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French Wines on the Decline? Econometric Evidence from Britain

Bodo Steiner[1]

French wines, differentiated by geographic origin, served for many decades as a basis for the French success in the British wine market. However in the early 1990s, market share began to decline. This article explores the values that market participants placed on labelling information on French wines in Britain in 1994. Results from a parametric hedonic approach indicate that both the lack of a consistently positive valuation of varietal wines and the low valuation of wines with geographical appellation help to explain the overall decline of France's role in the British wine market.

1. Introduction

Despite the large array of geographical labels and a stringent approach to labelling, French wines with geographical appellation were, for many decades, successfully marketed in Britain and other markets. Since 1992, however, France's overall market share in the British wine market has declined, and it has become questionable whether French wines based on geographic appellation have been able to meet the expectations of the current generation of wine consumers in Britain. In response to the decline, French producers have adopted new labelling approaches for a limited number of regional wines and a number of questions arise in this context. First, has the French expansion of, and emphasis on, varietal wines during the early 1990s been able to mitigate the overall decline of French wine in the British wine market?[2] Second, how did consumers value these new varietal wines relative to the traditionally labelled AOC wines (as epitomised, for example, by the wines from the Bordeaux region)?[3]

This article analyses the values that market participants place on the labelling information provided by French wine labels of still light wine in the British off-licence sector.[4] The British wine and off-licence market is of particular interest for

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2 'Varietal' refers to the descriptive term for a wine named after the dominant grape variety from which it is made. Any wine produced in the European Union (EU) that mentions a grape variety on the label must contain at least 85% of that variety.

3 AOC denotes 'Appelation d'Origine Contrôlée' and stands for the highest wine classification a French wine can attain. Though the requirements may vary from one region to another, they are very tightly defined, particularly in terms of grape varieties and maximum yield per hectare permitted.

4 As explored below, the off-licence sector is characterised by the fact that wine is consumed outside the premises in which it was purchased (*e.g.* retail outlet). Still light wine is defined as the product obtained exclusively from the total or partial alcoholic fermentation of fresh grapes or fresh musts, with a total alcoholic strength usually not exceeding 15% volume.

at least three reasons. First, Great Britain has become renowned for its expertise in selecting, importing, bottling and cellaring wine. The prosperous wine trade of French wine from Bordeaux began in 1152, and prior to the re-unification of Germany, the UK was the world's largest wine importer in terms of value (1990: £993.3 million, Spahni, 2000). UK imports of still light wine were responsible for 34% of the total wine imports of the EU in 1993 (by value). Second, since Britain has never produced much wine of its own, consumers have traditionally been exposed to a large variety of wines from many origins.[5] Third, the emergence of supermarkets as the most crucial retailing channel for wine has resulted in intensified competition among distributors and the restructuring of many specialist shops (Spahni, 2000, p.187). Using observed consumer choices of heterogeneous bundles of labelling attributes for wine, this paper employs hedonic price analysis to explore the implicit valuation that market participants place on labelling attributes.[6]

Several recent studies on wine have applied hedonic price analyses, among them Golan and Shalit (1993), Oczkowski (1994), Nerlove (1995) and Combris *et al.* (1997). In Golan and Shalit's (1993) study on hedonic grape and wine pricing, the authors aim to identify and evaluate the wine quality characteristics of Israeli grapes. By estimating the relative contribution of grape characteristics to wine quality, and using the monetary values from the Californian market, the authors are able to provide a producer pricing schedule for Israel. This quality-based pricing schedule is derived to reduce the production of poor-quality wines, by giving Israeli farmers an appropriate incentive to supply higher quality grapes.

Based on recommended retail prices for Australian premium table wine, Oczkowski (1994) identifies the implicit valuation of wine attributes for consumers and retailers. On the producer side, the author suggests that the hedonic functions estimated provide important information upon which longer-term investment decisions may be made. Oczkowski (1994) includes dummy variables for producer size in the hedonic regression and argues that this allows for two effects. First, for possible pricing strategies and second, as measuring the characteristic of 'exclusiveness'. That is, some consumers desire particular wines from small producers because of their limited availability, rarity and 'trendiness'. The author's innovative approach to the underlying dummy variable model permits explicit estimation of coefficients for all dummy variables.

In contrast to previous hedonic analyses, Nerlove (1995) assumes that variety prices are exogeneously determined and consumer preferences are expressed by the quantities of each variety they buy. His assumption that the state-owned Swedish retail monopoly does not exercise any monopsony power leads him to take variety supplies as perfectly elastic for the group of consumers being considered. Therefore, the quantities of each variety consumed are regressed on the variety's

[5] The percentage volume shares of both British and English still light wine sales were below 3% in 1992 (CFCE, 1994). Wine grown and made in England is called English wine, whereas wine made in Britain from imported concentrate is called 'British wine' or 'British made wine'.

[6] The fact that hedonic analysis has been applied to a large field of quality-related issues is largely due to the work of Zvi Griliches and Sherwin Rosen (*inter alia* Griliches, 1961 and 1971;Rosen, 1974). Using the generalised commodity approach to demand analysis, Houthakker (1952) was first to present the hedonic function as a market phenomenon.

price and on the quality attributes which characterise that variety. Estimates of the implicit valuations of quality attributes are shown to differ greatly from those obtained from the classical hedonic regression with price as the dependent variable.

Combris *et al.* (1997) apply a stepwise regression procedure to investigate whether quality matters in explaining Bordeaux wine market prices. The authors suggest that for their data set, quality, as measured by a jury grade assigned by professional wine tasters is mainly explained by the 'subjective' sensory characteristics of the wine, which are unobservable when consumers choose the wine. Implicit price estimates are derived from data of a wine tasting panel that is unable to observe any of the 'objective characteristics' (grape variety, vintage year *etc*.), including price, of the wines they judge. Comparing these jury grades with hedonic estimates of labelling attributes, the authors conclude that many variables, which are important in explaining quality, do not play a role in the determination of market prices. The authors explain their findings with taste differences between wine tasters and consumers and imperfect information on the wine consumers' behalf.

More generally, labelling issues and the degree and value of product attribute information have been addressed by several recent papers in the literature. In the context of international trade and economic growth, Basu *et al.* (2003) examine the effectiveness of eco-labels in providing a market-based solution to the under-consumption of eco-friendly products in developing and developed countries. Nimon and Beghin (1999) examine the implications of eco-labelling schemes on consumer choice sets and product quality in the textile and apparel trade. Mahé (1997) and Bureau *et al.*(1998) investigate the role of information on quality attributes and the role of quality labelling in the process of agricultural trade liberalisation and calculate the welfare effects from such de-regulation. Marette *et al.* (1999) analyse the impact of certified quality labelling on welfare when common labelling schemes matter and asymmetric information is present. Bureau *et al.* (2001) investigate the informational role of quality labelling for trade policy and welfare when adverse selection matters due to the presence of food hazard risk. In a vertical differentiation model, Ibanez and Stenger (2000) investigate the efficiency of labelling, emphasising food safety as a means of reducing negative production externalities and raising consumer welfare. By expanding an AIDS model to include information effects and demographic characteristics, Teisl and Levy (1997) show that nutrient labelling can affect consumer purchase behaviour in significant ways. Van der Lans *et al.* (2001) employ a conjoint analysis to show that Protected Designation of Origin (PDO) labels have no direct effect on consumer preferences in the case of olive oil. Bonnet and Simioni (2001) use a mixed logit model of demand to recover the distribution of consumers' willingness-to-pay for labelled cheese (Camembert), and to demonstrate that consumers do not value the quality signal provided by PDO labels for these French cheeses.

Our analysis contributes to the existing hedonic price literature on wine markets in the following ways. First, we expand the dummy variable approach that was pioneered by Kennedy (1986) and Oczkowski (1994) to obtain a distinct and comparable contribution of each attribute to the variation of prices. The econometric approach addresses heteroscedasticity explicitly by using a General Least Squares (GLS) estimator. Second, in contrast to Combris *et al.* (1997) we do not rely on sensory characteristics, but use attributes that can be observed by

consumers through the label (grape variety, vintage year *etc*.). Third, in contrast to previous hedonic studies related to wine, we do not rely on recommended retailer prices, but rather on actual retail prices. This has significant implications since many wines sold in the off-trade are sold by way of promotional discounts. The empirical study uses a survey comprising actual retail prices of 7062 bottles of still wine, identified by 'objective' labelling attributes (region of origin, vintage *etc*.).

Section 2 provides relevant background information to the British wine market. The theoretical framework for describing agents' valuation of wine attributes is developed in section 3.1. Section 3.2 introduces the empirical model specification and is followed by a discussion of the data (section 3.3) and the functional form (section 3.4). Section 3.5 discusses the data analysis and specification search. Finally, section 3.6 provides an empirical assessment of the postulates from the above. Section 4 concludes.

2. The British Wine Market

The right to sell alcoholic beverages in the UK is linked to two types of licence: the 'off-licence', where the product is consumed outside the premises in which it was purchased (*e.g.* retail outlets), and the 'on-licence' where alcohol is consumed *in situ* (*e.g*. pubs, clubs and restaurants). [7] The structure of the off-licence trade is such that two main commercial categories can be distinguished: those firms who only have wines and other alcoholic drinks on offer (the 'wine specialists') and others, for which wine is only part of their product range (the grocery-multiples). Amongst the former category, the independent specialists can be distinguished from those belonging to breweries or other groups. The grocery-multiples include independent food retailers, large general retailers (*e.g.* Marks and Spencer) and Co-ops. With more than 45,000 points of sale and 70% (by value) of total wine sales in 1993, the off-licence sector dominates the wine market in the UK. Within the off-licence sector, France, Germany, and Italy held traditionally the largest market shares (Table 1).

In recent years however, there has been a decline in the popularity of wine from these sources. The combined volume share of imported wine from France, Germany, Italy and Spain, declined from 89% in 1983 to 78% in 1993 and 71.5% in 2000 (DWI, 2002). French volume shares of total light wine in the off-licence sector alone, declined from 29% in 1992 to 23% in 2000 (CFCE, 2001).

In order to explore the relative performance of French varietal and appellations wines in more depth, we first need to consider the French classification system. For French wines, the European classification scheme for 'quality wines that are produced in certain regions' (VQPRD) contains both AOC wines and 'high-quality wine from an approved regional vineyard' (VDQS).[8] The varietal wines are to be found in the non-VQPRD wine category, which consists of table wine ('Vins de table') and country wines ('Vins de pays').

[7] Sales beyond those in the off- and on-licence market can be attributed to catering and sales by mail.

[8]. VQPRD denotes 'Vins de Qualité Produits dans des Régions Déterminées', whereas VDQS denotes 'vins délimités de qualité supérieure'. Compared to the AOC wines, the laws for VDQS are often less stringent on yields and grape varieties, yet all VDQS wines have to undergo an official tasting.

Table 1: Country Shares of Still Light Wine Sales in the Off-licence and On-licence Trades (1992, percentage of volume)

	Off-licence	On-licence
France	28.8	52.2
Germany	25.8	28.0
Italy	18.1	10.2
Spain	5.5	1.6
Bulgaria	4.5	0.5
Australia	4.3	1.7
UK (British & English)	2.7	0.1
Yugoslavia	2.0	1.7
Portugal	2.0	0.6
USA	1.9	0.4
Hungary	1.5	0.0
EU blends	0.3	0.5
Other origins	2.6	2.5
Total	100.0	100.0

Source: CFCE, 1994

This country wine category (which consists of three distinct categories) contains the majority of varietal wines.[9] In the British off-licence trade in 2000, 61% of varietal wines were from the 'country wine' category (CFCE, 2001). To understand how these wine categories evolved during the 1990s consider Figures 1 and 2 which show total sales of French varietal wines (non-VQPRD from France) and total sales of French wines with geographic appelation (French VQPRD wines) in Britain.

Whereas French varietal wines have sustained their sales and have recorded a slow but steady growth since 1995 (Figure 1), only a slight upward trend is apparent for French wines with geographic appellation (Figure 2). Nevertheless, French wines with geographic appellation appear to have performed better than geographic appellations from other origins (Figure 2). However, comparing non-VQPRD wines from France with non-VQPRD from other origins (Figure 1), it is apparent that varietal wines from other countries have been far more successful than varietal wines from France. Whereas sales of non-VDPRD wines from other origins more than tripled between 1991 and 1998, the growth of French non-VDPRD wines was modest over the same period.

Figure 1: Sales of Non-VQPRD Wines in Britain

[9] The country wine category consists of 'Vins de pays de département', 'Vins de pays de petite zone' and 'Vins de pays de région'.

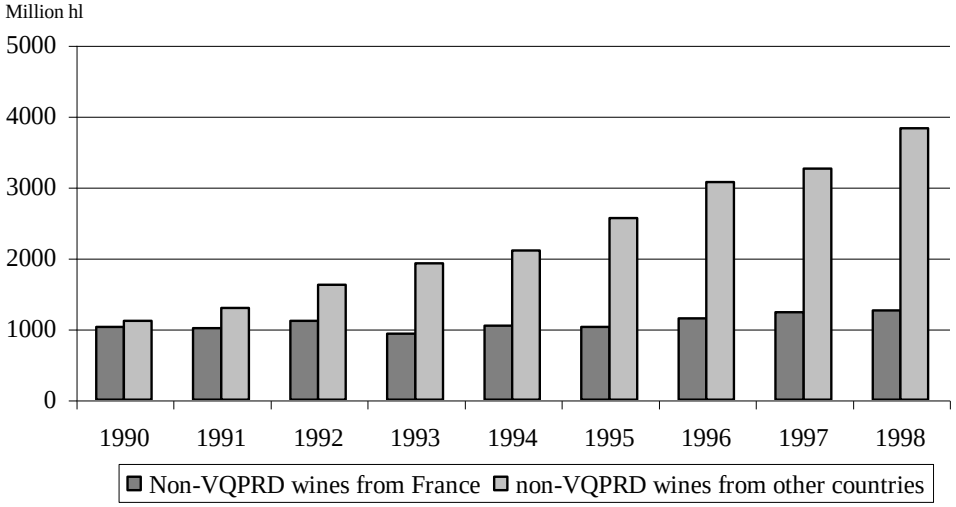
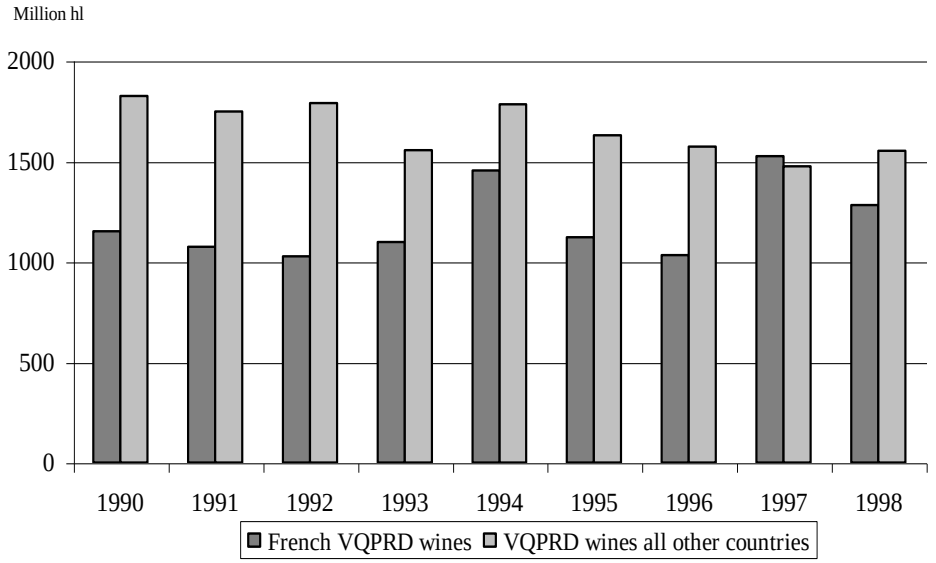


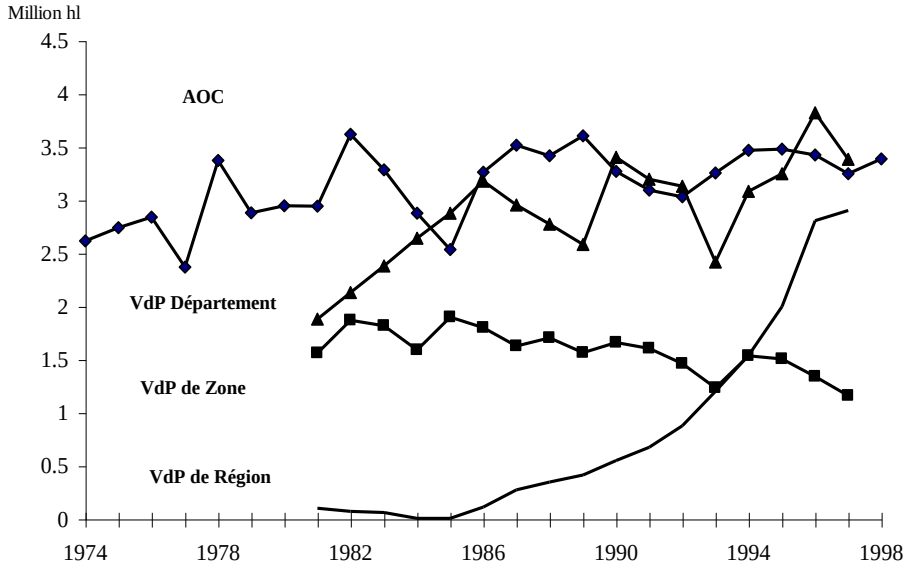
Figure 2: Sales of VQPRD Wines in Britain



Source: Onivins (2003)

Since the country wine category (VdP) is that category in which most varietal wines are found, and since most varietal wines which are sold off-licence in the UK originate from the region of Languedoc-Roussillon (86% by volume in 2000, CFCE, 2001), consider the evolution of production of varietal wines versus AOC wines in this region. Figure 3 displays the production of AOC wines, VdP from Languedoc-Roussillon, 'VdP de petite zone' and 'VdP de région'.

Figure 3: Production of VdP and AOC Wines from Languedoc-Roussillon



Source: Veille International Vins et Spiritueux (CFCE, various Issues)

The most striking change is for wines from the 'VdP de région', which has shown impressive growth since the 1980s.[10] It is therefore instructive to enquire whether these supply-side changes reflect British consumers' valuation of varetial wines *per se* or simply those from the Languedoc, and the degree to which this has been at the expense of AOC and varietal wines from other French origins. The following empirical analysis seeks to shed light on this issue and in so doing, contribute to our understanding of the declining importance of French wines in the British wine market?

3. Application of the Hedonic Framework to Wine Labelling

3.1 Theory

In Rosen's (1974) model of product differentiation, upon which this paper relies, the market notion of hedonic prices, as initiated by Houthakker (1952), is developed. Hedonic prices are defined as the implicit prices of attributes as they are revealed by economic agents from observed prices and the specific amounts of those characteristics which are associated with each observed price. What is being estimated in Rosen's (1974) description of a competitive equilibrium is the locus of intersections of the demand curves of different consumers with varying tastes and the supply functions of different producers with possibly varying technologies of

[10] In order to replace poor quality varietals, more than 200.000 hectares were uprooted in Languedoc-Roussillon during the 1970s.

production. The implicit estimated prices give us, therefore, the implicit marginal valuation that consumers and producers place on labelling attributes.

We consider that wine sold at the retail level can be characterised by n observed labelling attributes, such that a bottle of wine is described by a vector of wine attributes $x = (x_1,...,x_n)$ and a corresponding price $p(x) = p(x_1,...,x_n)$, which is defined at each point in the attribute space. Given consumer preferences over m other goods, $z_1,...,z_m$, and assuming that the utility function U is concave with respect to wine and other goods, we envisage a consumer that is maximising utility over the composite good x and other goods, subject to a non-linear budget constraint.

Further, we assume that agents cannot trade wine attributes directly since attributes are bundled within a wine bottle. Due to the bundling of characteristics in terms of goods, there may not be enough trading possibilities (say, certain grape varieties can only be grown in certain regions). Thus, equilibrium prices may not be linearly decomposed in the Lancaster (1966) sense and a mutually advantageous trade in goods may not be possible, with the result that marginal utilities may not be proportional in equilibrium. Given that attribute packages may not be untied, yet perfect divisibility in both product and attribute markets is satisfied, we expect that the hedonic price function is convex in equilibrium (Jones, 1988).

Rosen (1974) shows that in the case where only one unit of the good is purchased and where production sets of the goods are convex with a non-empty interior, marginal analysis can proceed. However, he emphasises that where perfect divisibility in production cannot be justified, generalisation has to incorporate non-convexities and account for discontinuities (p.54). Thus, only when isolated locations on the attribute surface are filled, can non-marginal decisions be addressed in markets where pure competition is absent. In the case of the British wine market, we assume that perfect competition prevails amongst retailers and that no discontinuities apply. However, we acknowledge that this will be an approximation since production sets of wine attribute bundles may be non-convex due to the inability of producers (and retailers) to supply a continuous range of attribute combinations to consumers.[11]

3.2 Empirical model specification

Due to the nature of the data, which are binary (*i.e.* the attribute is present or not), and due to the necessity to retain comparability across attributes, our variables undergo a modification that changes the interpretation of the estimates produced. As a result of this modification, and after adjusting the coefficient estimates with the estimated variances, the correct interpretation is that the coefficients measure the relative impact on the dependent variable (the unit price evaluated at the sample means) in the presence of the attribute *ceteris paribus*.

[11] A strict interpretation of continuity would refer to choice sets, which have infinitely many products that span a continuous spectrum in attribute space.

From theory we expect that non-linear functional forms provide an appropriate specification, although the choice of the functional form for the hedonic price function should remain an empirical matter. Considering a semilogarithmic (log-lin) model, we follow Kennedy (1981) and Goldberger (1968) to obtain a dummy variable coefficient estimate g , such that

$$g^* = \exp\left(\hat{c} - \frac{1}{2}\hat{V}(\hat{c})\right) - 1 \tag{1}$$

where $\hat{V}(\hat{c})$ is an estimate of the variance of $(\hat{c})$, the estimated coefficient of the dummy variable. Further, we rely on a procedure for adjusting dummy variable coefficient estimates that does not result in the discarding of variables from the equation (Suits, 1984). Following Suits (1984), who interprets the estimates as deviations from average behaviour, we impose identifying restrictions, but instead of employing Kennedy's (1986) laborious extension of Suits (1984), we expand on Oczkowski (1994), and substitute the full constraint into the initial equation.[12] Then, following symmetrical estimation, it is possible to obtain all coefficient estimates. The following example illustrates the procedure. If, for example, the objective is to obtain coefficient estimates for wine colours (red, white, rosé: C_1, C_2, C_3) and, say, three producer regions (R_1, R_2, R_3), the constraints can be substituted as following:

$$\begin{aligned} &\alpha_1 Pc_1 + \alpha_2 Pc_2 + \alpha_3 Pc_3 = 0 \\ &\alpha_1 = [-(\alpha_2 Pc_2)/Pc_1 - (\alpha_3 Pc_3)/Pc_1] \end{aligned} \tag{2}$$

where Pc indicates the mean, hence the proportion of non-zeros in the colour categories for each bottle of wine. Also,

$$\begin{aligned} &\beta_1 \mathrm{Pr}_1 + \beta_2 \mathrm{Pr}_2 + \beta_3 \mathrm{Pr}_3 + \beta_4 \mathrm{Pr}_4 = 0 \\ &\beta_2 = [-(\beta_1 \mathrm{Pr}_1)/\mathrm{Pr}_2 - (\beta_3 \mathrm{Pr}_3)/\mathrm{Pr}_2 - (\beta_4 \mathrm{Pr}_4)/\mathrm{Pr}_2] \end{aligned} \tag{3}$$

where, Pr reflects the proportion of non-zeros in the region categories for each bottle of wine. This, substituted into the initial equation, gives

$$\begin{aligned} P = {} & [-(\alpha_2 Pc_2)/Pc_1 - (\alpha_3 Pc_3)/Pc_1]C_1 + \alpha_2 C_2 + \alpha_3 C_3 + \beta_1 R_1 \\ & + [-(\beta_1 \mathrm{Pr}_1)/\mathrm{Pr}_2 - (\beta_3 \mathrm{Pr}_3)/\mathrm{Pr}_2 - (\beta_4 \mathrm{Pr}_4)/\mathrm{Pr}_2]R_2 + \beta_3 R_3 + \beta_4 R_4 \end{aligned} \tag{4}$$

and,

$$\begin{aligned} P = {} & \alpha_2[C_2 - (Pc_2/Pc_1)C_1] + \alpha_3[C_3 - (Pc_3/Pc_1)C_1] \\ & + \beta_1[R_1 - (\mathrm{Pr}_1/\mathrm{Pr}_2)R_2] + \beta_3[R_3 - (\mathrm{Pr}_3/\mathrm{Pr}_2)] \\ & + \beta_4[R_4 - (\mathrm{Pr}_4/\mathrm{Pr}_2)R_2] \end{aligned} \tag{5}$$

The corresponding hedonic model assumes therefore,

$$\boldsymbol{p} = \alpha_2[\boldsymbol{X}_{\boldsymbol{a}2}] + \alpha_3[\boldsymbol{X}_{\boldsymbol{a}3}] + \beta_1[\boldsymbol{X}_{\boldsymbol{b}1}] + \beta_3[\boldsymbol{X}_{\boldsymbol{b}3}] + \beta_4[\boldsymbol{X}_{\boldsymbol{b}4}] + \boldsymbol{\varepsilon} \tag{6}$$

[12] Instead of forcing one of the coefficients of the dummy variables to be zero, all of them could be restricted to zero and the resulting intercept can be interpreted as the average of the intercepts of all observations in the sample.

where $\boldsymbol{p}$ is a $N \times 1$ vector of transformed observations on the price per bottle P, there are five $N \times 1$ vectors of $\boldsymbol{X}$ observations, α and β define the unknown parameters, and $\boldsymbol{\varepsilon}$ is a $N \times 1$ vector of unknown stochastic disturbances. A symmetrical substitution generates estimates for the remaining coefficients α_1 and β_2. Importantly, this specification would embody an equivalence effect, if we were to drop one category to avoid perfect multicollinearity. So, for example, the estimated implicit price differences between Cabernet Sauvignon and Merlot would be assumed to be the same across all regions. To avoid this equivalence effect we specify an empirical model that includes interaction terms.[13]

3.3 Data and variables

Our analysis relies on bottle prices and labelling attributes of French still wines from a survey that was undertaken in August 1994 in 94 retail outlets of different commercial forms in England and Scotland (see Table 2).

Table 2: Number and Type of Retailer

Supermarket (27)	**Wine specialist (37)**	**Hypermarket (18)**	**Large retailer (5)**	**Other (7)**
7 Tesco	4 Wine Rack	6 Asda	2 Littlewoods	1 Co-op
3 Co-op	14 Victoria Wines	1 Morrisons	3 Marks & Spencer	1 Cullen's
1 Somerfield	3 Unwin's	1 Safeway		1 Europa Food
1 Kwiksave	8 Thresher	6 Sainsbury		1 Gateway
6 Safeway	2 Oddbins	1 Scotmid		1 Independent
6 Sainsbury	2 Majestic	3 Tesco		1 Kwiksave
3 Waitrose	2 Cellar Five			1 Spar
	1 Bottom's up			
	1 Haddows			

All French wines sold in those outlets were sampled, according to their market share in those regions. Since the data set reveals the number of outlets in which a particular bottle was found, we employ this information as a quantity proxy. In total, the data set comprises the prices of 7062 bottles. Since each bottle of wine appears on average in 3.2 outlets of each retailer, there are 2200 uniquely identified bottles.

[13] The interaction terms of primary interest are those for region/variety.

Table 3: Summary Statistics

VARIABLE DESCRIPTION	NO. OF OBSERVATIONS	MEAN PRICE £	STANDARD DEVIATION	VARIANCE
TOTAL	2200*	6.47	5.69	32.14
Red	1167	6.8788	6.77664	45.79
White	975	6.1506	4.11092	16.885
Rose′	58	3.6994	1.92853	1.65
Vin de table	303	3.6331	1.30032	1.6985
AOC	1780	7.1731	6.07686	36.828
Vin de pays	117	3.1605	0.56599	0.3149
Asda	47	3.2679	0.88623	0.7777
Littlewoods	14	3.1714	0.66441	0.4444
M & S	44	5.2039	3.01071	9.0426
Safeway	45	3.6707	1.08776	1.16
Sainsbury	82	5.0207	3.02218	9.1312
Tesco	109	4.1749	2.71108	7.3485
Oddbins	3	3.3233	0.29868	0.08
Cab Sauv	34	3.6044	0.76756	0.5789
Chardonnay	58	4.5462	1.04426	1.0869
Merlot	17	3.3935	0.65514	0.4321
Muscat	12	5.3792	3.19987	10.23
Pinot Blanc	15	5.2087	1.73316	2.9985
Pinot noir	24	6.7825	2.84363	8.0448
Semillon	192	3.3458	1.36644	1.8617
Sauv. Blanc	48	3.7854	0.68716	0.4718
Syrah	19	3.5416	0.51048	0.2659
Gamay	5	3.43.43	0.59566	0.3043
Vintage-83	6	18.843	15.0001	225.04
Vintage-84	8	16.066	6.18174	38.118
Vintage-87	28	13.526	6.49489	42.107
Vintage-88	61	13.391	6.99933	48.906
Vintage-89	131	10.096	5.73731	32.844
Vintage-92	541	5.7962	2.96625	8.7767
Alsace	89	7.6988	3.62154	13.07
Bordeaux	222	4.3851	1.29924	1.6704
Languedoc	431	3.7513	1.24369	1.5353
Sauternes	16	13.371	3.05696	9.35
South west	164	3.8151	1.13322	1.2882
Cote de Beaune	74	15.328	6.34374	40.163
Chablis	62	8.4989	2.69897	7.2346
Cote de Nuits	56	17.313	8.28869	68.673

*The descriptive statistics apply to the 2200 uniquely identified bottles in the sample. The difference between the total sum of all observed prices after accounting for replicates [7062] and the sum of observations for the above attributes as they remained in the final specification, is due to statistically in-significant attributes and the nature of the data set: some wines are specified by less attributes than others, (a) indication of the retailer's name from which the price was collected is only given if the retailer's name appears on the label of the bottle, or (b) it is due to legal restrictions (*i.e.* EU or national law does not allow to indicate the region of origin or the vintage for certain wines).

Each price for a bottle of wine is, where appropriate, described by colour, grape variety, region of origin, category (*e.g.* AOC), importer, volume, producer, place of bottling and vintage. Thus all information that appears on the label of the bottles was recorded, except for the degree of alcohol. Summary statistics of the variables used in the following analysis are presented in Table 3. It is striking that the mean price of *Appellations Contrôlées* is more than twice as high as that for *vin de pays*, and that there is a much larger variance in *Appellations Contrôlées* prices (36.82) compared to that for the *vin de pays* prices (0.31).

3.4 The functional form

Since all our explanatory variables are dummy variables, the choice of the functional form is limited to the linear and the log-lin specifications. Nevertheless, the use of interaction terms allows us to gain additional flexibility.[14] When we employ a log-lin hedonic price function, we assume non-constant marginal Engel prices (the prices paid for incremental units of characteristics when purchased as part of the same bundle) and constancy of relative prices with respect to changes in proportions of characteristics (Triplett, 1975). This log-lin specification therefore assumes homotheticity of the utility function, hence homogeneity of degree zero of the demand equations for attributes. Since only relative prices matter, the imputed price is independent of the level of the characteristic, which appears to be a realistic and convenient assumption, since only dummy variables are used as explanatory variables in the present model. Also, since the log-lin form allows each marginal implicit price to be a non-linear function of the entire set of characteristics, it appears as an attractive alternative hypothesis, since it accommodates the idea that bundling constraints are present for wine attributes in a bottle of wine.

3.5 Data analysis and specification search

The modelling strategy follows Hendry (2000) and Leamer's (1990) approach to data analysis in terms of estimation and sensitivity analysis. Although the Hendry methodology is time series based, the 'general-to-specific' approach and the related steps are thought to be appropriate in the present cross-sectional context (Hendry, 2000).[15] Further, we apply the diagnostic framework suggested by Belsley *et al.* (1980), and Belsley (1986), to uncover statistical problems in an OLS framework.

Estimation

Model selection

Theory does not provide further guidance on the inclusion of variables in the present application (it is assumed that all pre-selected variables have a resource cost/user value interpretation). Therefore we aim to pursue a rigorous estimation and testing procedure. Mindful of the degrees of freedom, we do not include the individual AOC names, but rather account for the presence or absence in a particular category (AOC, *Vins de pays*, *etc*.). Hence in the initial regression, we include region of origin, category, brand, importer, grape variety, colour and

[14] Although we would expect that limited functional flexibility may limit the validity of the estimates, early studies suggest that such constraints may not be as limiting as expected (Butler (1982), Bartik and Smith (1987)).

[15] See Hansen (1996) for a discussion of Hendry's specification searches and his 'general-to-specific' approach.

vintage, jointly with a subset of interaction terms: colour/region of origin, category/region of origin, grape variety/region of origin, and grape variety/category. In contrast to previous hedonic studies, the subsequent selection procedure does not follow a purely mechanical procedure, such as stepwise regression, since the dangers of doing so are well established (*e.g.* Wallace and Ashar, 1972; Judge and Bock, 1983; Leamer, 1983; Greene, 2000).

In our specification testing we follow Berndt and Griliches (1993) and compensate for the large sample size by choosing very small significance levels (*i.e.* 1%) for the standard *F*-tests. Further, we use the standard errors of the residuals (SER) between the unconstrained and constrained regressions, to aid inference (*inter alia* Ohta and Griliches (1975, 1986). If the difference in the SER of the regressions is smaller than or equal to 0.01 in the system under the test, the null hypothesis is not rejected. For the semilogarithmic regression, an increase in SER by 0.01 implies an increase in the standard deviation of the unexplained component of price of about 1%.[16] In searching for the most parsimonious specification, we follow Berndt and Griliches (1993) in rejecting the null-hypothesis when the root mean squared errors under the alternative results in a reduction of more than 5% in the standard deviation of the unexplained variation of log prices. In addition, the following specification tests were applied:

(a) Tests for Heteroscedasticity
We apply the Breusch-Pagan test (Breusch and Pagan, 1979) and its extension by Koenker (1981) to correct for heteroscedasticity.[17] Using weighted regressions also satisfies hedonic theory, as each attribute should be accounted for in terms of its market significance.

(b) Specification tests for collinearity
Since multicollinearity deserves special attention in hedonic models (Atkinkson and Crocker, 1987), we proceed in three steps:

(i) We consider *F*-values, *t* values and corrected *R*-square together, but also rely on the Akaike information criterion (AIC) in order to attempt a judgment about the trade-off between model complexity and goodness of fit.[18]

[16] Consider a difference in the standard errors in the constrained and unconstrained regressions of 0.01 and a SER of the constrained regressions of 0.1. The implication is that the lack of fit of the constrained regression is increased by 10% compared with that of the unconstrained regression (0.01/0.1=0.1). Equally, if the SER was 0.2, the 0.01 criterion implies the willingness to accept up to a 5% deterioration in the fit of the model as measured by the standard error of its residuals.

[17] Since the present analysis employs GLS, only one form of heteroscedasticity is tested for. Given the weights in the present study, is assumed that the error variance varies with the expected price. The consequence is that White's (White, 1980) heteroscedastic-consistent covariance matrix estimation cannot be employed.

[18] We prefer the AIC to the Schwarz criterion in the present context of a large number of potential variables, as the latter penalises model complexity much more heavily.

(ii) Auxiliary regressions are estimated since collinearity can appear both in the form of linear dependence between variables, and as a lack of variation in the values of a control variable about its mean.

(iii) We follow Belsley *et al.* (1980) and Judge *et al.* (1985) in examining the condition number of the data matrix.

Sensitivity Analysis

A 'classical approach' to robust estimation is pursued as in Leamer (1990). In addition, we apply techniques for discovering influential observations, as developed by Belsley *et al.* (1980). These techniques are complemented by applying the trimmed least squares estimation method as performed by SHAZAM.[19] Following Belsley *et al.* (1980), three diagnostics are examined: single-row diagnostics, an examination of the hat matrix, and the Lagrange-Multiplier test for normality (Jarque-Bera).[20] For detecting those observations that are most strongly influential in relation to the others, we follow Belsley *et al.* (1980) and apply external scaling with corresponding size-adjusted cut-off values. If observations have a high leverage *and* a significant influence on the estimated parameters, we consider them as presenting potentially serious problems. We find that 2.1% of the observations fall into this category. However, after running trimmed least squares estimation, the parameter estimates were judged to be sufficiently robust to continue with weighted least squares regression.

3.6 Estimation results

The hedonic price functions are estimated by employing a General Least Squares (GLS) estimator. The resulting GLS regressions were performed for two reasons. First, employing GLS rather than OLS as an estimation rule is pursued on the basis that each attribute (and its price) in the context of hedonic market studies is important only to the extent that it captures some relevant fraction of the market (Griliches, 1961). Here, the weights applied in the GLS regressions reflect in how many retail outlets of each retailer type (*e.g*. Marks and Spencer) a uniquely identified bottle was found. It is therefore implicitly assumed that the sample fractions are directly proportionate to the number of bottles sold. Second, the implementation of GLS allows us to account for heteroscedasticity due to omitted variables and/or due to misspecification.

The results suggest that retailer traits affect consumer choice in significant ways. Although it was not possible to compare exact attribute bundles across retailers, distinct and significant valuation of retailers were identified. However, lacking further heterogeneity in the data, we were only able to obtain an aggregate valuation of retailer traits which may well include the valuation of product diversity, reputation, as well as service and locational cost advantages of a given retailer.[21] In

[19] All regressions were performed by using SHAZAM, version 7.0.

[20] This hat matrix (equation 2.15 in Besley *et al.,* 1980) determines the fitted values. Since the diagonal elements of the hat matrix have a distance interpretation, they provide a basic starting point for revealing 'multivariate outliers' which would not be revealed by scatter plots when $p > 2$.

[21] Betancourt and Malanoski (1995) provide empirical evidence of the mechanisms through which retail distribution services (cleanliness, short wait for checkout, unit pricing on shelves, convenient store location) affect demand, costs and retail competition. The authors demonstrate that for their

all cases where conditional effects between attributes were found to have a significant impact on price, consumers are viewed as regarding these attribute bundles as imperfect substitutes. In these instances, outstanding grape varieties are shown to have a strongly positive or negative regional impact on price, just as outstanding regions have a similar grape varietal impact.
As in many previous applications of hedonic price analysis, the linear specification was rejected in favour of the log-lin model and the estimation results of the log-lin model are presented in Table 4. Recall that the coefficient estimates measure the relative impact on the dependent variable (the unit price evaluated at the sample means) of the presence of the attribute *ceteris paribus*. The estimates are therefore interpreted as follows. The relative impact of red and white wines on price (1.97% and −0.99%, respectively) suggests that market participants attribute a higher valuation to red wines, although the impact is close to average. This is expected insofar as France is better known in Britain for its classic reds (clarets) than for its white wines. The fact that rosé wines are relatively less appreciated seems to be reflected in the negative impact on price (−20.26%).

As for the wine categories, consumers appear to value regional appellations (AOC wines) positively (6.9%), whereas the Vins de Pays (VdP), which contain most varietal wines, and the Vins de Table (VdT) show a negative impact on price (−33.3% and −21.06% respectively). The more negative valuation of the VdP compared to the VdT appears initially surprising, because the VdP were originally conceived as a superior sub-category of the VdT.

However, if we reconsider the production figures of the largest region where varietal wines originate from (Figure 3), our results support the observation that French varietal wines were still in their early stages of being highly appreciated by British consumers. Assuming that most varietal wines are consumed when still young (before they are two years old), we may compare our estimates for 1994 with the production data for 1992. Considering Figure 3, we observe that varietal wines grew steadily until 1996, where they reached a production of about 3 Million hl. In 1992, however, the production had reached around 1 Million hl. Therefore, the conclusions that we can draw from the production data is in line with our estimates, which suggest that French varietal wines, as they appeared in retail outlets during 1994, had not achieved a sufficiently positive valuation by British market participants in order to reverse the overall diminishing role of French wines in Britain.

As for the valuation of off-license outlet traits, the high impact of Oddbins and Marks and Spencer on price is positive as anticipated (+71.3% and +46.6%, respectively), possibly reflecting the value consumers place on the knowledgeable service in the case of the former, and the consistently good quality of the latter. In contrast, Asda achieves a lower impact on price (-13.3%) reflecting its position in the market as a large discount-conscious supermarket chain.

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sample of 616 supermarkets across the United States, distribution services have a positive effect on the demand for product.

Table 4: Estimation Results of the Log-Lin Hedonic Model

VARIABLE	ESTIMATED COEFFICIENT	RELATIVE IMPACT%	STANDARD ERROR	T-RATIO (7025 DF)
RED	1.95E-02	1.97	4.87E-03	4.00
*WHITE	-9.88E-03	-0.99	5.85E-03	-1.69
ROSE	-0.22608	-20.26	2.60E-02	-8.71
VIN DE TABLE	-0.23634	-21.06	1.41E-02	-16.71
A.O.C.	6.69E-02	6.92	3.09E-03	21.63
*VIN DE PAYS	-0.40553	-33.35	1.98E-02	-20.51
ASDA	-0.14243	-13.30	2.13E-02	-6.69
LITTLEWOODS	0.11537	12.00	6.45E-02	1.79
M & S	0.38308	46.61	3.06E-02	12.50
*SAFEWAY	-0.10476	-9.97	2.40E-02	-4.36
SAINSBURY	-3.71E-02	-3.65	1.45E-02	-2.56
TESCO	-5.10E-02	-4.98	1.31E-02	-3.89
ODDBINS	0.54887	71.29	0.1463	3.75
CAB SAUVIGNON	-0.35025	-29.88	9.77E-02	-3.59
CHARDONNAY	1.84E-02	1.78	3.77E-02	0.49
MERLOT	0.10625	11.08	4.80E-02	2.21
MUSCAT	0.35031	41.49	8.06E-02	4.35
*PINOT BLANC	-0.37107	-31.12	5.94E-02	-6.25
PINOT NOIR	0.11722	12.35	3.92E-02	2.99
SEMILLON	7.00E-02	7.24	1.58E-02	4.44
SAUVIGNON BLANC	-8.28E-02	-7.98	2.70E-02	-3.07
SYRAH	0.16399	17.69	4.71E-02	3.48
GAMAY	-0.27659	-24.50	9.44E-02	-2.93
VINTAGE-83	0.48509	61.24	0.1215	3.99
VINTAGE-84	0.25442	28.47	8.84E-02	2.88
VINTAGE-87	0.43912	55.01	4.01E-02	10.94
*VINTAGE-88	0.47508	60.75	2.85E-02	16.66
VINTAGE-89	0.22599	25.34	1.81E-02	12.52
VINTAGE-92	-0.14016	-13.08	5.50E-03	-25.47
ALSACE	0.29492	34.25	2.68E-02	11.00
BORDEAUX	-0.18206	-16.65	1.26E-02	-14.41
LANGUEDOC	-0.23204	-20.71	1.00E-02	-23.17
SAUTERNES	0.83904	130.93	6.46E-02	12.98
*SOUTH WEST	-0.23212	-20.72	1.49E-02	-15.58
COTE DE BEAUNE	0.9656	162.52	3.01E-02	32.07
CHABLIS	0.39811	48.85	2.73E-02	14.56
COTE DE NUITS	0.90325	146.64	3.10E-02	29.16
**CHARDONNAY-LANGUEDOC	0.31296	36.56	5.25E-02	5.96
**MUSCAT-ALSACE	-0.30713	-27.19	0.1425	-2.16
**SAUVIGNON BLANC-BORDEAUX	-0.13177	-12.41	3.91E-02	-3.37
**CABERNET SAUV-LANGUEDOC	0.53514	69.70	0.1122	4.77
**SEMILLON-LANGUEDOC	-1.61E-02	-1.61	9.74E-03	-1.66
CONSTANT	1.64		4.80E-03	341.40

$\overline{R}^2$: 0.51. Breusch-Pagan Test: χ^2 = 45.6 with 36 D.F. [for 36 D.F., P (χ^2 > 50.9985 = 0.05]

* Variables are taken from symmetric regressions.** Variables are interaction terms. 'E-02' and 'E-03' denotes 10^{-2} and 10^{-3}, respectively. The impact of the attribute on price is measured as in equation (1).

Marks and Spencer, in contrast, whose reputation is built on quality, dependability and good value, is a traditional retailer that is tailored towards consumer groups with higher income. Closest to average impact is Sainsbury (-3.6%), followed by Tesco (-4.9%) and Safeway (-9.9%). Tesco's additional 'trait' of arguably offering the widest range of wines amongst all retailers does not, therefore, appear to be sufficient to make Tesco more highly regarded than Sainsbury.[22] As emphasised in section 3.6, product diversity, reputation as well as service and locational cost advantages of a given retailer may all contribute to these impacts on price. But since we have no further heterogeneity in the data set that we could exploit, we cannot disentangle these effects further.

The following paragraphs focus on the estimation results with regards to the valuation of grape varieties, regional origins and vintage. To begin with, the valuation of the different vintages should be regarded with caution. If unmeasured quality attributes make certain vintages survive in the market, the vintage coefficients could reflect these unmeasured quality differences among the surviving wines.[23] No consistent pattern emerges, although we would expect that an increasing valuation of older vintages would reflect both interest rate differentials as well as cost of storage. However, both 1987 as well as 1988 show a higher contribution than expected (+55% and +60.7%, respectively). Interestingly, the 1988 vintage is reputed to be particularly good for wines from Sauternes, Rhône and for red wines from Burgundy.[24]

A more detailed look at the estimates for regional origins supports our previous assertion that the positive valuation of French varietal wines by market participants was not sufficient to reverse the overall competitive decline of French wines in the British wine market. Although Alsace is not a very important contributor to the overall sample, the fact that Riesling, Muscat, Pinot Blanc and Pinot Noir are classic grapes that appear on the label of wines from Alsace, puts their overall price impacts in a different light (no significant impact of Riesling; +41.5%, -31.2% and +12.3% for the others respectively). The negative overall impact of Muscat from Alsace (-27.2%) is especially surprising and suggests that consumers' valuation for Muscat from other regions has a far greater influence on Muscat's overall impact on price (+41.5%) than the impact of Muscat from Alsace.

The very high valuation of wines from Sauternes (+130.9%) is not surprising, given its special regional recognition in the wine world and its costly production methods. Although Semillon achieves a positive overall impact on price (+7.2%), an expected significant regional valuation for Semillon from Sauternes does not emerge. Similarly, a high valuation for Chablis (+48.85%), a producer of Chardonnay, and the Côte de Nuits (+146.6%), whose Pinot Noir is generally well known, is anticipated.

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[22] However, the present methodology is clearly not aimed nor suited to provide an explicit valuation that consumers place on product diversity *per se*. See Kadiyali *et al.* (1999) and Perloff and Ward (2000) for an empirical investigation into the competitive effects of product line extensions, and the valuation of product diversity in a random-parameter discrete choice model, respectively.

[23] See Berndt and Griliches (1993) for a discussion of age coefficients among microcomputers.

[24] For details, consult the vintage chart of The International Wine and Food Society, Robinson (1994), p.1046.

At first sight, the impact of Merlot, Gamay and Syrah on price (+11%, -24.5% and +17.7%) lies within expectations. While Syrah is the noble grape of many Rhône wines (it also goes into red AOC Chateauneuf-du-Pape wines), our finding of a positive impact on price is also supported by its high appreciation when Languedoc-Roussillon is its regional origin (Robinson, 1994, p.942). Gamay, which is the basis for Beaujolais, is generally not known for superior quality.[25] The estimate for Merlot is more difficult to explain. Merlot is an increasingly important grape variety that appears explicitly on the label of many wines from the South West and Languedoc-Roussillon. In Languedoc-Roussillon itself, the area of Merlot plantings has increased by 166% between 1979 and 2000 (Harpers, 2003). But Bordeaux wines, which are dominated by AOC wines for which the label does not disclose the grape variety, is responsible for two thirds of the 40,000 ha merlot plantings in France. In sum, despite insignificance of corresponding region-variety interaction terms, the positive impact of Syrah and Merlot is likely to be explained by its valuation when originating from Languedoc-Roussillon.

It is interesting to note that out of five significant interaction terms, three are related to Languedoc-Roussillon. The relatively high regard of wines from Languedoc-Roussillon, in terms of its regional, rather than overall, impact on price, is especially evident in the case of Cabernet Sauvignon (+69.7%) and Chardonnay (+36.6%). If we consider this high regional valuation of Chardonnay together with the significant but only slightly positive overall price impact of Chardonnay, and the much higher positive overall price impact of geographical origins like Chablis, Sauternes or Côte de Nuits, our results point to the still rather modest recognition of French varietal wines in the UK in 1994.

The negative impact of Bordeaux origin on price is not too surprising (-16.6%), both on the overall as well as on the regional level, as in the case of the interaction with Sauvignon Blanc (-12.4%). Compared to other AOCs, the Bordeaux AOCs comprise a rather large category. Robinson (1994) suggests that the ubiquitous and undistinguished Bordeaux AOCs emerge with a quality variation that is "simply frustrating" (p.42).

In sum, two findings are particularly striking. First, the low market valuation for Bordeaux wines, which represent not only the second largest regional origin in the off-licence sales under investigation, but also a reputational cornerstone of French wines. Second, the modest valuation by market participants of a relatively small market segment, the varietal wines. Given these findings, it is not surprising that French wines underwent a competitive decline in Britain since the early 1990s.

4. Concluding Remarks

Since the early 1990s French wines have lost market share in the British wine market. This occurred after decades of successful marketing of French wines in Britain, differentiated by geographic appellation. This article explores to what extent the relative valuation of varietal wines and geographic appellations can serve to explain the French decline in the British off-licence sector. We examine the

[25] "... generic blended Beaujolais can simply be a thin, inky liquid that is in all senses lacklustre." (Robinson, 1994, p.105).

values which consumers place on the information provided by French wine labels in the British wine market. By means of a parametric hedonic approach, implicit prices for these labelling attributes are derived from prices and quantity proxies of wines sold in the British off-licence market in 1994.

Considering consumers' region-specific valuation of grape varieties together with their overall recognition of varieties beyond specific regions, our results point to a rather modest recognition of French varietal wines in the UK in 1994. In contrast to Languedoc, which is known for its dynamic approach to labelling and technology adoption, varietal wines from a region that underwent a more traditional approach to varietal labelling, notably Muscat from Alsace, do not achieve a positive impact on price. Further, our estimates indicate that the two categories which contain most of the French varietal wines, the country and table wine category, achieve a distinctly negative valuation. Considering these results together with the negative valuation of Sauvignon Blanc from Bordeaux, the overall low valuation of varietal wines could be regarded as an important factor in explaining the continuing decline of France's role in the British wine market after 1994. The negative valuation for Bordeaux is particularly surprising, considering the leading role that these wines have traditionally taken in promoting French wines. However, it may be explained by the possible overload and confusing array of geographical indications under which a large and undistinguished range of Bordeaux AOCs is sold.

Accounting also for the more vigorous expansion path of sales of varietal wines from other origins ('New World wines'), there appears to be further evidence that the highly detailed labelling approach to French wines based on traditional category classifications schemes (the country and table wine category) were, by 1994, unable to reverse the competitive decline of French wines in Britain. The only modestly positive valuation of the *Appellations Contrôlées* by market participants adds further to explain the overall decline of the role of French wines since 1992. In sum, both the lack of a consistently positive valuation of varietal wines and the low valuation of long-established wines with geographical appellation in our sample point to a weakness of the French labelling approach in the early 1990s.

Given this lack of success of French wines in the British off-licence sector, we conjecture that a reconsideration of the labelling approach might have improved the position of French wines in the British wine market. Specifically, our results suggest that a more transparent, flexible and simplified approach to labelling would have been beneficial to the sales of French wines. Apart from serving legislative demands, the question still remains whether the established labelling regulations have truly served to promote informed consumer choices between distinct attribute bundles, and sent the appropriate market signals to producers.

Future research could proceed along several lines. Firstly, the analyst may be interested in eliciting the 'true preferences' of the consumers in the context of attribute demand and welfare analysis. An evaluation of a change in labelling policy could benefit from linking revealed and stated preference approaches (Herriges *et al.*, 1999). Secondly, a more refined decomposition of the contributions to the implicit price estimates could follow from exploiting existing heterogeneity in the data. Although we find significant and expected valuations for the dummy variables

of the retailers, product diversity, reputation as well as service and locational cost advantages of a given retailer may all contribute to the implicit price estimates. Further, since the aggregate market valuation of retailers in our sample is likely to include a valuation for product diversity, the analyst may be interested in a distinct valuation of product diversity *per se*, as it is provided by different retailers. With greater heterogeneity in the data, such issues could be further disentangled (Nevo, 2001; Kim *et al.*, 2002).

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