

# A Hedonic Pricing Model for German Wine

## Ein hedonisches Preismodell für Qualitätswein aus Deutschland

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### Zusammenfassung

Wir erstellen ein hedonisches Preismodell für Qualitätswein aus Deutschland. Als Indikatoren der Qualität von 4,141 Weinen dienen die Ergebnisse der sensorischen Prüfung der jährlichen Bundesweinprämierung und die Einstufung in die gesetzlichen Qualitätskategorien sowie eine Reihe von Kontrollvariablen wie z.B. regionale Herkunft, Weinart, Geschmacksrichtung oder das Alter der Weine zum Zeitpunkt der sensorischen Prüfung. Die Datengrundlage bestätigt, dass die Ergebnisse der Prämierung sowie die Qualitätsstufen und die meisten der Kontrollvariablen einen signifikanten Einfluss auf den Preis haben.

### Schlüsselwörter

Wein, hedonische Preismodelle, Reputation

### Abstract

We develop a hedonic pricing model for German quality wine. Quality indicators for 4,141 wines are sensory awards received at the annual German wine competition and the legally required quality category as well as a set of control variables including regional origin, color, style, and their age at the time of judging. The data confirms that sensory quality awards have a significant and positive price impact. Moreover, we estimate significant relative differences between quality categories, growing regions and most of the control variables.

### Key words

wine, hedonic pricing models, reputation

## 1. Introduction

Because any expert appraisal of sensory wine quality is based on subjective impressions, wine is also classified according to legally binding criteria and standards that are measurable and verifiable. Such a notion of "quality" is outlined in wine laws and regulations. The EU wine law assigns general conditions that apply to all wine-producing member states, but takes common interests as well as national differences into account. For example, the vineyard areas in the EU are divided into climatic zones to help compensate for the climatic variations that influence wine production. Similarly, the EU wine law defines quality categories that enable legally equivalent comparisons among member states. However, each member state is permitted to

determine the criteria and method of assessment necessary to meet local (and EU) quality standards.

In some countries, wine quality is closely tied to origin; i.e. the system is based on given conditions. Quality standards vary considerably, depending on appellation of origin, and the qualitative assessment is usually determined by regional wine trade organizations. However, in Germany quality is confirmed or denied by official testing. The quality in the glass rather than origin counts. The standards are largely uniform and the assessment is determined through quality control testing. Regulations governing quality categories and testing are important components of the German wine law.

Germany is the world's sixth largest wine producer with a total production of about ten million hectoliters. German wine is grown in 13 classified regions and renowned for its white varieties such as Riesling and Müller-Thurgau. Table 1 provides an overview of production by growing region. Vineyard area and production quantity remained relatively steady over the last decade. However, there have been significant structural changes (DWI, 2001). In particular, the proportion of red variety vineyards has grown from 16% to over 26%. Mass producing white varieties are now declining and the production increasingly focuses on premium quality wine (STORCHMANN and SCHAMEL, 2002).

**Table 1. Vineyard area and production in Germany in 2000**

Region	Vineyards (ha)	Production (1,000 hl)	Main Varieties
Ahr	513	45.6	Pinot Noir
Baden	15,372	1,225.4	Pinot Noir, Müller-Thurgau
Franken	5,925	479.5	Müller-Thurgau, Sylvaner
Hess. Bergstraße	443	41.9	Riesling
Mittelrhein	540	45.0	Riesling
Mosel-Saar-Ruwer	11,042	1,127.6	Riesling
Nahe	4,428	361.4	Riesling
Pfalz	22,606	2,610.5	Riesling, Müller-Thurgau
Rheingau	3,144	275.1	Riesling
Rheinessen	25,596	2,606.1	Müller-Thurgau, Sylvaner
Saale-Unstrut	621	42.2	Müller-Thurgau, Pinot Blanc
Sachsen	415	23.2	Müller-Thurgau, Riesling
Württemberg	10,903	1,197.2	Trollinger, Riesling
Total	101,548	10,080.8	Riesling, Müller-Thurgau

Source: DWI (2001)

In this paper, we analyze an extensive data set of 4,141 wines evaluated during the annual competitions administered by the German Agricultural Society (DLG). The hedonic model includes award level (bronze, silver, gold, gold

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extra), wine style (dry, off-dry, mild), barrique aging, color (red, white, rosé), special quality attributes (e.g. Spätlese, Auslese), and regional origin (e.g. Baden, Pfalz) as independent variables to explain variations in price. We show that the estimated implicit prices for these quality characteristics are highly significant (except for one regional indicator and rosés) and that they exhibit expected signs and relative magnitudes. The price premiums for special quality attributes are significantly larger than the premiums for competition awards. Moreover, the smaller wine growing regions (e.g. Ahr, Saxony) receive high price premiums relative to the larger bulk producing regions.

## 2. Regulations and quality control

By law, German wines are categorized by the degree of ripeness, which the grapes have achieved at harvest. Ripeness is determined by the sugar content in the grapes measured in degree Oechsle. The Oechsle requirements for the respective categories vary by growing region. They do not reflect sweetness levels in the finished wine. Riper grapes provide more aroma and more flavor, hence a more expressive and flavorful wine. Sweetness depends on the winemaker's decision and is independent of wine quality. If the fermentation process, which converts natural sugar into alcohol, stops or is interrupted before all sugar is transformed, it will result in sweeter wines. If the fermentation continues until little or no sugar is left, it results in drier wines. Grapes for dessert wines have so much natural sugar that they will not ferment completely and residual sugar (sweetness) will remain.

German wine producers are required to declare specific quality categories on their labels. The European Union wine law mandates two broad quality categories: Table Wine and Quality Wine. Within these quality categories, the German wine law specifies more sub-categories than other EU countries. For example, the table wine category has two levels: simple table wines (Deutscher Tafelwein) and superior table wines (Deutscher Landwein). However, we will not further elaborate on table wines because of our focus on quality wines in this paper.

Standard quality wine (Qualitätswein - QbA) must be made exclusively from German produce, be from an approved grape variety grown in one of the 13 specified wine-growing regions, and reach an existing alcohol content of at least 7% by volume. However, winemakers are allowed to add sugar to QbA wines before fermentation to increase the alcohol level of the wine. This so-called chaptalization process is commonly used around the world and adds more body to otherwise lighter wines.

The quality wine category has six higher-rated sub-categories identified by special quality attributes (QmP).<sup>1</sup> QmP must be from a certain district within a wine-growing region and reach a specified natural alcohol content for the region, grape variety and special attribute category. Chaptalization is not allowed. The special attribute categories are subject to additional regulations concerning ripeness,

method of harvesting, and marketing. In ascending order of ripeness at harvest the special attribute categories are:

- **Kabinett:** fine, usually “naturally” light wines made of fully ripened grapes, low in alcohol, may not be sold prior to January following the harvest.
- **Spätlese:** late harvest, from superior quality grapes, more intense in flavor and concentration than Kabinett, not necessarily sweet.
- **Auslese:** from selected, very ripe bunches, noble wines with intense in bouquet and taste, usually, but not always sweet.
- **Beerenauslese (BA):** from selected, overripe berries (usually Botrytis), harvested only during exceptional weather conditions, yielding rich, sweet dessert wines noted for their longevity.
- **Eiswein:** from grapes as ripe as BA, but harvested and pressed while frozen, unique wines with a remarkable concentration of fruit, acidity, and sweetness.
- **Trockenbeerenauslese (TBA):** from individually selected, overripe berries (dried up almost to raisins); rare, rich, lusciously sweet wines with an extraordinary longevity.

Moreover, note that all special attribute categories except “Kabinett” wines may not be sold before the month of March following the year of harvest and that BA and TBA wines may not be harvested mechanically.

The German wine law also defines four basic wine styles (dry, off-dry, mild, sweet) in terms of their dryness or sweetness. Dry (“trocken”) indicates that most of the natural sugar has been fermented (up to 9 grams/liter of residual sugar, total acidity must be 2 grams/liter less than residual sugar content). Off-dry (“halbtrocken”) includes wines with 9-18 grams/liter of residual sugar and total acidity must be 10 grams/liter less than the residual sugar. Mild wine (“lieblich”) has a residual sugar content between 18 and 45 grams/liter. Sweet wines (“süß”) have more than 45 grams/liter of residual sugar.

The wine regulations have been subject to much criticism since becoming law in 1971. For example, there are no yield limits, which have increased without enough regard for quality. Another problem is that sugar content at harvest is the only criteria for inclusion into a quality category although the boundaries between sub-categories (e.g. Spätlese or Auslese) are adjusted by region. Thus, a higher sugar content is required for wines from warmer regions (e.g. Baden) relative to the cooler areas (e.g. Nahe). However, the required sugar levels for higher-rated categories are generous. Moreover, some producers declassify wines reasoning that it is better to offer an excellent QbA rather than a mediocre Kabinett.

Concurrently to the new wine law coming into force, modern early-ripening varieties came into production. Whereas previously a wine labeled “Auslese” indicated a highly selective harvest in the vineyard and correspondingly high quality, it now became much easier to produce a high-sugar content “Auslese” from Ortega grapes. Moreover, it became perfectly legal to blend Riesling Auslese with a modern early-ripening variety or to chaptalize a QbA but not a QmP such that the former was not necessarily inferior to the

<sup>1</sup> QbA = Qualitätswein bestimmter Anbaugebiete (quality wine from a specified appellation)

QmP = Qualitätswein mit Prädikat (quality wine with special attributes).

latter. The potential for abuse became immense and the fine name that once attached to 'Auslese' was degraded.

Many producers acknowledge the inadequacy of the wine law, but the main regulatory and marketing bodies have resisted any reforms. As a consequence, leading German estates have formed associations such as the "Verband Deutscher Prädikatsweingüter" (VDP) in an effort to change the system and demand far stricter quality controls than the current wine law. Many estates have imposed strong self-regulation, ensuring that anything offered to consumers under their label is of good quality. Despite the failings of the wine law, the DLG administers a sound system of wine quality control, which we will analyze subsequently.

Each German wine, which is labeled as a "quality wine" first undergoes a critical, blind, sensory testing procedure based on a uniform five-point scale, devised by the DLG. For each wine to be tested, producers have to submit an application for an official quality control test number (A.P.Nr.)<sup>2</sup>. The actual examination procedure is divided into two rounds: (a) checking specific prerequisites and (b) examining a wine's sensory characteristics. In the first round, the examination panel verifies whether the wine is typical for the region of origin, grape variety and quality category stated on the application. Just one negative score on any of these questions disqualifies a wine from further assessment. Subsequently, the second round is a sensory evaluation of three important characteristics: *bouquet*, *taste* and *harmony*. "Harmony" embraces all sensory impressions, including color. The overall balance between sweetness and acidity as well as alcohol and body are also considered. Up to five points or fractions thereof are awarded for each of the three characteristics. A minimum of 1.5 points (per characteristic) is necessary to avoid rejection. The total sum of this characteristic score yields an overall evaluation that is divided by three to determine the wine's quality rating number - the wine must achieve at least 1.5 points in order to receive a quality control test number (A.P.Nr.).

The DLG and its regional associations use the same testing procedure and "five-point system" to determine wines of superior quality, which are worthy of seals, award medals and prizes. In order to qualify for the German Wine Seal (Deutsches Weinsiegel), a wine must achieve at least 2.5 points, i.e. achieve a significantly higher quality rating than required to simply receive a quality control test number (A.P.Nr.). The German Wine Seal also indicates wine styles using a color-coding system. Dry wines bear a bright yellow seal; a lime green seals identifies off-dry wines; and the red seal is reserved for sweeter wines.

State Chambers of Agriculture (Landwirtschaftskammern) award bronze, silver and gold medals that require a minimum of 3.5, 4, and 4.5 points, respectively. These medal-winning wines are then eligible to enter the annual national wine competition (Bundesweinprämierung) administered by the DLG at which they can win bronze, silver and gold awards (DLG-Prizes). In a special competition, the Gold Extra Prize (Goldener Preis Extra) may be awarded to wines that achieve a perfect 5-point score. For consumers, wine seals, medals and DLG awards are valuable guides to

assess the quality of German wine. In the next section, we briefly review the literature on hedonic price analysis specifically as related to wine quality indicators.

### 3. Literature review

A number of studies apply hedonic models to estimate implicit prices for wine quality attributes. They are based on the hypothesis that any good represents a bundle of characteristics that define quality. Theoretical foundation is the seminal paper by ROSEN (1974), which posits that goods are valued for their utility-generating attributes. ROSEN hypothesizes that consumers evaluate these attributes when making a purchasing decision. The competitive market price is the sum of implicit prices paid for embodied product attributes. Rosen recognizes an identification problem for supply and demand functions derived from hedonic models, because implicit prices are equilibrium prices jointly determined by supply and demand conditions. Thus, implicit prices may not only reflect consumer preferences but also factors determined through production. In order to solve the identification problem it is necessary to separate supply and demand conditions. ARGUEA and HSIAO (1993) argue that the identification problem is essentially a data issue that can be avoided by pooling cross-section and time-series data specific to a particular side of the market. In this paper, we chose not model the supply side, because we assume a market equilibrium. That is, all consumers have made their utility-maximizing choices, given their knowledge of prices, characteristics of alternative wines and other goods. When making their buying decision, they use available information on how experts evaluate a particular wine and how the growing region succeeds a supplier of quality wine. Moreover, all firms have made their profit-maximizing decisions given their production technologies and the costs of alternative wine qualities producible, and that the resulting prices and quantities clear the market. According to FREEMAN (1992), the equilibrium assumption implies that implicit prices may be specified without separately modeling supply conditions.

SHAPIRO (1983) presents a theoretical framework to examine the effects of producer reputation on prices, assuming competitive markets and imperfect information. For consumers, it is costly to improve their knowledge about quality. He demonstrates that reputation allows high-quality producers to sell their items at a premium which may be interpreted as return on investments in reputation building. In an imperfect information environment, learning about reputation indicators may be an effective way for consumers to reduce their decision-making costs. Since the quality of a bottle of wine is unknown until it is de-corked, reputation indicators associated with it will affect consumer willingness to pay. TIROLE (1996) presents a model of collective reputation as an aggregate of individual reputations where current producer incentives are affected by their own actions as well as collective actions of the past. He derives the existence of stereotype producers from history dependence, shows that new producers may suffer from past mistakes of older producers for a long time after the latter disappear, and derives conditions under which the collective reputation can be regained. GOLAN and SHALIT (1993) identify and evaluate quality characteristic applying he-

<sup>2</sup> A.P.Nr. = Amtliche Prüfnummer

donic pricing to wine grapes sold in Israel. Thus, they study the input supply side of the wine market. They propose that high-quality wines are produced only when growers are given strong price incentives to supply better grapes. In a two-stage model, they first develop a quality index by evaluating the (relative) contributions of various physical grape attributes to wine quality. Second, they construct a quality-price function relating the price of Californian wine to the quality index developed in the first stage. NERLOVE (1995) examines the Swedish wine market having no domestic production, a small share of global consumption, and government controlled prices. He assumes that wine consumers express their valuation for a particular quality attribute by varying the derived hedonic demand for it and estimates a reduced form hedonic price function, regressing sold quantities on quality attributes and prices. COMBRIS et al. (1997) estimate a hedonic price equation and what is referred to as a jury grade equation for Bordeaux wine to explain the variations in price and quality, respectively.

LANDON and SMITH (1997, 1998) present further empirical analyses of Bordeaux wine, focusing on reputation indicators in addition to sensory quality attributes. In both papers, they study the impact of current quality as well as reputation indicators on consumer behavior using hedonic price functions. Lagged sensory quality ratings define individual product reputation. Regional reputation indicators are government and industry classifications. Their main findings are: reputation indicators have a large impact on consumer willingness to pay, an established reputation is considerably more important than short-term quality improvements, and ignoring reputation indicators will overstate the impact of current quality on consumer behavior. The 1997 paper analyzes five vintages individually (1987-91) and the estimated coefficients vary substantially across these vintages.

OCZKOWSKI (1994) estimates hedonic price function for premium Australian wines, examining six attribute groups and various interaction terms. In another paper, he argues that single indicators of wine quality and reputation are imperfect measures because tasters' evaluations differ and thus contain measurement errors. Employing factor analysis and 2SLS, he finds significant reputation effects but insignificant quality effects (OCZKOWSKI, 2001).

ROBERTS and REAGANS (2001) examine market experience, consumer attention, and price-quality relationships for New World wines in the U.S. They argue that producer or regional quality signals improve with the duration of market exposure and evaluation. Controlling for vintage, blind-tasted quality, and variety, BROOKS (2001) applies hedonic price analysis to study the effect of country-of-origin brands on international competitiveness. Comparing price residuals across-countries suggests that international brands can affect a wine bottle's price in excess of fifty percent. SCHAMEL and ANDERSON (2003) evaluate wine quality and regional reputation indicators for Australia and New Zealand. In each country, price premiums associated with sensory quality ratings, and winery ratings are highly significant. For Australia, regional reputations in general are becoming increasingly significant through time, indicating intensifying regional

quality differentiation. For New Zealand, regional quality differentiation is also significant, although less than in Australia.

SCHAMEL (2000) estimates a hedonic model for the U.S. market with sensory quality ratings for a white and a red variety (Cabernet Sauvignon and Chardonnay) from seven different wine-growing regions. The estimated price elasticity of sensory quality is larger for white wine, indicating that consumers were willing to pay a higher quality premium for white compared to red wine. However, the results suggest both regional reputation and individual quality indicators seem to be more important to U.S. consumers of red wine. The results also suggest the public-good value of a regional appellation is higher for red wine regions and that individual producers in those regions may benefit more from collective marketing efforts. In another paper, SCHAMEL (2002) argues that as quality indicators improve over time, spillovers will affect other producers within a region. Quality indicators for premium California wine are medals awarded during nine annual wine competitions, variety, regional origin, judging age as well as derived producer (brand) and regional reputation indicators. Estimating a hedonic model, the data confirms that a wine's price is significantly related to its own quality as well as to historically accumulated producer and regional reputation indicators for quality.

#### 4. Data and analysis

We analyze quality indicators for German wine admitted to the annual national wine competition (Bundesweinprämierung). The results of the competition are published in print and via the Internet (DLG, 2001). The original data set extracted from the Internet consisted of 4,281 observations. The sample size used for the estimation procedure was reduced to 4,141 because 140 wines listed no price information. However, for most wines, producers state a retail price per bottle on the submission form before entering the competition. Therefore, the price information is pre-competition and does not reflect any direct effects from awarded medals. Table 2 presents the distribution of medals (Bronze, Silver, Gold, and Gold Extra) by growing region. Overall, 19.5% of all medals awarded are Bronze, 36.5%

**Table 2. Distribution of medal winners by region**

Region	Bronze	Silver	Gold	Gold Extra	All
Ahr	0.5%	1.1%	1.3%	1.3%	1.1%
Baden	5.7%	11.5%	17.6%	23.1%	13.2%
Franken	11.0%	9.5%	9.9%	1.3%	9.8%
Hess. Bergstraße	1.3%	1.6%	2.2%	2.5%	1.8%
Mittelrhein	1.3%	2.9%	1.8%	1.3%	2.1%
Mosel-Saar-Ruwer	18.8%	9.8%	5.1%	2.6%	9.4%
Nahe	3.6%	3.7%	3.0%	1.3%	3.4%
Pfalz	22.6%	19.1%	19.9%	26.9%	20.2%
Rheingau	5.3%	4.2%	3.0%	2.5%	3.9%
Rheinhessen	18.2%	14.6%	14.4%	16.7%	15.2%
Saale-Unstrut	0.9%	1.0%	0.4%	0.0%	0.7%
Sachsen	2.0%	1.2%	0.4%	0.0%	1.0%
Württemberg	8.8%	19.8%	21.1%	20.5%	18.2%

Source: DLG (2001), own calculations

are Silver, 42.1% are Gold and 1.9% are Gold Extra.<sup>3</sup> The model employs dummy variables for the medals as an indicator of sensory quality in addition to the quality attributes (e.g. Spätlese, Auslese) ensuing from the wine law. The data set also denotes wine style, color, regional origin, age at the time of judging, and whether or not the wine was aged in barrique (oak barrels). Table 3 lists the independent variables used in the model. All independent variables are categorical dummies, except for judging age and Barrique (regular dummy). The dependent variable in the model is the logarithm of the retail price [log(Price)].

**Table 3. Description of independent variables**

Variable	Parameters
Award	Gold Extra, <b>GOLD*</b> , Silver, Bronze
Quality Level	Qualitätswein (QbA), Kabinett, <b>SPÄTLESE*</b> , Auslese, Beerenauslese (BA), Trockenbeerenauslese (TBA), Eiswein
Wine Style	lieblich/mild, halbtrocken, <b>TROCKEN*</b> , Barrique
Color	Weißwein, Rosé, <b>ROTWEIN*</b>
Regions	Ahr, Baden, Franken, Hessische Bergstraße, Mittelrhein, Mosel-Saar-Ruwer, Nahe, <b>PFALZ*</b> , Rheingau, Rheinhessen, Saale-Unstrut, Sachsen, Württemberg
Age	1 – 5 Years

\* Parameters in **BOLD** are chosen as base category.  
Source: own description.

In table 4, we summarize frequencies and price statistics differentiating the four prize levels, seven quality categories, wine style, color as well as the 13 classified wine regions. Over 42% of the sample were awarded the DLG Gold prize and more than a third of the sample was categorized “Spätlese.” Moreover, it contains about 68% white wine, 29.5% red wine, and 2.5% rosé. The average nominal price is 8.96 € (range 2.05€ – 184 €).<sup>4</sup> For the estimation, “Gold” was selected as base award, “Pfalz” as base region, “Spätlese” as base quality attribute, and dry/white as base style/color category. The regional ranking of award winning wines reflected by the relative frequencies differs somewhat from the production shares with the smaller regions winning a more than proportional large share of medals.

The theory of hedonic pricing models is well documented in the literature (e.g. NERLOVE, 1995). Therefore, we neglect a detailed exposition. We hypothesize that consumers are uncertain about wine quality and their willingness to pay depends on quality evaluations from DLG awards received. Control variables include a set of indicators for quality attribute, wine style and color, growing region as well as the age of the wine at the time of judging as we can expect that older wines should achieve higher prices. Building on the seminal work by ROSEN (1974), we assume

<sup>3</sup> The skewed distribution in the awards is a weakness in the data. However, in recent years an effort was made to toughen the annual national competition in order to improve the credibility of the quality indicator.

<sup>4</sup> It is interesting to note that both the cheapest and the most expensive wine in the sample received a Gold prize. Moreover, the least expensive Gold Extra prize wine is a bargain at 3.48 €.

that the price of a particular wine  $i$  ( $P_i$ ) as a function of its characteristics  $z_j$ :

$$(1) P_i = P_i(z_{i1}, \dots, z_{ij}, \dots, z_{in})$$

We employ a log-linear function for the estimation. Following OCZKOWSKI (1994), we used a RESET test which rejected other functional forms (i.e. inverse, linear).<sup>5</sup> Thus, we estimate the following multivariate regression model:

$$(2) \log(P_i) = \alpha + \beta_1 D_i^{\text{Award}} + \beta_2 D_i^{\text{Quality level}} + \beta_3 D_i^{\text{Style}} + \beta_4 D_i^{\text{Color}} + \beta_5 D_i^{\text{Region}} + \gamma \text{Age}_i + \delta \text{Bar}_i + \varepsilon_i$$

where  $\log(P_i)$  is the logarithm of the retail price  $P_i$  and the error term  $\varepsilon_i$  is distributed identically and independently with a zero mean and uniform variance. Given the functional form and the nature of the categorical dummies for award, quality level, style, color and region ( $D_i$ ), the estimation of equation (2) yields price premiums and discounts  $\beta_i$  ( $i = 1, \dots, 5$ ) relative to the contribution of the base category (Gold, dry, white Spätlese from the Pfalz region). Specifically,  $\beta_1$  is the coefficient for the medal received,  $\beta_2$  for the quality attribute,  $\beta_3$  for wine style,  $\beta_4$  for color, and  $\beta_5$  for regional origin. The coefficients  $\gamma$  and  $\delta$  measure the price premiums paid for older wines and barrique-aged wine, respectively. According to HALVORSEN and PALMQUIST (1980),

appropriate adjustments are to be made to interpret the estimated dummy coefficients as percentage premiums or discounts.

### 5. Estimation results

Table 5 lists the regression results for the model defined in equation (2). The last column translates the estimated coefficients into money equivalents relative to the base category (a dry-white Gold award winning Spätlese from Pfalz) at the average price in the sample (= 8.96 €). As expected, prices are positively related to the sensory evaluation (DLG-prize medal) and wines receiving higher ranking awards command significantly higher prices. Ceteris paribus, the discount for a Silver (Bronze) award relative to a Gold is 3.4% (7.5%) and the premium for a Gold Extra prize is 11.2%. In monetary terms, the discount for a Silver (Bronze) award relative to a base category wine is equal to about 30¢ (67¢) while the premium for a Gold Extra prize is roughly 1 €. These numbers are in contrast to much larger price differentials for the quality attributes, which are all highly significant. For example, an “Auslese” commands more than a 50% premium relative to a Spätlese, other things equal. As expected, specialty wines such as TBA or Eiswein receive premiums well above 100%. Barrique-aged wine carries a high premium of about 7 €. With respect to style and color, dry reds carry a premium relative to non-dry whites. However, there is hardly a price differential between mild and off-dry styles (11.6% vs. 10.9%). The price premium for red wine is 19.7%, which may help to explain why the proportion of red variety vineyards has grown from 16% to over 26% in recent years.

<sup>5</sup> For the log-linear functional form, the RESET statistic (F-Test) equaled 1.24.

**Table 4. Summary statistics**

		Frequency		Price (€)		
		Count	Relative	Average	Median	Std. dev.
<b>Award</b>	Bronze	809	19.5%	6.49	4.96	6.42
	Silver	1,511	36.5%	7.41	5.34	7.39
	Gold	1,743	42.1%	11.07	6.90	13.83
	Gold Extra	78	1.9%	17.36	11.96	20.84
<b>Quality level</b>	QbA	958	23.1%	5.73	4.57	3.32
	Kabinett	710	17.2%	4.62	4.35	1.34
	Spätlese	1,412	34.1%	6.41	5.88	2.50
	Auslese	586	14.2%	10.16	8.69	5.51
	BA	182	4.4%	19.21	14.83	13.41
	TBA	57	1.4%	34.68	19.94	38.81
	Eiswein	236	5.7%	33.34	25.54	22.45
<b>Style</b>	Barrique	218	5.3%	13.62	12.27	6.76
	lieblich (mild)	1,949	47.1%	11.69	6.44	15.18
	halbtrocken (off-dry)	639	15.4%	5.18	4.55	2.60
	trocken (dry)	1,553	37.5%	7.09	6.08	3.77
<b>Color</b>	Rosé	101	2.4%	12.54	4.86	17.02
	Red Wine	1,221	29.5%	7.28	6.14	4.25
	White Wine	2,819	68.1%	9.56	5.75	12.60
<b>Regions</b>	Ahr	44	1.1%	13.16	10.74	8.29
	Baden	545	13.2%	10.53	7.16	9.05
	Franken	406	9.8%	12.14	7.67	13.11
	Hess. Bergstraße	75	1.8%	13.83	6.14	21.00
	Mittelrhein	87	2.1%	5.65	4.70	2.79
	Mosel-Saar-Ruwer	391	9.4%	10.91	5.62	17.14
	Nahe	139	3.4%	7.82	5.62	5.78
	Pfalz	838	20.2%	7.06	4.86	7.18
	Rheingau	160	3.9%	9.85	6.14	11.82
	Rheinessen	631	15.2%	8.20	4.86	14.20
	Saale-Unstrut	30	0.7%	7.97	7.18	2.69
	Sachsen	42	1.0%	10.67	8.69	8.34
	Württemberg	753	18.2%	7.48	5.62	5.55
<b>Age</b>	1 Year	3,862	93.3%	8.75	5.62	11.07
	2 Years	246	5.9%	11.55	9.20	9.18
	3+ Years	33	0.8%	14.36	10.23	15.93
<b>Vintage</b>	≤ 1996	32	0.8%	14.15	7.67	18.48
	1997	126	3.0%	11.74	10.18	9.23
	1998	466	11.3%	12.18	7.16	17.06
	1999	3,517	84.9%	8.39	5.62	9.83
<b>Full sample</b>		4,141	100.0%	8.96	5.85	11.04

Sources: DLG (2001), own calculations

Price differentials for the 13 classified wine regions are all significant and positive relative to the base region Pfalz (other things equal). Rheinessen being the largest region in terms of vineyard area is the only exception. In Pfalz and Rheinessen, vineyard area and production is far larger than in the other regions (see table 1). They produce the bulk of German quality wine and as large regions are less suited to command a regional premium. Many of the smaller regions (e.g. Ahr and Saxony) carry very large price premiums, which would indicate that they have been quite successful in niche marketing their premium wines.

Overall, the results indicate that although the sensory quality indicator is significant, special quality attribute and regional effects dominate. The explanatory power of the

model is good ( $F = 512.66$ , adj.  $R^2 = 76.94\%$ ) and the data set confirms strong positive price effects for quality indicators such as competition prizes awarded and quality attribute.

## 6. Summary and conclusion

In Germany, wine quality is confirmed or denied by official testing. The German wine law categorizes wines by their degree of ripeness at harvest. It also defines four basic wine styles in terms of residual sugar content and total acidity. Producers are required to declare specific quality categories on their labels. The quality wine category has six higher-rated sub-categories identified by special quality attributes (QmP). The German wine law, which is quite different from regulations in other EU countries, has been subject to much criticism especially because sugar content at harvest is the sole criterion for inclusion into a special quality attribute category.

In addition to the quality categorization by law, the DLG administers a critical and blind, sensory testing procedure based on a uniform five-point scale for every German "quality wine". In an annual national wine competition (Bundesweinprämierung) bronze, silver and gold prizes as well as special Gold Extra Prizes are awarded. DLG-awards provide a valuable guide for consumers to assess the quality of German wine and in our analysis we confirm that they have a highly significant and positive impact on the prices for premium wines, even after correcting for legal quality categorization and regional origin. This is consistent with various other studies based on quality ratings. However, the estimated premiums for individual wine quality appear to be small in the context of quality assessments at wine competitions as well as relative to estimated premiums based on the quality categories. This result is in line with a study of premium California wine tasted and evaluated at multiple wine competitions (SCHAMEL, 2002). Moreover, the results indicate that although the sensory quality indicators are significant, special quality category and regional effects dominate.

We estimate significant relative differences between quality categories and between growing regions, which warrant important marketing implications for quality categories as well as individual producers and their regional and sub-regional associations. From the estimation, it follows that for specialty wines (esp. BA, TBA, Eiswein) quality categorization seems to work quite well. However, in the lower categories, the estimated differences are smaller such that Silver vs. Bronze (36¢) yields about the same premium as

**Table 5. Results [dependent variable: log(Price)]**

Parameter	Estimate	t-Statistic	P-Value	Price effect (€) <sup>†</sup>
Constant	1.579	68.07	0.00%	---
Bronze	-0.078	-5.65	0.00%	-0.67
Silver	-0.035	-3.13	0.18%	-0.31
Gold Extra	0.106	3.01	0.27%	1.01
Qualitätswein (QbA)	-0.348	-23.89	0.00%	-2.63
Kabinett	-0.286	-20.12	0.00%	-2.23
Auslese	0.417	27.28	0.00%	4.64
Beerenauslese	1.087	43.41	0.00%	17.61
TBA	1.512	36.04	0.00%	31.68
Eiswein	1.590	69.51	0.00%	34.99
lieblich (mild)	-0.123	-9.81	0.00%	-1.04
halbtrocken (off-dry)	-0.116	-7.81	0.00%	-0.98
Barrique	0.580	24.26	0.00%	7.05
Rosé	0.060	1.89	5.84%	0.55
Red Wine	0.180	12.15	0.00%	1.77
Ahr	0.542	11.36	0.00%	6.45
Baden	0.284	16.56	0.00%	2.94
Franken	0.471	25.61	0.00%	5.39
Hess. Bergstraße	0.350	9.53	0.00%	3.75
Mittelrhein	0.123	3.56	0.04%	1.17
Mosel-Saar-Ruwer	0.334	17.55	0.00%	3.56
Nahe	0.223	7.96	0.00%	2.24
Rheingau	0.384	14.63	0.00%	4.20
Rheinhessen	0.002	0.15	87.95%	0.02
Saale-Unstrut	0.509	8.98	0.00%	5.95
Sachsen	0.734	15.19	0.00%	9.71
Württemberg	0.185	11.01	0.00%	1.82
Age	0.064	3.95	0.01%	0.57

<sup>†</sup> relative to base category (Gold, Spätlese, dry, white, Pfalz) at average price (8.96 €), adjustments made according to HALVORSEN and PALMQUIST (1980).

F = 512.66; R<sup>2</sup> = 77.09 %; adj. R<sup>2</sup> = 76.94 %.

Source: own calculations

Kabinett vs. QbA (40€). Thus, the strategy of some producers to declassify their wines (e.g. reasoning that it is better to offer an excellent QbA rather than a mediocre Kabinett) is reconfirmed through the data. Critics of the German wine law argue that the reputation of the quality categories has degraded. However, the reputation of a quality category has public good properties and it is crucial to promote its value. Here, TIROLE'S (1996) model of collective reputation applies to quality categories. The collective reputation for a specific wine quality attribute is an aggregate indicator. When producers declassify their wine their incentives seem to be affected by collective actions of the past. Following TIROLE (1996), regaining collective reputation depends on producer eagerness, the trust level required by consumers, and on free riders.

Our results point towards the need for greater regional differentiation. In their search for more knowledge about wine quality, discerning consumers value more specific information. It seems that the degree of regional differentiation in Germany is mainly a result of the wine law and is not reflecting recent industry trends. We confirm positive price effects for sensory quality indicators such as competition prizes awarded. However, price-quality relationships depend on the performance of producers over time and of other producers in the same region. As consumers become aware of producer (brand) or sub-regional quality and reputation indicators, they will pay more attention to pro-

ducer and site-specific quality signals. At the same time, they become less reliant on more diffuse signals, such as special quality attributes specified by the wine law which may blur the supremacy of distinct vineyard sites in larger regions. Efforts by leading German wine estates to change the current regulatory system and to demand stricter quality controls point in this direction. They strive for stronger property rights and value in sub-regional or site names, thereby raising the rates of return on individual promotion efforts. Then, the French tradition of emphasizing regional origin would take hold in Germany.

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Agrarwirtschaft 52 (2003), Heft 5

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