and telephone transaction platform for wine professionals. The company brands itself “industry standard” and “the official valuer for a number of leading wine funds”.

The Liv-ex platform is organized in a similar fashion as a stock exchange: bids and/or offers are put on the platform by professionals. In case of a trade happening, both counterparties are notified of the transaction. The seller then delivers within 14 days the wine to the Liv-ex warehouse that is verified by Liv-ex. Simultaneously, the buyer sends the funds to Liv-ex that transfers the money to the seller within three weeks, whereas the buyer can either collect the wine at the warehouse, or be delivered.

The Liv-ex exploits available information on its platform to produce valuations of wines. The valuation method is the following: upon submission of a list of wines to be valued, the exchange verifies the current best offer for each wine in its own system and at other dealers. The valuer then observes the best bid on the platform and looks at the most recent transaction (within the last 30 days). If it lies within the bid-offer spread, then this transaction is used for valuation, otherwise, the mid-price is computed as the average between the bid and the offer. The scenario becomes more complex when no offer is available. In this case, Liv-ex relies on an undisclosed list of offer prices by merchants “identified as the major stockholders of wine”. In case no offer was available in the last 30 days neither at a dealer or on the Liv-ex, then the valuation

is performed by a “valuation committee” that uses “off-market bids and offers, historical list prices and transaction data”. In case no bid is available, the bid is estimated from the average spreads to “orphan offers”, defined as “an offer price where [Liv-ex has] no corresponding bid. Orphans can be both live exchange offers or merchant list prices”. Surprisingly, the Liv-ex does not include auction prices in calculation “due to a lack of standardization of auction lots” that can make weekly prices “very volatile with large swings” and also because “auction commissions can vary”.

Despite being an interesting approach, the method fails to meet requirements for fair-value computation of wine as a financial asset, especially in the IFRS 13 sense. First, despite being a very successful venture with 400 members and more than 1000 transactions per month, there is little evidence that Liv-ex is the most advantageous market to sell any type of wine that could be held by a fund. According to Liv-ex, in 2010, Bordeaux wines accounted for 95% of its exchanges, with five Premiers Crus standing for 61% of Liv-ex trades by value: Château Lafite-Rothschild (Pauillac), Château Latour (Pauillac), Château Margaux (Margaux), Château Haut-Brion (Pessac, Graves), Château Mouton-Rothschild (Pauillac).

In 2011, more than GBP100m worth of wine were exchanged on the Liv-ex platform, which is a considerable amount in absolute value but indeniably smaller than the yearly USD397m+ worth of transactions reached the same year at major auction houses Acker Merrall and Condit, Christies International, Sothebys, Zachys and Hart Davis Hart Wine Co. In some cases, favouring ask prices of dealers to estimate a bid price instead of favouring auction house transactions publicly available seems an unreasonable choice given the opacity of dealer prices and the relative importance of large auction houses in the secondary market for wine (auctions would account for roughly 10% of the market according to Liv-ex), especially as far as old vintages and collectible wines are concerned.

As stated by Jones and Storchmann (2001), wines are “*traded all over the world in established wine auctions. The system guarantees, similar to a stock market, a comparatively high price transparency. Therefore, it can be assumed that auction prices indicate the relative (economic) scarcity and therefore the international esteem for those wines*”. Second, unlike auctions, the Liv-ex is based on standard contracts that assume similar quality for wines presenting similar features. This approach, well suited to recent vintages, prevents investors from gaining complementary information about condition of older wines. In the case of auctions, on the other hand, Ashenfelter (1989) highlights that at wine auction, “*revealing information tends to remove uncertainty and make low bidders more aggressive; this puts upward pressure on the bidding of others, which is in the interest of the auctioneer*”. Similarly, Muth et al. (2008) showed that in the market for fed cattle, auction barn prices are higher than equivalent forward prices. Pagano

and Roell (1996) proved that “the implicit bid-ask spread in a transparent auction is tighter than in a less transparent dealer market”. For the art market, Bocart and Oosterlinck (2011) showed that large auction houses act as agents mitigating authenticity issues.

Finally, one can reasonably question the independence of an exchange excluding its competitors (auction houses) but including data from its clients or prospects (dealers). The inclusion of a valuation committee in case of absence of data lets stakeholders clueless about the methodology and data eventually used to perform valuation. In any case, the conflict of interest is obvious between an exchange that simultaneously acts as intermediary and expert and a fund whose fee, like the exchange, depends on the price level.

### 3 New approach to valuation of wine as an investment

IFRS 13 provides three degrees of hierarchy in inputs that can be used for fair value measurement. The idea behind the hierarchy is that lower levels should be preferred: Level 1 inputs are “quoted prices in active markets for identical assets or liabilities that the entity can access at the measurement date. [IFRS 13:76]”. Level 2 inputs “are derived mainly from or corroborated by observable market data by correlation or other means (‘market-corroborated inputs’) [IFRS 13:81]”. Level 3 inputs are unobservable inputs used “*with the best information available in the circumstances, which might include the entity’s own data, taking into account all information about market participant assumptions that is reasonably available*” [IFRS 13:87-89].

In the case of wine, Level 1 inputs are not readily available, especially considering the fact that available exchanges (Hong-Kong Wine Exchange, BWinex in the Bordeaux region, Vinetrade in Japan, BBX and Liv-ex in the U.K. to name but a few) are highly specialized and do not represent the market with the greatest volume and level of activity for the asset or liability. Level 2 inputs, on the other hand, are accessible to wine funds since, first, they observe their own transactions, and second, they observe prices reached at auction and also on electronic platforms. Level 3 inputs are also of significant importance for wine funds since it concerns their intrinsic qualities to generate profit. Indeed, their strategies often involve acquisition and selling tactics that best exploits their positioning in the market since they can benefit from significant economies of scale. Furthermore, they can act as liquidity providers and rip a liquidity premium. They can best adjust their movements in a market prone to dysfunctionalities, as mentioned by Ashenfelter (1989): “*at the first wine auction I ever attended, I saw the repeal of the law of one price*”, referring to the declining price anomaly in wine auctions provoked by non-optimal absentee bidders (see Ginsburgh, 1998). Naturally, funds’ strategies differ from each other. Some specifically focus on heavily traded Bordeaux wines and try to track the overall price



levels, whereas others play in niche markets of collectibles. They trade intensively in the OTC (Over The Counter) market for restaurants, dealers and collectors, whose volume of transactions was estimated to be close to USD 4 billion in 2011. Our approach to fair-valuation of a wine fund combines level 2 and level 3 inputs.

Level 2 inputs consist of observed transactions, both made by the fund itself and observable prices reached at auction, buyer's premium included, for identical wines. The auction market can be considered as the most advantageous market since it is open to all and applies an English auction system, known to be the one that maximizes seller revenues amongst auction mechanisms (see Lopomo 1998). As a consequence, Level 3 inputs should consist of a function that marries the fair-value of a wine  $i$  with its expected price  $p$  at auction at time  $t$  ( $p_{it}$ ). Formally,  $w_{it} = E(p_{it})$ , that is, the fair-value  $w$  of wine  $i$  at time  $t$  should be the expected price at auction of the same wine  $i$  at time  $t$ . If for a wine an identical peer is observed simultaneously at auction, the fair value should simply be  $w_{it} = p_{it}$ . However, if no such price is observed,  $E(p_{it})$  needs to be estimated:

$$w_{it} = E(p_{it}) = v_{it_i} \exp(r_{t_i,t} + \delta) \quad (1)$$

where  $v_{it_i}$  is the acquisition price of wine  $i$  at time  $t_i$ , which is the last time a transaction was made by the fund on wine  $i$ , and  $r_{t_i,t}$  is the log-return of prices between time  $t_i$  and  $t$ . The term  $\delta$  is the spread between auction prices and transaction prices, which can be estimated by using, for instance, the mean or the median of  $\log(v_{i,t} - p_{i,t})$  for those wines for which both auction and transaction prices are available at the same time.

Estimation of returns is generally tackled by two approaches: repeated-sales-regression and hedonic regression. In repeated-sales-regression (Bailey et al., 1963), only pairs of sales of identical wines are taken into consideration to compute their returns. A single trend in price is then obtained by averaging these returns. Formally,

$$r_{ist} := \log(v_{it}) - \log(v_{is}) \quad (2)$$

$$= \sum_{\tau=s}^t \beta_{\tau} X_{i\tau} + \varepsilon_i, \quad (3)$$

for  $i = 1, \dots, N$ , where  $r_{ist}$  is the log-return of wine  $i$  with an observed transaction at time  $s$  and another at time  $t$  with  $s < t$ ,  $\beta_t$  is the marginal impact of time  $t$  and  $X_{it}$  is a dummy variable that takes the value  $-1$  if the transaction was observed at time  $s$ ,  $+1$  if the transaction was observed at time  $t$ , and  $0$  otherwise. Finally,  $\varepsilon_i$  is an error term. This model can be estimated

by OLS. Then, the estimated return to be used in equation (1) is given by

$$r_{t_i,t} = \hat{\beta}_t - \hat{\beta}_{t_i} \quad (4)$$

An important concern with repeated-sales-regression is the fact that observations that don't fall in pairs are wasted (Chanel et al., 1996). In the case of wines, this could concern, for instance, exceptionally rare bottles or rare productions. As an alternative, in hedonic regression, all wines are regressed on their intrinsic characteristics in order to obtain the residual marginal impact of time on prices. Since not all wines are traded at all times at auction and/or in the fund, we suggest the following semi-log hedonic approach based on internal transaction  $v$  on wine  $i$  at time  $t$ :

$$\log(v_{it}) = \alpha_0 + \sum_{k=1}^K \alpha_k X_{ik} + \beta_t + \nu_i, \quad (5)$$

where  $\alpha_0$  is an intercept,  $X_{ik}$  is the  $k$ th characteristic of wine  $i$  (such as vintage, region, château, etc.), of which there are  $K$ . The term  $\beta_t$  is the marginal impact of time on prices which is the same across wines. We suppose that  $\beta_t$  is an unknown smooth function of time which for identification is restricted to have a mean of zero. Finally,  $\nu_i$  is a Gaussian error term with mean zero.

The model can be estimated similar to Bocart and Hafner (2011). At a first stage, estimate

$$\log(v_{it}) = \alpha_0 + \sum_{k=1}^K \alpha_k X_{i,k} + \eta_{it} \quad (6)$$

by OLS, where  $\eta_{it} = \beta_t + \nu_i$  is a mean zero error term. At a second stage, estimate  $\beta_t$  by a Nadaraya-Watson estimator,

$$\hat{\beta}_t = \frac{\sum_{i=1}^N K\left(\frac{t-t_i}{h}\right) \eta_{i,t}}{\sum_{i=1}^N K\left(\frac{t-t_i}{h}\right)}, \quad (7)$$

where  $K$  is a kernel function such as the Gaussian kernel, and  $h$  is a bandwidth that can be selected using, for instance, a plug-in bandwidth selection (Gasser et al., 1991).

This approach has several important advantages: First, it reconciles transaction levels of funds with verifiable market inputs of auction prices. As a consequence, the approach penalizes funds that overpay wine, hence overestimate their stock using a historical cost approach. On the other hand, it properly reflects fair value of funds that can benefit from economies of scales, ensuring, for example, that redemptions be made at a fair level. Second, it allows fair valuation of the stock at all times, given the fact that  $\beta_t$  is continuous, so that even rarely traded wines or collectible editions can be tracked through time. Finally, since the error term is centered on

zero, the overall revaluation of the fund is expected to be asymptotically correct.

## 4 Empirical results

We create a virtual stock made of 206 transactions in 110 different types of wines from Bourgogne, Rhône and Bordeaux. Transaction prices are either prices observed at auction, at Sotheby's Hong-Kong, Christie's London and Acker Merrall Hong-Kong or on online websites such as La Place des Vins and Laithwaite's, between January and September 2012. All prices are translated in euros using the daily exchange rate. The portfolio is revalued in September 2012. Out of the 110 types of wines, 35 have matching transactions at public auction (in the auction houses mentioned above) in September 2012 that can relate to 53 transactions out of the 206. We compare revaluation using returns estimated with a hedonic approach, regression approach and revaluation using historical cost. Valuations for these 53 transactions are presented in Table 2.

The hedonic regression is made using 51 explanatory variables and 8 time dummies. The 51 explanatory variables are split into 5 categories: region, name of the wine, format (magnum or bottle), producer and vintage. Results from the regression are available in Table 3. The estimated  $\delta$  (relative spread) between transactions and observed auction prices is of -0.402. The estimate was obtained using the median of the differences between the logged auction prices and the logged transaction prices.

For the repeated-sales-regression, we use 27 pairs available in our sample. Results for the regression are presented in Table 4.  $\delta$  in the case of the returns estimated with RSR is of -0.581, lower than the hedonic approach, meaning that, at least in our exemple, RSR initially overestimated the returns as compared to hedonic. There is, however, no reason to believe that this will always be the case. The largely negative  $\delta$  in our exemple is mainly due to the fact that prices used to construct our exemple are mostly ask prices from online dealers. To the contrary, an actual fund is expected to encounter a positive  $\delta$ , which would mean that its structure allows it to buy at interesting levels. If it is not the case, then it would mean that its strategy is sub-optimal as compared to simply acquiring wine at auction houses. Table 5 presents results for the overall valuations: the historical cost method yields a total valuation of 508,849 euros, which stand for the money spent in all for the stock. By comparison, the hedonic-based revaluation yields a value of 417,670 euros, against 454,406 euros for the revaluation using RSR. When focusing only on the 53 bottles that have a true observation at auction, 176,859 euros were spent on them (historical cost), but they would be revalued at only 145,827 euros in September 2012 at auction. By comparison, the hedonic method yields a valuation of 145,297

Table 2: Results from revaluation for 53 transactions (out of 206)

Name	Date of acquisition	Auction	Hedonic	RSR	Historical cost
montrachet 2007 (bt)	10/01/2012	3,200	2,910	6,899	2,990
la tache 2003 (bt)	16/02/2012	1,650	2,496	3,964	2,616
montrachet 2005 (bt)	01/03/2012	3,775	3,496	4,848	3,738
montrachet 2008 (bt)	08/03/2012	2,700	3,636	5,042	3,887
montrachet 2000 (bt)	13/03/2012	3,350	3,496	4,848	3,738
montrachet 2004 (bt)	15/03/2012	3,025	3,496	4,848	3,738
montrachet 2001 (bt)	16/03/2012	3,600	3,496	4,848	3,738
montrachet 2007 (bt)	19/03/2012	3,200	3,706	5,139	3,962
la tache 2003 (magnum)	02/04/2012	4,000	4,524	6,163	4,934
echezeaux 2005 (bt)	11/04/2012	678	685	934	748
montrachet 2005 (bt)	14/04/2012	3,775	4,524	6,163	4,934
vosne-romanee 1 cru 2008 (bt)	15/04/2012	450	318	434	347
richebourg 2007 (bt)	16/04/2012	551	685	934	748
romanee st. vivant 2007 (bt)	19/04/2012	465	685	934	748
romanee st. vivant 2005 (bt)	21/04/2012	1,063	1,371	1,868	1,495
la tache 2005 (bt)	22/04/2012	3,300	3,427	4,669	3,738
haut-brion 2000 (bt)	05/05/2012	765	807	835	897
latour 2000 (bt)	11/05/2012	1,250	1,344	1,392	1,495
montrachet 2003 (bt)	22/05/2012	3,525	3,361	3,481	3,738
romanee-conti 2007 (bt)	01/06/2012	7,550	8,798	8,505	10,465
mouton-rothschild 2000 (bt)	02/06/2012	1,275	974	942	1,159
romanee-conti 2001 (bt)	08/06/2012	7,900	8,798	8,505	10,465
lafite-rothschild 2000 (bt)	10/06/2012	2,425	2,388	2,308	2,841
haut-brion 2000 (bt)	11/06/2012	765	786	759	934
montrachet 2008 (bt)	13/06/2012	2,700	3,394	3,280	4,037
montrachet 2007 (bt)	15/06/2012	3,200	3,394	3,280	4,037
romanee-conti 2008 (bt)	15/06/2012	8,850	8,798	8,505	10,465
margaux 2000 (bt)	16/06/2012	970	1,100	1,063	1,308
latour 2000 (bt)	19/06/2012	1,250	1,257	1,215	1,495
romanee-conti 2007 (bt)	19/06/2012	7,550	8,798	8,505	10,465
ausone 2000 (bt)	21/06/2012	1,625	1,885	1,822	2,243
la tache 2009 (magnum)	23/07/2012	7,400	7,221	7,521	9,269
ausone 2000 (bt)	25/07/2012	1,625	1,281	1,334	1,645
mouton-rothschild 2000 (bt)	03/08/2012	1,275	1,025	928	1,420
lafite-rothschild 2000 (bt)	08/08/2012	2,425	2,266	2,052	3,140
haut-brion 2000 (bt)	10/08/2012	765	745	674	1,032
romanee-conti 2007 (bt)	11/08/2012	7,550	7,555	6,841	10,465
chambertin clos de bze 2009 (bt)	14/08/2012	970	1,079	977	1,495
romanee-conti 2002 (bt)	15/08/2012	9,200	7,555	6,841	10,465
latour 2000 (bt)	18/08/2012	1,250	944	855	1,308
lafite-rothschild 2000 (bt)	22/08/2012	2,425	1,856	1,681	2,571
chambertin clos de bze 2008 (bt)	25/08/2012	970	513	464	710
montrachet 2008 (bt)	25/08/2012	2,700	2,698	2,443	3,738
chambertin 2008 (bt)	28/08/2012	1,170	513	464	710
latour 2000 (bt)	03/09/2012	1,250	850	710	1,271
chambertin clos de bze 2006 (bt)	12/09/2012	970	400	334	598
romanee-conti 2008 (bt)	12/09/2012	8,850	6,501	5,432	9,718
chambertin clos de bze 2005 (bt)	14/09/2012	970	1,000	836	1,495
chambertin 2005 (bt)	23/09/2012	1,170	1,000	836	1,495
chambertin 2006 (bt)	24/09/2012	1,170	425	355	635
ruchottes-chambertin 2006 (bt)	26/09/2012	370	200	167	299
chambertin clos de bze 2009 (bt)	28/09/2012	970	833	696	1,246

Table 3: Variables in the hedonic regression and their coefficients

Variable	Estimate	s.d	T-test	p-value	
(Intercept)	7.48	0.2	32.1	1.04E-67	***
(region)bourgogne	-1.16	0.3	-3.4	8.83E-04	***
(region)rhone	-1.59	0.3	-5.8	3.81E-08	***
(name)bonnes mares	0.21	0.3	0.7	4.86E-01	
(name)carruades de lafite	-1.56	0.2	-8.4	3.78E-14	***
(name)chambertin	0.37	0.3	1.2	2.16E-01	
(name)chambertin clos de bze	0.29	0.3	1	3.37E-01	
(name)chambolle les amoureuses	0.49	0.3	1.7	9.82E-02	.
(name)charmes-chambertin	-1.08	0.4	-2.6	1.01E-02	*
(name)cheval blanc	-0.58	0.2	-2.4	1.70E-02	*
(name)clos de la roche	-1.08	0.4	-2.6	1.01E-02	*
(name)corton-charlemagne	0.14	0.3	0.5	6.09E-01	
(name)echezeaux	0.66	0.2	2.8	6.66E-03	**
(name)gevrey 1er cru clos st jacques	-0.59	0.3	-1.8	7.21E-02	.
(name)griotte-chambertin	0.16	0.3	0.5	6.24E-01	
(name)haut-brion	-0.5	0.2	-3	3.52E-03	**
(name)hermitage blanc	-0.53	0.3	-1.6	1.23E-01	
(name)loville las cases	-1.88	0.2	-7.8	1.33E-12	***
(name)la mission haut-brion	-0.9	0.2	-4.2	4.03E-05	***
(name)la mission haut-brion blanc	0.11	0.3	0.4	7.20E-01	
(name)la tache	1.94	0.2	8.5	2.14E-14	***
(name)lafite-rothschild	-0.05	0.1	-0.4	6.97E-01	
(name)latour	-0.14	0.1	-0.9	3.63E-01	
(name)le pin	0.87	0.2	4.2	5.49E-05	***
(name)les forts de latour	-1.6	0.2	-7.8	8.53E-13	***
(name)margaux	-0.47	0.2	-2.3	2.09E-02	*
(name)mazis-chambertin	-1.08	0.4	-2.6	1.01E-02	*
(name)montrachet	2.13	0.2	10	3.16E-18	***
(name)mouton-rothschild	-0.31	0.2	-1.3	1.90E-01	
(name)musigny	1.66	0.3	5.9	2.81E-08	***
(name)petrus	0.79	0.2	3.3	1.06E-03	**
(name)richebourg	1.17	0.3	4.5	1.25E-05	***
(name)roman-conti	3.22	0.2	13.1	2.36E-26	***
(name)roman st. vivant	1.03	0.2	4.3	3.68E-05	***
(name)ruchottes-chambertin	-0.61	0.4	-1.5	1.44E-01	
(producer)coche-dury	0.7	0.3	2.2	3.05E-02	
(producer)comte lafon	-1.67	0.3	-5	1.32E-06	
(producer)drc	-0.42	0.2	-2.6	1.08E-02	
(producer)faiveley	-0.28	0.3	-0.9	3.68E-01	
(producer)ponsot	0.88	0.4	2.4	1.73E-02	
(format)magnum	0.65	0.1	5	1.73E-06	
(vintage)2001	0.38	0.2	1.8	7.36E-02	
(vintage)2002	0.37	0.2	2.2	3.06E-02	
(vintage)2003	0.02	0.2	0.1	8.95E-01	
(vintage)2004	0.08	0.2	0.3	7.30E-01	
(vintage)2005	0.69	0.1	4.9	2.14E-06	
(vintage)2006	-0.18	0.2	-1.1	2.92E-01	
(vintage)2007	-0.03	0.2	-0.2	8.45E-01	
(vintage)2008	0.04	0.2	0.2	8.25E-01	
(vintage)2009	0.48	0.1	3.3	1.26E-03	
(vintage)2010	-0.06	0.1	-0.6	5.56E-01	
(vintage)2011	-0.74	0.1	-7.2	3.36E-11	
(month)beta2	-0.1	0.2	-0.4	6.74E-01	
(month)beta3	-0.21	0.2	-1.1	2.90E-01	
(month)beta4	-0.17	0.2	-0.9	3.63E-01	
(month)beta5	-0.06	0.2	-0.3	7.74E-01	
(month)beta6	0	0.2	0	9.94E-01	
(month)beta7	-0.06	0.2	-0.3	7.81E-01	
(month)beta8	-0.03	0.2	-0.2	8.79E-01	
(month)beta9	0.16	0.2	0.8	4.20E-01	

Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1

Residual standard error: 0.2794 on 145 degrees of freedom

Multiple R-squared: 0.9448, Adjusted R-squared: 0.9219

F-statistic: 41.34 on 60 and 145 DF, p-value: < 2.2e-16

Table 4: RSR

Variable	Estimate	s.d	T-test	p-value
beta1	- 0.21	0.07	- 2.89	9.68E-03
beta2	0.21	0.16	1.31	2.06E-01
beta3	0.37	0.26	1.38	1.84E-01
beta4	0.40	0.21	1.89	7.55E-02
beta5	0.70	0.24	2.90	9.58E-03
beta6	0.83	0.26	3.20	4.91E-03
beta7	0.83	0.29	2.89	9.76E-03
beta8	1.05	0.32	3.33	3.69E-03
beta9	1.21	0.36	3.36	3.46E-03

Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.1427 on 18 degrees of freedom

Multiple R-squared: 0.6639, Adjusted R-squared: 0.5145

F-statistic: 4.445 on 8 and 18 DF, p-value: 0.004109

Table 5: Valuation of stock

Stock	Method	Value, September 2012 (EUR)
53 bottles	Auction prices	145,827
53 bottles	Hedonic-based	145,297
53 bottles	RSR-based	159,376
53 bottles	Historical cost	176,859
206 bottles	Auction prices	unknown
206 bottles	Hedonic-based	417,670
206 bottles	RSR-based	454,406
206 bottles	Historical cost	508,849

euros for these 53 bottles, whereas the RSR-based method gives an estimate of 159,376 euros.

## 5 Conclusion

IFRS 13 compliant revaluation of wine as an investment is an important topic for fund managers, investors and fiscal authorities. Since the notion of “highest and best use” for non-financial assets is difficult to apply for bottles of wine, a fair valuation can only rely on a market approach. Unfortunately, wines are heterogeneous goods that are not traded continuously. Furthermore, they can be traded at different places: dealers, local exchanges and auction houses. Wine funds use independent valuation, auction and dealers based methodology, or the so-called “Liv-ex” method. We argue that none of these fully satisfy the stringent requirements of IFRS 13. They either fail to justify the origin of data (such as in the case of independent expertise), hence the type of input, or are calibrated on markets that are not principal or most advantageous (such as the Liv-ex). We suggest estimating returns of a wine portfolio by applying either hedonic or repeated sales approach. We advocate that data used to calibrate the model should be the fund’s own transactions corrected for a possible spread with data from auction houses, the latter being the biggest observable market for wine transaction, and the one that best fits the definition of “most advantageous market”. Our empirical results show similar performance between the hedonic and repeated-sales approach. A historical cost approach yields distorted results and fails to capture the market’s dynamics.

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