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Old World Wines Revisited:
Consumers' Valuation of Spanish and German Wines
In the UK Wine Market

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Abstract

The mid 1990s was a pivotal period for the UK retail wine market, as New World Wines started to expand significantly at the expense of Old World Wines. This paper reviews supply and demand-side characteristics of the UK wine market during this period, and the underlying wine labeling scheme, before assessing how wines from Old World wine producing countries were valued by consumers in the British wine market. Following a more detailed discussion of econometric estimation issues, hedonic price analysis is applied in order to analyze consumers' valuation of wine label attributes of Spanish and German wines sold in Britain in 1994.

Keywords: wine labels, UK wine market, hedonic price models, Spain, Germany

JEL Codes: Q13, L66, D01

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1. Introduction

In the evolution of the global wine industry over the past two decades, Britain has played a pivotal role. The British wine market largely served as a gateway for New World Wines into Europe (Steiner 2005), so that particularly wines from Australia challenged the dominance of French, Italian, Spanish and German wines (Steiner 2004). This rise of the New World Wines in Britain began around the middle of the 1990s. By 2004, Australian wines surpassed wines from Italy and France, to become the country's top seller (Foley 2009). One of the likely key drivers of this success was Australia's emphasis on simple labeling, with its focus on single-variety wines and branding (Steiner 2004; Foley 2009). However, as sales volumes of Australian wines doubled in Britain over the past decade, profit margins of Australian winemakers appear to diminish, such that the Australian wine industry is currently seeking rejuvenation through a focus on Old World wine attributes: regional origin and variety of grape varietals (Foley 2009). Therefore, as the lifecycle of single-variety labeling and branding of New World Wines seems to come to a close (at least in the case of Australia), it is likely that competition and product differentiation will continue to be exerted on those 'traditional' Old World Wine attributes, such as regional origin and diversity of grape varieties.

Considering the beginning of this phase of emerging New World Wine dominance in Britain, around 1994, how were wines from Old World wine producing countries valued by consumers in the British wine market? The objective of this study is to employ hedonic price analysis in order to analyze consumers' valuation of wine label attributes of Spanish and German wines sold in Britain in 1994. Considering the analytical focus of this study on data from 1994, the following sections first describe the labeling regulations and market conditions during the mid 1990s (section 2 and 3), before proceeding to the empirical analysis (section 4).

2. Wine labeling and the UK wine market

2.1. Wine labelling: the importance of origin and grape variety

Although as of August 1 2009, new labeling rules will be implemented in the European Union (EC 2009), the basic labeling of wine in can still be divided into two main groups (Robinson 1994). First, still light wine, sparkling wine and aromatised wines, which must be labelled in accordance with legislation laid down by the European Union (EU). Secondly, semi-sparkling and liqueur wines, which must be labelled in accordance with the Food Safety Act 1990 and Food Labelling Regulations 1996 of the United Kingdom (UK). The precept behind the EU controls affecting still wines, produced within or outside the EU, is that anything that is not specifically permitted is forbidden. Implicit in those regulations are five different categories for still wines.

(1) Quality Wine Produced in a Specified Region (QWPSR)

This is a category for wine made from grapes grown within a specified region in the EU. The region concerned must be registered with the EU, and legislation in each member country will implement the EU criteria for the category. Such legislation will cover:

- grape varieties authorised or recommended
- viticultural practices, especially pruning systems used
- maximum vineyard yields
- controls on winemaking, acidification, enrichment, ageing requirements
- minimum or maximum alcoholic content
- analysis of the finished wine, including, in many cases, organoleptic analysis (tasting)

Many EU countries have two categories of QWPSR. France has two grades of QWPSR: *Appelation d'Origine Controlee* (AOC) and the smaller category of *Vin Delimite de Quality Superieure* (VDQS). Italian 'Quality Wine' is divided into *Denominazione di Origine Controllata* (DOC) wines and those in the higher quality *Denominazione di*

Origine Controllata e Garantita (DOCG). In Germany, the term *Qualitätswein bestimmter Anbaugebiete* (QbA) is used for most of the QWPSR's and *Qualitätswein mit Prädikat* (QmP) for the top wines.

(2) Table Wine with Geographical Description

This is a wine, other than a 'quality wine', from an EU country, which mentions a specific source within, and is produced under the laws of that country. Examples of *table* wine with geographical description include:

Spain:	Vino de la Tierra
France:	Vin de Pays
Germany:	Landwein, Deutscher Tafelwein Rhein

This wine may have a vintage and up to two grape varieties mentioned on the label.

(3) Table Wine

The term table wine can be expressed on the label in any of the principal European languages, but it can only be applied to wine produced in the EU. Table wine can bear neither a vintage nor a grape variety.

(4) Wine with Geographical Description

This is wine from outside the EU, known officially as "third country wine", which names the specific producing region in that country, for example Margaret River Chardonnay from Australia. A vintage may be mentioned on the label and up to two grape varieties.

(5) Wine

This is a non-EU wine which does not fall into category (4). Grape varieties and vintages may not be mentioned.

Country-specific requirements

The AOC is the highest level a French wine can attain. Though the requirements may vary from one region to another, they are most tightly defined, in particular in terms of grape varieties and maximum yield per hectare permitted. The laws for VDQS are often less stringent on yields and grape varieties, yet all wines have to undergo an official tasting. However, the VDQS wines represent only about 1% of France's production (volume, 1994).

In order to qualify for *Vin de Pays*, wines have to meet stricter criteria than for *Vin de Table*. Also, relative to AOC wines, the approved list of grape varieties for *Vin de Pays* is much broader and allows therefore more experimentation.

The Italian wine laws recognize four different categories. The DOCG wines must meet all the requirements of DOC, and, additionally, be bottled in the region of production and be subject to a Ministry of Agriculture tasting and seal of approval. The DOC was the first designation to be introduced and it is similar to the French AOC system in specifying geographical zone, grape varieties, yields and the like. Wines with the *Indicazione Geografica Tipica* (IGT) are the result of the 1992 Italian wine laws and form the equivalent to the French *Vin de Pays*. A small market remains thus for *Vino da Tavola*.

As in other countries, geographical location and grape variety are factors governing the classification of German wines. A third factor, however, distinguishes the German scheme from any other. The sugar content of the grapes when harvested is the primary factor governing the classification of a German wine. Three consequences flow from this approach. First, and most significant, each vintage must be assessed for granting of quality status. Second, because of this annual assessment, no vineyard is guaranteed to produce QWPSR every year, almost by rote, which happens in other countries. Third, and conversely, any vineyard in Germany is potentially eligible to be awarded QWPSR for its wines if the grapes are ripe enough.

Most wines produced fall into the two QWPSR categories (90% in volume in 1994). Wine designated as QbA must be produced from specific grape varieties from a single region, hence no blending between regions is permitted. As with QbA wines, the QmP wines must be made from specified grapes from a single region, the name of which must be shown on the label. In addition, the grapes must all come from a single district. The grapes will have higher natural must-weights than QbA wines because, for wines of this quality, chaptalisation, or must-enrichment, is forbidden. In ascending order, according to their range of minimum must weights, the different Prädikat grades are Kabinett, Spätlese, Auslese, Beerenauslese and Trockenbeerenauslese.

Varietal labelling

Any wine produced in the EU which mentions a grape variety on the label must contain at least 85% of that variety. For most non-EU countries a wine sold in the EU must contain 100% of the named variety, although there are derogations for certain countries, including Australia, New Zealand and Hungary, permitting 85% and one for the United States permitting 75%. No wine label may list more than two varieties, and, where two are listed, they must represent 100% of the grape mix of that wine. A limited number of countries outside the EU may name two varieties, including Austria, Bulgaria and Chile. Unusually, Australia is permitted to list up to five varieties.

2.2. The EU wine regime as enforced the United Kingdom during the 1990s

From the above, still light wine produced in or imported into the UK must comply with legislation laid down by the European Community which is enforced in the UK by the Common Agricultural Policy (Wine) Regulations.[1]

[1] Imports of wine into the UK from within the EU do not require an import licence. Also, if the wine is for personal consumption, no documentation is required provided the wine is imported in containers of not more than 5 litres and the total quantity of the consignment does not exceed 100 litres. For wine imported in excess of 30 hectolitres from third countries outside the EU, an import licence is required.

The principal features of the EU wine regime are rules governing the production and classification of wines, a range of support schemes (including guide prices, and three compulsory distillation schemes, which both apply only to table wines), subsidies for the use of grape juice, a vineyard abandonment premium scheme, detailed rules governing the description and labelling of wines, and a series of third-country trade agreements. It does not cover “made wines”, which are made either by fermenting reconstituted concentrated grape must or by blending wine with a non-regime product. In the UK, this is known as British Wine.

Wines from third countries are subject to the EU Common Customs Tariff (CCT). Under the General Agreement of Tariffs and Trade (GATT) Agreement, introduced on 1 July 1995, the Commission opted to abolish reference prices for wine altogether rather than convert them into tariff equivalents. Third country imports are therefore subject to duties which should gradually be reduced in conformity with the GATT Agreement. Export refunds are currently still available for exports of EU table wines to certain non-EU countries.

English and Welsh wine, produced from fresh grapes, accounts for only 0.3% (value, 1997) of domestic consumption. There are currently around 410 commercial vineyards with a total area of almost 1,000 hectares. Imports, primarily from the EU but increasingly from a wide range of third countries, make up the balance. UK receipts from wine regime expenditure (currently totalling £600m per year for the Community as a whole) amount to £250,000, principally as aid for the use of grape must in the production of British Wine and wine kits.

The wine market in the UK has a market volume of 7.5 million hectoliters, with an import value of more than £1.1 billion (1994). It is dominated by still light wine imports (> 90%, value 1994), which themselves contribute 33.6% to the total wine imports into the EU (value, 1993).

More than 25 countries of origin were represented in the UK wine market during the mid 1990s, suggesting that it is a market in search of novelty, with an overall declining market share of ‘old world wines’, and prospering demands for ‘new world’ wines and wines from Eastern Europe.

2.3. The evolution of the UK distribution and import sector

Two types of licences give the right to sell alcoholic beverages in the UK. 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).

Table 2.1.: Sales of still light wine[2] by type of licence, 1984-93 (% of volume)

	Off-licence	On-licence
1984	70	30
1985	72	28
1986	71	29
1987	72	28
1988	74	26
1989	75	25
1990	77	23
1991	80	20
1992	83	17

Source: Economist Intelligence Unit (EIU), 1994

As for wine, the structure of the off-licence trade is such that two main commercial categories can be distinguished: those firms who have only wines on offer, the ‘wine specialists’, and others, for which wine is only part of their assortment, the grocery-multiples. Amongst the wine specialists, the independent specialists can be distinguished from those specialists belonging to breweries or other groups. The grocery-multiples include independent food retailers, large general retailers (e.g. Marks & Spencer) and Co-ops. With more than 45,000 points of sale and 70% of total wine sales in 1993, the off-licence dominates the wine market in the UK.

[2] Including made wine (British Wine), almost all of which is sold in the off-licence trade.

Table 2.2.: The off-licence sector in 1994

GROCERY- MULTIPLES					
		Number of outlets	**Market share of alcoholic drinks in the off-licence sector (%)**	**Number of wine and spirit items on shelf**	**% of sales realised under own-brand**
SAINSBURY		350	9.6	500	80
TESCO		400	9.3	600	75-80
SAFEWAY (ARGYLL)		339	7	350	own-brand sales very important
ASDA		206	6	400	70
WAITROSE		100	3	500	no own-brand sales, but some exclusive brands
SOMERFIELD		600	3.5	300	own-brand sales important
WILLIAM MORRISON		59	1	420	own-brand sales of little importance
MARKS & SPENCER		300	3.5	300	own-brand sales highly important; only mentioned on the back label
WINE SPECIALISTS					
	Parent company	**No. of stores**	**Market share of alcoholic drinks in the off-licence sector (%)**		
THRESHER	Whitbread	1600	9		
VICTORIA WINE	Allied Lyons	1500	8.6		
GREENALL CELLARS	Greenall	491	3		
UNWINS	independent	297	n.a.		
ODDBINS	Seagram	200	3		
DAVISONS	independent	77	n.a.		
FULLERS	Fuller Smith & Turner	58	n.a.		
THOS PEATLING	Greene King	27	n.a.		
MAJESTIC WINE	independent	47	0.5		

Source: Centre Francais du Commerce Exterieur (CFCE), 1994a

Most of the grocery-multiples and specialists source their supplies through intermediate agents and wine brokers who ‘filter’ the offer from different countries. Only about 25% (1996) of supplies to the off-licence sector are received direct, circumventing the agents.

The distribution sector is more and more dominated by large importers, such as British breweries and national or international conglomerates (Grants of St. James, Boutinot-

Prince, Grierson’s, Winerite and Waverley Vintners), which bypass the traditional agents and wine brokers. The market is therefore characterised by an increasing concentration, as reflected in a declining importance of small importers that supplied the traditional on-licence sector. Nevertheless, most of the on-licence trade sources its supplies by intermediates:

- breweries, which own pubs, hotels, etc.
- importers/regional wholesalers of medium size
- importers/wholesalers operating on a national scale (less than 10)

It is difficult to consider the various elements in the distribution sector separate from each other. Some importers act entirely independently, while others act jointly with other links in the supply chain.

First, there are importers that represent a certain number of brands, or importers which form an intermediate position between the exporter firm and the final buyer in the UK. These importers are responsible both for promotion and diffusion of the products they represent for their clients (example: Whiclar and Gordon Wines).

In contrast, the wine brokers research essentially for their UK clients for specific wines in foreign markets. They work frequently for larger retailers.

The third type of wine merchant is a commercial one, whose sole activity is to represent one or two large wine producers. These are in fact marketing offices that distribute and promote exclusively for their client exporter (example: Peter Sichel).

Furthermore, wine merchants who buy in grapes or wine, blend different lots of wine within an Appelation, and bottle the result under their own label, are known as *Negotiant*, especially concentrated in Burgundy (example: Louis Jadot).
The majority of wines imported into the UK have to pass through a customs warehouse, where they remain frequently for only a short period of time in stock. However, a number of firms have their own warehouse under customs control.

As the following diagram reflects, the distribution sector could be separated into three categories: the off-licence, the on-licence and others. The latter include

- sales to embassy personnel
- sales to sports and cultural events (Ascot, Wimbledon)
- purchases by other institutions (banks, insurance companies)
- sales by mail (responsible for about 5% of sales of alcoholic beverages (1994)).

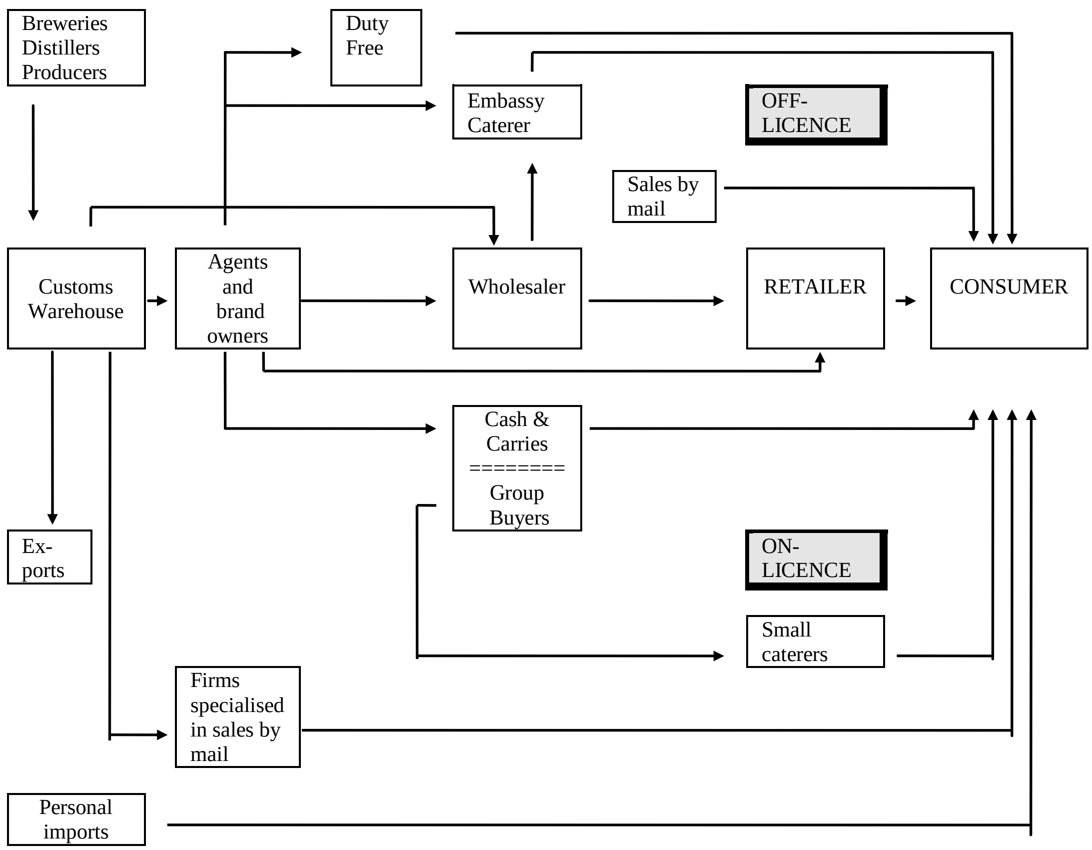
These ‘other’ parts of the distribution chain capture a market share of about 20% (1994) of the entire wine market.

Within the off-licence trade, which excludes the Cash & Carries (supplying restaurants and retailers) and the wholesalers, two categories are distinguished:

- The Specialists: These are firms that achieve more than 50% of their turnover from selling alcoholic drinks. If they sell food products, their turnover from alcohol has to exceed 80% in order to qualify as ‘wine specialist’.
- The grocery and other food stores, whose main activity is not selling alcohol. These include independent groceries, minimarkets and co-ops.

A simplified summary of the flow of imported alcoholic beverages is shown in the following diagram:

Table 2.3.: The flow and distribution of imported alcoholic beverages in the UK in the 1990s



Source: adapted from CFCE, 1994a

In 1991, more than 55% of all the firms in the off-licence trade were independent grocers and food stores, though their contribution to the overall turnover in the sector had declined to 9%. In contrast, the retail chains, which comprised only 9.3% in terms of total number of enterprises, accounted for 45% of the turnover in the off-licence trade and supplied 80% of all wines under £3 per bottle. The co-ops followed with a 7% market share.

Independent wine specialists, responsible for 10% of the total turnover in the off-licence trade (1991), have continuously lost market share to grocery-multiples and owned specialists. The 'big three' specialists in this group, Thresher, Victoria Wine and Augustus Barnett (for which no figures were available in the table 1.1.), contribute 20% turnover to the off-licence. The remaining wine specialists have continuously lost market share to grocery-multiples and the ‘big three’. Still, they held 9.2% of the market in 1991. Amongst others, they comprise Oddbins, Cellar 5, Unwins, Davisons and Fullers.

Two categories within the on-licence trade sell alcohol for both consumption *in situ* as well as for consumption off the premises:

- The ‘Tied On Licence’: These are pubs and bars which are owned by a brewery. They are either let as a ‘managed outlet’ or a ‘tenanted outlet’.
- The ‘Free Trade On Licence’: These are not owned by breweries, and can be distinguished according to their type of licence:

  * The ‘public bars’: also called ‘fully licenced’, they have a licence to sell alcohol to all categories of clients without restriction. These compromise pubs, bars, hotel bars, theaters.

  ** The ‘clubs’: They are only allowed to sell alcohol to their members. The ‘Licenced clubs’ are commercially run, while the ‘registered clubs’ are organised on a non-profit-making basis.

  *** The ‘restricted licenced’ are restaurants which can only sell alcohol to accompany a meal, or hotels which are closed to non-residents.

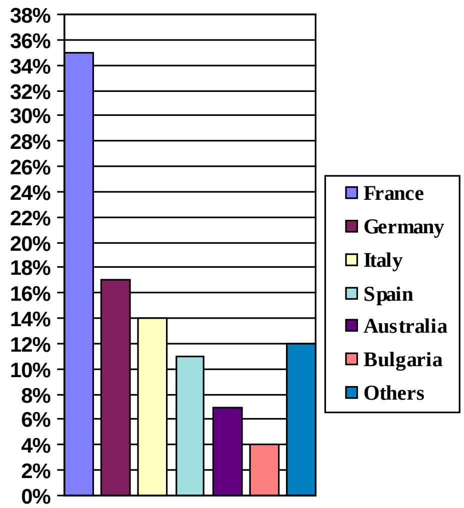
2.4. The supply side: the British import market during the mid 1990s

In contrast to the wide range of grape varieties and countries of origin on offer in the off-licence sector, the on-licence-trade is largely dominated by a more traditional wine consumer and thus a more traditional spectrum of wines on offer: 66.5% and 57% of wines consumed in hotels and restaurants, respectively, were of French origin.

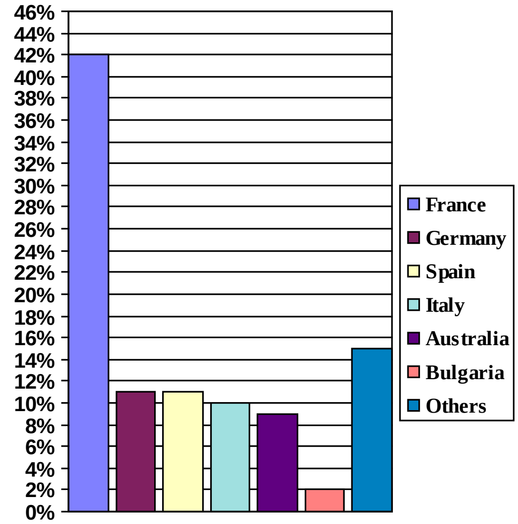
Against this background, it is of interest to compare the different country shares for still wines entering the UK:

Table 2.4.: Principal suppliers of still light wines to the UK

Principal suppliers of still light wines to the UK (volume, 1994):



Principal suppliers of still light wines to the UK (value, 1994):



Source: CFCE, 1996

Table 2.5.: UK imports of still wines [3]

	Volume (1000 hl, 1994)	Change in 1994/93	Market share [4]	Change in 1994/93
FRANCE	2509	22,15%	35,39%	2,85%
GERMANY	1231	0,00%	17,36%	-2,14%
ITALY	974	9,32%	13,74%	-0,38%
AUSTRALIA	481	11,09%	6,79%	-0,08%
SPAIN	760	28,51%	10,72%	1,35%
SOUTH AFRICA	176	86,44%	2,48%	0,99%
BULGARIA	266	-7,86%	3,75%	-0,82%
USA	137,6	24,75%	1,94%	0,19%
HUNGARY	99,4	23,17%	1,40%	0,12%
CHILE	59,7	32,08%	0,84%	0,13%
NZ	46,7	-8,61%	0,66%	-0,15%
OTHERS	348,6	-20,81%	4,92%	-2,06%
TOTAL	7089	12,33%		

Source: CFCE, 1996

[3] A more detailed analysis of the evolution of sales of imported still light wines by country of origin can be found in EIU Retail Business No.439 (1994, pp.20).

[4] The differences between volumes imported and market share for the corresponding year is due to storage.

Regarding the evolution of sales by country of origin, the big four traditional suppliers, France, Germany, Italy and Spain, continued to dominate but, collectively, if not in all cases individually, have seen their share eroded. Their combined share declined from 89% of volume of imported wine of fresh grape in 1983 to 78% in 1993. However, this drop in share took place in a market which has grown considerably.

Table 2.6.: Share of sales of imported still light wine by country of origin, 1980-93
(% of total)

<table>
<tr><th></th><th>1980</th><th>1983</th><th>1984</th><th>1985</th><th>1986</th><th>1987</th><th>1988</th><th>1989</th><th>1990</th><th>1991</th><th>1992</th><th>1993</th></tr>
<tr><td>France</td><td>35.7</td><td>38.2</td><td>37.6</td><td>38.6</td><td>40.6</td><td>38.9</td><td>38.7</td><td>36.6</td><td>35.1</td><td>35.6</td><td>34.2</td><td>31.4</td></tr>
<tr><td>Germany</td><td>20.9</td><td>27.1</td><td>31.7</td><td>30.3</td><td>26.9</td><td>27.9</td><td>27.3</td><td>28.2</td><td>28.8</td><td>27.6</td><td>26.8</td><td>25.0</td></tr>
<tr><td>Italy</td><td>17.1</td><td>14.5</td><td>14.0</td><td>16.1</td><td>16.5</td><td>16.4</td><td>17.7</td><td>18.8</td><td>18.8</td><td>18.2</td><td>16.9</td><td>16.2</td></tr>
<tr><td>Spain</td><td>13.2</td><td>9.1</td><td>6.7</td><td>6.0</td><td>6.4</td><td>6.2</td><td>5.4</td><td>4.7</td><td>4.3</td><td>4.3</td><td>4.8</td><td>5.9</td></tr>
<tr><td>Portugal</td><td>2.1</td><td>0.8</td><td>1.2</td><td>1.3</td><td>1.6</td><td>1.8</td><td>1.4</td><td>1.4</td><td>1.3</td><td>1.4</td><td>1.7</td><td>1.8</td></tr>
<tr><td>Other EU</td><td>0.6</td><td>0.6</td><td>0.5</td><td>0.6</td><td>0.6</td><td>0.5</td><td>0.5</td><td>n/a</td><td>n/a</td><td>n/a</td><td>n/a</td><td>n/a</td></tr>
<tr><td>Yugoslavia</td><td>5.9</td><td>5.0</td><td>3.9</td><td>3.9</td><td>3.8</td><td>3.5</td><td>2.6</td><td>3.2</td><td>2.9</td><td>2.6</td><td>2.0</td><td>1.6</td></tr>
<tr><td>Bulgaria</td><td>0.0</td><td>0.7</td><td>0.6</td><td>0.7</td><td>1.1</td><td>1.7</td><td>2.8</td><td>2.8</td><td>3.7</td><td>3.7</td><td>3.8</td><td>5.1</td></tr>
<tr><td>Hungary</td><td rowspan="9">4.6</td><td rowspan="9">4.1</td><td rowspan="9">3.7</td><td rowspan="9">2.5</td><td rowspan="9">2.5</td><td rowspan="9">3.2</td><td rowspan="9">3.6</td><td>0.5</td><td>0.8</td><td>1.0</td><td>1.2</td><td>1.6</td></tr>
<tr><td>Cyprus</td><td>0.1</td><td>0.1</td><td>0.1</td><td>0.0</td><td>0.0</td></tr>
<tr><td>Australia</td><td>n/a</td><td>1.2</td><td>2.1</td><td>3.8</td><td>5.8</td></tr>
<tr><td>New Zealand</td><td>n/a</td><td>0.3</td><td>0.4</td><td>0.6</td><td>0.8</td></tr>
<tr><td>South Africa</td><td>0.2</td><td>0.2</td><td>0.2</td><td>0.4</td><td>0.9</td></tr>
<tr><td>USA</td><td>0.6</td><td>1.0</td><td>1.4</td><td>1.7</td><td>1.9</td></tr>
<tr><td>Chile</td><td>n/a</td><td>0.2</td><td>0.5</td><td>0.8</td><td>0.6</td></tr>
<tr><td>EU blends</td><td>1.3</td><td>0.9</td><td>0.5</td><td>0.4</td><td>0.2</td></tr>
<tr><td>Other</td><td>1.6</td><td>0.4</td><td>0.4</td><td>0.9</td><td>1.2</td></tr>
<tr><td>Total</td><td>100.0</td><td>100.0</td><td>100.0</td><td>100.0</td><td>100.0</td><td>100.0</td><td>100.0</td><td>100.0</td><td>100.0</td><td>100.0</td><td>100.0</td><td>100.0</td></tr>
</table>

Source: EIU (1994)

The wine market can also be viewed in terms of the following three broad categories: shippers' brands, direct shipments and retailer own-label. Traditionally, the term 'brand' has been used to embrace wines bearing an importer's name or a brand name devised by the importer. Today, many wines could be regarded as brands by virtue of the prominence of the producer's name, in particular New World wines. The name of the producer is highly visible and may be written larger than any other source of information on the label. A 'brand' may thus trade more on the name of the producer or importer than on origin or grape variety (Jacob's Creek, Gallo, Penfolds, Black Tower, Le Piat d'Or). However, as many uprising New World wines are now handled directly by UK subsidiaries of the producers, these New World producer brands may be regarded as direct shipments. Branded wines of shippers' labels accounted for around 20% of total

UK still light wine of fresh grape volume (1994) compared with 30% in 1988. In contrast, the shares of both direct shipments and own-label have increased from 35% to 40% in 1993.

Table 2.7.: Sales of still light wine (excluding made wine) by type of label, 1988 and 1993
(% of volume)

	1988			1993		
	Off-licence	**On-licence**	**Total**	**Off-licence**	**On-licence**	**Total**
Shippers's brands/labels	25	55	30	15	40	20
Direct shippers	25	45	35	35	60	40
Retailers' own-label	50	0	35	50	0	40
Total	**100**	**100**	**100**	**100**	**100**	**100**

Source: EIU, 1994

The on-licence trade remains rather more brand-oriented than the off-trade. With brands accounting collectively for only around 20% of total market share volume, and just 15% of off-licence volume (1994), the fragmentation of the market makes it difficult for individual brands to hold a significant position.

Most countries depend heavily upon off-licence sales, with France and, to a lesser extent, Germany depending disproportionately upon the on-licence trade.

Table 2.8.: Country shares of still light wine sales in the off-licence and on-licence trades, 1992:
(% 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, 1994a

In 1994, more than half of the total off-trade volume sold at a price below £3.25 per 75cl bottle, although the average is considerably skewed upwards by the presence of relatively small volumes of much higher priced wines. The highest price ranges are largely a province of French wines, although Australian wines, in particular, have taken market share from the higher price bands. Overall, New World origins, including Australia, New Zealand, South Africa, California and Chile, are generally absent from the lowest price rungs. The most heavily populated price bands were 2.51-2.75 and 2.76-3.00 which together accounted for 31.1% of sales.

Table 2.9.: Country price profiles for still light wines in the off-licences, 1992/93 (% of volume)

Retail price (£)	FRANCE	GERMANY	ITALY	SPAIN	OTHER	ALL ORIGINS
2.05 or less	8.2	17.8	6.9	12.0	2.1	8.5
2.06-2.20	3.0	6.5	3.4	14.5	3.3	4.6
2.21-2.35	1.7	6.7	11.4	2.4	3.1	4.6
2.36-2.50	2.6	15.7	9.6	13.3	2.8	6.9
2.51-2.75	11.6	18.3	17.1	19.7	13.9	14.9
2.76-3.00	17.1	13.1	19.0	12.8	16.7	16.2
3.01-3.25	9.7	6.3	8.0	4.4	9.6	8.4
3.26-3.50	8.0	6.0	6.7	2.2	6.8	6.7
3.51-3.75	10.1	3.1	5.9	3.5	10.5	7.8
3.76-4.00	6.6	3.5	5.2	4.6	13.3	7.4
4.01-4.25	2.5	0.7	2.1	1.2	5.8	2.9
4.26-4.50	2.7	0.8	1.1	2.4	3.3	2.2
4.51 or more	16.2	1.5	3.6	7.0	8.7	9.0
Total	**100**	**100**	**100**	**100**	**100**	**100**

Source: EIU,1994

Table 2.10.: Country market shares by price band for still light wines in off-licences, 1992/93
(% of volume)

Retail price (£)	FRANCE	GERMANY	ITALY	SPAIN	OTHER	TOTAL
2.05 or less	31.7	39.0	12.6	10.0	6.7	100.0
2.06-2.20	21.2	26.1	11.7	22.2	18.8	100.0
2.21-2.35	12.5	27.2	39.0	3.7	17.6	100.0
2.36-2.50	12.2	42.2	21.6	13.5	10.5	100.0
2.51-2.75	25.6	22.8	17.9	9.3	24.4	100.0
2.76-3.00	34.5	14.9	18.2	5.5	26.9	100.0
3.01-3.25	37.9	13.8	14.7	3.7	29.9	100.0
3.26-3.50	38.9	16.6	15.5	2.3	26.7	100.0
3.51-3.75	42.5	7.4	11.7	3.1	35.3	100.0
3.76-4.00	29.2	8.7	10.9	4.3	46.9	100.0
4.01-4.25	28.5	4.4	11.4	2.9	52.8	100.0
4.26-4.50	39.6	6.5	8.0	7.6	38.3	100.0
4.51 or more	59.5	3.3	6.0	5.5	25.7	100.0
ALL PRICES	**32.7**	**18.5**	**15.5**	**7.0**	**26.3**	**100.0**

Source: EIU, 1994

As for German wines, 17.8% of sales were made at a price of 2.05 or less, more than twice the overall share, while only 1.5% sold at 4.51 or above. In contrast, France saw 16.2% of its volume retail at 4.51 or more, close to twice the overall figure, with 8.2% selling at 2.05 or less. Italian wines were strongest in the 2.21-2.35 band, their share reaching 34.0% compared with an overall share of 15.5.%. Spanish wines were strong in the two lowest price bands, their share reaching 22.% in the 2.06-2.20 range, three times the 7.0% overall share. They performed weakly in many of the intermediate price bands but reasserted themselves to some degree in the top bands.

Accounting for excise duty, but ignoring differences in production cost and the different intermediates in import and distribution, how might the cost breakdown of a bottle of wine be viewed?

Table 2.11.: Cost breakdown for wine by price, 1994 (£ per 75cl bottle)[5]

	Retail price				
	£ 1.99	**£ 2.99**	**£ 3.99**	**£ 4.99**	**£ 9.99**
Production cost, including wholesale margin	0.17	0.61	0.99	1.50	4.09
Packaging & overheads	0.12	0.15	0.20	0.25	0.50
Transport	0.07	0.10	0.10	0.15	0.20
Retail margin	0.32	1.10	1.10	1.34	2.70
Excise duty	1.01	1.01	1.01	1.01	1.01
VAT	0.30	0.45	0.59	0.74	1.49

Source: EIU, 1994

Table 2.12.: Details for a French still wine with less than 15% alc.Vol. (75cl, 1994)

Price f.o.b. (£)	0,78	1,04	1,30	1,95	2,60	3,25	5,19
Transport (£)	0,10	0,10	0,10	0,10	0,10	0,10	0,10
Stockage (£)	0,15	0,15	0,15	0,15	0,15	0,15	0,15
Excise Duty (£)	1,05	1,05	1,05	1,05	1,05	1,05	1,05
VAT (17.5%)	0,36	0,41	0,45	0,57	0,68	0,80	1,14
Distributor's margin	0,66	0,74	0,82	1,03	1,24	1,44	2,06
Retail price (£)	**3,10**	**3,49**	**3,88**	**4,85**	**5,82**	**6,78**	**9,69**

Source: CFCE, 1996

[5] In 1994, 89% of all wines sold in the off-licence were offered in glass bottles of 75cl.

2.5. The demand side [6]

The consumption of wines in the UK has steadily grown between 1975 and 1995. During the mid 1990s, wine wass no longer considered as a drink exclusively for special occasions, but is rather regarded as suitable for all occasions. The penetration rate has correspondingly increased over that period.

Table 2.13.: **Penetration of still light wine drinking (1993)**
(% of adults in group drinking at some time)

ALL ADULTS (> 15 years)	78
BY SEX	
Male	68
Female	72
BY AGE	
15-24	56
25-34	77
35-44	79
45-54	78
55-64	71
> 64	61
BY SOCIO-ECONOMIC GROUP	
A	87
B	85
C1	78
C2	69
D	56
E	52
BY REGION	
Scotland	63
North	60
Yorkshire/Humberside	67
North West	67
East/West Midlands	68
Wales	67
South West	75
South East/East Anglia	78
Greater London	71

Source: EIU, 1994

Furthermore, the greatest level of penetration was achieved by German white wines, drunk by 29% of all adults (15+), followed by French white (21%) and French red (16%). Comparison of penetration levels among men and women reveals that the gap is wider for red wines than for white wines of any particular origin.

[6] All figures in this section for 1996, unless stated otherwise.

Table 2.14.: **Volume shares of alcoholic drinks consumed in Great Britain**

% of total volume consumed	1971	1981	1991
Cider and Perry	2,5	3,5	5,2
Wine	3,9	7,0	10,2
Beer	93,6	89,5	84,6

Source: British Customs & Excise

The per head consumption of wines has sharply increased, from 5.8li/year in 1971 to 15.8 li/year in 1991 (for all consumers > 15 years). Nevertheless, with the exception of Northern Ireland, Great Britain is the country within the EU with the lowest level of consumption.

Table 2.15.: **Wine consumption per head in the EU (in liters)**

	France	Italy	Luxembourg	Belgium	Denmark	Britain
1990	73,1	61,4	58,2	24,9	21,3	11,56

Source: CFCE, 1994a

The British consumer purchases mainly white wines (60%), though red wines, taking almost 40% of the market share, have recently enjoyed a substantial expansion.

Table 2.16: **UK sales of imported still light wine by colour, 1980-93**
(% of volume)

	RED	ROSE	WHITE
1980	36.8		63.2
1981	33.8		66.2
1982	31.6		68.4
1983	28.7		71.3
1984	29.1		70.9
1985	30.0		70.0
1986	30.9		69.1
1987	29.8		70.2
1988	32.8		67.2
1989	26.1	3.6	70.3
1990	27.0	3.8	69.2
1991	28.5	3.8	67.5
1992	30.6	3.2	66.0
1993	33.2	2.9	63.7

Source: EIU, 1994

During the 1990s, it has been suggested that the UK wine market is far from being a mature market for light wines (EIU, 1994, p.19). The growth in the share of white wines up to 1983 has therefore been regarded as the result of large numbers of new consumers entering the category for the first time in that period, swamping the effect of existing consumers moving towards red. Similarly, the stability of shares through to 1989 has been suggested to reflect the two opposing factors coming broadly into balance. While existing consumers were showing some shift in preferences away from white and towards red/rose, the market was still at a stage of 'development' where new consumers were continuing to make their presence felt. This balance of factors has only begun to reverse since the beginning of the 1990s, with maturing wine consumption patterns among the existing body of drinkers holding greater sway over market developments than the preferences of new entrants to the category (ibid.).

Impediments on the demand side during the 1990s

Several government laws and activities influence the wine consumption in Great Britain:

- It is forbidden to sell alcohol to minors under 18 years
- It is forbidden to sell and to consume alcohol in specific public areas and at certain times (in particular, on Sundays, though this varies according to region)
- Pubs had traditionally to close at 11pm, now have more flexible opening hours
- Taxes on alcoholic drinks are amongst the highest in Europe.

Table 2.17.: Excise duties in Great Britain

		w.e.f. 16 March 1993	w.e.f. 1 January 1998
Still wines:	5,5 - 15% alc. vol.	132,26 £/hl	144.65 £/hl
Sparkling wines:	5,5 - 15% alc. vol.	218,40 £/hl	
Sparkling wines:	5 ,5 - 8.5% alc. vol.		201.50 £/hl
Sparkling wines:	8 ,5 - 15% alc. vol.		206.66 £/hl
Still wines:	15 - 22% alc. vol.	220,43 £/hl	192.86 £/hl
Still wines:	exceeding 22% alc. vol.		19.56 £/ litre of pure alcohol

Source: CFCE, 1994a/British Customs & Excise

Between 1984 and 1994, the excise duty on still light wine was increased by 49%, broadly in line with the increase for beer, but greater than the 28% increase for spirits. Since 1977, duty on still light wine has increased by 88%, marginally below the 90%

increase for spirits and far below the 235% rise in beer duty. Made wine, a largely UK produced product, enjoys a 29.8% lower duty than the wine of fresh grape wine equivalent. The prevailing duty system effectively discriminates therefore against imported products.

Table 2.18.: Rates of excise duty on still light wine, 1977-94

	Rate of duty		
	£ per hectoliter	**pence per 75cl bottle**	**% change**
Jan 1, 1977	71.50	53.63	n.a.
Mar 27, 1980	81.42	61.07	13.9
Mar 11, 1981	95.20	71.40	16.9
Mar 10, 1982	106.80	80.10	12.2
Mar 16, 1983	113.00	84.75	5.8
Mar 14, 1984	90.50	67.88	-19.9
Mar 20, 1985	98.00	73.50	8.3
Mar 16, 1988	102.40	76.80	4.5
Mar 21, 1990	110.28	82.71	7.7
Mar 20, 1991	120.54	90.41	9.3
Mar 11, 1992	125.96	94.47	4.5
Mar 17, 1993	132.26	99.20	5.0
Jan 1, 1994	134.77	101.08	1.9

Source: British Customs & Excise/EIU, 1994

Consumption patterns of wines in the UK during the 1990s

In 1992, 22% of the consumers purchased wine regularly, that is to say, at least once per week (in contrast to 34% purchasing beer with the same frequency). However, this level of ‘regular’ consumers is one of the lowest in the EU. Nevertheless, the participation rate for wines in the UK is about average, as only one out of four British consumers never purchases wine. Amongst the ‘regular’ consumers, only 4%, however, drink wine every day. While regular beer consumption is less of a female phenomenon (54%), wine is consumed with the same frequency amongst the sexes.

Table 2.19.: Wine consumption by socio-economic groups

	% of UK population	**% of wine consumption**
CSP: D, E	28,6	15,6
CSP: C2	29,2	24,7
CSP: C1	23,4	28,6
CSP: A, B	18,2	29,9

Source: EIU, 1994

Wine consumption can be characterized in terms of socio-economic groups, dominated in particular by groups A, B and C1. In the off-licence sector, in particular, classes C2, D and E are still showing a strong preference for beer. The highest percentage of regular wine consumers can be found amongst high grade-employees, with highest grade employees contributing 47,5% to those regular consumers. In contrast, farmers, laborers and unemployed, which made up about 14% of the population, contribute 30% to the non-wine-consumers (in contrast to 6% of high grade employees).

Table 2.20.: Consumption of wine by region (1990)

	% of UK population	% of total wines consumed
London	10,2	11,9
South except London	11,9	5,9
Midlands	5,9	7,6
North East	8,5	6,8
Lancashire	8,5	9,3
Yorkshire	9,3	8,5
Scotland	5,1	6,8
Anglia	14,4	14,4
Wales	17,8	19,5

Source: CFCE, 1994a

Although regional consumption patterns have become more homogeneous, Greater London, the South and the Midlands are those regions where regular and occasional wine consumers are to be found most frequently. Nevertheless, previous studies have suggested that there are "no marked differences" in consumption patterns amongst the regions in the UK.[7]

Table 2.21.: Profile of weekly drinkers of still light wine, 1988-92
(% of all adults drinking at least weekly)

	Still light wine			Adult population		
	1988	1990	1992	1988	1990	1992
BY SEX						
Male	47	46	46	48	48	48
Female	53	54	54	52	52	52
Total	100	100	100	100	100	100

[7] "*L'ensemble des professionnels du secteur des vins s'accorde sur le fait qu'au niveau des ventes, il ne se degage aucune tendance permettant d'affirmer qu'il existe des differences marquees de consommation entre les differentes regions du Royaume-Uni*." (CFCE, 1994a, p62).

BY AGE						
18-24	14	13	11	15	14	13
25-34	22	22	23	19	20	20
35-49	32	33	33	25	25	26
50 and >	32	32	33	41	41	40
Total	100	100	100	100	100	100
BY SOCIO-ECONOMIC GROUP						
A, B	34	34	33	18	18	18
C1	29	30	30	22	23	24
C2	22	22	22	25	28	28
DE	15	14	15	35	31	30
Total	100	100	100	100	100	100
BY REGION						
Scotland	6	5	5	9	9	9
North East	4	5	5	6	6	6
Yorkshire	9	8	8	10	10	10
Lancashire	11	11	12	12	12	12
Midlands/Anglia	23	23	23	23	23	23
Wales/South West	10	11	10	11	11	11
South	11	12	11	9	9	9
London	25	25	26	20	20	20
Total	100	100	100	100	100	100

Source: EIU, 1994

At least three points deserve to be emphasised:

- The greatest concentration of weekly drinkers is to be found in the age group of the 35-49
- The 50 plus groups are under-represented
- Females account for 54% of weekly drinkers, slightly above their 52% population share

Regular wine drinkers are most dominant in the age group above 50, but it is in the same group that some of the highest percentages of non-participants in the wine market is found.

The color and origin of wines consumed

In 1994, about 70% of wines (volume) imported into the UK were white. Although this proportion has continued to decline since, distinct consumption patterns exist as a function of colour.

Table 2.22.: **Profile of weekly wine drinkers of still light wine by colour, 1992:**
(% of all adults drinking at least weekly)

	WHITE	RED	ROSE	ANY	Adult population
BY SEX					
Male	37	55	35	46	48
Female	63	45	65	54	52
Total	**100**	**100**	**100**	**100**	**100**
BY AGE					
18-24	11	7	12	11	13
25-34	23	23	20	23	20
35-49	32	37	35	33	26
50 and >	35	34	33	33	40
Total	**100**	**100**	**100**	**100**	**100**
BY SOCIO-ECONOMIC GROUP					
A, B	32	46	34	33	18
C1	29	30	28	30	24
C2	22	15	22	22	28
DE	17	8	18	15	30
Total	**100**	**100**	**100**	**100**	**100**
BY REGION					
Scotland	5	5	3	5	9
North East	5	3	4	5	6
Yorkshire	8	8	9	8	10
Lancashire	10	9	8	12	12
Midlands/Anglia	24	22	29	23	23
Wales/South West	10	8	8	10	11
South	11	13	17	11	9
London	27	32	23	26	20
Total	**100**	**100**	**100**	**100**	**100**

Source: EIU, 1994

The consumer profile reveals that

- red wine has an older consumer profile
- red wines have a more upmarket and male profile

Table 2.23.: **Profile of weekly drinkers of still wines by country of origin (1992)**
(% of all adults drinking at least weekly)

	France	Ger-many	Italy	Spain	Por-tugal	Bul-garia	Yugos-lavia	US	Aus-tralia	Any wine	Adult Popu-lation
BY SEX											
Male	50	35	38	49	40	45	50	59	50	46	48
Female	50	65	62	51	60	55	50	41	50	54	52
Total	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**

BY AGE											
18-24	8	9	14	6	8	10	14	12	7	11	13
25-34	21	22	26	23	26	25	17	35	31	23	20
35-49	38	31	34	29	26	29	14	30	35	33	26
50 and >	33	38	27	42	38	36	54	23	26	33	40
Total	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**
BY SOCIO-ECON. GROUP											
A, B	50	30	27	37	32	36	54	47	51	33	18
C1	28	31	29	26	32	38	26	32	35	30	24
C2	15	23	27	16	21	19	17	12	10	22	28
DE	8	17	18	22	14	6	6	9	4	15	30
Total	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**
BY REGION											
Scotland	4	5	5	3	4	3	0	5	6	5	9
North East	3	4	3	5	6	2	9	5	2	5	6
Yorkshire	7	8	10	7	6	10	17	8	6	8	10
Lancashire	7	9	12	11	12	12	14	6	7	12	12
Midlands/ Anglia	21	27	21	22	26	23	43	32	18	23	23
Wales/ South West	9	11	7	9	10	12	0	5	10	10	11
South	15	11	12	13	7	11	3	9	12	11	9
London	34	24	29	31	29	27	17	32	40	26	20
Total	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**

Source: EIU, 1994

The profile discloses that

- Australian, ex-Yugoslav, U.S., and French wines have the most upmarket profiles, led by wines of Australian origin (86% of weekly drinkers).
- Germany's reliance on the higher socio-economic groups is below average, but least dependent of all are Italian wines.
- the older groups share of drinkers (35 +) ranges from a low of 53% (USA), followed by Italy (61%), Australia (61%), Portugal (64%), Bulgaria (65%), to a high of 71% in the case of French and Spanish wines.

3. Analysis

3.1. Data description

The AC Nielsen data that is used in the following analysis has been compiled by the *Centre Francais du Commerce Exterieur*.[8] The data was collected in August 1994 in 94 retail outlets of different commercial forms in England and Scotland. It aims to give a representative sample of foreign still wines sold in the off-licence sector in those regions. The retail outlets were therefore selected according to the company's market share in 1993/94.

The data is based on the following regions, towns and cities visited:

Regions visited	**Towns and cities visited**	**Number of outlets**
SCOTLAND	Edinburgh Bathgate	9
GREATER LONDON	London Guilford Godalming	34
NORTH-EAST	Leeds	6
NORTH-WEST	Manchester	9
CENTER	Birmingham Northhampton Nottingham	17
SOUTH-WEST	Bristol	11
SOUTH-EAST	Southhampton Portsmouth	8

These 94 outlets can be distinguished by commercial forms as following:

27 **Supermarket** outlets	37 **Wine specialist** outlets	18 **Hypermarket** outlets	5 **Large retailer** outlets	7 **Others**
7 Tesco	4 Wine Rack	6 Asda	2 Littlewoods	1 Coop
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 (Coop)		1 Independant
6 Sainsbury	2 Majestic	3 Tesco		1 Kwiksave
3 Waitrose	2 Cellar Five			1 Spar
	1 Bottom's up			
	1 Haddows			

[8] C.F.C.E., Direction des Produits Agro-alimentaires, 10 avenue d'Iena, 75116 Paris.

The cross-section data for 1994 consists of actual retail prices. However, some of the prices for wine specialists are given as average prices, as they vary with the geographical location of specialists that belong to the same chain. Also, wines that are sold in 0.375l bottles or bottles and containers larger than 0.75l are not included in the present analysis.

From the data available, off-licence outlets could therefore be distinguished according to their commercial form and their way of presenting wines on the shelf:

NAME OF RETAILER	**COMMERCIAL FORM**					**STYLE OF PRESENTATION**			
	Wine Specialist	Large Retailer	Super-market	Hyper-market	Mini-market	Colour and Country	Colour and Country & Region	No Classi-fication	Colour only
Sainsbury			•	•		•			
Asda				•			•		
Tesco			•	•		•			
Safeway			•	•		•			
Waitrose			•			•			
Morissons				•		•			
M & S		•				•			
Victoria wine	•					•			
Thresher	•					•			
Oddbins	•						•		
Coop					•			•	
Gateway					•			•	
Kwiksave					•			•	
Cellar Five	•							•	
Unwin's	•							•	
Littlewoods		•							•

Source: own, compiled from CFCE, 1994a

Additional traits are as following:

NAME OF RETAILER	general size characteristics or particular traits	size of the wine section	locational traits	% of wines presented on shelf under own-brand
SAINSBURY	great variability in size: 200 to 5000 m^2	for the hypermarkets: 100 to 170m for the supermarkets: 40 to 100m	smallest outlets situated in town centers	85
ASDA	-	110 to 140m	generally situated in the periphery of towns	40
TESCO	great variability in size: 200 to 4000 m^2	for the hypermarkets: 150 to 180m for the supermarkets: 10 to 70m	situated both in town centers as well as in the periphery of towns	45
SAFEWAY	-	for the hypermarkets: 60 to 100m for the supermarkets: 50 to 90m	situated both in town centers as well as in the periphery of towns	40
WAITROSE	supermarkets between 500 and 1500 m^2 in the South and London only; great emphasis on wine presentations on shelf	varies between 50 and 70m	town centers and retail parks	very rare
GATEWAY & QUIKSAVE	wine is not given a separate shelf section	8 to 50m	often in town centers	very rare
COOP	little importance given to wines; great variability in size	10 to 40m	town centers or residential areas	none
VICTORIA WINE	nationwide; size of the outlet of little importance	20 to 60m	residential areas and retail parks	5
THRESHER	nationwide; great size variability: 35 to 60 m^2	25 to 70m	high street stores and residential areas	none
ODDBINS	great emphasis placed on offering a wide variety of wines; very competent store managers; very distinct style of the outlets	120m	high street stores and residential areas	none

NAME OF RETAILER	general size characteristics or particular traits	size of the wine section	locational traits	% of wines presented on shelf under own-brand
CELLAR 5	outlets only in the North	10 to 15m	high street stores and residential areas	none
UNWINS	outlets in the South and London; 40 to 60 m^2	40 to 55m	town centers	none
LITTLEWOODS	wine section in the midst of the food section ; 400 to 1000 m^2	40 to 60m	in pedestrian zones and retail parks	none

Source: own, compiled from CFCE, 1994a

Each price for a bottle of wine collected is described by the following dimensions:

- the country of origin	- the importer
- the colour	- the brand (e.g. Gallo)
- the category (DOC, QbA, DO, etc.)	- the vintage
- the region of origin	- the place of bottling
- the appelation (Chianti, Rioja, etc.)	- the volume
- the producer	- the grape variety

Hence, all information that appears on the label of the bottle of wine was collected, except for the degree of alcohol. A quantity proxy is also given as the survey reveals in how many outlets out of each company a uniquely identified bottle was found.

In total, 14,440 prices are identified by 575 attributes. Since there are 3940 uniquely identified bottles of still wines, each one of them appears on average in 3.7 retail outlets. However, the present data set is characterized by missing values. The information given about the attributes of each bottle appears in a rather unequal manner due to two reasons. First, 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. Second, due to national or EU legislation, the region of origin, the grape variety or the vintage may not appear on the label (see section 1. for details).

The fact that the information collected is far from satisfactory can be seen in the following list of attributes and retailer traits that would be desirable in a 'first best world':[9]

Category A

These are attributes frequently acknowledged as determining the quality - positively or negatively - of the wine in the bottle. Sometimes some of these are stated on the label. As a result, category A will be divided into (i) those attributes nearly always stated on the label, and (ii) those attributes less often stated on the bottle. and (iii) those attributes never stated on the bottle.

A (i) (a) Country of origin
A (i) (b) Region
A (i) (c) Vintage

A (i)/(ii) Grape variety (sometimes this is not stated as such, but the purchaser is frequently able to deduce it from A (i) b.)

A (ii) (a) Producer
A (ii) (b) Bottler

A (iii) (a) How the wine has been transported and stored (this is partly related to A (ii) (a) and (b))
A (iii) (b) The taste of the wine (consumption experience of an identical bottle an earlier occasion)
A (iii) (c) Recommendations (e.g., wine columnists in The Guardian or The Observer)

Category B

These are attributes that do not need in any way to be related to the tasting qualities of the wine inside the bottle, but they are 'attributes' from among which the purchaser makes his or her choice.

B (i) (a) The name of the importer

[9] From all these, it should be possible to distinguish 'reputation effects' from other effects. We would expect reputation effects to come exclusively from Category B, but A (iii) (b) and (c) get close to being reputation attributes (see section 4.4.).

B (i) (b) The shape of the bottle (not 'on' the label, but incontrovertibly visible to the purchaser)
B (i) (c) The colour of the bottle (ditto as above):
  B (i) (c) 1 for **white** and **rose** wines:
    B (i) (c) 1 (a) Clear glass. This is significant, because it reveals the true colour of the wine contained (from deep golden to pale yellow for whites, from dark to light red for rose), and this is probably seen by the purchaser as a Category A attribute.
    B (i) (c) 1 (b) Pale green
    B (i) (c) 1 (c) Pale brown
  B (i) (c) 2 for **red** wines:
    B (i) (c) 2 (a) Dark green
    B (i) (c) 2 (b) Dark brown
B (i) (d) The nature of the stopper (ditto as for B (i) (b)):
  B (i) (d) 1 Wired cork (for sparkling wines).[10]
  B (i) (d) 2 Standard cork
  B (i) (d) 3 Screw top. This is significant, because it is associated with Category A attributes - purchasers may associate screw-tops with lesser quality wines.
B (i) (e) Where and how the retailer displays the bottle (ditto as for B (i) (b))

B (ii) (a) Advertising
B (ii) (b) What other people have bought.
B (ii) (c) The 'convenience' (e.g., accessibility, parking facilities, opening hours) of the retail outlet.

3.2. Estimation and validation of hedonic price functions applied to wine market data

3.2.1. Estimation issues

A large number of papers has dealt with hedonic price analysis applied to wine from different regions, also discussing the underlying estimation issues (for an overview of the studies, see Oczkowski, 1994, Nerlove 1995, Buccola and van der Zanden 1997, Combris, Lecoq and Visser 1997, Steiner 2004 and Cardebat and Figuet 2009). However,

[10] This is significant as it is associated socially with celebration, with spending more money as a gesture in itself. An anomaly would be Lambrusco Bianco, a wine which is sparkling, but which has a screw top.

the following sections provide a more detailed overview, while focusing on the data and estimation issues that are specific to the present data set.

In general, the validity of the hedonic model as a representation of a disaggregator function for wine attributes is determined by the appropriateness of the theoretical specifications, the functional form selected and the statistical properties of the estimated equations.

The estimation procedure assumes a one-period model of consumer behaviour, where consumers are assumed not to be responding to a pattern of price changes.[11] It is further assumed that the consumer buys one variety of wine at a time from among a number of different varieties.

The testing procedure as applied in the present analysis began with the estimation of the hedonic price functions employing General least squares (GLS) estimator.[12] However, given the qualitative nature of the data and the necessity to retain comparability across attributes, the variables have to undergo a modification first that alters the interpretation of the estimates only. The modification does not alter the underlying meaning of the implicit price estimates as 'missing prices' in a hypothetical market where both consumers and producers were asked to attribute their valuation to the existence of a particular wine attribute, *ceteris paribus*. As a result of this modification and after adjusting the coefficient estimates with the estimated variances, the final interpretation is 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*.

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[11] If they were, the problem of endogeneity of prices would arise. Marginal prices of an attribute could then no longer be regarded as constant, hence both the quantities consumed of this attribute, as well as those of others may be affected, leading to unanticipated quantity changes. Criticism of the assumption (no endogeneity) could be partly defended. The nature of the chosen functional form, the log-lin, allows each marginal implicit price to be a nonlinear function of the entire set of characteristics (Wahl *et al*., 1995, p.40). This functional assumption is therefore consistent with the observation that the implicit price of an attribute may not only be a function of the level of the attribute itself, but also a function of the levels of other attributes in the wine (Jones, 1988).

[12] GLS, as is ordinary least squares, is valid since regression lines for dichotomous regressors pass through group means.

Both linear and non-linear regression are performed using SHAZAM. As it has been argued above on theoretical grounds, non-linear models should provide the more realistic alternative. Also, on pragmatic grounds (with respect to heteroskedasticity), a non-linear functional form such as the semilogarithmic (log-lin) model should be preferable. In this instance, the derivative of the dependent variable with respect to the dummy variable does not exist, as the dummy variable enters the equation in dichotomous form. The coefficient of a dummy variable rather measures the discontinuous effect on the dependent variable of the presence of the factor represented by the dummy variable. Halvorsen and Palmquist (1980) demonstrate in the context of binary-coded dummy variables that in the instance where the dependent variable is *lnY*, the coefficient of the dummy expresses change in units of *ln Y* since it reflects the difference in subgroup means between the designated group and the reference group in units of the dependent variable. The authors report the general form of a log-lin equation as,

$$\ln Y = a + \sum_i b_i X_i + \sum_j c_j D_j \tag{1}$$

where the X_i reflects continuous variables and the D_j represent dummy variables. In the above, simplified case of a single dummy variable, the interpretation of the coefficient of the dummy variable is revealed by transformation of equation (1):

$$Y = (1+g)^D \exp(a + \sum_i b_i X_i)\,, \tag{2}$$

where $g = (Y_1 - Y_{ref}) / Y_{ref}$. Y_1 and Y_{ref} are the predicted values of the dependent variable when the dummy variable is equal to one and stands for the reference group, respectively. The coefficient of the dummy variable in equation (1.) is therefore

$$c = \ln \frac{1 + Y_1 - Y_{ref}}{Y_{ref}}\,. \tag{3}$$

Since g displays the relative effect on Y of the presence of the factor represented by the dummy variable, the percentage effect of the dummy variable on Y, in units of Y, is found by applying the antilog function,

$$100 \cdot g = 100 \cdot \{\exp(c) - 1\}\,, \tag{4}$$

which is therefore the percentage difference associated with being in group 1 rather than being in the reference group. Thus, if for example -.246 would emerge, after taking the antilog to the base e and after subtracting 1, the expected value of Y for the designated group is found to be 24.6% lower than the value for the reference group. The expected implicit price for a bottle of wine from region A would thus be 24.6% lower than the expected price for a bottle from region B, the reference group.

However, Kennedy (1981) objects to Halvorsen and Palmquist's (1980) interpretation of estimating the percentage effect on asymptotic grounds as their suggested procedure leads to a biased estimator for the dummy variable. Instead of estimating g by

$$\hat{g} = \exp(\hat{c}) - 1 \tag{5}$$

he suggests to follow Goldberger (1968) and to estimate g by

$$g^* = \exp\left(\hat{c} - \frac{1}{2}\hat{V}(\hat{c})\right) - 1\,, \tag{6}$$

where $\hat{V}(\hat{c})$ is an estimate of the variance of $\hat{c}$, which has less bias than $\hat{g}$.

By adjusting coefficient estimates with a constant value, it is possible to shift an interpretation associated with *binary-coded* dummy variables, where each of the designated categories is expressed in relation to the reference category, to an interpretation consistent with *effects-coded* dummy variables, where each category is compared to the mean of the subgroup means. Suits (1984) suggests a procedure for adjusting dummy variable coefficient estimates which leaves all variables in the equation and interprets the estimates as deviations from average behavior.[13]

In an OLS regression where any constant k is added to the value of each of the coefficients b_i and subtracted from the intercept, all calculated values of the residuals u - and hence the sum of u^2 - are unaffected. Following Kennedy's (1986) extension of Suits (1984), in a first step, take the sum of all observations and divide both sides of the equation by the sample size N. It follows that the new dummies reflect the proportion of non-zeros in the original variables.

Then, only one regressor is restricted to be zero. In order to obtain estimates for all variables, including the zero coefficient of the omitted dummy, choose $k = -(b_1 + b_2 + \ldots + b_n + 0) / n$ (where n corresponds to the total number of variables in each category) so that the resulting coefficients average zero:

$$\sum b_i^* = \sum (b_i + k) = 0 \tag{7}$$

That is, imposing the identifying restriction $\beta_a P_a + \beta_b P_b + \cdots + \beta_n P_n = 0$, the least square estimate will produce $\beta_0^* = \overline{Y}$ as the estimate of the intercept β_0. All other coefficient estimates can be interpreted as deviations from the average value of the dependent variable.

Once the coefficient estimates yield k, add this value to each of the coefficients, including the zero, and subtract it from the constant term. This is done for each subgroup simultaneously, i.e. add $k_{grape\text{-}variety}$ and k_{region} to all coefficients of the corresponding

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[13] A relationship that contains all dummy variables as independent variables on the right hand side usually cannot be estimated since it is unidentified due to perfect multicollinearity. 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. Thus, rather than comparing differences between individual estimates and the estimate of the omitted dummy, the interpretation of all estimates as deviations from average behaviour allows a more effective interpretation and presentation of results.

subgroups and subtract them from the constant. The statistical properties of the resulting equation are identical to an equation that excluded one of the variables and established this as a base line from which all others are measured as deviations. Unique values of all coefficients are obtained, the values of u are unaffected and the dummy variable coefficients measure deviations from the 'average' intercept that is the average of the intercepts of all prices, where the intercept incorporates the information about the relative information of each attribute.

However, a simpler alternative to the above adjustment procedure is to substitute the full constraint into the original equation (Oczkowski, 1994, p.100). Following symmetrical estimations, it is possible to obtain all coefficient estimates. If, for example, the objective was to get coefficient estimates for wine colors (red, white, rose: c_1, c_2, c_3) and, say, all four producer regions of a given county (r_1, r_2, r_3, r_4), both constraints (8) and (9.) could be substituted into the original equation as following:

$$\begin{aligned} &\alpha_1 Pc_{i1} + \alpha_2 Pc_{i2} + \alpha_3 Pc_{i3} = 0 \\ &\alpha_1 = [-(\alpha_2 Pc_{i2}) / Pc_{i1} - (\alpha_3 Pc_{i3}) / Pc_{i1}] \end{aligned} \qquad (8)$$

where P_c indicates the mean, hence the proportion of non-zero’s, in the color categories for each bottle of wine. And

$$\begin{aligned} &\beta_1 \Pr_{i1} + \beta_2 \Pr_{i2} + \beta_3 \Pr_{i3} + \beta_4 \Pr_{i4} = 0 \\ &\beta_2 = [-(\beta_1 \Pr_{i1}) / \Pr_{i2} - (\beta_3 \Pr_{i3}) / \Pr_{i2} - (\beta_4 \Pr_{i4}) / \Pr_{i2}] \end{aligned} \qquad (9)$$

where P_r reflects the proportion of non-zero’s in the region categories for each bottle of wine. This, substituted into the original equation, gives

$$\begin{aligned} P &= [-(\alpha_2 Pc_{i2}) / Pc_{i1} - (\alpha_3 Pc_{i3}) / Pc_{i1}] C_{i1} + \alpha_2 C_{i2} + \alpha_3 C_{i3} + \beta_1 R_{i1} + \\ &[-(\beta_1 \Pr_{i1}) / \Pr_{i2} - (\beta_3 \Pr_{i3}) / \Pr_{i2} - (\beta_4 \Pr_{i4}) / \Pr_{i2}] R_{i2} + \beta_3 R_{i3} + \beta_4 R_{i4} \end{aligned}$$

(9a)

and,

$$
\begin{aligned}
P &= \alpha_2[C_{i2} - (Pc_{i2} / Pc_{i1})C_{i1}] + \alpha_3[C_{i3} - (Pc_{i3} / Pc_{i1})C_{i1}] \\
&+\beta_1[R_{i1} - (\mathrm{Pr}_{i1} / \mathrm{Pr}_{i2})R_{i2}] + \beta_3[R_{i3} - (\mathrm{Pr}_{i3} / \mathrm{Pr}_{i2})R_{i2}] + \beta_4[R_{i4} - (\mathrm{Pr}_{i4} / \mathrm{Pr}_{i2})R_{i2}]
\end{aligned}
\quad \text{(9b)}
$$

The corresponding linear hedonic model assumes therefore,

$$
p = \alpha_2[X_{a2}] + \alpha_3[X_{a3}] + \beta_1[X_{b1}] + \beta_3[X_{b3}] + \beta_4[X_{b4}] + \varepsilon, \quad \text{(9c)}
$$

where p is a $N \times 1$ vector of observations on the dependent variable, unit price P, there are five $N \times 1$ vectors of X of observations, α and β define unknown parameters, and ε is a $N \times 1$ vector of unknown stochastic disturbances.

Following a symmetrical substitution, the estimates for the remaining coefficients α_1 and β_2 can be obtained. Due to this transformation, coefficient estimates are no longer directly interpretable as equilibrium marginal implicit prices, hence consumers' equilibrium marginal willingness-to-pay. For a given coefficient estimate, the vector of that particular member of the category is adjusted by the weighted vector of a reference vector, another member of that category, that is subsequently exchanged in the symmetrical regression. The weights constitute the ratio of the means of the particular vector under question, and the means of the reference vector. Assume that a log-lin model has been estimated, then the final adjustment of the estimates according to equation (6) permits us to interpret the values as measuring the percentage impact of the dummy variable on *p*, in units of *p*, *ceteris paribus*.

However, the above specification embodies an equivalence effect. The effect of grape variety, for example, i.e. the estimated implicit price differences between Cabernet Sauvignon and Shiraz, are assumed to be the same across all regions.[14] It is, however, suspected that some regions/grape varieties are carrying a 'reputation', or are of special interest to the consumer. Therefore, a model should be specified that provides sufficient flexibility as to allow these effects to show. The introduction of *interaction terms* is one

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[14] This assumes that the traditional way of dropping one category to avoid perfect multicollinearity, is pursued.

way to specify such a model that allows us to test for differential effects. These are the product of two or more independent variables, reflecting the conditional effects of one variable. In the context of continuous variables, the interaction of X_a with X_b describes how X_a and X_b relate to *P* (the dependent variable), thus how the slope of X_a is affected by the value of X_b. Therefore, interaction can be computed only when *P* scores are known, which is not necessary for the determination of intercorrelation.[15]

The interaction terms of primary interest are those for *region/variety*. The coefficient estimates for those product variables estimate then the differential effect of region by variety. For example, the interaction term for grape variety and region estimates the extent to which, say, the effect of being Riesling differs for Mosel versus Rhine Valley.

3.2.2. Model specifications

3.2.2.1. The functional form

The evaluation of the functional form is an important aspect of diagnostic testing (McAleer, 1995; Greene 2007), which will be discussed below in the context of specification search. However, the choice of functional form for estimation will also be addressed here, with reference to the present data set.[16]

Since there is little theoretical guidance to the functional form, the objective should be to include all forms that theory shows are plausible. Halvorsen and Pollakowski (1981) suggest a systematic way to choose the functional form for hedonic price equations. This combines the Box-Cox and flexible functional form approaches. However, as all explanatory variables in the present study are of qualitative nature, hence the *log* of dummy characteristic variables cannot be taken, the choice of the functional form is

[15] Interaction between two dichotomous regressors in a single regression reflects two non-parallel regression lines, so that the coefficient estimate of the interaction term equals the difference between differences of cell means.

[16] The following discussion and estimation is restricted to the parametric approach, although there have been nonparametric hedonic analyses (e.g. Meese and Wallace, 1991).

limited to the linear and the log-lin specification.[17] Nevertheless, the use of interaction terms allows a more flexible approach in terms of the examination of possible interactions between individual attributes.

As the above discussion on the selection of attributes and the interpretation of hedonic prices emphasized, the log-lin hedonic function produces non-constant marginal Engel prices (the prices paid for incremental units of characteristics when purchased as part of the same bundle), but exhibits constancy of relative prices with respect to changes in proportions of characteristics. This log-lin specification assumes therefore homotheticity of the utility function, hence homogeneity of degree zero of the demand equations for attributes.[18] Since only relative prices matter, the imputed price is independent of level of the characteristic (which appears to be a realistic and convenient assumption since only qualitative variables are used as explanatory variables in the present model).

The log-lin form allows each marginal implicit price to be a nonlinear function of the entire set of characteristics. It appears therefore as an attractive alternative hypothesis since it accommodates the bundling constraints that wine attributes face in the bottle.

However, the implication of the case where the linear hedonic contour cannot be rejected statistically, is that both special cases (identical user or seller techniques) would have to be rejected (Triplett, 1989, p.203).[19]

3.2.2.2. Specification search and estimation of the hedonic price models

In the following modeling exercise, the attempt is to provide an adequate representation of the given price data in a systematic and transparent manner. As there appears to be no single, readily available econometric approach for the estimation of the above functional

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[17] In contrast to the log-linear or constant elasticity models, which are linear in the parameters and linear in the logarithms of both the dependent and independent variables, the log-lin models are semilog models.

[18] This reflects the assumption of no change in consumption pattern following a proportinate change in prices of all attributes, given the same proportional change in money income.

[19] With normal convexity of production sets nonlinearity is a necessary, though not sufficient, condition for identification.

(hedonic) relationship, the following modeling strategy borrows from several methodologies.[20] Before describing the final approach, the following section discusses why particular avenues were pursued and others were left unexplored. In particular, two econometric methodologies are briefly discussed in the present context, those frequently associated with David Hendry and Ed Leamer.

Pagan (1995, pp.14) compares the steps taken in both methodologies and summarises them in four points each. Hendry suggests to first formulate a general model that is consistent with what economic theory postulates and that is subsequently reparameterised to obtain explanatory variables that are near orthogonal. Leamer suggests the formulation of a general family of models and, in a second step, to decide what inferences are of interest and express these in terms of parameters. Then, in a bayesian manner, he suggests the formation of 'tentative' prior distributions that summarise the information not contained in the given data set. In addition, in this estimation stage, Leamer recommends the use of specification uncertainty diagnostics and measurement error diagnostics.

As Pagan (1995, p.15) emphasizes, Hendry does not differ greatly in these two initial steps from Leamer, the main distinction being that in Hendry, the emphasis is on building a model from which inferences will later be drawn, whereas Leamer focuses upon the desired inference from the beginning. Thus, Leamer would want a clear definition of what the issues in modeling are at the beginning, whereas in Hendry's case it is rare to find a particular set of coefficients being the center of attention; it is variable interrelationships as a whole that seem to dominate (Pagan, 1995, p.16). Having initially set out which variables are theoretically admissible, and focusing upon a subset of variables that are likely to be highly valued by the consumers, the present analysis follows Leamer in terms of misspecification tests, hence specification uncertainty diagnostics and measurement error diagnostics. Although the Hendry methodology is time series based, Hendry's 'general-to-specific' approach and the above, related steps, are thought to be appropriate in the present cross-sectional context.

[20] "Our data are such that we cannot ignore the fact that the information therein may need to be extracted by a wide range of techniques borrowed from many different approaches." (Pagan, 1995, p.26)

In following Leamer's specification uncertainty diagnostics and measurement error diagnostics, tests of the following null hypotheses will be conducted to evaluate the adequacy of the model:

- Correct functional form
- No heteroskedasticity
- Normality
- Parameter constancy
- Non-nested models
- Robustness/lack of sensitivity

While conducting tests for these null hypotheses, the objective is to take account of the various possibilities for rejecting them, as outlined in detail by McAleer (1995, pp.102).

The third step in Hendry consists of the simplification of the model to one that is congruent, hence compatible with the data. Leamer, at this stage, suggests sensitivity analysis, both in a 'classical' and a bayesian manner, as discussed below. The present study follows Leamer in his 'classical' references to sensitivity analysis, and subsequently attempts to simplify the models incorporating the insights gained from specification uncertainty diagnostics and measurement error diagnostics, while ignoring the causal significance attached to coefficient estimates at this stage.[21]

Leamer (1990) adopts a more transparent approach to the fragility of statistical inferences. In a bayesian manner, Leamer examines the extreme values of the point estimates, leading to his 'extreme bound analysis' (EBA), as briefly discussed below.[22]

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[21] Pagan (1995, p.13) suggests that Hendry's applied papers frequently leaves only "puzzlement" about how he actually did the simplification: "... it is hard to have much confidence in a model if little is explained about its origin. Hendry's attitude seems to be that how a final model is derived is largely irrelevant... ."

[22] Although Pagan (1995, p.16) suggests that in this third step both approaches share the same set of difficulties, he underlines that, "Whenever a large number of variables are deleted in a simplification exercise, the provision of extreme bounds for any coefficients of interest seems desirable." (Pagan, 1995, p.17).

Nevertheless, this analysis suggests that EBA has only limited applicability in the present context. Bearing in mind the frequently voiced criticism of EBA, as outlined below, we attempt to follow Leamer in the 'classical' manner.

In order to obtain a narrower range for the inference, Leamer promotes a further step. That is to study, in a bayesian manner, how the mean of the posterior distribution changes as the prior variances change. In this approach to 'sensitivity analysis' it is the question of sensitivity of inferences to variation in assumptions that preoccupy the Leamer-econometrician.[23]

The present study follows Leamer (1990) in his 'classic' approach to sensitivity analysis, and also borrows elements from the final step in Hendry's analysis, the evaluation of the resulting model by extensive analysis of residuals and predictive performance. By proceeding in this fashion, it is hoped that the strengths from both approaches can be applied together so as to ensure a robust estimation procedure that provides stable implicit price estimates. While taking into account the above considerations, the present data analysis follows Leamer (1990, p.239) in distinguishing three phases in data analysis: (a) estimation, (b) sensitivity analysis and (c) simplification.

(a) Estimation

Model selection and pretesting [24]

Most model search procedures recognize the importance of economic theory in narrowing the range of admissible design matrix specifications (Judge *et al*., 1985, p.854). However, since the above hedonic price theory does not provide further guidance to the inclusion of variables in the following hedonic regressions (it is assumed that all preselected variables

[23] However, Pagan (1995, p.19) remarks that, "My main reservation about step 4, however, is that it does not do enough sensitivity analysis, being restricted to the parameters of the prior distribution.".

[24] See Judge *et al*. (1985, p.856) and Greene (2007) for an overview of some model selection procedures.

have a resource cost/user value interpretation), it appears that estimation and testing requires particular attention.[25]

Data mining could lead here to an inappropriate estimation.[26] Pretesting, which is another form of sequential model formulation, as is typical data mining, relates to model choice following preliminary testing for significance. As for the present analysis, further restrictions are no longer implied by economic theory, but, in a first step, are imposed in the hope that a restricted model will be easier to estimate and will yield more efficient estimates than the unrestricted model. However, no bayesian approach is undertaken here.

Within the classic approach, since estimation and testing are based on the same data, the properties of the final estimates may be difficult to analyze. This is the problem of pretesting (Davidson and MacKinnon, 1993, p.94). More specifically, the implication of following such a sequential testing procedure as in data mining is that the probability of adopting an incorrect set of independent variables increases. The impact of this specification error due to the incorporation of incorrect extraneous information becomes evident in biases in the pretest estimator (Judge *et al.*, 1988, p.834). The investigator is likely to be faced with the failure of an estimator of an unknown parameter, selected on the basis of the outcome of a pre-test, to achieve the properties of the OLS estimator using the correct specification.[27]

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[25] "Although there is a certain intuitive appeal and logic to many of the ad hoc, informal model selection rules that have been suggested, we should not forget (1) their heuristic base, (2) the fact that their sampling properties are virtually unknown, and (3) that their practical utility is mainly demonstrated by numerical examples." (Judge et al., 1985, p.888)

[26] "'Data mining' in its various forms reflects the general problem of not being in a position to conduct controlled experiments. This may lead to procedures which use a fixed data sample in some sequential manner to arrive at the final model specification." (Charemza and Deadman, 1993, p.14). Hence, a large number of different hypotheses are tested to select a relatively small set of independent variables.

[27] Preliminary-test or 'pretest' estimates are those coefficient estimates in a model that have been chosen from the outcomes of one or more hypothesis tests. Whenever some aspect of a model's specification is tested and thereafter decided, on the basis of the test results, what version of the model to estimate or what estimation method to use, a pretest estimator is employed. Inferences about the estimator based on the usual OLS covariance matrix may be misleading since they fail to take into account the pretesting that occured previously (Davidson and Mackinnon, 1993, p.97). The fact that reported standard errors are only valid if the preliminary testing had not taken place, implies that they are likely to overstate the preciseness of the coefficient estimates. Moreover, as the brief discussion of MSE's suggests, it is also likely that the pretest estimator will be biased.

One way to identify the significance of this bias, which is not pursued here, is to examine the *mean square error* (MSE) properties of the pretest estimator relative to its competitors.[28]

The present modeling strategy proceeds by first and foremost looking at misspecification, in particular by considering the problem of heteroskedasticity in terms of the Breusch-Pagan test. Then, looking at the *t*-tests, *p*-values, *F*-tests, confidence intervals before and after imposing restrictions and the coefficients of determination, a first attempt is made to select the most appropriate set of regressors and an appropriate model. Jointly, a standard model selection criteria - the Akaike information criterion (AIC) - is selected here in order to attempt a judgment about the trade-off between model complexity and goodness of fit. The AIC is preferred to the Schwarz criterion in the present context of a large number of potential variables, as the latter penalises model complexity much more heavily than other criteria.[29] To re-emphasise, the coefficient of determination is not of primary interest. The objective is rather to identify a robust estimation procedure that provides stable implicit price estimates.

First, a model is considered where the consumer is postulated to value both regions and countries of origin jointly. One of the issues that emerges with respect to the model is therefore whether consumers regard mainly country/region of origin as their focus attribute and consequently compare identical grape varieties and vintages across

[28] If out-of-sample information is incorrect in that relevant variables are excluded or irrelevant variables are included, bias and inflated variance of the estimator induce a search for a measure of the adequacy of an estimator (Judge, et al., 1985, p.860). The analyst builds on the likelihood that when extraneous information is sufficiently close to the truth, the induced bias will be offset by the improvement in the variance of the estimator in its expected squared error (Greene, 1993, p.249). However, since the available non-sample information may or may not be correct and thus may only permit a vague notion about the loss function, the results are of little help in choosing between the restricted and unrestricted estimators, i.e. choosing the biased estimator with a minimum risk (Judge and Bock, 1983, p.617). The implications of pretesting are at least clear-cut in the instance of an accurate and strong prior specification belief: ”If we are not sure *a priori* whether a particular variable(s) belongs in a model, pretesting in the sense discussed here or in a more elaborate step-wise regression selector programs will, on average, yield estimators that are sure to be worse than least squares estimators derived from an accurate prior specification.” (Wallace and Ashar, 1972, p.177). Nevertheless, faced with this trade-off, the analyst may still attempt to identify her loss function, the variance plus the square of the bias, in the form of the MSE of the estimator (Leamer, 1990, p.241). This leads to the concept of relative efficiency, which is judged from the ratio of the respective MSE’s (Ramanathan, 1993, p.165).

[29] Ramanathan, 1993, p.281 for the AIC formula and a brief comparison of several model selection criteria.

countries/regions *or* whether grape varieties are regarded as the main focus variables and conditioning factors.[30]

Selecting a model that includes regions and countries from the most important producing countries would assume that consumers make parallel and cross-country comparisons. However, if consumers are regarding the origin attributes as their main focus attributes, and all other attributes are subordinates to be compared to other 'sub-attributes' from different country/region of origin, separate regressions for countries of origin and their corresponding regions may be justified.

Several models are therefore suggested for estimation:
(1) a 'full' model, including regions, countries of origin, varieties, vintages and importers and corresponding interaction terms
(2) hedonic models for particular countries of origin and their corresponding regions.

Faced with the uncertainty as to which variables to include in the initial hedonic regressions, a decision was made to incorporate all those regressors that are expected to be most highly valued from the consumer's point of view.[31] However, this choice is already constrained from the outset due to multicollinearity. Therefore, certain categories are excluded from the outset. This includes the appelations, the producer, the brand, and the place of bottling. All the remaining attributes were included in the initial regressions, jointly with a subset of interaction terms: interactions for colour/country of origin, colour/region of origin, category/country of origin, grape variety/region, and grape variety/country of origin.

Following this preselection of regressors, the subsequent selection procedure, based on the single equation hedonic approach, does not follow a purely mechanical procedure -

[30] In terms of a matrix of regions/countries and grape varieties, consumers could thus be termed 'horizontal' or 'vertical' wine drinkers.

[31] As from section 4.2., there are 575 potential attributes.

such as stepwise regression - as the dangers of doing so are well established (e.g. Wallace and Ashar, 1972; Judge and Bock, 1983).[32]

1.1. Specification tests

The hedonic hypothesis asserts the existence of a reduced form relationship between prices and the various characteristics of the commodity (Griliches, 1975, p.326). It is therefore in the nature of hedonic analysis that some degree of misspecification is unavoidable. Butler (1982, p.97), for example, concludes in the context of housing markets that ”*... any estimate of the hedonic relationship will have to be misspecified because some of the relevant independent variables must be omitted*.”. However, before looking at the previously mentioned specification tests to validate the hedonic regressions in more detail, what are the underlying statistical hypotheses and what are the parameter restrictions to be tested?

The hedonic framework (Rosen 1974) is assumed to have testable implications, hence testable restrictions are implied by the above theory on the hedonic model that is estimated below. This concerns the non-linear nature (convexity) of the price function, in particular. A statistical model is thus formulated that contains the above hypotheses as restrictions on its parameters.

First, the following constraint will be imposed on the parameters: **[I]** Test of equality of implicit price contributions, i.e. null hypothesis of parameter equality. Although this hypothesis can be tested with a standard *F*-test, Ohta and Griliches (1975, 1986) suggest in the context of hedonic models to deviate from the standard *F*-test methodology and to employ other criteria for hypothesis testing: ”Having large samples and using standard tests, we are likely to reject most such simplifying hypotheses on purely statistical grounds, even though they may still serve as adequate approximations for our purposes.

[32] Not only may the analyst be throwing out relevant variables whose coefficients are insignificant because of poor data. Also, in the reestimated equation, standard errors, confidence intervals, and hypothesis tests are not valid. Strictly speaking, they are valid only if the adopted strategy always produces the correct model. However, this will not be true since any hypothesis testing strategy, by its nature, produces Type I and Type II errors.

The rejection or acceptance of a hypothesis should depend on the researcher's interests and his loss function. If the researcher is interested in predicting price differentials, then he should be interested in the difference in fit between the unconstrained and constrained regressions. He should compare the standard errors of both regressions instead of following formal F tests and not reject the simpler hypothesis unless they are very different." (Ohta and Griliches, 1975, p.339)

Nevertheless, in order to circumvent the problem of rejecting most simplifying parameter restrictions on purely statistical grounds, Berndt and Griliches (1993, p.75) suggest compensating for larger sample size by choosing very tight significance levels for the standard F-tests (.01 significance levels).

Following Ohta and Griliches (1975, 1986), a relevant test in the present context (**[1]**) should be based on economic significance rather than on statistical significance. If the difference in standard error of regression (SER) is smaller than or equal to .01 in the system under the test, the null hypothesis will not be rejected on practical grounds. As the regression is semilogarithmic, an increase in SER by .01 implies an increase in the standard deviation of the unexplained component of price of about 1% (the fit to actual price data is smaller by 1 per cent in the constrained regression than in the unconstrained regression). If this is accepted as a just noticeable difference in terms of economic significance in the present context, the difference in the standard errors of the unconstrained and constrained regressions could be assumed to be a relevant measure of the price-explanatory power of a particular hedonic model.[33]

The reoccurring issue is therefore what cost the analyst is willing to pay to obtain the benefits of significant analytical, empirical and expositional simplifications associated with the null hypothesis (Ohta and Griliches, 1986, p.193). It is of course left up to the

[33] Assume a difference in the standard errors in the constrained and unconstrained regressions of .01 and a standard error of the constrained regressions that was .1. The implication is that the lack of fit of the constrained regression is increased by 10 per cent compared with that of the unconstrained regression (.01/.1= .1). Equally, if the SER was .2, the .01 criterion implies the willingness to accept up to a 5 per cent deterioration in the fit of the model as measured by the standard error of its residuals.

reader to judge the adequacy of this trade-off, but the present analysis follows 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 per cent in the standard deviation of the unexplained variation of log prices. With a SER of, say, .27, this SER criterion implies that a movement of at least 0.01 (3.7%) is required before the more parsimonious parameterisation implied by the null hypothesis is selected as preferred choice. Hence if the difference in SE's between the constrained and the unconstrained does not exceed .01, it is reasonable to consider the null hypothesis as not rejected. The conclusion for the most parsimonious specification would be that, by and large, wine importers evaluate physical characteristics correctly in the sense that they do so in the same way as consumers.[34]

In this stage of the analysis, the aggregation problem may come to play. Burgess and Harmon (1991, p.379) emphasize that the usefulness of specification testing is tied to its potential for studying separate segments of the system in isolation, and conclude that, " ... researchers attempting to use less than ideal data sets [Separate hedonic price equations are estimated in each market, and the generated exogenous price variation is used to identify a single preference equation for each characteristic of interest], as we choose to do here, are cautioned that misspecification may be unavoidable." (Burgess *et al*., 1991, p.384). Taking into account all of the above considerations, which specification tests were applied during the following analysis?

(a) Tests for Heteroskedasticity

Heteroskedasticity may be present due to omitted variables and/or misspecification.[35] The problem is that the OLS estimator will be unbiased but significance tests will be no longer reliable. The Breusch-Pagan (1979) test is employed in the present study.[36]

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[34] Furthermore, apart from tighter significance levels for *F*-tests and examining the difference in standard errors, a third way has been suggested to accommodate the problem that with large samples and standard test procedures, most simplifying parameter restrictions are likely to be rejected on purely statistical grounds. This is to adopt a more agnostic and conservative criterion that the null hypothesis holds only approximately rather than exactly in the sample (Leamer, 1978, for details).

[35] For more reasons to reject the null hypothesis of no heteroskedasticity, see McAleer, 1995, p.102.

[36] An alternative test, the Goldfeld-Quandt test, may lack power if an error variance is present that is related to more than one variable. In this instance, it is no longer possible to unambiguously split the sample into two parts, one with

If the Breusch-Pagan test rejects the null hypothesis of homoskedastic errors, several transformations could be applied.[37] As discussed in more details in the context of the results, weighted regressions are applied to the current data set. This has a double advantage, as on the one hand, it allows a correction for heteroskedasticity, but it also follows directly from hedonic theory, as each attribute should be accounted for in terms of its relative importance. Hence, using weighted regressions, where the weights reflect a proxy for the quantity demanded, should provide meaningful results.

(b) Specification tests for collinearity

Atkinson and Crocker (1987, p.28) emphasise two consequences of multicollinearity in hedonic models. First, the mean squared error of the estimator may cause substantial instabilities in coefficient signs and magnitudes as independent variables are added or removed from the model. Second, measurement error bias may be transferred in part to collinear variables measured without error and may alter their signs. Therefore, in the presence of substantial collinearity, the choice of covariates and the issue of data mining is particularly important. How can we proceed?

(i) As in standard analysis, *F*-, *t*-values and corrected *R*-squared are considered jointly: Is there a lack of individual significance despite overall significance and high *R*-square?

(ii) Auxiliary regressions are considered:

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. Thus, both auxiliary regression R square and the sum of squared least squares residuals from the auxiliary regression should be considered together (Griffiths, *et al.*, 1993, p.437):

(a) the higher the auxiliary regression R-square, the more severe the collinearity

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high error variance(s), the other part with low error variance(s), since the observations can no longer be ordered according to increasing or decreasing variances.

[37] One transformation yields transformed error terms that have the same variance for all observations, namely one. Due to the homoskedastic transformed error term, least squares will be the minimum variance linear unbiased estimator. However, since the variance parameters are unknown, estimates can be used instead to transfrom the variables as if the estimates were the true variances. The new estimator is therefore known as an *estimated* generalised least squares estimator (EGLS) or a *feasible* generalised least squares estimator (Griffiths *et al*., 1993, p.498).

(b) consider the sum of squared errors (SSE) of the auxiliary regression: lack of variation in the values of a control variable about its mean implies that OLS residuals from the auxiliary regression will vary even less.[38]

(iii) consider the *determinant of* ***X'X*** : The closer the determinant of the cross-product matrix det (***X'X***) to zero, the more severe the multicollinearity problem (Judge et al., 1988, p.869 for limitations).

(iv) the *condition number* (Belsley Kuh and Welsch, 1980, p.101)

The condition number of a nonsingular matrix provides a measure of the potential sensitivity of the solution vector **z** of a linear system of equations **Az = c** to changes in the elements of **c** and **A** of the linear system

- the larger the condition number, the more ill conditioned the given matrix
- the conditioning of any square matrix **A** can be summarised by a condition number, defined as the product of the maximal singular value of **A** (its spectral norm) and the maximal singular value of $\mathbf{A}^{-1}$ (the square root of the ratio of its largest to its smallest eigenvalue)
- the condition number of any matrix with orthonormal columns is unity
- Belsley *et al*. (1980) suggest that values in excess of 20 indicate potential problems

After applying *specification uncertainty diagnostics*, the analysis proceeds with *measurement error diagnostics*.

1.2. Measurement error diagnostics

Due to unmeasured attributes and proxy variables, the problem of errors in variables is suspected to be particularly important in the context of the present study. Again, the issue emerges of what meaning the analyst is willing to address to 'region', 'grape variety', etc.. From the study of implicit prices alone, the *origin* of the differences in terms of willingness-to-pay for different attributes or their apparent proxies cannot be expected to

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[38] The lack of variation stems from a linear dependence between the control variable and the intercept variable. Since the other control variables are not involved in the collinear relationship, the auxiliary regression R square may be low and in itself insufficient to judge for collinearity.

become transparent. Nevertheless, the impact of the estimated differences in willingness-to-pay - irrespective or their origin - will be of interest here, as they have direct marketing implications.[39] The objective is to identify the importance of measurement error in any variable with respect to the estimation of the coefficients of interest.

For example, consider $P_i = f(A_m + A_u)$ where A_m reflects the measured attributes (the hedonic part), A_u reflects the unmeasured attributes (omitted variables). In a model where one or more of the regressors is measured with error, contemporaneous correlation results between random regressors and the error term.[40] The OLS estimator will therefore be inconsistent.[41]

The problem could be approached by performing ‘reverse regressions’ in order to find bounds on Maximum Likelihood parameter estimates. This is the Klepper-Leamer (1984) approach, which extends Frisch (1934). However, Leamer’s ‘global sensitivity analysis’ and a special case of it, the ‘extreme bounds analysis’ bears several problems and does not seem to be applicable in the present analysis.[42] First, the bounds depend on the family of prior distributions:

- the bounds depend on the choice of variables that are treated as doubtful

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39 As Sen (1990, p.210) emphasises, attributing ‘utility’ to choices made is not sufficient as a final answer to what the inherent aims of the consumer were when making that particular choice: ”Rationality may be seen as demanding something other than just consistency of choices from different subsets. It must, at least, demand cogent relations between aims and objectives actually entertained by the person and the choices that the person makes. This problem is not eliminated by the terminological procedure of describing the cardinal representation of choices as the ”utility” of the person, since this does not give any independent evidence on what the person is aiming to do or trying to achieve.”

40 ”Because hedonic studies try to infer the marginal market valuation of different characteristics from observed market data, they require observations on models or variants of the commodity that differ significantly in the combination and range of characteristics contained in them. To accomplish that, and to increase sample size, authors are tempted to define the commodity broadly and to assume that there is enough substitution and competition across various boundaries to lead to relatively stable equalizing price differentials. One of the major boundaries that such studies cross are those connected with makes or brands. The essence of the hedonic approach is the assumption that one can find a metric for crossing such boundaries, that specify the underlying characteristics creates adequate commensurability. However, since the list of measurable characteristics is never complete, there may be systematic differences across makes in the levels of the ”left-out” variables, real (physical) or putative." (Ohta and Griliches, 1975, p.329).

41 The inconsistency will depend on the magnitude of the variance of the measurement error relative to the variance of the observed values of the unobservable variables (Griffiths *et al.*, 1993, p.460).

42 ”The ‘extreme bounds analysis’ is one special case with an unbounded interval of covariance matrices for a subset of coefficients and a sharply defined covariance matrix for the others.” (Leamer, 1985, p.310)

- if there are two or more doubtful variables, a coefficient on a doubtful variable may be either positive or negative, regardless of the degree of correlation between the variables
- the bounds for the free coefficients will be wider the more statistically significant are the doubtful variables.

Hence, the range between the bounds tends to infinity as the sample size grows, making Leamer's approach equally vulnerable to complaints that are voiced about classical hypothesis testing (Pagan, 1995, p.17). McAleer (1995, p.119) provides a more detailed account of the voiced criticism of EBA and concludes that,

- several published papers which use Leamer's EBA do not provide any evidence of the usefulness of their estimated models
- in spite of the limitations of EBA, it continues to be used uncritically
- using the bootstrap technique to calculate the standard errors, McAleer and Veall (1989, p.106) cast serious doubt on the usefulness of the bounds.

In the present study, a major problem would seem that of determining the 'free variables' that should always be left in the equation. It appears that since there are not too many constraints from the theory side, there would be too many 'free variables' left in the regression so that the bounds will no longer be useful. To go further, it is questionable whether any of the wine attributes could be classified as 'doubtful', as it was previously argued that they all may enter the consumer's utility function. Since it appears therefore neither to be appropriate nor possible to determine a priori the 'doubtful' variables ”that the researcher feels comfortable experimenting with” (Leamer, 1985), EBA is not further pursued.[43] However, a partial solution to the problem of errors in variables could come from related methods of instrumental variables.

[43] Graves *et al*. (1988, p.232) emphasise that it ”... seems alerting that small measurement error in the focus variables renders even qualitative estimates dubious.”

(b) Sensitivity Analysis

The objective of sensitivity analysis is to apply a robust selection procedure (Leamer, 1990) that works well regardless of the assumptions.[44] More specifically, the robustness of an estimation procedure refers to the ability of that estimation procedure to produce estimates that are insensitive to model misspecifications (Judge et al., 1988, p.887). For example, the assumption of normality may bias parameter estimates as it has too little weight in its tails, so that great importance is placed on outlying observations (Graves, Murdoch, Thayer and Waldman, 1988, p.231).

Leamer (1990, p.242) suggests two approaches to sensitivity analysis: 2.1. the bayesian approach [45] and 2.2. the 'classical approach', which will be followed here.

2.2. *The 'classical approach'*

If simplification consists of more than one step, the presence of 'data mining' may require a modification in the decision rule (critical values).[46] For the case of orthogonal explanatory variables, Charemza and Deadman (1992, p.25) show that the nominal significance level understates the probability of incorrectly rejecting the null hypothesis when the regressors have been selected on the basis of their Student-*t* statistics in the course of exploratory regression analysis. This 'Lovell-bias', which refers to the alteration that needs to be made to the nominal significance level where regressors are selected from a set of candidates (in the presence of orhogonal variables), is therefore zero when the true and nominal significance levels are equal, hence if no data mining is performed. Lovell's (1983) 'rule of thumb' for computing the true significance level α^* when selecting *k* regressors out of *c* 'candidates' at a nominal significance level α is:

44 "When a set of acceptable assumptions does not map into a specific decision, the inference is said to be fragile." Leamer, 1990, p.242

45 Leamer and Leonard (1983, p.313) propose that the calculation of extreme bounds guards against the possibility that the researcher will be unaware of the sensitivity of his results to a particular choice of (or combination of) exclusion restrictions that are admissible under his "prior". If the extreme bounds are wide, the analyst should consider whether the extreme estimates are supported by "reasonable" restrictions. The authors suggest that the use of extreme bounds methodology provides a more comprehensive picture of specification uncertainty than can any ad hoc search (ibid.).

46 When there is more than one step in the simplification path, the critical values cannot normally be taken from a chi-square distribution, and it may be misleading if one proceeds as if they can (Pagan, 1995, p.14).

$$\alpha^* = 1 - (1-\alpha)^{c/k} \tag{11}$$

which can be approximated as

$$\alpha^{*\prime} \cong (c/k)\alpha\,. \tag{12}$$

However, since it is expected that the explanatory variables are more frequently not orthogonal in the hedonic regressions, it is expected that the effect of data mining may not be as significant as shown by the scale of the 'Lovell bias'. Nevertheless, by comparing both probabilities of the type I error, an indication of the potential problem is expected.

Detection of influential observations

The application of techniques for discovering influential observations, as developed by Belsley *et al.* (1980), is of interest as it focuses on those data points that may call for further study.[47] The authors suggest three means for deletion diagnostics, which will be employed in the present study.

Single row diagnostics and coefficient sensitivity

First, examine single-row diagnostics. Investigate the change in the estimated regression coefficients that would occur if the *i*th row were deleted (ibid., p.13 for the corresponding equation 2.7 as it is applied in the present estimation). Here, the impact due to the deletion is assessed relative to the variance of the estimated coefficient. If instead, one observation was deleted, Belsley *et al*. (1980, p.15) suggest this as being another way to summarise the change in fit, while gaining insight into forecasting effects. This diagnostic measure (DFFIT, equation 2.10) has the advantage that it is independent from

[47] "An influential observation is one which, either individually or together with several other observations, has a demonstrably larger impact on the calculated values of various estimates (coefficients, standard errors, *t*-values, etc.) than is the case for most of the other observations." (Belsley et al., 1980, p.11)

the particular coordinate system used to form the regression model. Scaling this measure with the standard deviation of the fit display a scaled row-deleted change in fit (equation 2.11; DFFITS).[48]

Leverage and hat matrix diagonals

Second, the authors suggest examination of the *hat matrix*, more specifically to study the diagonal elements of the least-squares projection. This hat matrix (equation 2.15) determines the fitted or predicted values. The influence of the response value on the fit is most directly reflected in its impact on the corresponding fitted value. It is this information that is contained in the hat matrix. Since the diagonal elements of the hat matrix have a distance interpretation (ibid., p.16), they provide a basic starting point for revealing 'multivariate outliers' which would not be revealed by scatter plots when $p > 2$. Based on the Gaussian assumption, Belsley *et al*. (1980, p.17) identify when a value of the hat matrix is large enough, i.e. far enough away from the average, to warrant attention. The authors define the *i*th observation a *leverage point* when the hat matrix exceeds $2p/n$. However, because leverage only measures the influence of the regressors and not the influence of outlying observations that are caused by large absolute errors, measures could be considered that are designed to detect large errors (Judge *et al*., 1988, p.894).

A third group of deletion diagnostics is based on the diagnostic value of the effects that deleting rows can have on the regression residuals. Testing for approximate normality of the disturbance term is of particular interest in the context of the Gauss-Markov assumptions since even moderate departures from normality can impair estimation efficiency (minimum MSE) and the meaningfulness of standard tests of hypotheses.[49] Also, it is of particular interest in the context of the present data set, as the sample size is relatively large.

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48 First, sort both DFITS and log price, then plot them to get an impression of the relative magnitudes of the DFITS and notions of price clusterings.

49 Large outliers among the true errors can often be reflected in only modest-sized least-squares residuals, since the squared-error criterion weights extreme values heavily (Belsley *et al*., 1980, p.19).

The authors present three diagnostic measures based on regression residuals. Two of them are employed in the present study:

(i) A graph of the frequency distribution of the residuals proves informative if there is evident visual skewness, multiple modes, or a heavy-tailed distribution (Histogram).

(ii) A normal probability plot displays the cumulative normal distribution as a straight line whose slope measures the standard deviation and whose intercept reflects the mean (Normal Cumulative Density Function). A failure of the residuals to be normally distributed will often reveal itself as a departure of the cumulative residual plot from a straight line. Outliers frequently appear at either end of the cumulative distribution (Belsley *et al*., 1980, p.19).

The authors suggest another way to modify residuals in a way that will enhance the investigator's ability to detect problem data. Exploiting the link between the hat matrix and the residual variance (Belsley *et al*., 1980, equation 2.24, p.19), the standardized residual,[50] which is frequently called the *studentized residual*, is a better way of examining the information in the residuals, both because they have equal variances and because they are easily related to the *t*-distribution.[51] If the observation conforms to the model that is estimated with other observations, this standardized residual should be small (the calculation is repeated for each observation). Absolute values less than two are acceptable in terms of the model specification. Others are regarded as outliers. Outliers may arise in the course of a model, but they are worth checking for unmodelled aspects that are peculiar to that particular observation. Also, too many outliers may cast doubt on the normality assumption, in which case robust estimation techniques might be appropriate (Judge et al., 1988, p.984).

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[50] In search of residuals which are significantly large, it is required to standardise them by dividing by the appropriate standard error for that particular residual.

[51] In contrast to Judge et al. (1988, p.984) and Belsley et al. (1980, p.20), Greene (1993, p.288) suggests that the standardised residual is approximately distributed as standard normal, and not distributed as *t*.

Both outliers and high leverage points can be an indication of exceptional data points that deserve closer scrutiny. However, what is likely to be of more importance is whether these data points contribute significantly to the values of the coefficient estimates and the model predictions (Judge et al., 1988, p.985). Furthermore, since some of the most influential data points can have relatively small studentized residuals, row deletion and the analysis of residuals need to be studied together and on an equal footing (Belsley *et al*., 1980, p.21).

Covariance matrix sensitivity

Returning to the diagnostic technique of row deletions, Belsley et al. (1980, p.22) suggest the comparison of the covariance matrix using all data with the covariance matrix that results when the *i*th row has been deleted (ibid., equation 2.36, COVRATIO). Since this magnitude is a ratio of the estimated generalised variances of the regression coefficients with and without the *i*th observation deleted from the data, it can be interpreted as a measure of the effect of the *i*th observation on the efficiency of coefficient estimation (Belsley et al., 1980, p.48). Since the two matrices differ only by the inclusion of the *i*th row in the sum of squares and cross products, values of this ratio near unity can be taken to indicate that the two covariance matrices are close, or that the covariance matrix is insensitive to the deletion of row *i*. A value of COVRATIO greater than one indicates therefore that the absence of the associated observation impairs efficiency.

However, in order to be able to discover which observations are most strongly influential in relation to the others, external scaling can be applied where cutoff values are determined by recourse to statistical theory. The size-adjusted cutoff values are calculated as following:

DFBETAS	$2/\sqrt{n}$
DFFITS	$2\sqrt{p/n}$
HAT MATRIX DIAGONALS	$2p/n$
COVRATIO	$1 \pm 3(p/n)$

where *n* denotes the sample size and *p* is the number of variables

If observations have a high leverage *and* a significant influence on the estimated parameters, enough evidence exists to view them as presenting potentially serious problems. Hence, what percentage of the observations are influential by single-row deletion diagnostics?

Multiple-row effects

Since some influential observations may be overlooked by single-row diagnostics (one outlier can mask the effect of another), multiple row diagnostics should also be considered. Belsley *et al*. (1980, p.33) suggest a sequential procedure which is based on the principle that the largest changes in fit should occur for those discrepant observations not used in the estimation of the coefficients.

(c) Simplification

In this phase of data analysis, the objective is to find a simple quantitative facsimile that can be used as a decision-making tool (Leamer, 1990, p.243). The causal significance attached to coefficient estimates is regarded of no importance.[52]

(d) Criticism

Leamer (1990, p.244) considers the function of criticism in highlighting anomalies in the data set that might lead to 'Holmesian revisions' in the model. He suggests that unexpected parameter estimates are probably the most effective criticism of a model. However, the overall issue is whether there is a plausible model alternative that makes the data appear less anomalous (Leamer, 1990, p.244).

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[52] A model with a high coefficient of determination can be expected to provide accurate forecasts in a stable environment, whether or not the coefficients can be given a causal interpretation (Leamer, 1990, p.243). However, and as emphasised above, less weight is given to the R square in the decision making process in the present study.

3.2.3. Further specification issues

Before proceeding with the discussion of results, it seems appropriate here to point out specific problems that arise within the context of the present study, as well as to more general problems that appear to be common to many hedonic studies. Several problems emerge due to quality change, due to the assumption of divisibility, bias from a changing size and composition of the sample (new wines) as well as from shifts in average income (e.g. Muellbauer 1974; Brown and Rosen 1982; Berndt and Griliches 1993). Furthermore, the problem of information asymmetry and quality uncertainty could also be addressed explicitly.

Amongst the econometric specification problems, the following problems are considered as the most severe and reoccurring.

(1) The problem of excluded variables

This problem has to be considered in the context of separability (Deaton 1974) and will be further considered below in the context of hedonic residuals and market shares. However, in order to demonstrate the econometric problem explicitly, consider the estimation of implicit prices of wine characteristics (x_{ij}) in which the dependent variable is a vector of observations on unit prices on *n* different models at a given time, and each of the *m* independent variables is a vector of data for a quality attribute for the different models. Following Gordon (1990, p.92), assume that the correct structural model determining the price of two different wines in two adjacent years can be completely described with no error:

$$\log p_{it} = a_0 + d_1 D_1 + \sum_{j=1}^{m} b_j x_{ijt} + b_{m+1} x_{i,m+1,t}. \quad i = 1,\ldots,n; \;\; t = 0,\ldots,N. \tag{13}$$

Estimating this model while erroneously including only the first *m* quality attributes, while assuming that the *m+1* variable is uncorrelated with the first variable, the estimate of the rate of true price change (d_1) will be biased as follows whenever the quantity of the excluded quality attribute varies:

$$\hat{d}_1 = d_1 + b_{m+1}\Delta x_{i,m+1}. \tag{14}$$

Assume that a variable has purposefully been omitted because in one or more periods it has been observed to be perfectly collinear with one of the included characteristics, say the first:

$$b_{m+1}x_{i,m+1,t} = \alpha x_{i1t}, \;\; t = 1. \tag{15}$$

This causes no problem if (13) is valid for both of the adjacent time periods. Then the estimated value of b_1 will include the effect of the omitted variable, and the estimate of pure price change will be correct:

$$\hat{b}_1 = b_1 + \alpha; \;\; \hat{d}_1 = d_1 \tag{16}$$

A problem emerges if in period 2 the additional quality characteristic yields a marginal product per unit of the first quality characteristic that increases by ε over its value in period 1, so that (15) is replaced by:

$$b_{m+1}x_{i,m+1,t} = (\alpha + \varepsilon)x_{i1t}, \;\; t = 2. \tag{17}$$

The coefficient of b_1 estimated in a regression that excludes variable *m+1* understates the combined influence of characteristic 1 and *m+1* in period 2, and the extra ”quality” of characteristic 2 is picked up by the time dummy and can therefore be interpreted as pure price change:

$$\hat{b}_1 = b_1 + \alpha; \;\; \hat{d}_1 = d_1 + \varepsilon \tag{18}$$

It follows that the d_1 coefficient is biased whenever there is a shift between one year and the next in the relation between the omitted variables and the included ones. However, in comparing the relative advantages of hedonic and other specification methods, Gordon (1990, p.100) concludes that: ”There is no escape from the excluded variable problem with either the hedonic or the conventional methods.”

(2) Flexibility and functional form

Given the qualitative nature of the data, the functional form is limited to linear and log-lin. It was emphasised above that additional flexibility can be gained by introducing interaction terms. However, theory suggests that as many different forms as possible should be considered. The issue remains therefore how limited the results have to be considered, given the constraints in terms of flexibility of testing for alternative hypotheses.

Bartik and Smith (1987, p.1234) consider the implications in both a conventional statistical framework (such as that used to analyse specification errors generally), as well as the performance of controlled experiments. In the latter, the matching process is replicated which is assumed in a hedonic equilibrium, and the performance of alternative specifications for the price function in characterising it as theory would imply it should, is evaluated. Their results in this context of alternative functional forms indicate that "... if the equilibrium assumptions are satisfied the other assumptions of the hedonic framework may not be as limiting as previous theoretical discussions may have implied." (Bartik and Smith, 1987, p.1237). Butler (1982, p.97) reviews results from the housing market and seems to come to a similar conclusion.[53]

[53] ”... researchers who have compared alternative functional forms for hedonic indexes of housing have by and large found little basis for choosing one form over another. ... though, there is theoretical support for a functional form that incorporates at least some interactions among the various characteristics of housing, empirical experience suggests that most of the feasible approximations to the correct form are close substitutes.”

However, even with a correctly specified price function, a central problem remains: the hedonic equation may overstate the valuation of an additional unit of the characteristics (Harrison and Rubinfeld, 1978; Follain and Jimenez 1985). Therefore, it may be desirable to go beyond the estimation of marginal equilibrium willingness-to-pay and focus independently on the inverse demand function or the offer price function.

(3) Multicollinearity

After identifying the relevant characteristics as above, the range of potentially available variables for the regression is so large that multicollinearity precludes the estimation of separate implicit price coefficients for each characteristic. Given the uncertainty of whether the included variables are capturing the most important aspects of the wines while providing sufficient independent variation, multicollinearity increases the likelihood that a bias will be caused by excluded variables.

So far, this study has attempted to provide a detailed and frank approach to the theoretical problems surrounding hedonic analysis. We attempt to continue along these lines in the empirical part, and it is therefore that the reader is reminded of some remaining, yet important, problems, before looking at an interpretation of the estimates.

(1.) Single market data

Ideally, separate hedonic regressions should be run according to the geographic location of the retail markets and a corresponding pattern of demographic differences and thus differences in regional consumption patterns across regions in England and Scotland. Since the present data set does not allow any regional disaggregation, some bias in the estimates is expected. In any case, this is to some extent unavoidable as a trade-off has to be made: the level of disaggregation aggravates multicollinearity problems.

(2.) Interpretation of the estimates given the level of aggregation of the data

If every consumer has different tastes, nonhomothetic utility functions imply that for different income levels, consumers will have different marginal rates of substitution. Therefore, the meaning of 'quality' changes with the level of income (Muellbauer, 1974, p.989). The interpretation of the hedonic model based on the aggregate market data poses therefore a problem, irrespectively of whether the hedonic price function is regarded solely as a reflection of consumer behaviour, as in Lancaster (1971) or Fisher-Shell (1971), or whether the postulate of an equilibrium price concept is put forward.

(3.) Proxy variables and the 'true' attributes

The question remains as to whether the attributes included as variables in the regression are proxies for other attributes, which themselves are the 'true' attributes in the eyes of the consumers.[54] The introduction of a utility function that assumes a second step in consumption technology, with separability assuring that the same attribute may enter the utility function in a different way, could accommodate the issue of proxy variables from a theoretical perspective.

Despite the seemingly disaggregate nature of the present data set, the problem of proxy variables appears almost unavoidable. Hence, it is the extent to which it occurs that aggravates the reliability of the estimates. For example, for the estimates of the retailers, it is known *a priori* that a retailer's name carries several traits. Marks & Spencer trades particularly on image, whereas Victoria Wine, or Threshers have late opening. Nevertheless, the present data set is not disaggregate enough to reveal such information and incorporate it into the analysis.

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[54] "... it is often the case that the quality variables employed in hedonic regression equations are not in themselves measures of quality but are presumed to be highly correlated with consumers' perceptions of qualities." (Berndt, 1991, p.129)

3.2.4. Interpretation of qualitative attributes in the characteristics space model

The question remains as to how qualitative attributes, as they appear on the label of a bottle of wine, can be interpreted in the standard characteristic space model. Lucas (1975, p.169) suggests that there are circumstances in which two of the sets of variables in the Lancastrian model can assume only discrete values: when quantities of commodities are not continuously variable, and when the *B*, a matrix describing the amount of attributes per unit of commodity, represents a dummy characteristic variable. When the two sets of discrete variables occur simultaneously, the Lancastrian framework is appropriate (Lucas, 1975, p.171). However, the fact that the consumer in the Lancastrian (1971) world may choose several qualities at one time makes it necessary to consider the case of only dummy characteristic variables.

The difficulty with Lancaster, the units of measurement, disappears when discrete activity levels, where the consumer can only choose one item, are accompanied by dummy characteristics. Under these circumstances the consumption technology becomes $Z_j = \sum_i B_{ij} x_i$, where x_i, $B_{ij} = 1{,}0$ all *i*, and $\sum_i x_i = 1$. Therefore, for that single good chosen $Z_j = B_{ij}$. Lucas (1975, p.171) advocates that a consumption technology with these features renders the Lancaster framework appropriate, and the same approximate relationships between the hedonic price function and consumer utility function hold as above, for *H* in footnote 83.

In contrast, assume that only dummy characteristic variables are present, but that the consumer can choose more than one item. If, in that case, for some *j*, $B_{ij} = 1{,}0$ all *i*. Lucas (1975, p.169) suggests that B_{ij} is "... clearly not defined in terms of the units of measurement of the commodity." The application of Lancaster's linear technology under these circumstances results in Z_j measuring the sum of the quantities of different commodities which possess characteristic *j*. Z_j is therefore sensitive to the units of measurement of commodity quantities and has no clear economic meaning. Lucas (1975, p.169) concludes therefore that "... Lancaster's framework is not very suitable under these circumstances", and suggests that, "Dummy variable characteristics cannot be conveniently handled by the Lancastrian model, except in the case that the solution set of commodities is confined to one commodity type. Nor can this problem be rectified by simply generalzing to a non-linear technology, for the heart of the problem is knowing what meaning one would wish to attach to the characteristic totals, *Z*, in this context." (Lucas, 1975, p.176)

Two claims could be made with reference to the present study. First, it could be asserted that no unit of measurement problem arises for the above case of only dummy characteristic variables on the label, where the solution set is confined to only one set of commodities, wine.

Second, the Lancastrian may object and insist that red and white wines are different commodities, leading to the above unit of measurement problem. In that instance, if Houthakker (1952) and Rosen (1974) are taken as the theoretical underpinnings of the analysis, as extended with Fisher and Shell's (1971) generalised utility function due to Muellbauer (1974), a clear economic meaning for the case of dummy characteristic variables could still be asserted.[55] This is because the assumption that one variety is bought, emerges as the *outcome* of optimisation and hence both of Lucas's (1975) conditions are met.[56]

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55 In this instance, the category utility function in the 'transformed Rosen model' contains quality indices that themselves are a function of physical characteristics - the specification variables - which are weighted by the number of goods purchased. As shown in section 3.1.2.2., this specification coincides with Lancaster's utility function, which contains the characteristic totals, *Z*, themselves a function of specification variables, weighted by the quantity of good *i* consumed, if the utility function is separable and the category function $X_0(.)$ linear and additive both in the x_i , i = 1, ..., m and the Z_j , j = 1, 2, ...

56 Muellbauer (1974) uses Fisher and Shell's (1971) generalised utility function in order to be able to assume that the Rosen and Houthakker assumption that only one variety is bought emerges as the outcome of the optimising model, rather than being imposed as an extraneous assumption. Furthermore, Muellbauer (1974) makes the quality indices of the Fisher and Shell (1971) utility function functions of the level of utility in order to provide a natural motivation for taste differences in Rosen (1974).

3.2.5. Final model specifications: a brief summary

The following regressions are implemented as weighted least squares regressions, where ordinary least squares (OLS) is applied to a transformed model. The resulting generalized least squares (GLS) regressions were performed for two reasons. First, and most importantly, 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, p.5, 1971). Here, the weights applied in the GLS regressions constitute the number of times a unique bottle of wine appears in different retail outlets. It is therefore implicitly assumed that the sample fractions are directly proportionate to the number of bottles sold, although this is clearly an imperfect assumption. Second, the implementation of GLS allows us to account for heteroskedasticity. It leads to a transformed model with errors that are assumed homoskedastic and uncorrelated, without changing the meaning of the coefficients. Coefficient estimates are assumed to measure the relative impact on the dependent variable (the unit price evaluated at the sample means) of the presence of the attribute, *ceteris paribus.*

Although consumers may, for example, take the grape variety as first order choice criterion, and then descend along their decision trees to region (country) of origin or other attributes (which could be tested through models for discrete choice; Greene 2007), the analysis proceeds with country-of-origin regressions for the following reason. It does not appear reasonable to employ different hedonic models according to, say, grape variety *or* country of origin, and ‘test’ for their relative performance, while at the same time assuming that this would amount to testing for a particular consumer preference ordering. Given the same independent variation in the same data sub-sets, the estimates should be the same, irrespective of the ordering according to, say, country of origin or grape variety.

Hedonic price regressions were run for wines from Germany and Spain. Interactions for colour/country of origin, colour/region of origin, category/country of origin, grape variety/region and grape variety/country of origin were applied.

COUNTRY OF ORIGIN	GRAPE VARIETY	REGIONS IN WHICH GRAPE VARIETIES ARE PLANTED
GERMANY	gewürztraminer	rheinpfalz
	mueller thurgau	mosel
		nahe
	muscat	rheinpfalz
	morio muscat	rheinhessen
		rheinpfalz
	riesling	mosel
		rheinhessen
		rheinpfalz
	silvaner	rheinhessen
		rheinpfalz
	pinot blanc	rheinhessen
		rheinpfalz
	pinot noir	baden-wuertemberg
SPAIN	chardonnay	penedes
	sauvignon blanc	rueda
		valencia
	muscat	valencia
	cabernet sauvignon	la mancha
		navarra
		penedes
		valencia
	cencibel	la mancha
	trempanillo	la mancha
		navarra
		rioja

To emphasize, if heteroskedasticity is present due to omitted variables and/or misspecification, the assumption of homoskedasticity will no longer hold. As a result, the OLS estimator will still be unbiased, yet significance tests are no longer reliable. In the present study, the application of weighted least squares to the presumed heteroskedastic error models implies that we have no longer to rely on the Gauss-Newton assumption. The reliance on the weighted least squares estimator, followed by tests for heteroskedasticity is assumed to ensure that the above tests statistics are reliable.

The Breusch-Pagan test is employed here as main test for heteroskedasticity. The test statistic is distributed as χ^2 with *p* degrees of freedom, where *p* is the number of parameters without the constant term. A significant test statistic implies the presence of heteroskedasticity.[57] It is assumed that under the alternative hypothesis of the form H_1: $\sigma_t^2 = h(z_t^{'}\alpha)$ = $h(\alpha_1 + \mathbf{z}_t^{*'}\alpha^*)$, where *h* is any function independent of *t*, $\mathbf{z}_t^{'} = (1, \mathbf{z}_t^{*'}) = (z_{t2}, z_{t3}, \ldots, z_{tS})$ is a vector of observable explanatory variables that determines the form of heteroskedasticity, and $\alpha^{'} = (\alpha_1, a^{*'}) = (\alpha_1, \alpha_2, \ldots, \alpha_S)$ is a vector of unknown coefficients. Since the first element in z_t is unity, a null hypothesis of homoskedasticity is equivalent to $H_0 = \alpha^* = 0$. Under this null hypothesis and the assumption that the least squares residuals are normally distributed, Breusch and Pagan show that the statistic for this null hypothesis does not depend on the function *h*, and that one-half the difference between the total sum of squares and the residual sum of squares from the regression

$$\frac{\hat{e}_t^2}{\tilde{\sigma}^2} = z_t^{'}\alpha + v_t \tag{19}$$

is distributed asymptotically as $\chi^2_{(S-1)}$. The $\hat{e}_t^2 = y_t - \mathbf{x}_t^{'}\mathbf{b}$ are the least squares residuals, and $\tilde{\sigma}^2 = \sum_{t=1}^{T} \hat{e}_t^2 / T$. [58]

Since the present analysis employs GLS, only one form of heteroskedasticity 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 (1980) heteroskedastic-consistent covariance matrix estimation, which corrects the estimates for an unknown form of heteroskedasticity, cannot be employed.[59]

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[57] Since the Goldfeld-Quandt (G-Q) test may lack power in situations where an error variance is related to more than one variable (Greene, 1993, p.394; Griffith *et al*., 1993, p.495) it is not considered here. If the analyst wants to investigate the alternative hypothesis that the variance is some function (but not necessarily multiplicative) of a more than one explanatory variable, the G-Q test would be too restrictive since it does not allow to order the observations according to increasing variance (Judge *et al*., 1988, p.372).

[58] See Judge, et al. (1985, p.447) for a discussion when the residuals are not normally distributed.

[59] However, Waldman (1983, *in* Greene, 1993, p.395) has shown that if the variables in **z** are the same as those used for the White (1980) test, a variant of the Breusch-Pagan and the White (1980) test are algebraically the same.

3.2.6. 1. Log-lin model estimates for Spanish wines

SUMMARY STATISTICS						
VARIABLE DESCRIPTION	NUMBER OF OBSERVATIONS	MEAN***	STANDARD DEVIATION	VARIANCE	MINIMUM	MAXIMUM
PRICE **(£)**	1067** (248*)	(4.0043)	(1.8321)	(3.3565)	1.67	14.59
RED	632	0.62903	0.48404	0.2343	0	1
WHITE	390	0.32661	0.46992	0.22083	0	1
ROSE	45	4.44E-02	0.2063	4.26E-02	0	1
VINTAGE-83	3	4.03E-03	6.35E-02	4.03E-03	0	1
VINTAGE-84	2	4.03E-03	6.35E-02	4.03E-03	0	1
VINTAGE-85	14	2.42E-02	0.15396	2.37E-02	0	1
VINTAGE-87	73	7.26E-02	0.25997	6.76E-02	0	1
VINTAGE-88	58	5.65E-02	0.23126	5.35E-02	0	1
VINTAGE-90	50	4.84E-02	0.21502	4.62E-02	0	1
VINTAGE-91	46	2.82E-02	0.16595	2.75E-02	0	1
VINTAGE-92	139	9.68E-02	0.29625	8.78E-02	0	1
VINTAGE-93	82	0.10081	0.30168	9.10E-02	0	1
CO-OP	28	4.84E-02	0.21502	4.62E-02	0	1
M & S	9	2.42E-02	0.15396	2.37E-02	0	1
SAFEWAY	26	2.82E-02	0.16595	2.75E-02	0	1
SAINSBURY	90	6.45E-02	0.24617	6.06E-02	0	1
VICTORIA WINE	7	4.03E-03	6.35E-02	4.03E-03	0	1
NAVARRA	55	5.65E-02	0.23126	5.35E-02	0	1
PENEDES	112	6.05E-02	0.23886	5.71E-02	0	1
RIOJA	301	0.31048	0.46363	0.21495	0	1
VALENCIA	239	0.22177	0.41628	0.17329	0	1
RUEDA	24	8.06E-03	8.96E-02	8.03E-03	0	1
CHARDONNAY	40	1.61E-02	0.12623	1.59E-02	0	1
MUSCAT	18	2.42E-02	0.15396	2.37E-02	0	1
SAUVIGNON BLANC	20	8.06E-03	8.96E-02	8.03E-03	0	1
CABERNET SAUVIGNON	45	2.82E-02	0.16595	2.75E-02	0	1

* There are 248 unique and hence different bottles in the sample. Corresponding descriptive statistics are in brackets. Since the same unique bottle appears frequently in different outlets, the total sample size is given by 1067.
** The difference between the total sum of all observed prices after accounting for replicates [1067] and the sum of observations for the above attributes as they remained in the final specification, is therefore due to:
(1) statistically non-significant attributes
(2) 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; see section 1.2. for details).
*** The sample mean applies to the observations not accounting for replicates, which explains the divergence between the proportion of non-zero's of each attribute in each category (i.e. the mean value) and the number of observations.

VARIABLE DESCRIPTION	ESTIMATED COEFFICIENT	**RELATIVE IMPACT %**	STANDARD ERROR	T-RATIO 1041 DF
* RED	2.06E-02	2.08	6.17E-03	3.35
WHITE	-2.61E-02	-2.58	1.15E-02	-2.28
ROSE	-0.10064	-9.62	3.31E-02	-3.04
VINTAGE-83	0.98291	164.99	0.1296	7.58
VINTAGE-84	0.57267	74.02	0.1932	2.97
VINTAGE-85	0.18767	20.44	5.87E-02	3.20
VINTAGE-87	0.26176	29.88	2.62E-02	10.01
* VINTAGE-88	0.14895	16.01	2.92E-02	5.11
VINTAGE-90	-0.13491	-12.67	3.41E-02	-3.96
VINTAGE-91	-0.14431	-13.50	3.71E-02	-3.89
VINTAGE-92	-0.15893	-14.71	1.89E-02	-8.40
VINTAGE-93	-0.12141	-11.47	2.69E-02	-4.51
CO-OP	7.19E-02	7.39	3.49E-02	2.06
M & S	0.21091	23.21	6.62E-02	3.19
* SAFEWAY	7.12E-02	7.29	4.23E-02	1.68
SAINSBURY	-0.14114	-13.18	2.19E-02	-6.45
VICTORIA WINE	-0.36842	-31.07	8.50E-02	-4.34
** CABERNET SAUV-NAVARRA	0.17335	18.69	6.37E-02	2.72
** CABERNET SAUV-PENEDES	0.26475	30.07	6.07E-02	4.36
NAVARRA	-8.66E-02	-8.36	3.63E-02	-2.39
PENEDES	0.32498	38.35	2.78E-02	11.70
RIOJA	0.23137	26.02	1.13E-02	20.43
VALENCIA	-0.28571	-24.86	1.35E-02	-21.14
RUEDA	-8.73E-02	-8.57	6.75E-02	-1.29
CHARDONNAY	0.17718	19.26	4.62E-02	3.84
MUSCAT	0.126	13.27	5.25E-02	2.40
SAUVIGNON BLANC	0.15209	16.11	7.43E-02	2.05
CABERNET SAUVIGNON	-0.10154	-9.75	4.55E-02	-2.23
CONSTANT	1.304		7.47E-03	174.60

- R-square adjusted: 0.60
- Breusch-Pagan: Chi-Square = 19.6 with 25 D.F.
  [for 24 D.F., *P*(chi squ > 36.42) = 0.05]; for 26 D.F., *P*(chi squ > 38.89) = 0.05]
- variables preceded by a * are taken from symmetric regressions
- variables preceded by ** are interaction terms

*** the impact of the attribute on price is measured as $g^* = \exp\left(\hat{c} - 0.5\hat{V}(\hat{c})\right) - 1$, as in equation (6)

3.2.6.2. Discussion of estimation results for Spanish wines

First of all, it would be of interest to examine the reliability of the Spanish official category designations (see section 2.1.) in terms of their informational value to the consumer: “France’s appellation controlee designation is in general a very much more reliable guide to the country’s best wines than, for example, the QBA category of ‘quality wines’ in Germany, the liberally applied DOC designation in Italy and Portugal, and its DO counterpart in Spain (all of the last three modelled in the AC system).” (Robinson, 1994, p.42). However, it is regrettable that the present data set does not provide sufficient information on the different quality categories as to make an examination of this issue possible.

In the above regression, the colors achieve a distinct valuation, as red wines appear in general to be associated with higher utility than whites (+2% and -2.6% respectively).

Since Navarra is a major producer of rose wines, the negative impact of the latter (-9.6%) may in part originate from the negative, yet only overall impact of Navarra itself (-8.4%). However, since Garnacha, the grape that is widely used to produce these rose′s, is neither contributing on an overall nor on a regional level, this interpretation could be questioned.

The valuation of grape vintages is in line with expectations, although the model suggests that consumers associate a distinctly higher value with an average Spanish wine for the year 1987 (+29.9%).

As for the retailers, the consumer of Spanish wines seems to give Victoria Wine a highly negative impact on price (-31%), and appears rather to be willing to pay for the traits that M&S has to offer (+23.2%). However, in both cases the sample size urges caution. Furthermore, Safeway’s traits are valued distinctly higher than those of Sainsbury’s (+7.3% and -13.2%, respectively). Again, particular traits of Co-op are acknowledged by the consumer and are reflected in a positive impact on price (+7.4%).

Although two traditional grapes, Airen and Garnacha, are responsible for many rather undistinguished wines (Fielden, 1994, p.219) and most of the Spanish plantations, not many of these wines enter the UK market. Their complete absence in the present sample explains also why foreign varieties, such as Cabernert Sauvignon, Chardonnay and Sauvignon Blanc have a more than average impact on price (-9.7%, +19.3%, +16.1% respectively). While Cabernet Sauvignon has both for Navarra as well as for Penedes a distinctly positive impact on price (+18.7% and +30%, respectively) - and this against the background of a negative overall valuation of Cabernet Sauvignon (-9.7%) - the magnitude of the impact of Sauvignon Blanc may seem unexpected. However, the increasing popularity of Sauvignon Blanc from Penedes may be reflected here in its high valuation, despite the lack of a regional impact on price. Fielden (1994, p.214) suggests that Penedes "... has been in the forefront of viticultural and winemaking advances in Spain and it was one of the first areas to make large scale use of "foreign" grape varieties.".

Also anticipated are the impacts of Valencia (-24.9%) and Rioja (+26%) on price. While Valencia is known as an exporter of bulk wines (Fielden, 1994, p.217), Rioja is recognized as the leading wine region of Spain (Robinson, 1994, p.805). However, somewhat surprising is the negative impact of Rueda on price (-8.6%). This region in the Duero Valley is generally known for its 'modern Rueda', a light, fruity and dry white wine (Robinson, 1994, p.831), but produces also some finer white wines, including Sauvignon Blanc (Marques de Riscal).

3.2.7.1. Log-lin model estimates for German wines

SUMMARY STATISTICS

VARIABLE DESCRIPTION	NUMBER OF OBSERVATIONS	MEAN***	ST. DEV	VARIANCE	MINIMUM	MAXIMUM
PRICE **(£)**	801** (266*)	(3.4792)	(1.2719)	(1.6178)	1.09	10.52
"Q.B.A."	474	0.50752	0.50089	0.25089	0	1
"Q.M.P."	213	0.35714	0.48006	0.23046	0	1
"AUSLESE"	26	4.89E-02	0.21601	4.67E-02	0	1
"KABINETT"	93	0.15414	0.36176	0.13087	0	1
"SPATLESE"	68	0.11278	0.31692	0.10044	0	1
GEWÜRZTRAMINER	4	7.52E-03	8.65E-02	7.49E-03	0	1
MUELLER THURGAU	4	1.50E-02	0.12193	1.49E-02	0	1
PINOT BLANC	5	1.50E-02	0.12193	1.49E-02	0	1
RIESLING	95	0.14662	0.35439	0.12559	0	1
SILVANER	9	1.50E-02	0.12193	1.49E-02	0	1
NAHE	34	6.77E-02	0.25165	6.33E-02	0	1
RHEINHESSEN	346	0.40602	0.49201	0.24208	0	1
RHEINPFALZ	79	0.11278	0.31692	0.10044	0	1
VINTAGE-88	17	3.01E-02	0.17112	2.93E-02	0	1
VINTAGE-90	34	6.39E-02	0.24505	6.01E-02	0	1
VINTAGE-93	126	0.17293	0.3789	0.14357	0	1

* There are 266 unique and hence different bottles in the sample. Corresponding descriptive statistics are in brackets. Since the same unique bottle appears frequently in different outlets, the total sample size is given by 801.
** The difference between the total sum of all observed prices after accounting for replicates [801] and the sum of observations for the above attributes as they remained in the final specification, is therefore due to:
(1) statistically non-significant attributes
(2) 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; see section 1.2. for details).
*** The sample mean applies to the observations not accounting for replicates, which explains the divergence between the proportion of non-zero's of each attribute in each category (i.e. the mean value) and the number of observations.

VARIABLE DESCRIPTION	COEFFICIENT	**RELATIVE IMPACT %**	STANDARD ERROR	T-RATIO 788 DF
"Q.B.A."	-3.46E-02	-3.40	8.50E-03	-4.07
"Q.M.P."	0.14929	16.09	1.24E-02	12.06
"AUSLESE"	0.18396	20.09	4.15E-02	4.44
"KABINETT"	-7.43E-02	-7.18	1.72E-02	-4.33
* "SPATLESE"	2.19E-02	2.19	2.27E-02	0.96
GEWÜRZTRAMINER	0.23632	25.86	0.1123	2.11
MUL THURGAU	-0.49867	-39.60	0.1053	-4.74
* PINOT BLANC	0.1206	12.30	9.57E-02	1.26
RIESLING	5.21E-02	5.34	1.49E-02	3.50
SILVANER	-0.24804	-22.17	7.24E-02	-3.43
* NAHE	4.97E-02	5.03	3.69E-02	1.35
RHEINHESSEN	2.47E-02	2.50	7.70E-03	3.21
RHEINPFALZ	-0.11892	-11.24	2.32E-02	-5.13

VARIABLE DESCRIPTION	COEFFICIENT	**RELATIVE IMPACT %**	STANDARD ERROR	T-RATIO 788 DF
* VINTAGE-88	0.39468	48.16	5.54E-02	7.12
VINTAGE-90	8.70E-02	9.03	3.39E-02	2.57
VINTAGE-93	-0.1008	-9.60	1.41E-02	-7.15
CONSTANT	1.2109		0.8229E-02	147.10

- R-square adjusted: 0.39
- Breusch-Pagan: Chi-Square = 28.05 with 12 D.F. [for 12 D.F., *P*(chi squ > 21.02) = 0.05; for 12 D.F., *P*(chi squ > 26.21) = 0.01]
- variables preceded by a * are taken from symmetric regressions

*** the impact of the attribute on price is measured as $g^* = \exp\left(\hat{c} - 0.5\hat{V}(\hat{c})\right) - 1$, as in equation (6)

3.2.7.2. Discussion of estimates for German wines

The German wines sold in the UK wine market, as reflected in the present data set, are offered at a lower minimum and maximum price compared Spanish wines (Minimum price: £1.09; Maximum price: £10.52). Furthermore, only white wines are part of the sample.

The estimates suggest that “Q.m.P.” (see section 1.2.) appears to be recognized as a separate attribute, since it is valued in addition to Kabinett, Spätlese and Auslese, all three supposedly denoting different Prädikat grades (-7.2%, +2.2, +20% respectively). Rather than as a success of labelling, this could be regarded as evidence of confusion in the consumer’s mind. Nevertheless, the impact on price is in ascending order, suggesting that the consumer is willing to pay for distinct degrees of ripeness (must weight) and able to distinguish them (assuming a market of near perfect competition, as before).

The rather depressing impact that Müller-Thurgau (MT) has on price (-39.6%) is in line with expectations, as this variety is largely the basis for ‘Liebfraumilch’, a medium dry white wine, which has been credited with being the best-selling style of wine in the UK (Fielden, 1994, p.158). This estimate could be seen in the light of the impact that Rheinpfalz has on price (-11.3%), as MT is (quantitatively) its most important grape variety. However, those bottles that have been labelled with both MT and the originating region come only from Nahe and Mosel, the latter showing a surprising positive impact

(+5%, though not significant at the 5% level). Nevertheless, the small sample size for MT (0.5%) is unsatisfactory, although the reason for this in the present sample could be the fact that most Liebfraumilch will contain MT, yet it is not displayed on the label.

Germany's noble grape, the Riesling, has its strongest base in the Rheingau and the area of Mosel-Saar-Ruwer. However, neither of these regions achieves a significant impact on price, nor does the grape's impact itself (+5.4%) appear to be impressive. Given the price range on offer in the present sample, it may be that most of the top quality German Riesling produced just was not exported to the UK.

The valuation that consumers seem to place on Gewüztraminer is neither unexpected in terms of its sign, nor in terms of its magnitude (+11.7%).[60] Since it is mostly grown in the Rheinpfalz, the impact on price of the latter (-11.3%) comes as a surprise. However, considering the sample size of this variety (0.5%), and yet an absence of a regional impact, the results should be viewed with a certain amount of prudence.

Silvaner, once Germany's most widely planted variety, shows a high negative impact on price, which is also not anticipated (-22.17%), in particular relative to Riesling and MT. Although the sign of the estimate is not surprising, and given that Silvaner is generally acknowledged as lacking frame and body compared to Riesling (Robinson, 1994, p.879), the impact of two important regions where it originates, Nahe (+5.03%) and Rheinhessen (+2.5%), would suggest a more positive overall and regional impact. However, the sample size of Silvaner is not satisfactory (1.1%).

Coefficient estimates for vintages are in line with expectations, although the 1988 vintage seems to have a more than proportionate contribution to price (+48.2%), relative to 1990 (+9%) and 1993 (-9.6%). Since only three vintages are valued more than average by the consumer, further evidence seems to be present to suggest that consumers choose predominantly according to region and grape variety.

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60 This is a special case. Since Gerwurztraminer comes exclusively from the Rheinpfalz, its impact is accounted for by taking the difference between the estimates, rather than taking +25.9% as the assumed impact.

Considering the above results for Spain and Germany, they could be summarized as following.

	SPAIN	GERMANY
Degrees of freedom	1041	788
Mean price (£)	4.0	3.48
Max price (£)	14.59	10.52
Min price (£)	1.67	1.09
Retailers with significant **positive** impact on price	M&S, Co-op, Safeway	-
Retailers with significant **negative** impact on price	Victoria Wine, Sainsbury	-
Red grape varietals that consumers regard most **highly ***	Cabernet Sauvignon	-
Red grape varietals that consumers value **least ***	-	-
White grape varietals that consumers regard most **highly ***	Chardonnay, Sauvignon Blanc, Muscat	Gewürz-traminer, Pinot Blanc, Riesling
White grape varietals that consumers value **least ***	-	Müller-Thurgau, Silvaner
Number of regions with significant price impact	5	3
Number of differential effects of region by grape variety	2	-

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