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Fine Wines and Stocks from the Perspective of UK Investors: Hedge or Safe Haven?*

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Abstract

The prior literature disregards the time-varying conditional correlation and its importance for portfolio diversification when it assesses the risk-return profile of fine wine with that of stocks. To address this limitation, this paper applies a dynamic conditional correlation model and examines the co-movements between fine wine and stock prices in the United Kingdom (UK). Based on monthly data from January 2001 to February 2014, we find that fine wine is a hedge against movements in UK stocks. Nevertheless, it cannot act as an effective safe haven during market turmoil. Those findings have noteworthy implications for financial advisors and portfolio managers who are interested in alternative investments. (JEL Classifications: G1, G11, Q1, Q14)

Keywords: Dynamic conditional correlation, fine wines, hedge, safe haven, UK stocks.

I. Introduction

Fine wine as an alternative investment (Fogarty, 2010; Fogarty and Sadler, 2014; Masset and Henderson, 2010; Storchmann, 2012) has recently attracted considerable attention from wine researchers and financial media, such as Bloomberg television and the *Financial Times*. In particular, market reports often refer to fine wine as a fashionable and valuable asset that individual and institutional investors need to consider in protecting their portfolios from adverse market conditions.

Previous studies on the diversification benefits of fine wine, such as Fogarty (2007, 2010), Kourtis et al. (2012), Masset and Henderson (2010), and Sanning et al. (2008), usually use unconditional correlation frameworks and focus only on risk-return

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relationships. In asset allocation and risk management, however, conditional covariance matrices typically outperform unconditional covariance matrices (Harris and Nguyen, 2013). Furthermore, these studies do not focus on the diversification benefits of fine wine during market turmoil, when these benefits are most needed by investors who want investment protection against downside risk. An exception is the particular work of Masset and Weisskopf (2010) that uses both unconditional and conditional capital asset pricing model (CAPM) frameworks to examine the relationship between fine wines and stock markets during a period of intense market stress—the 2007–2008 financial crisis. The authors, who calculate monthly price indices from the Chicago Wine Company using the repeat-sale regression method, provide evidence on the defensive characteristics of fine wine during periods of economic downturn.

Using a different dataset and a different methodology, this paper contributes to the existing literature by examining the hedge and safe haven roles of fine wine. To our knowledge, no previous study has focused on these roles in the wine market. Our research should prove of interest to the majority of investors, who face outright losses in their portfolios challenges during periods of market stress.

Before proceeding with our analysis, we need to give clear definitions of hedge and safe haven terminology. If an investor holds an asset that does not co-move (negatively correlated or uncorrelated) with a portfolio *on average*, the price of this (hedge) asset rises or simply does not fall when the price of the portfolio falls, thereby preserving the portfolio value. However, a hedge asset does not necessarily compensate for sharp losses in the portfolio during periods of market turmoil, when this compensation is the most needed by investors. A safe haven is thus defined as an asset that is uncorrelated or negatively correlated with a portfolio *in times of stress,* not on average. Adding a safe haven to a conventional portfolio reduces losses in extreme adverse market conditions; in other words, it compensates the investor for sharp losses in times of market stress. The definitions of hedge and safe haven assets, which is consistent with the definitions in Baur and Lucey (2010), allows for an examination of the ability of fine wine to compensate investors for losses in other portfolios or assets on average and during periods of market stress.

Methodologically, we estimate the dynamic conditional correlation generalized autoregressive conditional heteroskedasticity (DCC-GARCH) model of Engle (2002) and study the resulting time-varying correlations between the returns on fine wine and United Kingdom (UK) stocks by focusing on bull/bear periods, particularly on periods of market stress. This allows us to investigate the extent to which fine wine can be considered a hedge or a safe haven.

The lack of correlation between fine wine and stocks is a crucial feature in an era of globalization in which correlations among most asset classes increased sharply. Using monthly data on the UK main stock index and the London International Vintners Exchange (Liv-ex) wine indices covering the period January 2001–February 2014, our results provide evidence that fine wine is a hedge against UK

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stocks and a very weak safe haven. Several robustness checks ensure that our empirical results resist alternative model specifications.

This paper proceeds as follows. Section II presents the literature on the diversification ability of fine wine investment. Section III describes the data and the research methodology. Section IV reports the empirical results. Section V presents our conclusions and highlights some future research possibilities.

II. Related Literature

A handful of studies have examined the wine market, focusing on the relationship between risks and returns compared to traditional assets. In order to capture the potential benefits of diversification, however, portfolio management requires the examination of assets beyond the simple study of risks and returns. Exceptions to this strand of wine literature are of Bouri (2014), Fogarty (2007, 2010), Kourtis et al. (2012), Masset and Henderson (2010), Masset and Weisskopf (2010), and Sanning et al. (2008), who addressed this issue. Based on the efficient frontier method, Fogarty (2007) provides evidence that the inclusion of fine wine in a portfolio of stocks and bonds leads to a better risk-return trade-off. Sanning et al. (2008) use the capital asset pricing and the Fama-French three-factors models to compare the risk-return profile of fine wine to that of stocks. The authors indicate that fine wines have a low covariance with both the stock market and the Fama-French risk factors, suggesting the ability of wine to diversify portfolios. Fogarty (2010) highlights some diversification benefits of Australian wines, even though wine returns are below those of stocks and bonds. To address diversification possibilities between stocks and wine, Masset and Henderson (2010) account for covariance, coskewness, and co-kurtosis. The authors show that investing in wine allows significant risk-reduction benefits for an equity portfolio. Fine wines in particular are important for investors who are concerned about the skewness of their portfolios. Using different approaches, Masset and Weisskopf (2010) analyze risk, return, and diversification benefits in the wine market. Using both conditional and unconditional CAPM frameworks, the authors provide evidence that adding wine to a conventional portfolio of stocks and bonds produces higher returns and lower risks than the Russell 3000 equity index during most of the period 1996–2009. In addition to the positive effects on the first and the second moment of the return distribution, the skewness and kurtosis are also positively affected. During stress periods in particular the defensive characteristics of wine are pronounced, as the price of fine wine has declined less than that of other assets. Kourtis et al. (2012) assess the risk factors that can affect wine prices. To this end, they use unconditional correlation coefficients to examine how wine returns are related to stock market performance, interest rates, and the performance of the agriculture and food industries. The authors highlight that diversification benefits are significant in the wine markets of Italy, Australia, and Portugal, and, to a smaller extent, in the French market. More recently, Bouri (2014) focuses on the negative relation between return and conditional volatility in the wine market and reveals that past positive shocks increase the current conditional volatility to a greater extent than past negative shocks. As neither the leverage effect nor the volatility feedback effect adequately explains this inverted[1] asymmetric volatility in the wine market, Bouri (2014) proposes the safe haven effect as an explanation.

These studies examine the basic features of the risk-return relationship in fine wine compared to conventional assets but disregard the time-varying conditional correlation and its importance in portfolio diversification. In particular, measuring unconditional correlations between fine wine and other assets to assess diversification possibilities (Kourtis et al., 2012) is inappropriate, given the empirical evidence that correlations between assets are conditional and time-varying (Bouri, 2013). Bouri (2014) focuses only on the safe haven role of fine wine and thereby overlooks the hedge effect. To complement these works, we examine the hedge and safe haven properties of fine wine using a suitable generalized autoregressive conditional heteroskedasticity (GARCH) framework capable of capturing the dynamic conditional correlations across the data series, on average and during periods of stress in particular.

III. Data and Methodology

A. The Dataset

The paper examines monthly prices for fine wine and stocks, as shown in Figure 1. The data sample comprises 158 monthly observations compiled from Bloomberg Professional, covering the period from January 2001 to February 2014. As the data coverage allows us to deal with two bull and two bear periods, we thus divide the sample into four periods. A bear market period from 2001 to 2003, a bull market period from 2004 to mid-2007, a bear market period from mid-2007 to 2009, and a bull market period from 2009 to 2014. The stock market proxy is the Financial Times Stock Exchange (FTSE) 100 index, given that most fine wine investment funds are located in the UK. The proxy for the fine wine market is the Liv-ex Fine Wine Investables Index from the global trading platform for fine wine, the Fine Wine Exchange. The Liv-ex indices,[2] which are denominated in British pounds, are used by several wine investment funds (e.g., Lunzer Wine Fund, Wine Investment Fund, Vintage Wine Fund) to value their wine stocks. The choice of a Liv-ex index to proxy fine wine prices (Bouri, 2013, 2014; Cevik and Sedik, 2013; Chu, 2014; Kourtis et al., 2012; Qiao and Chu, 2014) is due to the fact that there is no global wine price similar to that for other commodities, such as crude oil or gold. The Fine Wine Investables Index is calculated monthly using Liv-ex midprices for each component wine, which are derived from live bids,

[1] It is well known that negative shocks in the stock market usually generate more volatility than positive shocks. In the case of fine wine, the volatility is asymmetric and, in contrast to that found for stocks, responds more to positive shocks than negative shocks.
[2] For further discussion on the selection of a wine price index, see Bouri (2013).

Figure 1

Stock and Wine Prices

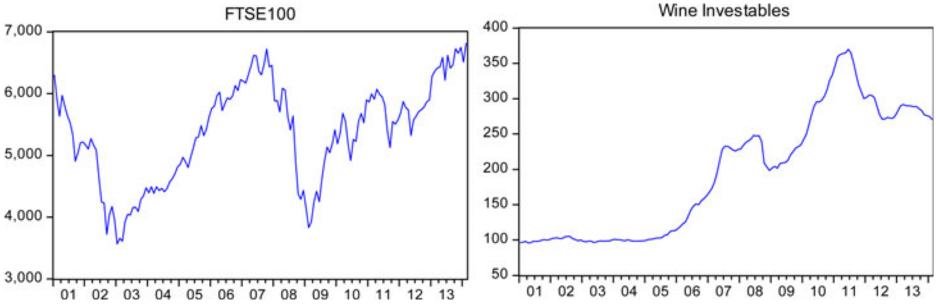
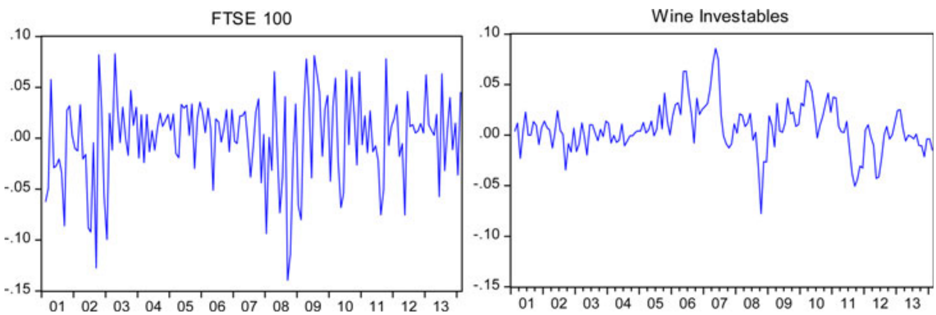


Figure 2

Stock and Wine Returns



offers, and transactions on the Liv-ex. The Fine Wine Investables Index consists of Bordeaux red wines from 24 leading châteaux that are chosen on the basis of ratings by Robert Parker, a leading critic. Parker gives wine numerical ratings on the basis of a score using a quality scale of 50–100-points, ranging from a vintage score of 50–59 for appalling wines to 96–100 for extraordinary wines. Figure 2 shows the return series for wine and stock prices. The continuously compounding monthly returns for each index are computed as the first difference of the logarithm of the market closing value of the index multiplied by 100.

B. Econometric Model

Given that the correlation matrix of financial asset returns is time-varying (Harris and Nguyen, 2013), it is crucial to employ a multivariate model that allows correlations to be positive, negative, or zero. The DCC-GARCH model developed by Engle (2002) can seize dynamic conditional correlations between several return series at various points in time (Celik, 2012). Furthermore, the DCC-GARCH model estimates correlation coefficients of the standardized residuals and therefore accounts for heteroscedasticity directly (Chiang et al., 2007). This solves the heteroscedasticity problem when estimating correlations, caused by volatility increases in times of market stress. In this view, the DCC-GARCH model provides a superior measure of correlation estimates compared to unconditional correlations, in which periods of high volatility can intensify concern over heteroskedasticity biases.

The DCC-GARCH estimates are based on a two-stage approach. First, we estimate conditional variances by using a univariate GARCH(1,1) model. Second, we estimate a time-varying correlation matrix using the standardized residuals from the first-stage estimation.

We model the mean equation of the DCC-GARCH framework with an ARMA (1,1) specification, which was sufficient to eliminate the substantial degree of autocorrelation in the returns (see the results of the Ljung and Box *Q*-statistics in Table 1). The mean equation is given by:

$$r_t = \mu_t + \omega\, r_{t-1} + \varphi\, u_{t-1} + u_t \tag{1}$$

where r_t is the vector of price returns for fine wine and UK equities, μ_t is the conditional mean vector of r_t, and u_t is a vector of residuals that are assumed to be conditionally multivariate normal.

The variance equation is given by:

$$h_t = c + a\, u_{t-1}^2 + b\, h_{t-1} \tag{2}$$

where h_t is the conditional variance; c is the constant; a is the parameter that captures the short-run persistence or the autoregressive conditional heteroskedasticity (ARCH) effect; b represents the long-run persistence of volatility or the GARCH effect.

The DCC(1,1) equation is given by Q_t, which is a square positive-definite matrix, such as:

$$Q_t = (1 - \alpha - \beta)\overline{Q} + \alpha\, u_{t-1}u'_{t-1} + \beta\, Q_{t-1} \tag{3}$$

where $\bar{Q}_t$ is the time-varying unconditional correlation matrix of u_t; u_t is a vector of standardized residuals obtained from the first-step estimation of the GARCH(1,1) process; α and β are parameters that represent, respectively, the effects of previous shocks and previous dynamic conditional correlations on current dynamic conditional correlation.

Following the DCC-GARCH estimation,[3] the time-varying correlations (between fine wine and the UK stock market) are extracted from the model into a separate

[3] For a detailed explanation on the GARCH DCC model and its estimation, see Engle (2002).

Table 1
Summary Statistics and Correlations of the Return Series

Periods	*2001–2014*	*2001–2003*	*2004–2006*	*2007–2008*	*2009–2014*
Panel A: Fine wine index					
Mean	10.178%	1.068%	23.557%	−0.925%	6.054%
Volatility	13.695%	4.379%	8.497%	12.623%	8.182%
Reward-to-risk	0.743	0.243	2.772	−0.075	0.739
Kurtosis	6.4065	0.652	0.526	9.934	−0.009
Skewness	−0.4053	−0.685	1.076	−2.859	−0.275
Jarque-Bera	22.218*	2.923	7.718**	58.090*	0.777
LB-Q (10)	168.64*	4.108	54.056*	7.799	93.041*
LB-Q^2 (10)	75.868*	6.599	31.680*	0.395	61.302*
ARCH LM (10)	52.009*	12.900***	39.808*	3.079	57.998*
ρ (wine & FTSE 100)	0.147	−0.086	−0.077	0.398	0.115
DCC (wine & FTSE 100)	−0.011	−0.032	−0.010	0.125	−0.003
Negative DCCs	132	34	36	7	55
Observations	157	35	42	18	62
Panel B: FTSE 100					
Mean	0.684%	−10.968%	11.125%	−26.593 %	8.305%
Volatility	14.681%	17.317%	7.002%	19.384%	14.452%
Reward-to-risk	0.047	−0.633	1.589	−1.372	0.575
Kurtosis	0.7455	−0.071	0.432	−0.230	−0.568
Skewness	−0.716	−0.422	−0.922	−0.540	−0.247
Jarque-Bera	15.768*	0.911	5.659***	0.909	1.589
LB-Q (10)	10.562	5.720	10.462	6.702	4.934
LB-Q^2 (10)	37.590*	16.86***	18.03**	4.210	3.598
ARCH LM (10)	35.781*	25.921**	30.932*	21.081**	22.390**
Observations	157	35	42	18	62

Notes: 2001–2014 represents the full sample period; 2001–2003 and mid-2007–2008 represent two bear market periods; 2004–mid-2007 and 2009–2014 represent two bull market periods; mean and volatility are reported on a yearly basis; LB-Q (Ljung and Box Q-statistics); ARCH LM (Engle Lagrange multiplier) heteroskedasticity test; ρ: unconditional correlation; DCC: dynamic conditional correlation; negative DCCs: the percentage of months for which the DCCs between wine and UK stocks is negative; for Jarque-Bera, Ljung and Box Q, and ARCH-LM tests, *, **, and *** indicate statistical significance at the 1%, 5%, and 10% levels respectively.

time series to assess the hedge and safe haven properties of fine wine. If fine wine acts as a *hedge* (*safe haven safe*) against movements in the UK stock market, the average of DCCs between the two assets is consistently negative or zero *for the entire sample* (*in times of stress*). We thus regress the DCCs on dummy variables (D), representing extreme movements in UK equities at the 10% (q_{10}), 5% (q_5), and 1% (q_1) quantiles of the most negative equity returns.

$$DCC_t = m_0 + m_1 D(r_{stock}\ q_{10}) + m_2 D(r_{stock}\ q_5) + m_3 D(r_{stock}\ q_1) + e_t \qquad (4)$$

where r_{stock} is the return of the FTSE 100 index, and e_t is the error term. Fine wines are a hedge if m_0 is zero or negative. Fine wines are a safe haven if the m_1, m_2, or m_3 coefficients are zero or negative.

Given that we run a regression on the conditional correlation coefficients obtained from the estimation of the DCC-GARCH model, the significance of the results may

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be overstated.[4] We therefore use a Monte Carlo simulation approach to correct any possible bias in the estimation of the regression model in Equation (4).

IV. Econometric Analysis

A. Descriptive Statistics

For the full sample and the subsamples, the descriptive statistics provide an insight into the diversification ability of investment in fine wine and allow the evaluation of its risk-return characteristics in comparison to UK equities. Table 1 shows the statistical properties of the return series for both the Fine Wine Investables and the FTSE 100.

(1) The Full Sample

During the full sample period, the mean returns of both indices are positive, however, wine has the highest mean return. Moreover, the wine index has the lowest volatility (13.695%), suggesting that the wine market is more stable than the UK stock market. The wine market has by far the highest reward-to-risk ratio (0.743). Both returns series are leptokurtic, and the Jarque and Bera (1980) statistics conclusively rejected the null hypothesis of normality in the return distribution at the 1% significance level. The Jarque-Bera test measures the departure from normality of a sample, based on skewness and kurtosis. Based on the Ljung and Box (1979) Q-statistics and their *p*-values, we reject the null hypothesis of zero correlation in wine returns and residuals of wine returns as well as in the residuals of returns for UK equities. Furthermore, the heteroskedasticity in the residuals of the returns are omnipresent in all series, as suggested by the results of Engle's Lagrange multiplier (LM) test. Such data characteristics justify the appropriateness of using a GARCH-type model that can model time-varying conditional volatility and eliminate the presence of autocorrelations and heteroskedasticity in the data.

Another remarkable point derived from Table 1 is that the DCCs differ slightly from the unconditional correlations. The DCCs are negative for at least 84.08% (132/157) of the sample months. This implies that an increase in the price of wine is often associated with a decline in the value of the FTSE 100, suggesting that the introduction of fine wine to a portfolio of UK stocks can reduce portfolio volatility considerably.

(2) Analysis of Subsamples

Looking at the subsamples, it is clear that the wine index outperforms the FTSE 100 based on reward-to-risk relationship, except for the bull market period of 2009–2014. Accordingly, the two bear market periods (2001–2003 and 2007–2008) did not prevent wine from offering a better reward-to-risk ratio. Although during one of

[4] We thank the reviewer for raising this point.

the two bull market periods fine wine underperforms the FTSE 100, in times of stress it considerably outperforms UK equities. In particular, wine provides positive returns during the bear market period 2001–2003. The volatility of wine returns is lower in almost all subsamples, in particular during the global financial crisis. While both wine and UK equity prices fall during the global financial crisis of 2007–2008, the wine index outperforms the FTSE 100 and experiences much less volatility. The DCCs are negative in almost all subsamples. The DCC becomes lower in the bear market period 2001–2003 compared to the full period, whereas during the global financial crisis it rises sharply (0.125). This implies a significant possibility of risk reduction in a portfolio that includes fine wines and UK equities.

The descriptive statistics in Table 1 implies that wine is superior to traditional assets such as stocks in that it is less volatile and has higher risk-to-reward ratio. Zero or negative correlations with UK equities also show that fine wine is valuable due to its diversification potential for investors who hold a portfolio of UK equities. Our analysis indicates that there is weak variation in the hedge or safe haven characteristics of fine wine across bull and bear market periods.

While this analysis of DCCs is more than informative for understanding the relationship between fine wine and UK equities, it would be useful to determine whether fine wine provides protection against extreme price changes in UK equities. We thus analyze the results of the econometric model.

B. Econometric Results

We estimate the ARMA(1,1) model, which corrects for the autocorrelation of the residuals in the DCC mean equation (1). An ARMA (1,1) model is sufficient to eliminate the substantial degree of autocorrelation in the returns.

The optimal number of lags for the GARCH model was chosen on the basis of Akaike and Schwarz information criteria. Accordingly, the GARCH (1,1) was found to be the best fit for estimation of univariate GARCH models for the data series. Furthermore, a comparison of the likelihood values across alternative lag specifications implies that the DCC (1,1) is the best choice. Table 2 reports estimation results for the DCC (1,1) GARCH (1,1) model for wine and UK equity prices. The mean equation parameters are generally significant. Similarly, GARCH parameters are all statistically significant at conventional levels. For each market, the estimated ARCH parameter is much smaller than the estimated GARCH parameter, implying that own long-run volatility persistence is larger than short-run persistence. The sum of ARCH and GARCH are close to one, suggesting that both univariate GARCH processes show a high degree of persistence. As for the DCC parameters, α and β are significant, reflecting time-varying correlations. Furthermore, the sum of the two coefficients is less than one, satisfying the condition that $\alpha + \beta < 1$.

While most of the coefficients in the mean, variance, and DCC equations are generally significant and the equations are well specified, we do not elaborate here on the

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Table 2
Estimation Results of the DCC-GARCH Model

	Wine return	*UK equity return*
First step: univariate GARCH parameters		
1. Mean equation		
Constant (μ)	0.000	0.000
	0.090	**0.005**
Ω	0.207	0.549
	0.000	**0.000**
φ	0.098	−0.075
	0.021	**0.095**
LB-Q (10)	5.900	7.023
LB-Q^2 (10)	17.835***	12.908
2. Volatility equation		
Constant (c)	0.000	0.000
	0.012	**0.250**
a	0.032	0.189
	0.000	**0.000**
b	0.905	0.772
	0.000	**0.000**
Second step: DCC parameters		
α	0.075	
	0.035	
B	0.822	
	0.021	
Diagnostics		
χ^2 test: $R_t = R$	8.717	
	0.009	
Log likelihood	1 022.935	

Notes: The estimations results are based on the DCC-GARCH model; LB-Q (Ljung and Box Q-statistics); probability values are in boldface; The χ^2 test assesses the null hypothesis of constant conditional correlation; *** indicates statistical significance at the 10% level, for Ljung and Box Q tests.

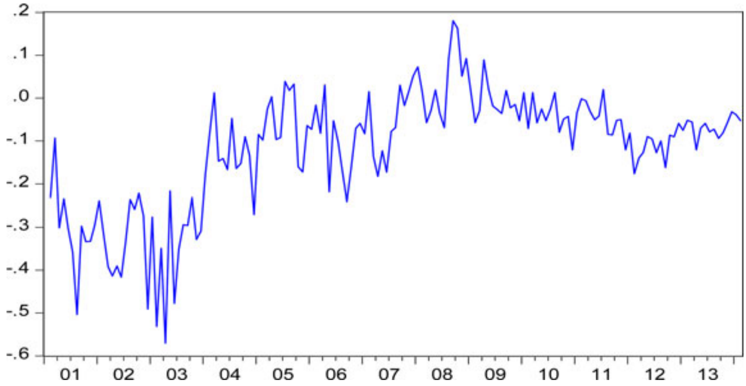
DCC-GARCH results. The purpose of DCC modeling, however, is not to derive estimates of the equations but to use them as inputs for assessing the hedge and safe haven properties of fine wine.

Prior to presenting the estimation results of the regression model specified in equation (4), in Figure 3 we show the dynamic conditional correlation[5] between fine wine and UK equities, extracted from the DCC-GARCH model into a separate time series. The time-varying correlation (see Figure 3) implies that the DCC-GARCH model provides a large amount of new information compared with the constant conditional correlation model of Bollerslev (1990). In this regard, the results of Engle and Sheppard (2001) χ^2 test indicate evidence against the assumption of constant

[5] The optimal number of lags for the GARCH DCC model was chosen on the basis of Akaike and Schwarz information criteria. Furthermore, a comparison of the likelihood values across alternative lag specifications implies that the GARCH (1,1) DCC (1,1) is the best choice.

Figure 3

Dynamic Conditional Correlation (Wine and UK Stocks)



conditional correlations, suggesting the appropriateness of the use of the DCC-GARCH model in the analysis of the return series. By testing the null hypothesis of $R_t = R$, the χ^2 test examines whether the DCC-GARCH model is appropriate or the constant conditional correlation model of Bollerslev (1990) is a better choice.

However, it is interesting to note that the DCCs are negative during the bear market period 2001–2003, suggesting that fine wine is a hedge against the decline in UK equities. While the DCCs remain negative for most of the bull market period 2004–2006, they oscillate around zero, presumably due to the impact of the global financial crisis. This implies that there were benefits from diversification even during periods of high volatility and market uncertainty, when they are most needed by investors. The relation then becomes negative during most of the bull market period 2009–2014. These noteworthy points add to the findings of Masset and Henderson (2010) and Masset and Weisskopf (2010), which show a weak correlation between fine wine and stocks.

In order to provide more feasible evidence, we assess the ability of fine wine to act as a hedge and safe haven against UK equities downside risk.

Panel A of Table 3 presents the estimates of the regression from equation (4). The DCC coefficients are regressed on a constant (m_0) and three dummy variables (m_1, m_2, m_3), representing extreme movements in UK equities in the negative 10th, 5th, and 1st quantiles of the return distribution. The model constant (m_0) shows a negative relationship between fine wine and UK equities, with significance at the 1% level. This implies that fine wines are a good hedge against UK equity risk. In addition, the regression coefficient for safe haven (m_1) is significant at the 10% significance level, implying that fine wines are a safe haven within the 10% stock quantile. In the 5% and 1% quantiles, however, fine wines are not a safe haven, as shown by the positive

Table 3
Fine Wine as a Hedge and Safe Haven Against UK Equities

	Fine Wine
Panel A: Regression results	
Hedge (m_0)	−0.112*
10% UK equity quantile (m_1)	−0.072*
5% UK equity quantile (m_2)	0.003
1% UK equity quantile (m_3)	0.081
Panel B: Simulation results	
Hedge (m_0)	−0.098*
10% UK equity quantile (m_1)	−0.059**
5% UK equity quantile (m_2)	0.012
1% UK equity quantile (m_3)	0.107

Note: * and ** indicate statistical significance at the 1% and 5% levels respectively.

and insignificant coefficients of m_2 and m_3. The safe haven property of fine wines may provide an additional benefit to UK stock investors beyond a long-term hedge. Accordingly, fine wine reduces risk during periods of extreme price movements in UK equities. Our results complement the work of Bouri (2014), who found that wine investment can provide protection against overall downside risk in the stock market.

I use a Monte Carlo simulation to provide much more accurate coefficient estimates of hedge and safe haven effects than the regression estimates considered in equation 4. After performing a Monte Carlo experiment involving 1,000 replications on the estimation results, we show that the initial parameters are accurate and unbiased. As shown in Panel B of Table 3, the Monte Carlo simulation produces, on average, coefficient estimates similar to those reported in Panel A of Table 3.

C. Robustness Analysis

In order to examine the robustness of our findings, we test whether our results are robust to alternative specifications. We consider alternative definitions of the crisis period and several benchmarks (Morgan Stanley Capital International [MSCI] world, bonds, commodities, and other wine indices).

First, we focus on the hedging and safe haven characteristics of fine wines during the global financial crisis by estimating the model:

$$DCC_t = m_0 + m_1 D(\textit{financial crisis}) + e_t \tag{5}$$

where D is a dummy variable that has a value of one during the crisis period and zero otherwise. The DCCs are regressed on a constant and a dummy variable to test fine wine as a hedge and safe haven asset against UK equities. Fine wines are a hedge if m_0 is zero or negative. Fine wines are a safe haven if m_1 is zero or negative.

Table 4
Fine Wine as a Hedge and Safe Haven During the Global Financial Crisis

	Fine wine during crisis period 1	*Fine wine during crisis period 2*
Hedge (m_0)	−0.017	−0.025**
Safe haven (m_1)	0.135	0.108

Note: Crisis period 1 (March 2008–March 2009); crisis period 2 (July 2007–March 2009); ** indicates statistical significance at the 5% level.

We consider two alternatives definitions of the period of the crisis (D). In the first definition, the crisis period runs from March 2008, following the collapse of Bear Stearns, to March 2009, when the bear market ended. In the second definition, the crisis period spans from July 2007, when the subprime crisis started, to March 2009. Table 4 provides the estimates of the regression model in equation (5). Using a first alternative crisis period from March 2008 to March 2009, the model constant m_0 is negative but insignificant, suggesting that fine wines are not a hedge against UK stock risk. Using a second alternative crisis period from July 2007 to March 2009, we find significant results supporting the hedging role of fine wine. In both alternative definitions of the crisis period, however, the insignificant coefficient of the model dummy m_1 suggests that fine wine is not a safe haven.

Second, we consider several benchmarks (MSCI world index as a proxy for international stocks,[6] Citigroup U.S. Broad Investment-Grade (USBIG) index as a proxy for the overall bond market, and Standard & Poor's Goldman Sachs (SPGS) commodity index as a proxy for the commodity market). Such a comparative analysis is needed because hedge and safe haven properties of fine wines may differ across assets. The estimation results of the regression models are presented in Table 5. Fine wine is a hedge for international stocks, bonds, and commodities at the 10% significance level. In addition, fine wine is a safe haven for international stocks and commodities at the 10% quantile at a significance level of 10%. Overall, the results are somewhat consistent with the hedge and safe haven argument. However, the strength of the hedge and safe haven effects varies across assets.

Finally, we investigate the sensitivity of our empirical results to sample composition (Table 6) using: (1) all the data available on the Fine Wine Investables Index since 1988, (2) another index of monthly wine prices—the Liv-Ex 1000 index, and (3) the daily version of the Liv-Ex 50 index.

Using full historical data on the Liv-ex Fine Wine Investables Index, our estimation results support those obtained for the sample period 2001–2014. Using the Liv-Ex 1000 index, likewise, the overall results we obtained do not change significantly from those reported in Tables 1 and 3. If anything, the hedge and safe haven terms are slightly stronger for the Liv-Ex 1000 index return series. However, the results

[6] We converted the dollar-denominated MSCI World Index from U.S. dollars to pounds sterling.

Table 5
Fine Wine as a Hedge and Safe Haven Against Different Benchmarks

	International stocks	*Bonds*	*Commodities*
Hedge (m_0)	–0.057**	0.005***	–0.009**
10% UK equity quantile (m_1)	–0.023***	–0.009	–0.012***
5% UK equity quantile (m_2)	–0.012	–0.002	0.005
1% UK equity quantile (m_3)	0.068	0.077	0.095

Notes: International stocks are represented by the MSCI world index, bonds are represented by the USBIG index, commodities are represented by the SPGS commodity index; ** and *** indicate statistical significance at the 5% and 10% levels respectively.

Table 6
Fine Wine as a Hedge and Safe Haven Against UK Equities – Sensitivity Analysis

	Monthly Liv-Ex Investables Index (Full sample: 1988–2014)	*Monthly Liv-Ex 1000 index (2004–2014)*	*Daily Liv-Ex 50 index (2010–2014)*
Hedge (m_0)	–0.140*	–0.125*	–0.079**
10% UK equity quantile (m_1)	–0.088*	–0.095*	–0.084
5% UK equity quantile (m_2)	–0.007	–0.023	0.014
1% UK equity quantile (m_3)	0.075	0.059	0.120

Note: This table presents the estimates of the regression from equation (4); * and ** indicate statistical significance at the 1% and 5% levels respectively.

obtained from the use of daily wine prices, available since February 26, 2010, do not support those obtained for the data in the Fine Wine Investables Index full history or the Liv-Ex 1000 index. Only the hedge term is significant at the 5% level. This specific result highlights the fact that investors are heterogeneous. Short-term investors typically focus on low frequency return series for wine and stocks, whereas long-term investors focus on higher frequency return series. The long-term view of market participants in the wine market makes less critical the inability of fine wine to provide a safe haven against UK equities *daily* returns.

V. Conclusion

The recent behavior of the fine wine market compared to conventional assets has increased the need to examine its hedge and safe haven properties and the related implications for portfolio diversification. Therefore, we focused on time-varying conditional correlations between fine wine and UK equity markets. While previous research automatically assumed the perspective of a U.S. investor (Masset and Weisskopf, 2010), we focused on UK investors, given that most fine wine investment funds are located in the United Kingdom. We thus analyzed monthly returns from January 2001 to February 2014 for fine wine and UK equity prices using the

DCC-GARCH model. The regression analysis provided noteworthy relations on the extent to which fine wine can act as a hedge and a safe haven. Our empirical results indicated a negative dynamic conditional correlation between fine wine and the UK stock market, suggesting the effectiveness of using fine wine as a hedge. With different methodology, this finding corroborates previous studies showing the significant diversification benefits from adding wine to a portfolio comprising stocks (Bouri, 2014; Fogarty, 2010; Kourtis et al., 2012; Masset and Henderson, 2010; Masset and Weisskopf, 2010). However, during periods of extreme stress, fine wine was a very weak safe haven against the UK stock market risk. Several robustness tests largely support our empirical findings.

It should be noted that the dataset used for this study holds one major limitation that might diminish the strength of the conclusions: We relied only on a weighted average method to construct wine price indices and thereby used Liv-ex indices in this study. But there are alternatives to the Liv-ex indices, such as more common wine price indices, constructed using the hedonic or the repeat sales regression method.

Our empirical results are important for financial market participants and portfolio managers for hedging strategies and for building an optimal portfolio in times of market stress. However, a word of caution is warranted regarding liquidity in the wine market. Investors have to be very prudent in dealing with wine investments, which are less financially liquid than stocks and bonds. To some extent, fine wines were limited to institutional investors and high-wealth clients. After the establishment of the London International Vintners Exchange (Liv-ex) in 1998 as well as emergence of specialized wine investment funds later, the issue of liquidity became less problematic (Bouri, 2014). Nevertheless, there is still a gap when compared to more conventional assets. The re-emergence of derivatives on wine prices might be able to satisfy the needs of market participants who are interested in adding wine to their portfolio. This will open the door to extending this research to analyze futures and options markets.

Supplementary Material

For supplementary material accompanying this paper visit https://doi.org/10.1017/jwe.2015.10.

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