Raise your Glass:
Wine Investment and the Financial Crisis

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Abstract

This paper uses auction hammer prices over the period 1996-2009, with a special emphasis on periods of economic downturns, to examine risk, return and diversification benefits of fine wine. We show evidence that the wine market is heterogeneous with wine regions and price categories evolving differently. We construct wine indices for various wine regions and prices and find that wine yields higher returns and has a lower volatility compared to stocks especially in times of economic crises. Results from the CAPM show that alpha is significantly positive while showing a low beta coefficient. The use of a conditional CAPM model allows us to clarify the time-variance of alphas and betas depending on the economic environment. The time-varying dynamics of alphas and betas are best explained by the spread between BAA- and AAA-rated bonds and the USD/EUR exchange rate. Our findings confirm that wine returns are primarily related to economic conditions and not to the market risk. Forming portfolios for typical investors with different financial assets and various wine indices we confirm that the addition of wine to a portfolio is beneficial for private investors. Not only are returns favourably impacted and risk being minimised but skewness and kurtosis are also positively affected. Particularly, during the recent financial crisis these effects are most pronounced and improve portfolio diversification when it is most needed. Most importantly, balancing a portfolio with fine wine has resulted in added return while reducing volatility with the most prestigious and expensive vintages and estates outperforming the General Wine Index (GWI).

JEL Classification: C60, G11, Q11
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1 Introduction

Epicureans have found a sense of satisfaction in securing and consuming a good bottle of wine for a long time. The same emotions might overcome an investor looking at the performance and diversification benefits of the same bottle in a portfolio. Similar to many other alternative investments and here especially collectibles, the market for fine wine is widely promoted as being an interesting choice due to its interesting risk-return profile and relative stability during market downturns. The Wall Street Journal (2008) recently described how investors tend to turn to hard assets, such as champagne or wine, in times of economic crises as these are real products that will not disappear. In 2008, in the midst of the financial crisis, the Financial Times (2008) designated the market for fine wine as "a haven for investors in difficult times" for which demand is very well alive and will continue to be in the future. As a consequence, wine can not only be viewed as a pure consumer good anymore but also as an interesting investment opportunity by many an investor.

As a result, a small but steadily growing investment market for fine wines has established itself. Auction houses have expanded their presence to new geographical regions outside Europe and the United States to reach new customers, especially in Asia, and have simultaneously increased the number of wine auctions throughout the world. The increase in worldwide turnover from some 90 million USD in 2003 to more than 233 million USD in 2009 at major auction houses as noted by Winespectator provides a proof for the growing popularity of this market. At the same time wine-funds (e.g. Elite Advisers Wine Fund) and -indices (e.g. Liv-Ex in the U.K. or Idealwine in France) have emerged to cater for this new demand from investors. The resulting improvement in transparency and liquidity has rendered this market even more attractive for investors.

In this paper we look at the characteristics of fine wine as an asset class over the period 1996-2009. We start by constructing different wine indices for various wine regions and price categories that allows us to build a complete picture of the market for fine wines. We then describe potential difficulties and costs investors might face when investing in the market. In a further step the investor will want to know what drives wine returns. We, therefore, use a conditional CAPM framework to assess the dynamics of wine returns in relation to economic determinants to gain a better understanding of factors influencing the market. Finally, investors will very rarely consider investing their wealth in a single asset class but will diversify. Therefore, we construct portfolios containing different asset classes that represent the risk attitude of typical investors. This allows us to gauge to what extent investing in wine may be of interest in general

and more specifically if risk aversion has an impact on an investor's choice when adding wine to their portfolio.

In a nutshell, our findings show that the inclusion of wine in a portfolio and, especially more prestigious wines, increases the portfolio's returns while reducing its risk, particularly during the financial crisis. This is true for all model-portfolios both during bull and bear periods; during crisis-periods the defensive impact of wine is more pronounced in aggressive style portfolios than in conservative ones. The defensive nature of wine is confirmed by a less negative skewness and a kurtosis approaching three. Using the classic CAPM we observe high alphas except during the crisis and low betas. The use of a conditional CAPM model allows us to clarify the time-variance of alphas and betas depending on the economic environment that does not seem to be captured by the traditional CAPM. Especially, the BAA-AAA spread and the USD/EUR exchange rate explain the time-varying dynamics of alphas and betas. Our findings confirm the cyclical nature of wine with returns primarily related to economic conditions and not to market risks.

This paper contributes to our understanding of the wine market as an asset class in several ways. First, it constitutes the most recent, most complete and largest dataset on the wine market spanning the 15 years from 1996 to 2009. It, therefore, allows us to provide wine indices not only for one region, like Bordeaux or Australia, as in most previous studies, but for different price categories and wine growing regions across the world. This enables us to analyse market segmentation in depth, to overcome a lack of global classification of fine wines and to give the fullest possible picture of the wine market. Second, this study is the first to investigate the dynamics of wine returns by incorporating effects of prevailing economic conditions. The use of a conditional CAPM framework for this has the advantage of keeping a standard financial framework that is easy to interpret while controlling for economic variables that might affect the wine market and are not captured by the traditional CAPM. Third, it extends existing evidence on risk-, return- and diversification-benefits of wine in a portfolio to both economic downturns and upturns. The possible robustness of wine to financial contagion delivers important insights into the stability of portfolio diversification across economic cycles.

The remainder of this paper is structured as follows: Section 2 gives a brief overview of the market for fine wine and a literature review. Section 3 describes the data and methodology employed in the present analysis. Section 4 shows main results on conditional portfolio evaluation and diversification while the paper ends with conclusions in section 5.

2 Literature

In response to the growing interest in wine as an asset class from investors academic research has been conducted on financial characteristics of the wine market. As early as 1979, Krasker (1979) analyses returns on wine investments but does not find evidence that wine can outperform a riskless asset. In a response to this paper, Jaeger (1981) argues that Krasker's use of rather a low number of observations and a short period (coinciding with the oil crisis in the 1970) may bias his results. Indeed in using Krasker's methodology and extending the period into the 1960s Jaeger comes up with much more favourable research results. Later studies expand the research framework to incorporate risk and conclude that wines, like other collectibles, have a higher volatility (Burton and Jacobsen (1999)) and are cyclical (Di Vittorio and Ginsburgh (1996), Bentzen et al. (2002), Fogarty (2006)). Burton and Jacobsen (2001) using a repeat-sale-regression show evidence that the heterogeneity of the wine market must be taken into account. Even inside the examined Bordeaux region, vintage can widely influence returns on wine investments. Although wine generates positive investment returns throughout the analysed period, only the 1982 vintage outperforms the Dow Jones Industrial Average. More recently, Fogarty (2006) in a study of premium Australian wines in the 1990s finds similar returns but a lower volatility of wines as compared to Australian equities. However, contrary to Burton and Jacobsen (2001) who find a worse performance for first growths Bordeaux wines than for their aggregate index more expensive wines seem to achieve larger returns and have a lower volatility in Australia.

If fine wines are to be considered as an asset class on its own the risk-return-framework used in the above studies needs to be extended. Potential diversification benefits from a collection of wines in an investor's portfolio and the possibility of a portfolio risk reduction through low correlations between wine and financial assets must be taken into account. Fogarty (2007) shows that the addition of wine to a portfolio consisting of stocks and bonds shifts the efficient frontier to the left which means a better risk-return trade-off for an investor once wine is included in the portfolio. Sanning et al. (2008) use the Capital Asset Pricing Model and the Fama-French three factors model to assess the benefits of wine with regard to portfolio diversification. They find evidence of excess returns for wines and suggest a low correlation of wine with financial markets and the Fama-French risk factors. Masset and Henderson (2009) confirm previous findings of a high return and low variance of wine assets and expand the focus by taking portfolio skewness and kurtosis into account. They find a low correlation between wine and other assets and suggest that best-rated wines offer the best portfolio return, volatility, skewness, kurtosis trade-off in the long-run for most investors.

3 Data and methodology

3.1 Data source and description

The data for the study is taken from The Chicago Wine Company (TCWC) and covers all auction hammer prices between January 1996 and March 2009. As early as 1977 TCWC has been (with Heublein) a pioneer in wine auctions and has since then established itself as a major US player. It nowadays conducts auctions at least once a month.

The data is first sorted according to characteristics such as region, vintage, producer and scanned for any apparent errors. Whenever possible, errors in the dataset are corrected or otherwise removed, where the correct value could not be inferred with certainty. In a second step we discard wines that are not traded on a regular basis and which therefore do not provide comparable results. We, therefore, concentrate on wines that meet certain liquidity conditions by compiling data as follows:

Step1: We only use vintages from 1981 to 2005. This enables us to discard wines that are viewed as antiques and not as wine as such. Vintages after 2005 are not yet interesting as they appeared on the market in 2008 at the earliest and thus are not reliably priced.

Step2: We only consider wines from major regions. Wines originating from France (Bordeaux, Burgundy and Rhône Valley), Italy and the United States represent 90% of all trades in the sample and are therefore analysed. Other regions from the initial sample only make up a very small part at auctions and are traded infrequently.

Step3: Unconventional bottle sizes are removed. The analysis only focuses on bottles with 0.375, 0.75, 1.5, 3, 4.5 and 6 litres contents.

Step 4: We only take those wines into account that have traded at least once every twelve months. This ensures that long periods without trades in a wine are eliminated since they lead to erroneous price jumps.

Step 5: We calculate monthly wine prices by taking the median price of every transaction of a specific wine pair for a given month.

The final sample consists of more than 340'000 transactions from 144 auctions and a turnover exceeding 237 million USD. The size of the dataset covering 15 years and therefore much larger than earlier studies allows us to cover two significant economic boom phases (1996-2001 and 2003-2007) as well as two major economic and financial crises (2001-2003 and 2007-2009) and is therefore an ideal setting for our research.

3.2 Index Construction

Our empirical analysis of the wine market relies on a variety of indices. While equity and fixed-income indices are widely available, indices on fine wine are scarcer. We therefore construct our own indices using the repeat-sale regression (RSR) method on the collected auction prices. This technique uses purchase and sales prices of a specific asset with identical properties (in our case a specific wine-vintage pair) to estimate price appreciations. This approach is usually used to estimate returns on infrequently traded assets and has found extensive usage on the real-estate market (e.g. Bailey et al. (1963), Case and Shiller (1987), Goetzmann (1992)) and more recently on collectibles. (e.g. Goetzmann (1993), Pesando (1993), Dimson and Spaenjers (2009)).

The use of the RSR method offers several interesting properties that make it ideal for the calculation of wine indices. The use of identical goods to calculate price fluctuations constitutes the main advantage of this technique. Compared to a hedonic pricing model in which individual specifications of a good must be collected and modelled appropriately the RSR allows for a simple mean to calculate quality-adjusted indices. Over a simple compounding formula using two endpoints and extrapolating annual returns the RSR method has the advantage of generating estimates for each period. It therefore maximises the information use of intermediate sales. The main drawback of the RSR model is sample reduction due to the fact that a good must at least be traded twice to be usable. However, examining a market like wine circumvents this problem. Unlike the arts market in which each painting is unique (the printing market marks an exception) any given wine is normally produced in multiples. This dramatically increases the probability that a given wine is sold more than once. However, the problem is not completely resolved as some wines might still be traded very infrequently or the number sold at any one auction might be very small and as a result bias the results in that an outlier is created.

3.3 Specificities of wine investments

Investing in real assets such as collectibles is very often associated with different costs that many an investor perceives as an impediment in entering these markets especially in comparison to traditional financial assets. Costs associated to buying and holding fine wine vary and take different forms. Storage costs are estimated to be between 1 and 4 USD per bottle depending on whether the investor has to pay somebody to store the wine or if he has a cellar and how well it is equipped. It can be argued that private investors that invest in wine are also wine aficionados who mostly will already have a well-equipped cellar for storing bottles for their own wine consumption. Insurance costs can rise to 0.50% of the value of the cellar per year. However, many households will already have some form of insurance beforehand which might cover part

of the cellar. Transaction costs are probably the biggest cost an investor faces when considering an investment in fine wine. At TCWC buyers do not pay any transaction costs, which leads to the hammer price at auctions being the true equilibrium price. However, the seller is charged 20-25% transaction costs.[1]

These costs indeed seem to be on the high side, however, it is also easily possible to circumvent some of them. For example it is possible to sell wine through other, cheaper channels than through auction houses. For example the wine fund Nobles Crus by Luxemburg based Elite Advisers never buys wine at auctions but mostly through direct contacts with big private collectors. For private investors it is also possible to go through classified ads or online auctioneers. These are ways to substantially reduce transaction costs that have immensely gained in popularity in recent times. Moreover, investments in standard financial assets also bear some even if smaller transaction and account fees. Fogarty (2007) brings a tax-argument in favour of wine investments forward. In certain countries, for example Australia or the United Kingdom, returns on wine investment are tax-free as compared to financial assets on which depending on the country capital gains and/or dividends are taxed.

3.4 Descriptive statistics

France is seen as the premier wine growing region around the world by wine drinkers and is bringing out some of the most sought after bottles year after year. As can be seen from table 1 this also holds true for the sale of bottles at wine auctions. Fine wines from France dominate the market by far and account for 70% of trades and 80% of total turnover.

[Insert table 1 here]

Not surprisingly, red wines from Bordeaux are very popular and represent the most liquid investment in wine with a market share of around 50%. It is followed by different regions, such as the Rhône valley, white Burgundy wines, or different US and Italian regions, which each account for 5-10% of trading volume. The predominance of Bordeaux is equally reflected in the volumes of individual wine producers. 17 of the top 20 producers in terms of turnover are from the Bordeaux region with one from the Rhône valley and 2 Port producers. In terms of trades the picture does not change. 15 of the top 20 are Bordeaux wines with one from the Rhône valley, two Port producers and 2 Californian wines.

[1] Assuming storage costs of 2 USD per bottle, 0.50% insurance costs and 10-25% transaction costs we estimate that yearly returns will on average be reduced by 2% (best case) to 6% (worst case) once all these fees are accounted for.

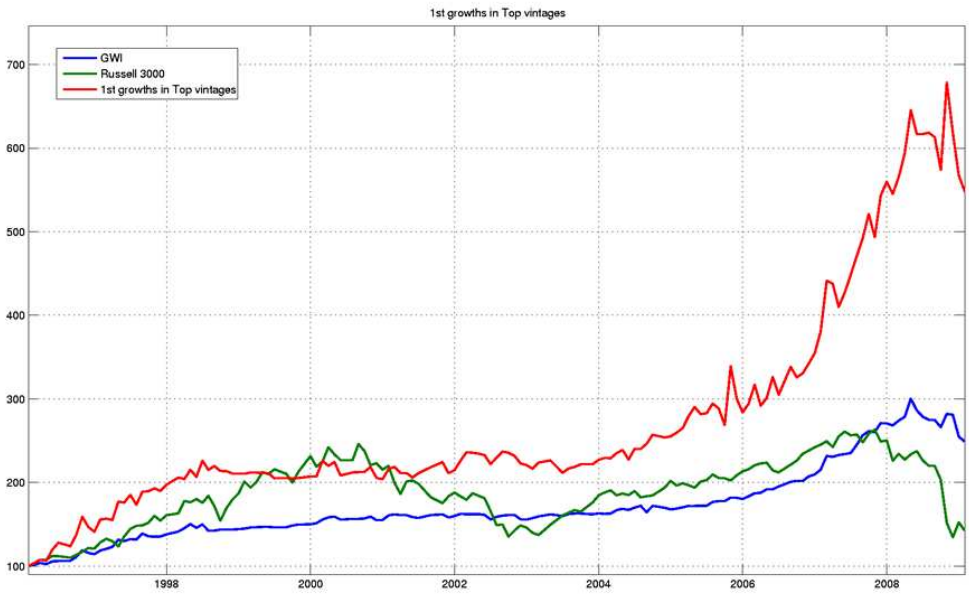
[Insert table 2 here]

4 Empirical results

4.1 Performance and impact of the crisis

Figure 1 shows the evolution both of the general wine index and for the very best wines for the period 1996-2009. The general wine index herby includes all wines irrespective of the region, while our best wines encompass only first growths wines of Bordeaux from exceptional vintages as 1982 for example.

Figure 1
Evolution of the Russell 3000, the general wine index and first growths for top vintages for the period 1996-2009



The wine index and the Russell 3000 have both gone up between 1996 and 1998. While the Russell 3000 declined heavily between 2001 and 2003 before it recovered again the wine index grew steadily over the period 1998-2005. Neither the terrorist attacks in New York (9.11), nor the burst of the internet bubble or the boycott of French goods after the Iraq invasion (Ashenfelter et al. (2007)) have had much effect on wine prices. The period 2005 to 2008 may be called the golden age for wine in which the index doubled. Since mid-2008 the wine index, however, decreased by 17% as a result of the economic and financial crisis in line with other financial assets but far more moderately than the Russell 3000 which lost 47% in the same period. Interestingly, the general wine index clearly outperformed the Russell 3000 during the crises in

this study, be it in 2002/03 or 2007/08. In comparing, first growths wines of top vintages only the general growth trend is similar to the general wine index. However, the amplitude is substantially bigger. Especially from 2005 onwards this category hugely outperforms both the general wine index and the Russell 3000.

Figure 2
Evolution of sub-indices for different wine regions for the period 1996-2008

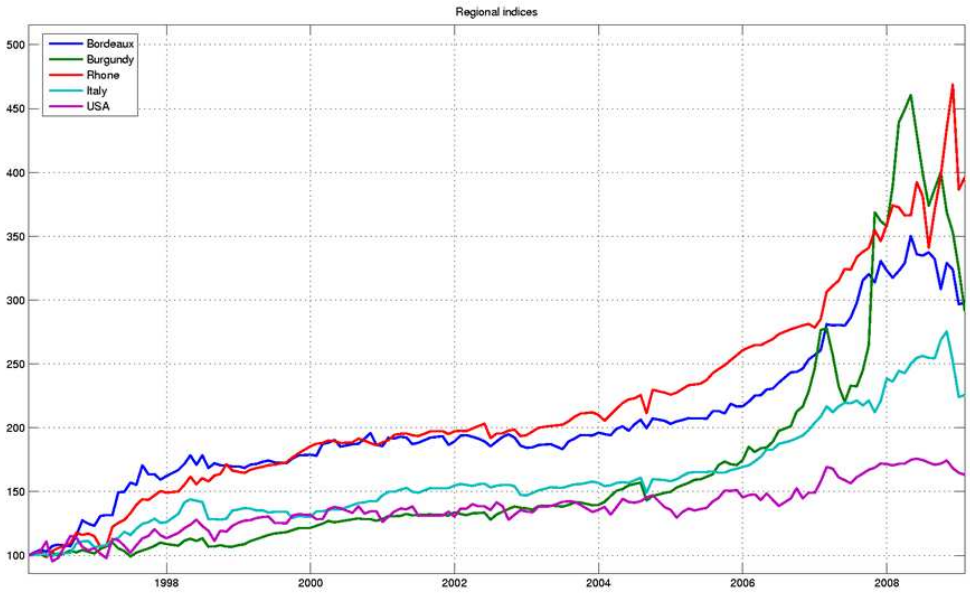
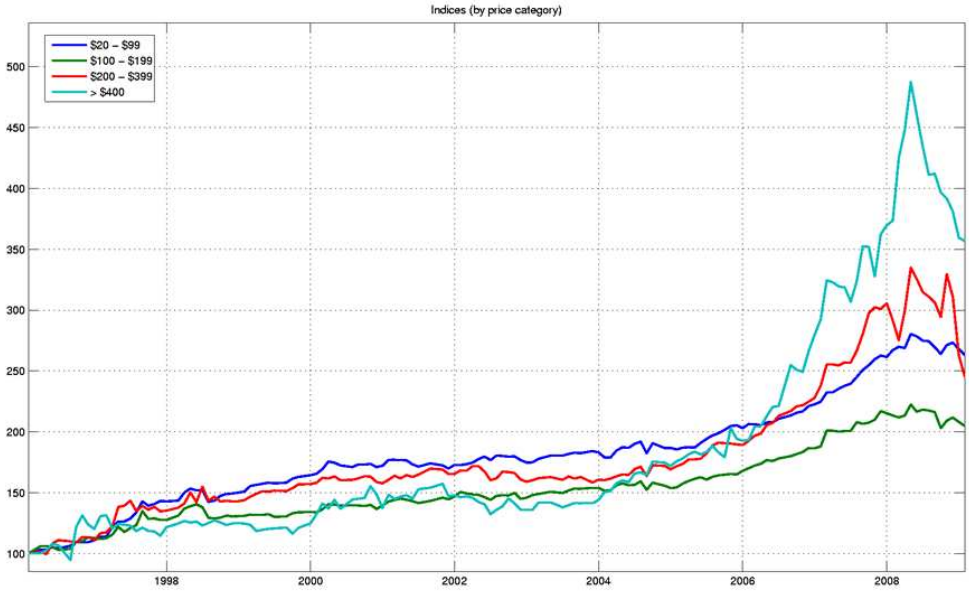


Figure 2 shows that all the different wine regions follow the upward trend of the general wine index but the amplitude is diverging. Regions outside France show positive returns for the period 1996-2009 but only at a cumulated scale of 66% for the USA or 125% for Italy. Prices for the various French wine regions have developed much more favourably and yielded returns of some 200% in Bordeaux (with very similar returns for the left and right bank) and Burgundy and 300% for the Rhône Valley. Prices have decreased in all regions since March 2008 as a result of the crisis. The effect has however been more moderate (minus about 15% for Bordeaux, the Rhône Valley and Italy and only 6% for US wines) than for major equity markets with the exception of the Burgundy region which suffered a setback of 39% (although from a record high). Over the period subject to our research the wine index has clearly beaten the Russell 3000 and experienced much less volatility.

Figure 3
Evolution of sub-indices for different price categories for the period 1996-2008



Looking at different price categories of wines sold at auctions as exhibited in figure 3 some interesting patterns appear. Wine selling below 200 USD a bottle has seen a steady increase over the period 1996-2009 and yielding a return of 120% (wines for 100-199 USD) and 170% (wines below 100 USD). On the other hand, wines selling for more than 200 USD a bottle and especially those above 400 USD that can be categorised as collectibles have seen a 3-4 fold price increase and have accordingly fallen most during the financial crisis. Since their high in March 2008 wines under 200 USD have only lost 5-10% of their value while those above have lost approximately 25%.

[Insert table 3 here]

Table 3 illustrates returns and volatilities for different wine indices and the Russell 3000. All wine indices have substantially outperformed the stock index while having a much lower volatility (except for the first growths index that had a similar risk) during the period 1996-2009. Looking at the sub-periods it becomes apparent that the outperformance is essentially due to favourable returns in downturns. During economic growth-periods wine underperforms the Russell 3000 but in crises times it substantially outperforms equities and mostly even yields positive returns. Volatility is lower for all wine indices (with the exception of best wines) in almost all subperiods. Interesting enough, the 2001-03 downturn did not result in an increase in wine volatility compared to prior and post boom cycles. The different wine indices are especially solid in down

markets and therefore seem to be ideally suited to provide balancing and diversification benefits to an investor's equity portfolio.

4.2 Determinants and Dynamics of Wine Returns

Literature on wine investments has shown that fine wine has a low correlation with other assets (Masset and Henderson (2009)) and that standard asset pricing models cannot explain wine returns on their own (Sanning et al. (2008)). Our results support these findings. Alphas of portfolios including wine seem to turn negative in periods of economic downturns and wines seem, at least graphically, to follow a similar trend as stocks. This indicates that while wines may not directly be correlated with stock returns they might at least be affected by similar economic factors.

The traditional, unconditional CAPM that is used to evaluate portfolio performance has the major drawback of not taking the changing nature of the economy into account. As a consequence alphas and betas might be miscalculated and misinterpreted. The use of a conditional CAPM model in which alphas and betas can be time-varying is therefore proposed. This approach allows us to identify economic and financial variables that might help explain wine returns more accurately. It, in particular, permits to deepen the understanding of how the wine market works and helps to forecast the evolution of future wine returns while keeping the intuitive interpretation of the CAPM.

The analysis fits the conditional performance of the General Wine Index, 4 sub-indices depending on price category and the first growths from top vintage index, using the Russell 3000 as a benchmark. The model takes the form:

$$r_{p,t} = \alpha_{0p} + \alpha_p^{'} z_{t-1} + \beta_{0p} r_{m,t} + \beta_p^{'} (z_{t-1} r_{m,t}) + \varepsilon_{p,t} \quad (1)$$

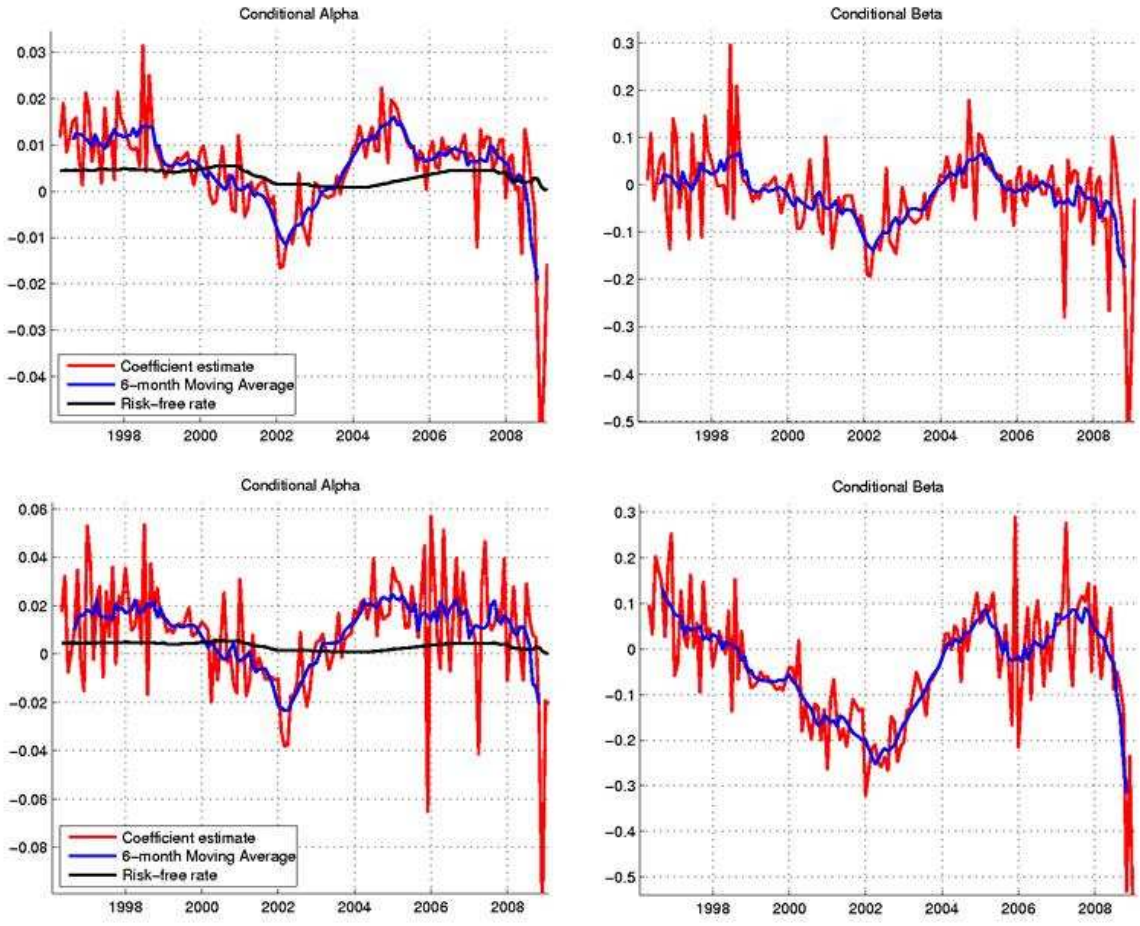
where α_{0p} and β_{0p} are the average alpha and beta, $A_p^{'}$ and $\beta_p^{'}$ the response of the conditional alpha and beta to the information variables z_{t-1}.

The market condition variables z_{t-1} that might influence the evolution of wine prices include: the spread between BAA- and AAA-rated bonds which is suggested by Jagannathan and Wang (1996) as an excellent indicator for the market risk premium; the USD/EUR foreign exchange rate to account for the fact that most wines in the sample come from Europe and are sold in the

US. Returns should therefore be especially influenced by this exchange rate. Finally, we also use the lagged wine index returns.[2]

We find evidence that neither alpha nor beta is constant over time. As can be seen in figure 5[3] beta oscillates around zero but does not seem to be too varying and can therefore not be the main driver of the wine market. Alpha, however, is clearly time-varying. It appears that it is strongly influenced by general economic conditions as alpha decreases below the risk-free rate in times of crises (2002/03 and 2007/08) but rises in boom periods.

Figure 4
Conditional alpha and beta for the General Wine Index (top) and for 1st growths from top vintages wines (bottom) for the period 1996-2009



Following equation 2 we present results of the conditional CAPM model in table 4. The USD/EUR foreign exchange rate and lagged returns of the wine index are not significant for the

[2] We also added the volatility index VIX as an investor fear measure (Whaley (2000)) in our conditional CAPM model. Although the use of the VIX is interesting conceptually and R2 increases slightly it is not significant and causes major multicollinearity problems with the spread variable.
[3] The figure refers to the General Wine Index and the index for first growth wines from top vintages. The same was done for the sub-indices with similar results.

beta coefficient but the spread between BAA- and AAA-rated bonds seems to explain some of the variation in market risk. However, it cannot fully explain the beta variation in wines under 200 USD. These wines are predominantly from Italy and the USA and are highly priced per se. Therefore they stay expensive but are far less affected by economic conditions and less speculative and volatile than French wines. The sensitivity of the alpha coefficient to the spread and foreign exchange rate is significantly negative for all but one index and thus seems to explain most of the variance. The autocorrelation of the index is also significantly negative apart for wines that cost less than 100 or more than 400 USD.

[Insert table 4 here]

The explanatory power (R2) can be used to compare the relative performance of the various specifications. The unconditional CAPM has a very low R2 for all portfolios (between 0 and 0.12) which indicates that it is not able to explain the wine market. For the conditional framework it increases (0.07-0.27) which indicates that parameters are time-varying and the estimation with a conditional model more precise. The low R2 of 0.07 and 0.09 for wines costing between 100 and 200 and more than 400 USD respectively can be explained by the characteristics of the wine market. The lower priced wines, come from less speculative wine regions while the wines costing more than 400 USD can primarily be rated as collectibles and thus are also less speculative and crisis resistant. Consequently, the market conditions do not have as high an impact on these wines as on others.

4.3 Portfolio performance and diversification

Investors will typically try to diversify their portfolio and will not only invest in a single asset class. We, therefore, analyse diversification attributes of an investment in fine wines by building different portfolios that represent the risk attitude of typical investors. This allows us to gauge to what extent investing in wine may be of interest in general and more specifically if risk aversion has an impact on investors' choice when adding wine to their portfolio. Following common bank practice and described in Canner et al. (1997) we denote the portfolios as conservative, moderately conservative, balanced, moderately aggressive and aggressive. Table 5 illustrates the asset allocation for each portfolio type.

[Insert table 5 here]

As can be expected risk averse investors, focus on low risk assets such as Fixed Income products, bonds or Blue Chips. Allocation will gradually move towards more volatile assets once risk aversion declines. We select four different cases for each of the five types of investors described above. The initial case stands for investors that hold a portfolio with the above-mentioned assets and does not consider investing in wine. The other three cases include an investment in (i) the general wine index, (ii) first growths wines only or (iii) first growths wines from top vintages. For these portfolios a share of 20% is allocated for and the weight of the other assets is reduced proportionally. An investor holding a portfolio with a value between 500'000 and 1 million USD would typically be able to diversify his portfolio in such a way.

Figure 5
Evolution of different portfolios without and with 20% invested in 1st growths from top vintage wines

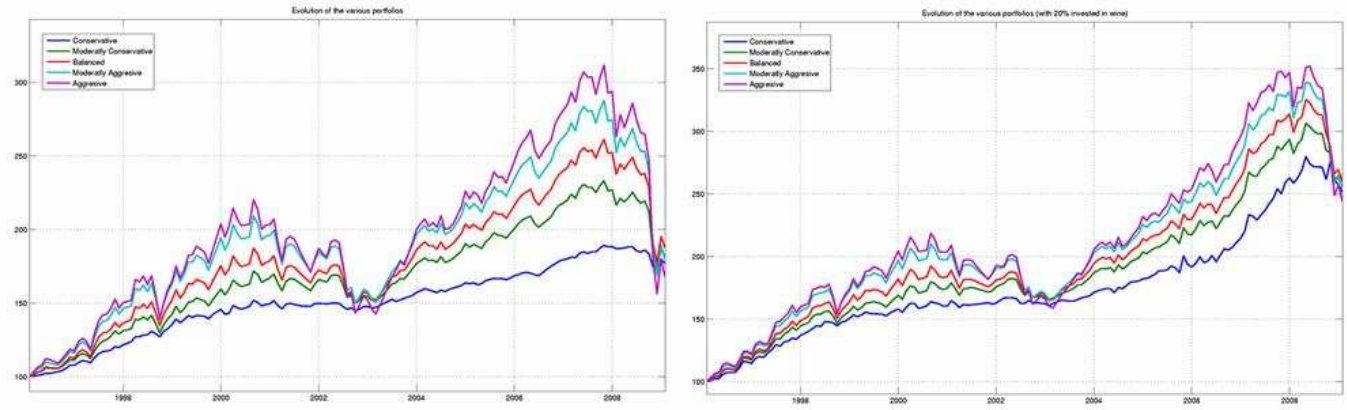


Figure 5 shows that the degree of risk has an impact on portfolio returns.[4] In boom-periods risky portfolios clearly outperform all other investor types. Performance trends are, however, reversed in crises periods. Figure 5 illustrates that the performance of all investor types actually finds a common return level in crises periods (2001-03 and 2007-09) since all the riskier types are losing the head start they have gained over conservative types during growth periods. The addition of wine, however, produces higher returns for all portfolios (different scale in right figure) including conservative portfolios. Again all portfolio types meet the same performance level during crises periods but at a much higher return level.

As can be seen in Panel A of table 4 the different initial portfolios appropriately model the risk-aversion of investors, i.e. volatility of a portfolio increases in line with its aggressiveness. However, more risk does not necessarily imply higher returns. During the financial crisis, the aggressive (higher risk) portfolios performed worse than the balanced or conservative ones. The

[4] Results for the General Wine Index and different price categories are similar to those shown in figure 4.

inclusion of wine as an additional asset-class into a portfolio is favourable. Compared to the initial portfolio, portfolio returns rise and volatility decreases across investor type and wine index. The defensive features of wine are further underlined by a slightly less negative skewness and a kurtosis approaching three. Panel B focuses on the period of the financial crisis (i.e. from mid-2007 onwards). Due to the worldwide crash of stock markets, returns obviously turn negative and volatility increases as compared to the period 1996-2008. It is not a surprise that more aggressive portfolios are the worst performers and have the highest volatility. As for the period 1996-2008 investors with wine in their portfolios perform better than without. In general, returns are higher and volatility is lower. Even more interestingly, a conservative portfolio with 20% first growths wines or first growths wines from top vintages yields a favourable return of some 3.5% during the crisis with a low volatility of 7-9%.[5]

[Insert table 6 here]

As a further step we run CAPM regressions for the different portfolios. As can be observed in table 6 the above mentioned results are being confirmed. Portfolios that invest in wine have a significantly higher alpha, which increases the more prestigious the wines are. For first growths wines from top vintages alpha at least doubles. This rise in alpha is accompanied by a significant decrease in beta for all portfolios. We broaden our research to include extended regressions in which a dummy for the crisis is added to obtain the following model:

$$R_p - R_f = \alpha_p + \beta_{pM}(R_M - R_f) + D_{FC}(\alpha_p^{FC} + \beta_{pM}^{FC}(R_M - R_f)) + \varepsilon \qquad (2)$$

where the first term represents the initial model and the second term the term for the crisis period with D_{FC} being a dummy taking the value 1 for the crisis period. It can be concluded that results for alphas follow those in the initial model. Alphas do not change for any portfolio type during the crisis and thus similar to the initial model increase in line with the portfolio aggressiveness and wine investment. On the other hand, betas vary significantly during the crisis. For the initial portfolio betas are either significantly positive or insignificant, but for all wine portfolios the beta-dummy for the crisis is significantly negative. It is further proof that the addition of fine wine in portfolios is generating high alphas while reducing its exposition to systematic risk.

[5] We also consider portfolios for economic boom periods only. Results are in line with those presented above. The addition of wine in a portfolio does yield positive results independent of the economic cycle.

[Insert table 7 here]

5 Analysis and Outlook

The analysis we perform and outline in the previous chapters confirms previous opinions that the wine market is a valid supplementary investment class. It suffered less during the financial crisis and should therefore be seriously considered by investors for balancing their portfolio. However, the further development and future direction of the still young market for fine wines remain open.

The results make us conclude that the ramp up in high-end wine prices may be related to a shift in demand. The recent appearance of new market participants, who consider wine primarily as an investment has had an effect on demand. Most importantly, the emergence of new customers, in particular from fast growing emerging markets, such as Russia and China (Mitry et al. (2009), Balestrini and Gamble (2006)), the rise in wealthy customers in developed countries and in wine consumption in general (Jenster et al. (2008)) has led to a further increase in trading activity. These new market participants do no longer perceive wine as a product destined for ultimate consumption, it is a genuine collectible similar to art works (Charters and Pettigrew (2005)) to them. This increasing interest in fine wine has led to more transparency and liquidity on the wine market which in turn will attract still more interest and activities[6] which suggests that prices will most probably not decrease in the foreseeable future.

Several instances make us however believe that returns for the most speculative wines might not be as staggering in the next few years as they have been during the past decade. The price spread between different vintages for the same wine or between exclusive wine and other investment grade wine is simply too important. Moreover, a scarcity of exclusive wines is not to be expected since production areas are rather growing year by year. One must also bear in mind that a correction is still possible. We however believe that the performance of wine investments, as a mean of diversification, should remain attractive even if returns might be less impressive than they have been during the past decade.

The wine market is slowly entering into its maturity phase. It becomes better organized and will benefit from investors' search for investment vehicles with low correlations; this may allow for the introduction of more innovative investment strategies. Mainly, investment grade wines that cannot be viewed as collectibles yet may drive additional volume as they are more affordable

[6] Several studies show that knowledge about wine leads to an increased consumption of it (see for example Hussain et al. (2007). Therefore the favourable and frequent press coverage and enhanced transparency of recent years should have a positive impact on demand.

and will benefit from areas/regions of origin. Such wines should be able to benefit from the general upward trend and constitute an interesting investment opportunity. The before-mentioned difference in valuation of vintages and renowned estates with only limited supply may favour a wine picking investment style already widely practised by investors on the stock market.

6 Summary and conclusions

In times of economic downturns correlation among financial assets tends to rise and diversification becomes less effective when it is most needed. As a result, investors are increasingly looking for alternatives to diversify their portfolio and often turn to less conventional assets. Fine wines are widely recommended as a possible choice due to their interesting risk-return profile and low correlation with other asset classes. In this paper, we have looked into investments in fine wine for the period 1996-2009 with a special emphasis on how they performed in economic crises.

In this paper we have analysed risk, return and diversification benefits in the wine market in general and in several submarkets. The use of a unique dataset from TCWC covering over 430'000 auction hammer prices allows us to build repeat-sales regression indices and to look at different wine regions, price categories and vintages. Our results show that since 1996, the General Wine Index and particularly first growths wines from top vintages have performed better than equities while showing a lower volatility.

Results when using the CAPM indicate higher alphas and lower betas for portfolios containing wine. By focusing on the financial crisis we find that although alpha is not significantly different in periods of economic downturns it also does not seem to be constant over time. We therefore extend the analysis to a conditional CAPM framework. This more detailed approach allows us to explain the low explanatory power of the unconditional CAPM and to find which economic variables are best able to describe wine returns while keeping the intuitive interpretation of a CAPM model. Our results suggest that alpha and beta both are time-varying. Wine returns are essentially unrelated to market risk but behave cyclically being affected by the state of the economy.

A further and more detailed research into different investor types and wine indices fully supports this evidence and confirms that wine in a portfolio has produced higher returns and lower risks than the Russell 3000 equity index during the period of time. Especially in times of economic downturns such as in the periods 2001-03 or 2007-09 the defensive characteristics of wine are most pronounced. Wine's performance has declined less than other assets. It had an even lower volatility (with one exception) and also showed improved skewness and kurtosis

measures. Fine wines may therefore be regarded as an interesting addition to an investor's portfolio.

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Table 1
Trading activity and market depth by region
This table presents the number of trades and the volume in USD of wines auctioneered at The Chicago Wine Company for the period 1996-2009.

	# Trades	Volume	# Trades in %	Volume in %
Bordeaux Left bank	79'572	$74'817'907	23.2%	31.6%
Bordeaux: Right bank	45'285	$48'380'649	13.2%	20.4%
Sauternes	10'856	$7'217'049	3.2%	3.0%
Bordeaux: White	4'058	$2'002'958	1.2%	0.8%
Burgundy: Red	13'994	$9'268'136	4.1%	3.9%
Burgundy: White	23'084	$13'880'653	6.7%	5.9%
Champagne	2'666	$1'962'665	0.8%	0.8%
Alsace	10'624	$4'126'383	3.1%	1.7%
Rhone North	25'099	$16'646'714	7.3%	7.0%
Rhone South	14'670	$6'446'572	4.3%	2.7%
Loire	4'997	$2'115'619	1.5%	0.9%
France: other	2'207	$948'703	0.6%	0.4%
Australia	9'579	$4'239'506	2.8%	1.8%
Germany, Austria	1'810	$644'465	0.5%	0.3%
Portugal	17'712	$9'563'622	5.2%	4.0%
Spain	8'559	$4'579'785	2.5%	1.9%
Others	379	$351'380	0.1%	0.1%
Piemond	15'776	$8'446'129	4.6%	3.6%
Tuscany	13'595	$7'493'619	4.0%	3.2%
Italy: other	4'139	$1'908'640	1.2%	0.8%
USA	35'037	$11'988'464	10.2%	5.1%
Total	**343'698**	**$237'029'618**	**100.0%**	**100.0%**

Table 2
Trading activity and market depth by wine

This table presents the number of trades and the volume in USD of wines auctioneered at The Chicago Wine Company for the period 1996-2009.

TOP 20: Number of trades			TOP 20: Turnover	
1	Château Mouton Rothschild	7'303	1 Château Petrus	$14'400'991
2	Château Latour	6'698	2 Château Mouton Rothschild	$10'031'385
3	Château Margaux	5'723	3 Château Latour	$9'726'174
4	Château Lafite Rothschild	5'645	4 Château Margaux	$8'591'410
5	Château La Mission Haut Brion	4'571	5 Château Lafite Rothschild	$6'581'088
6	Haut Brion	4'561	6 Château Cheval Blanc	$6'334'212
7	Château Léoville Las Cases	4'558	7 Haut Brion	$6'190'380
8	Château Petrus	4'367	8 Château La Mission Haut Brion	$5'245'360
9	d'Yquem	3'940	9 Palmer	$4'883'794
10	Château Pichon Longueville, Lalande	3'858	10 d'Yquem	$4'800'806
11	Palmer	3'605	11 Château Léoville Las Cases	$4'227'655
12	Fonseca Vintage Port	3'503	12 Château Pichon Longueville, Lalande	$2'995'808
13	Château Cheval Blanc	3'478	13 Château La Mondotte	$2'363'300
14	Château Cos d'Estournel	3'300	14 Fonseca Vintage Port	$2'262'125
15	Château Ducru Beaucaillou	3'027	15 Taylor Vintage Port	$2'230'063
16	Robert Mondavi Cabenet Reserve	2'848	16 Château Montrose	$2'181'848
17	Taylor Vintage Port	2'749	17 Château Cos d'Estournel	$2'124'386
18	Dominus	2'641	18 Château l'Evangile	$1'939'405
19	Hermitage, La Chapelle (Jaboulet)	2'634	19 Château Ducru Beaucaillou	$1'906'661
20	Lynch Bages	2'515	20 Hermitage, La Chapelle (Jaboulet)	$1'851'834

Table 3
Return and risk for different indices

Indices include the general wine index (GWI), four sub-indices depending on price categories, an index for first growths from top vintages and the Russell 3000. Periods are divided into two boom and two bear periods. Period one covers the period 1996-2001, period two 2001-2003, period three 2003-mid-2007 and period four mid-2007-2009.

	GWI	Bordeaux	Burgundy	Rhône	Italy	USA	<99 USD	100-199 USD	200-399 USD	>400 USD	First growth	Russell 3000
Total Return	148.86%	198.15%	190.98%	296.21%	125.75%	63.29%	170.62%	119.30%	146.96%	284.10%	447.91%	42.24%
Period 1	58.30%	88.44%	27.06%	90.11%	35.73%	36.39%	62.54%	57.05%	58.71%	57.04%	119.89%	142.16%
Period 2	0.10%	-2.05%	10.07%	5.55%	10.84%	0.25%	9.84%	0.94%	-3.22%	7.76%	-0.26%	-41.27%
Period 3	51.42%	59.11%	67.02%	65.63%	44.27%	16.46%	37.02%	34.09%	66.29%	105.92%	108.04%	72.11%
Period 4	-3.00%	-5.48%	18.89%	17.26%	3.76%	-0.55%	6.51%	2.51%	-11.00%	2.35%	11.32%	-42.67%
Volatility	8.23%	10.33%	14.71%	11.88%	9.09%	12.73%	6.84%	6.73%	11.20%	13.61%	18.72%	17.89%
Period 1	8.34%	12.77%	7.41%	11.39%	9.78%	17.57%	7.79%	8.44%	13.02%	14.51%	17.93%	15.56%
Period 2	5.28%	6.77%	4.69%	5.29%	4.41%	10.52%	3.86%	4.58%	5.55%	9.69%	11.49%	16.97%
Period 3	6.42%	6.68%	12.70%	7.47%	6.66%	10.76%	5.64%	5.70%	6.85%	11.69%	21.00%	8.63%
Period 4	14.26%	15.14%	34.16%	24.85%	16.68%	5.29%	10.50%	7.23%	19.81%	20.70%	24.34%	31.15%

Table 4
Conditional CAPM regressions for different portfolios

This table presents the average conditional alpha(s), the coefficient estimates for the conditional alpha function and the average conditional beta(s) for the general wine index, price category sub-indices and first growths from top vintages wines using a conditional CAPM model. The information variables are the Spread of BAA- and AAA-rated bonds, the USD/EUR foreign exchange rate and the autocorrelation of the respective wine index (ACWI). R2 is the coefficient of determination, expressed in percentage. The asterisks show significance levels of 1% (***), 5% (**) and 10% (*).

	GWI	**Price <99 USD**	**Price 100-199 USD**	**Price 200-399 USD**	**Price >400 USD**	**1st growths top vintage**
Alpha	0.0606***	0.0338***	0.0303**	0.0757***	0.0721***	0.1183***
	(4.21)	(2.74)	(2.45)	(3.79)	(2.87)	(3.65)
Alpha (Spread)	-0.3861***	-0.4231***	-0.1353	-0.4835***	-0.3010***	-0.2840***
	(-4.90)	(-3.07)	(-0.97)	(-5.00)	(-2.60)	(-2.93)
Alpha (USD/EUR)	-0.6023**	-0.4586	-0.7690*	-0.5271**	-0.6852**	-0.7109***
	(-2.56)	(-1.30)	(-1.88)	(-2.05)	(-1.98)	(-2.62)
Alpha (ACWI)	-3.7046***	-2.5296	-6.2574**	-4.6050***	0.0055	-2.6593***
	(-2.61)	(-0.95)	(-2.13)	(-4.14)	(0.00)	(-3.93)
Beta*Rm	6.5660	-8.3550	10.0759	3.8151	11.5409	5.0034
	(1.22)	(-1.03)	(1.08)	(0.64)	(1.47)	(0.81)
Beta*Rm(Spread)	-2.9290***	-1.5592	-1.4323	-2.6539***	-2.5007**	-1.8090*
	(-3.73)	(-1.31)	(-0.98)	(-2.96)	(-1.96)	(-1.93)
Beta*Rm(USD/EUR)	-4.3828	8.0148	-9.4257	-2.6539	-8.9293	-4.2849
	(-0.84)	(1.02)	(-1.03)	(-0.46)	(-1.16)	(-0.71)
Beta*Rm(ACWI)	-50.5660**	40.3136	-53.6898	-8.2761	-15.1290	11.5959
	(-2.14)	(0.91)	(-1.27)	(-0.50)	(-0.56)	(0.96)
R2	0.2295	0.1928	0.0665	0.2759	0.084	0.2077

Table 5

Asset allocation for different investor types

Allocation of different asset classes depending on the risk aversion of a typical investor. Fixed Income denotes savings that are invested at the 3-months LIBOR rate, bonds are represented by the CGBI USBIG overall AAA index, blue chips by the S&P500, mid caps by the S&P400, small caps by the S&P600 and international stocks by the MSCI World ex-USA.

	Conservative	Moderatly Conservative	Balanced	Moderatly Aggresive	Aggresive
Fixed Income	40%	25%	0%	0%	0%
Bonds	40%	35%	40%	20%	0%
Blue Chips	20%	20%	30%	40%	40%
Mid Caps	0%	10%	10%	15%	20%
Small Caps	0%	10%	10%	15%	20%
International	0%	0%	10%	10%	20%

Table 6

Return, volatility, skewness and kurtosis for different portfolios

Panel A shows total returns, volatility, skewness and kurtosis for the period 1996-2008. Investors are categorised according to their risk aversion and hold portfolios that are either conservative, moderately conservative, balanced, moderately aggressive or aggressive. Each investor type can further choose to invest in the initial portfolio consisting of different financial assets but no wine, a portfolio consisting of financial assets and the General Wine Index, of financial assets and first growths wines from the Bordeaux region or of financial assets and first growths wines from the Bordeaux region for top vintages only. Panel B shows the same for the period of the financial crisis (from mid-2007 onwards).

Panel A: Period 1996-2008

		Conservative	Moderatly Conservative	Balanced	Moderatly Aggresive	Aggresive
Inital Portfolio	Total returns	77.1237	81.437	87.3863	79.2411	67.3985
	Volatility	0.041	0.0848	0.108	0.1426	0.1761
	Skewness	-0.3347	-1.6096	-1.5141	-1.7208	-1.9434
	Kurtosis	5.4556	10.7716	10.4198	11.3909	12.817
Portfolio with the General Wine Index	Total returns	101.3297	104.7804	109.5399	103.0237	93.5496
	Volatility	0.0368	0.0641	0.0813	0.1074	0.1321
	Skewness	0.0173	-1.0583	-1.1524	-1.39	-1.6252
	Kurtosis	3.287	5.7762	6.3917	7.6735	9.0966
Portfolio with 1st growth wines	Total returns	137.3675	140.8182	145.5777	139.0615	129.5874
	Volatility	0.0483	0.0643	0.0781	0.1005	0.1219
	Skewness	0.226	-0.3646	-0.4889	-0.7282	-0.9537
	Kurtosis	3.0868	3.2889	3.208	3.7384	4.5558
Portfolio with 1st growth from top vintages	Total returns	151.2819	154.7325	159.492	152.9758	143.5017
	Volatility	0.0619	0.072	0.0827	0.1021	0.1214
	Skewness	0.3077	-0.3729	-0.4978	-0.686	-0.8616
	Kurtosis	4.4406	4.1372	3.5315	3.5559	3.9366

Panel B: Financial Crisis Period (since mid-2007)

Inital Portfolio	Total returns	-4.2401	-20.6806	-26.2372	-36.1765	-44.9145
	Volatility	0.0617	0.1561	0.1984	0.2669	0.3412
	Skewness	-0.3348	-1.1962	-1.105	-1.225	-1.2634
	Kurtosis	5.8931	5.8785	5.8379	5.8293	5.7703
Portfolio with the General Wine Index	Total returns	-3.0023	-15.583	-20.2723	-28.5779	-36.0587
	Volatility	0.0461	0.0998	0.1306	0.1793	0.2315
	Skewness	-0.1748	-1.0759	-1.0835	-1.2398	-1.298
	Kurtosis	2.8868	3.8564	4.3089	4.797	5.0137
Portfolio with 1st growth wines	Total returns	3.5804	-8.8442	-13.657	-21.8397	-29.2053
	Volatility	0.0715	0.0852	0.1054	0.1427	0.1851
	Skewness	0.1282	-0.3417	-0.3035	-0.5575	-0.7333
	Kurtosis	1.9148	2.236	2.0085	2.4715	2.9637
Portfolio with 1st growth from top vintages	Total returns	3.7613	-8.103	-12.7556	-20.6651	-27.8108
	Volatility	0.0977	0.1012	0.1134	0.1429	0.1789
	Skewness	-0.0056	-0.7098	-0.5305	-0.5685	-0.6351
	Kurtosis	2.3208	3.4196	2.8416	2.5156	2.5003

Table 7
Market model regressions for different portfolios

Panel A shows alphas and betas of market model regressions for the period 1996-2008 for different investor types and portfolios with and without wine. Panel B shows the same market model regressions with dummies for the financial crisis. The asterisks show significance levels of 1% (***), 5% (**) and 10% (*)

Panel A: Market model regressions

		Conservative	Moderately Conservative	Balanced	Moderately Aggressive	Aggressive
Initial Portfolio	Alpha	0.0008*	0.0015***	0.0019***	0.0020***	0.0018**
		(1.74)	(3.05)	(3.38)	(3.02)	(2.02)
	Beta	0.2124***	0.4787***	0.6135***	0.8138***	1.0006***
		(24.41)	(52.03)	(57.53)	(65.06)	(56.97)
Portfolio with the General Wine Index	Alpha	0.0014**	0.0019***	0.0022***	0.0023***	0.0022***
		(2.02)	(2.85)	(3.23)	(3.15)	(2.59)
	Beta	0.1337***	0.3355***	0.4426***	0.5986***	0.7395***
		(9.91)	(25.98)	(33.35)	(42.28)	(44.29)
Portfolio with the 1st growths wines	Alpha	0.0025**	0.0030***	0.0032***	0.0033***	0.0033***
		(2.21)	(2.79)	(3.07)	(3.10)	(2.88)
	Beta	0.0902***	0.2786***	0.3804***	0.5260***	0.6554***
		(4.11)	(13.59)	(18.69)	(25.35)	(29.75)
Portfolio with the 1st growths wines from top vintages	Alpha	0.0028*	0.0033**	0.0035**	0.0036***	0.0036**
		(1.87)	(2.30)	(2.54)	(2.59)	(2.48)
	Beta	0.0766***	0.2571***	0.3556***	0.4958***	0.6197***
		(2.62)	(9.39)	(13.29)	(18.39)	(22.20)

Panel B: Market model regressions with financial crisis dummies

Initial Portfolio	Alpha	0.0004	0.0014***	0.0017***	0.0020***	0.0021**
		(0.90)	(2.74)	(2.92)	(2.87)	(2.29)
	Beta	0.2395***	0.4717***	0.6095***	0.7962***	0.9467***
		(21.28)	(37.96)	(42.28)	(47.39)	(41.52)
	Alpha-Crisis	0.0014	0.0010	0.0015	0.0010	0.0011
		(1.01)	(0.65)	(0.85)	(0.49)	(0.39)
	Beta-Crisis	-0.0557***	0.0194	0.0144	0.0434*	0.1254***
		(-3.17)	(1.00)	(0.64)	(1.66)	(3.52)
Portfolio with the General Wine Index	Alpha	0.0014**	0.0021***	0.0023***	0.0025***	0.0027***
		(1.99)	(3.00)	(3.25)	(3.27)	(2.87)
	Beta	0.1736***	0.3565***	0.4681***	0.6219***	0.7429***
		(9.96)	(20.80)	(26.64)	(33.09)	(33.07)
	Alpha-Crisis	-0.0031	-0.0034	-0.0031	-0.0037	-0.0041
		(-1.42)	(-1.61)	(-1.40)	(-1.59)	(-1.46)
	Beta-Crisis	-0.1010***	-0.0598**	-0.0686**	-0.0660**	-0.0227
		(-3.71)	(-2.24)	(-2.50)	(-2.25)	(-0.65)
Portfolio with the 1st growths wines	Alpha	0.0023**	0.0028***	0.0030***	0.0032***	0.0033***
		(1.96)	(2.63)	(2.87)	(2.97)	(2.82)
	Beta	0.1666***	0.3458***	0.4556***	0.6065***	0.7249***
		(5.94)	(13.14)	(17.69)	(23.31)	(25.60)
	Alpha-Crisis	-0.0032	-0.0039	-0.0037	-0.0045	-0.0050
		(-0.93)	(-1.18)	(-1.15)	(-1.38)	(-1.42)
	Beta-Crisis	-0.1837***	-0.1654***	-0.1827***	-0.1974***	-0.1746***
		(-4.19)	(-4.03)	(-4.54)	(-4.86)	(-3.95)
Portfolio with the 1st growths wines from top vintages	Alpha	0.0027*	0.0032**	0.0034**	0.0035**	0.0036**
		(1.72)	(2.20)	(2.40)	(2.50)	(2.45)
	Beta	0.1528***	0.3296***	0.4381***	0.5872***	0.7042***
		(3.98)	(9.21)	(12.68)	(17.07)	(19.56)
	Alpha-Crisis	-0.0043	-0.0051	-0.0050	-0.0059	-0.0065
		(-0.91)	(-1.14)	(-1.16)	(-1.37)	(-1.46)
	Beta-Crisis	-0.1872***	-0.1817***	-0.2037***	-0.2272***	-0.2140***
		(-3.13)	(-3.25)	(-3.78)	(-4.23)	(-3.81)