WHAT DETERMINES THE PRICE OF PORT WINE?

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RESUMO:
A indústria do vinho do Porto caracteriza-se pela longevidade das suas existências. Devido à natureza das práticas e dos normativos contabilísticos, estas existências de longa duração são registadas no activo corrente e medidas ao custo. Este grupo de factos, em associação com a inflação, provoca um problema contabilístico: a subavaliação das existências. Este artigo analisa a questão: O que determina o preço do Vinho do Porto? Um modelo hedónico foi estimado de forma aexplicar as variações do preço em face das alterações das características do Vinho do Porto. Os resultados indiciam que a idade é um dos determinantes do preço (além de outros). Este facto confirma a convicção de que o processo de envelhecimento dos vinhos, em conjugação com as normas e as práticas contabilísticas, bem como a inflacção, conduzem a um problema contabilístico.

PALABRAS CLAVES:.Contabilidade de Vinhos, Modelos hedónicos

ABSTRACT:
Port wine industry is characterized by it long-lived inventories. Due to accounting standards and practices the long-lived inventories are recognized in the current assets account and are measured at cost. This group of facts, in association with inflation, leads to an accounting problem: the underestimated long-lived inventories. This paper addresses the question: what determines the price of Port Wine? A hedonic model is estimated to explain the variation in price between different Port wine characteristics. Our results suggest that age is market price determinant. This confirm the idea that maturing or ageing the wine has an effect on market price that, associated with accounting standards and practices and inflation, results in an accounting problem.

KEY WORDS: Wine accounting, hedonic model

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1. INTRODUCTION

The Port wine industry represents one the few Portuguese global products. Very little economic research has been completed on the industry, in particular, no systematic study has been undertaken to identify and determine market value for the individual attributes, which make up the product called "Port Wine".
Port wine is characterized by its large heterogeneity. When consumers want to buy a bottle of Port wine they face several "Port Wines" with different prices – young, old, Vintage, LBV, Tawny, Ruby, special categories, etc. A Port wines company produces bottles with a wide range of price, age and other characteristics. This heterogeneity makes Port wine a suitable product for a hedonic price analysis.

Accounting in the wine industry has developed greatly in recent years. The premium wine was the starting point for that development. As Blake *et al*. (1998) stated the application of a traditional accounting framework to the wine industry has a negative effect on premium wine as compared to low-quality wine. So, in order to promote quality production in the wine industry major amendments to financial accounting and management accounting are needed. Our work intends to be a contribution to the development of wine accounting.

Viana and Rodrigues (2004) showed that the traditional accounting framework is not a suitable framework regarding long-lived quality Port wine inventories and advocated that Port wine industry need, regarding the measurement of the long-lived inventories, a special accounting treatment. In this paper, we analyse the Port wine determinants, in concrete, if the age (or the ageing winemaking process) affects the market price.

In this study the determination of market values for wine attributes is undertaken through the estimation of a hedonic price function.
The hedonic (hedonic from the Greek word for pleasure or satisfaction) price method is a valid approach to study the price-attributes relationship of a product. The wine consumer faces difficult choices due to the fact that a port wine bottle embodies a bundle of characteristics that different consumers may identify and value differently.

The hedonic method amounts to a regression analysis of the price on the characteristics of the product. Basically, any variable which influences consumers' utilities or producers' cost is a candidate for inclusion in the regression analysis. The implicit price of a characteristic is defined as the derivative of the price with respect to the product attributes. Despite other influences from several authors, today is acceptable to all that the responsible from Hedonic Price Theory is Sherwin Rosen in his 1974 paper *Hedonic Prices and Implicit Markets: Product Differentiation in Pure Competition*.

Rosen (1974) has shown under which market conditions the implicit price can be interpreted as the value consumers place on additional unit of the characteristic. If the estimated implicit price turns out to be not significantly different from zero, then consumers do not value the characteristic, or the characteristic is not considered important or relevant in connection with the product.

The paper is structured as follow. We first review previous studies that adopt a hedonic approach regarding wine industry. Hedonic price theory and the appropriateness of the approach for Port wine are then described. Next the data set employed and the estimated function are outlined. This is followed by a discussion of the results and the implications of the analysis.

2. LITERATURE REVIEW

Wine accounting literature

We do not intend to do an intensive literature review regarding wine accounting, for this see Viana and Rodrigues (2004). In this paper, we will briefly present the major accounting problems stated in the literature: time related problems and tax related problems.

Time related problems
This accounting problems arrive from the long maturation time and stocking process related to the *premium* or high quality wines. The time needed by the *premium* wine winemaking process is in conflict with the traditional

accounting framework, in concrete, with the historical cost measurement rule. The time lag between cost and income recognition produces an important accounting problem. The way that this long-lived wine is recognized is also an important accounting wine issue. Rodriguez and Ocejo (2002), Juchau (1996), (AECA, 1999), Amat et al. (1998), Amat and Blake (1995) papers stated these wine accounting problems.

Tax related problems
The major impact comes out from the fact that the producer of long cellar wine be tax penalized - due to the inflation accounting treatment and the historical cost - resulting in a non-equity taxation comparing low quality to high quality wine companies. But there are other accounting issues regarding tax: the residual value, after depreciation, of a wine plantation is negative; non-realistic and non-economic depreciation rate of some tangible fixed assets like wood barrels. Rodriguez and Ocejo (2002), Amat et al. (1998), Juchau (1996) identify these problems.

Wine Hedonic literature

The hedonic price method has been applied mainly to durable goods. The housing market, the computer industry, the automobile industry are good examples of this durable heterogeneity goods.

There are two differences regarding Port wine: one, Port wine is a food product and two, not all relevant characteristics are easy identified by consumers. Nevertheless, wine hedonic price function had been estimated in last decade.

There is a fine literature review, although not very recent, in Unwin (1999) paper. This paper provides a critique to the use of hedonic price techniques for understanding market prices of wines. According with Unwin, the application of hedonic price indexes to the wine market is inappropriate because of the data (neither sufficiently robust nor consistent), the explanatory variables (closely interdependent), the lack of pure competition (necessary for Rosen) and insufficient knowledge about consumers' definition of quality.
This critique does affect our research because the empirical model used here is used in our context aim and goals. We are not trying to study consumer behaviour[349]. We do claim to try to expose the intrinsic characteristics of a bottle of wine that indeed point to its price, and we attempt to quantify that impact.

Still, part of the debate about hedonic pricing is the relation between subjective judgments of wine itself and objective characteristics. Our literature review is structured by the nature of the explanatory variables in the hedonic function: objective, subjective and both.

Objective explanatory variables
Blair and Burley (1998) investigated the proposition that a fair degree of the price variation several table red Australian wines can be explained by the objective such grape variety, the region of the grapes and the wine's vintage. All three were statistically relevant.

Wood and Anderson (2002) estimated a hedonic model to explain the variation in the auction price between different vintages of particular wine, using has explanatory variables the weather, vineyard management techniques, winemaking techniques and the age oh the wine. They found a statistically significant relationship between age, weather and technological change and the secondary market price of some Australian icon wines.

[349] The paper is a part of one's author Ph.D. research in Financial Accounting. The main goal of the Ph.D. research is to develop a Port Wine Index, with quality adjustment, in order to revaluate the long-term Inventories.

Ribeiro and Santos (2003) showed that some regions of origin have a significant impact on price. Other wine attributes such as colour (red), age (more years) and special attributes (reserve) all have positive effects on price.

Subjective explanatory variables
Landon and Smith (1997) examined the impact of quality and reputation on consumer decisions regarding Bordeaux wine. Their model of consumer decision making incorporated information on reputation and collective reputation and rejected current quality. Landon and Smith (1998) estimated the impact on price of current product quality and reputation using data from the market for Bordeaux wine. The empirical findings show that the price premium associated with a better reputation far exceeds that associated with improvements in current quality.

Objective and subjective explanatory variables
Although not directly using a hedonic method, Ashenfelter et al (1995) attempted to explain empirically the variation in price between different vintages. They studied the relationship between the price of some Bordeaux wine and their age or the weather during the grape growing season. They found that the weather is a fundamental and easily measured determinant of the quality of the mature wines.

Oczkowski (1994) estimated a hedonic price function for Australian wine that included both objective characteristics like grape variety, region, vintage of harvest and size of producer and also subjective attributes like overall quality and cellaring potential. He found that quality, cellaring potential, grape variety, grape region, grape vintage and producer size is statistically important in explaining price deviations from average price.

Combris et al. (1997) estimated a hedonic price function for Bordeaux wine that included both objective characteristics appearing in the bottle label and also sensory characteristics resulted from olfactory and gustatory examinations. Their estimation shows that the Bordeaux market price is essentially determined by the objective characteristics. Combris et al. (2000) made the same study for Burgundy wine and compared the results: they obtained the same results that confirm that objective characteristics are the most significant factors and have a strong effect on price.

Wade (1999) estimated two hedonic price equations regarding Australian table wine. In the first equation the consumers knew a substantial amount of information including current quality, grape variety, and region and cellaring potential of the wine. In the second equation, only reputation determines the price that consumer is willing to pay for the wine. The results found that reputation has a large impact on the price of the wine. Angulo et al. (2000) estimated a hedonic price function for Spanish red quality wine. In their model, the independents variables were region of production, the year of the vintage, grape variety, alcoholic content and expert quality ratings. The results indicated that the region of production and the year of vintage were the main market price determinants and that grape variety and alcoholic content were not significant correlated with red wine prices. Schamel (2000) estimated a hedonic pricing model using U.S data for premium wines from several countries including U.S, Australia. Schamel focus on the value of wine quality to consumers and how quality indicators influence their willingness to pay for premium wines. Wine attributes included variety, sensory quality ratings, and individual and collective reputation indicators. Regional origin was used as a collective reputation indicator. Individual reputation indicator included "cellar selection" (potential to improve with age), "recommended" (wine especially noteworthy) and "best buy" (outstanding values). Highly significant estimators for sensory wine quality, individual and collective reputation indicators explained price differences of premium wines.

Fogarty (2002) studied the Australian wine retail market and considered two perspectives: the consumers' and the producer's. From the producer's perspective the age of wine at time of release, region and variety were candidates for inclusion within the set of attributes likely to influence price. From the viewpoint of the consumer the age of wine at time of release, region, variety, investment quality and quality guides were likely to be factors important in valuing wine. The empirical results founded suggest that objective characteristics and long-term quality ratings explain price and annual quality ratings do not influence price. Noev (2002) estimated a hedonic price function for the Bulgarian wine market. He developed a hedonic price model for estimation of wine quality, regional and varietal reputation effects in Bulgarian wine market. He showed that wine quality has significant and positive impact on wine prices.

Ali and Nauges (2003) studied the relative impact of reputation and quality on the price of Bordeaux wine. The paper made a comparison between en *primeur* and bottled wine. In their paper, reputation is defined through its appellation and its rank. Their work was pioneer on en *primeur* price and confirmed several other previous studies that reputation is a major determinant of the price of bottled wine and that present quality as measured by experts' ratings has a much smaller impact. They showed that the rank of the Bordeaux wine (dates back to 1855) was still highly value by consumers. Bombrun and Summer (2003) focused on how grape characteristics affect wine prices. The explanatory variable were tasting score, age at release, label designation, grape variety, grape vintage and grape appellations. Region of origin, grape characteristics and vintage are the key attributes directly related to grapes that have a significant impact on wine prices.

3. RESEARCH METHOD AND DATA

Our Model

Rosen (1974) sates that a particular class of commodities can be described by a vector of n objectively measured characteristics as

(1) $z = (z_1, z_2, ..., z_n)$

where z_i is the amount of the *i*th characteristic contained in each good.

In our paper, the class of commodities refers to the set of special categories under consideration for a particular Port wine. The n characteristics, which differ between the special categories, include the age of the wine at the time of sale, Port Wine types, brand type, cellaring potential and company reputation. The market price of a particular wine reflects the "price" of each of the characteristics embodied in those special categories. That is,

(2) $p(z) = p(z_1, z_2, ..., z_n)$

where p is an increasing function of all the characteristics.

The aim in this paper is to estimate a Port wine hedonic price function in order to relate the price of a Port wine bottle to its quality, objectively measured by age, Port type, brand type, cellaring potential and companies' reputation.

Explanatory variables

Age of wine at time of sale

Age is related to price because of the scarcity. As a wine ages, more of the given port wine is consumed so that scarcity, and hence price, increases. Age is also related to price because of the wine's ability to develop and improve with age. Port wine, within special categories, is characterized by a high content of tannins in their youth, making them not so pleasant for early drinking. The quality gradually improves with the decrease of the tannins. At the same time, the longer a firm stores wine in barrels, or cellars it, the greater the cost. So the age of the wine at the time of release is likely to make a positive contribution toward the cost of production and therefore a positive contribution toward the price of sale.

In the port wine industry, due to product specification, the companies release several wines each year, all of different age. For example, a company may release several Vintage port, from the same brand, from several vintages. So, in the 2002, the buyer expects a bottle of an older Vintage port to be higher than another Vintage port (with the same vintage rating).

The Port Wine industry is much regulated so each type of Port is carefully regulated in terms of winemaking process. For each wine there is a minimum age of maturing before bottling and to be available to sale. In our study, we calculate the age by three processes: first, when a wine has in the label the wine vintage (like the Vintage, Late Bottled Vintage or Colheita – or Dated port) the age was calculated by the difference between the year of the sale and the year of the vintage; second, when the wine is an Indicating of Age Port (10, 20, 30 and 40 years old) we adopted that indication and third, the age of the other types is calculated through the minimum maturing age and winemaking process practices.

Port wine types

There are, according to the way they are aged, two major Port Wine categories: Ruby style, Tawny style. There is also the White port. The Ruby style is the type of wine that can be found in special categories like, in ascending order of quality: Ruby, Reserve, Late Bottled Vintage (LBV) and Vintage. The finest category wines, especially Vintage, followed by LBV, are good for storing as they age well in bottle. The Vintage Port is a wine of exceptional quality made in a single year. It must be bottled between the second and third year after the harvest; it is deep purple in colour and full-bodied. Due to its quality, he is approved as a Vintage (when the wine is two years old). As it ages in bottle it becomes smooth and elegant, and it gradually loses its initial astringency and acquires a balanced, complex and highly distinctive bouquet.

The Late Bottled Vintage (L.B.V.) is a wine of a superior quality from a single year that is bottled between the fourth and sixth year after it was made. Although equally well balanced, this Port type, is usually less astringent and less full bodied that a Vintage from the same year. Reserve Port Wines are very good quality wines obtained by blending wines with different ages. In this category, the most notable are the Tawny Reserve Ports. They are medium tawny in colour resulting from their compulsory minimum 7 years' aging in wood. In turn, Ruby Reserve Ports, a blend of younger wines that gives them their ruby colour and intense and fruity bouquet, are full-bodied and tannic in the mouth, but less so than Vintage and LBV. The tawny style wine is obtained from lots of different wines that have aged for different lengths of time in casks. The present categories in this style are: Tawny, Tawny Reserve, Tawny with an Indication of Age (10, 20, 30, 40 years old or more than 40 years) and Colheita (Dated port). These wines are ready to drink when they are bottled. Colheita or Dated Port are

superior quality wines from a single year that are aged in wood during varying periods of time, but never less than 7 years, before bottling.

Port with an Indication of Age: 10 years old; 20 years old; 30 years old; 40 years old are superior quality Ports are obtained by blending wines from different years in order to obtain complementary organoleptic characteristics. Aged in wood for varying periods of time, the age that is indicated on the label corresponds to the approximate average age of the different wines in the blend. From that age, one obtains an indication of the characteristics the wine acquired as it aged in wood.

White Port varies in style according to whether it has aged for a shorter or longer period of time, and different degrees of sweetness according to the manner by which it is made.

Type of Brand

All Port wine is sold under a brand. This brand can be a Shippers Own Brand – a brand own by a Port wine company – or a Buyers Own Brand. We think that the ownership of the brand is an important explanatory variable.
Although a bottle were sold under a buyers own brand, like a supermarket brand, the name of the Port firm is always disclosure in the bottle label.

Company Reputation

On Landon and Smith (1997) paper regarding Bordeaux wine, the author assumed a reputation model based on the fact that information on current quality is not available or is too costly to obtain and, as a result, the price of a firm's product depends on its reputation for quality, not its current quality. Their results indicated that the effect on price of short-term changes in quality is relatively small. According with the authors "this implies that consumers primarily base their purchase decisions on persistent, rather than short run, movements on quality" (Landon and Smith, pp. 313).

Every Vintage Port must be authorized and disclosure by the Port and Douro Wines Institute. The Port Wine Institute has, by companies and years, all Vintage declaration and we use this information to build a proxy to disclosure reputation. We grade each wine as "excellent", "very good", "good" and "regular" reputation based on firm's declaration and industry regulator authorization of "Vintage". The Douro and Port wine Institute disclosure all "Vintage" declaration by firm since 1900. Based on that data we built our proxy for Reputation.

In order to build that proxy, we start to count the number of Vintage declaration for each firm since 1900 to 2000. Then we found the fifty, seventy-five and ninety and ninety-five percentile for that collection of data – number of vintage declarations for each firm from 1900 to 2000. After that we grade as "excellent" firms whose number of declaration are higher than 95 percentile; grade as "very good" firms that are between 90 to 95 percentile; grade as "good" firms that are between 90 to 75 percentile and as "regular" the others – see Appendix II.

Table 1 - Number of Vintage declaration from 1900-2000

Average	50 Percentile	75 Percentile	90 Percentile	95 Percentile
14.73	11	23	38.6	41.9

Table 2 – Firm reputation classification

	Number of Firms
Excellent	4
Very Good	4
Good	12
Regular	54

We could establish, based on previous literature and theoretical background, the "expert opinion" as an explanatory variable but the lack of data - there is no Port Wine edition regarding international magazine or experts - stopped us.

Cellaring potential

As we stated before, there are several "Port Wines" - the Port types. The industry regulator (IVDP) states on his web site that "The finest category wines, especially Vintage, followed by LBV, are good for storing as they age well in bottle"[350]. After consulting several Port wine expert from the companies and from the industry regulator, we built this variable by "merging" their opinions regarding the cellaring potential of the port wines. We took this proceeding in order to reduce the subjectivity of the variable.
So, we classified the wines as:

- "high cellaring potential", if we are dealing with young Vintages (less than 15 years old);
- "medium cellaring potential", if we are dealing with young L.B.V. (less than 5 years old), young Dated Port (less than 10 years old) or Crusted type
- "low cellaring potential" if we are dealing with Vintage Character, Ruby Reserve, Tawny Reserve, Indication of Age, old Dated Port (more than 10 years old) and 5 to 10 years old L.B.V.;
- "null cellaring potential" regarding the Ruby, Tawny, White, old L.B.V. (more than 10 years old).

Vintage of harvest

This explanatory variable can only be used when studying the specific types of port: Late Bottled Vintage, Vintage or Colheita Port types. The reason is simple: the other Port types are blend wines so they are not directly connected with a vintage. As any other fruit, the quality of the grapes depends largely of the weather conditions during the growing season that produced the fruit. Smart (2001) argues that all climate parameters can be important in influencing grape quality. So, as we early stated, the potential quality of a wine is a result of the quality of the inputs (mainly grapes) and of the winemaking techniques, and the vintage[351] (of harvest) of the wine captures the influence of the weather conditions and its influence on the quality of the grapes. In this explanatory variable, the study tries to capture the vintage effect, associated with weather and grape conditions, and not with time.

The data

All the data was given to us by the IVDP but, as classified data, the access was given due to a clear authorization from each firm. Every Port wine firm and every time that makes a wine transaction (even a single bottle) must fill a document (RCDO) which has several information: name of the firm, destination country, brand code,

[350] http://www.ivp.pt/uk/TiposVinho/ - 04/06/2004
[351] The vintage is different from the Port's special category named "Vintage".

quantity and value of the transaction/sell. Brand code has itself several others information like the type of Port and its vintage. This document is stored in IVDP. The transactions regard sales to wholesalers, retailers or to final consumers. The data collected refers to sales made to the major Port wine world markets[352] and to the biggest Port Wine Companies during 2002. Out of the original sample of 14 209 sales, 14 122 were selected. The observations were eliminated due to the lack of one or more information like price. This situation occurs due to misfiled of the RCDO.

Price Data

The Price data was found by dividing the total amount of *i* wine by the total amount of litre of that *i* wine. The price collected is the price of the transaction, the market price; so it is not the offer price or the demand price.

Estimation methodology

In this study, the functional form used is the log-linear and we specify the following hedonic price function:

$$\text{Ln } P_i = F(Age_i, Brand_i, PorSty_i, FirRep_i, CelPote_i)$$

Our aim is to test whether the effect of Age on Port wine market price after controlling for some of the main effect that determinant price. The control variable included in the model, like type of Port (PortSty), type of brand (Brand), firm reputation (FirmRep) and cellaring potential (CelPot). The Country variable is also a control one and was introduced in order to capture the market effect: if the port wine determinants remain the same even when we considered each country individually.

$$\text{Ln } P_i = F(Age_i, Brand_i, PorSty_i, FirRep_i, CelPote_i, Country_i)$$

Where P_i = the sale price of the wine $_i$ per litre, Age*i* = the age at the time of sale of the wine $_i$, Brand*i* = the type of brand of the wine $_i$, PorSty*i* = the Style of the wine $_i$, FirRep*i* = the reputation of the firm that sales the wine $_i$, $CelPote_i$ = the cellaring potential of the $wine_i$, $Country_i$ = the country to where the $wine_i$ is shipped.

More specifically, the explanatory variables are present in Appendix 1.

4. ESTIMATION RESULTS

Both Linear and Log-linear (only in the dependent variable) form indicated significant degrees of heteroscedasticity and was difficult to identify the specific form of heterocedasticity. So, we used White's (1980) heterocedasticity consistent covariance matrix for further analysis. By doing this, the parameter estimates and summary statistics are still appropriately based on least squares estimates. We adopt the most used function form in wine hedonic studies: the Log-linear model. One hedonic price function was estimated- Table 6. The introduction of country dummies is justified as a control variable. Some information regarding the transactions:

[352] Portugal, France, Holland, Germany, United Kingdom, Denmark, Belgium, United Sates of America and Canada

Table 5 – Descriptive Statistics regarding 2002 Port wine transactions

Average price/litre	16.28 euros
Average of Age	7 Years
Highest price/litre	630 euros
Oldest wine	85 Years
Lowest price/litre	0.71 euros
Youngest Wine	2 Years
Number of Buyer's Own Brand transactions	2338
Number of Shipper's Brand transactions	11784
Number of Vintage transactions	2312
Number of LVB transactions	1437
Number of Tawny transactions	2776
Vintage average price/litre	50 euros
LBV average price/litre	8 euros
Tawny average price/litre	4.30 euros
Vintage average age	11.8 years
LBV average age	6.5 years
High cellaring transactions	1540
Medium cellaring transactions	1151
Low cellaring transactions	4881
Excellent reputation transactions	3403
Very Good reputation transactions	3368
Good reputation transactions	5638
Regular reputation transactions	1713

Table 6 – Hedonic Price Log-linear Model Estimates (control variables considered)

Dependent variable:	LN Price		N – 14122
VARIABLE	Coefficient (t Statistic) (a)	Std. Error	Percentage Impact (b)
Constant	1.311995 * (59.82059)	0.021932	2.712682
Age	0.030996 * (9.910241)	0.003128	0.031476
Type of Port dummies	**Yes**		
Type of Brand dummies	**Yes**		
Firm reputation	**Yes**		
Cellaring Potential	**Yes**		
Country dummies	**Yes**		
R-squared	0.681122	Mean dependent var.	2.058043
Adjusted R-squared	0.680466	S.D. dependent var.	0.972006

(a) White Heteroskedasticity-Consistent Standard Errors & Covariance

(b) $\text{Exp}\left(\hat{\beta}_i - 0.5\,\hat{\text{var}}(\hat{\beta}) \right) - 1$, Kennedy (1981) and Derrick (1984)

* the coefficient associated with the explanatory variable is significant at 99%
** the coefficient associated with the explanatory variable is significant at 90%

The estimated hedonic price function is presented in Table 6. Given the almost exclusive use of dichotomous variables, partial derivatives are not defined and thus the estimates do not represent conventional implicit attributes prices. Instead, the estimates measure the relative impact, from the average price, of the presence of the attribute represented by the variable.

The model explains 66% of the price variability among all 14 122 wines; hence the hedonic price equation fit is relatively good. The empirical results indicate that the Age of the wine has a significant and positive impact on market price of Port wine. We controlled the other explanatory variables (type of port and type of brand, firm reputation, cellaring potential and country). According with our data and regression all selected variable are statistically relevant and have the right sign. As we expected, none of the regression coefficients is negative: the price rises if the wine is older, if the wine belongs to an upper category, if the wine is a shipper's own brand, if the firm has increasing reputation, if the wine has increasing cellaring potential. All variables have a positive effect on market price. The percentage impact to average price regarding Age is 3%. An extra year of cellar increases by 3% the market price of a Port wine bottle, (holding every thing else constant). This fact has a strong influence on the winemaking process, mainly in *premium* or top quality wine industry. The premium wine industry is penalized in two ways: the underestimation of the value of the long-lived inventories and the report of earnings above it real value. The global estimation model is presented in Appendix 2.

5. CONCLUSION

Accounting in the wine industry has developed greatly in recent years. The premium wine was the starting point for that development. Our work intends to be a contribution to the development of wine accounting. Viana and Rodrigues (2004) showed that the traditional accounting framework is not a suitable framework regarding long-lived quality Port wine inventories and advocated that Port wine industry need, regarding the measurement of the long-lived inventories, a special accounting treatment. In this paper, we analyse the Port wine determinants, in concrete, if the age (or the ageing winemaking process) affects the market price.

In this study the determination of market values for wine attributes is undertaken through the estimation of a hedonic price function. The paper confirm that age has a positive effect on Port wine market price so, due to accounting standards and practices, in concrete historical cost, Port wine inventories become a source of non-recognized and non-disclosure assets. A hedonic function has been estimated for Port wine. Five broad attribute grouping were found to statistically important in explaining price deviations from average prices, i.e., age, type of port, type of brand, firm reputation and cellaring potential. The empirical results indicate that the market price of Port wine can be explained by the objective characteristics appearing on the label of the bottle: age, type of port and type of brand and subjective ones like cellaring potential and firm reputation. The estimated parameters for the hedonic price function for Port wine show us that objectives characteristics are the most significant

factors and have a strong effect on price. The study has several advantages regarding other wine hedonic studies. The number of observations (more than 14 000), the number of markets involved (nine), the number of brands and firms gives a good dimension to the research. The data were not collected from a private database or collected by the authors; the data were collected by the industry regulator which gives credibility to the research. Nevertheless, as far as we know, this is the first time such a thorough empirical study on Port wine prices has been reported.

The results of this empirical study have a strong influence on the winemaking process, mainly in *premium* or top quality wine industry. Due to the positive effect of age in the market price, the *premium* wine industry is penalized in two ways: the underestimation of the value of the long-lived inventories and the report of earnings above it real value.

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Appendix 1 – Variable descriptions

Variable	Description
Age*i*	the age at the time of sale of the wine $_i$,
$Ruby_i$	A dummy variable =1 for Ruby port
$Tawny_i$	A dummy variable =1 for Tawny port
$White_i$	A dummy variable =1 for White port
$RubyReserve_i$	A dummy variable =1 for Ruby Reserve port
$TawnyReserve_i$	A dummy variable =1 for Tawny Reserve port
$Colheita_i$	A dummy variable =1 for Colheita (Dated Port) port
$Crusted_i$	A dummy variable =1 for Crusted port
Ten_i	A dummy variable =1 for Ten Years Old port
$Twenty_i$	A dummy variable =1 for Twenty Years Old port=
$Thirty_i$	A dummy variable =1 for Thirty Years Old port
$Forty_i$	A dummy variable =1 for Forty Years Old port
$MorForty_i$	A dummy variable =1 for More than Forty Years Old port
$LateBottledVintage_i$	A dummy variable =1 for Late Bottled Vintage port
$Vintage_i$	A dummy variable =1 for Vintage port
$SBrand_i$	A dummy variable =1 for Shipper's Own Brand port
$BBrand_i$	A dummy variable =1 for Buyers' Own Brand port
$ExRep_i$	A dummy variable =1 for Excellent Reputation port
$VerRep_i$	A dummy variable =1 for Very Good Reputation port
$GoRep_i$	A dummy variable =1 for Good Reputation port
$RegPep_i$	A dummy variable =1 for Regular Good Reputation port
$HighPote_i$	A dummy variable =1 for High Cellaring Potential
$MediumPote_i$	A dummy variable =1 for Medium Cellaring Potential
$LowPote_i$	A dummy variable =1 for Low Cellaring Potential
$NullPote_i$	A dummy variable =1 for Null Cellaring Potential
$Portugal_i$	A dummy variable =1 for Portugal
$France_i$	A dummy variable =1 for France
$Holland_i$	A dummy variable =1 for Holland
$Germany_i$	A dummy variable =1 for Germany
$UnitedKingdom_i$	A dummy variable =1 for United Kingdom
$Denmark_i$	A dummy variable =1 for Denmark
$Belgium_i$	A dummy variable =1 for Belgium
USA_i	A dummy variable =1 for USA
$Canada_i$	A dummy variable =1 for Canada

Appendix 2 – Estimation Model (with control variables)

Dependent variable:	LN Price		N – 14122
VARIABLE	Coefficient (t Statistic) (a)	Std. Error	Percentage Impact (b)
Constant	1.311995 * (59.82059)	0.021932	2.712682
Age	0.030996 * (9.910241)	0.003128	0.031476
Ruby	0.034438 * (3.140255)	0.010967	0.034976
White	0.060651 * (4.978158)	0.012183	0.062449
Reserve Ruby	0.202772 * (3.126040)	0.064865	0.222219
Reserve Tawny	0.226696 * (2.851364)	0.079504	0.25049
Dated Port	0.810442 * (6.972241)	0.116238	1.23376
Crusted	0.155335 ** (1.705380)	0.091085	0.163214
Ten	0.482999 * (6.483455)	0.074497	0.616437
Twenty	0.786934 * (8.046116)	0.097803	1.18617
Thirty	1.099433 * (8.576384)	0.128193	1.977894
Forty	1.299577 * (8.439120)	0.153994	2.624513
More Than Forty	1.150379 * (6.909568)	0.166491	2.115904
L.B.V.	0.210677 * (3.105394)	0.067842	0.231676
Vintage	1.047060 * (10.04274)	0.104260	1.833818
Shipper's Own Brand	0.206748 * (27.04734)	0.007644	0.229637
Excellent Rep.	0.151095 * (8.321694)	0.018157	0.162915
Very Good Rep.	0.023047 (1.354784)	0.017012	0.023167
Good Rep.	0.072711 * (4.563480)	0.015933	0.075283
High Cellaring Pot.	0.336480 * (3.494007)	0.096302	0.393534
Medium Cellaring Pot.	0.263749 * (3.813932)	0.069154	0.298692
Low Cellaring Pot.	0.182491 * (2.935082)	0.062176	0.197886
Country dummies	**Yes**		
R-squared	0.681122	Mean dependent var.	2.058043
Adjusted R-squared	0.680466	S.D. dependent var.	0.972006

(a) White Heteroskedasticity-Consistent Standard Errors & Covariance

(b) $\mathrm{Exp}\left(\hat{\beta}_i - 0.5\,\mathrm{var}(\hat{\beta}) \right) - 1$, Kennedy (1981) and Derrick (1984)

* the coefficient associated with the explanatory variable is significant at 99%

** the coefficient associated with the explanatory variable is significant at 90%