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Effect of Sensory and Reputation Quality Attributes on Specialty Coffee Prices

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Introduction

The specialty coffee industry experienced one of the fastest growth rates in the global food markets in the 1990s through the proliferation of cafe and gourmet coffee retailers. Net sales were estimated to be \$9.6 billion for the U.S. in 2004 (SCAA 2006). Specialty coffees are made with the highest quality coffee beans and tend to present distinctive sensory attributes shaped by the unique characteristics of production, i.e. the coffee grower level. The trade and promotion of specialty coffee beans from different origins have been particularly successful through e-auctions such as the Cup of Excellence (CofE). These auctions are organized around an exhaustive quality evaluation by expert cuppers to select only the best coffees from each origin. The auction prices of coffee beans are related to the score given in the sensory evaluation, however, this relationship is not perfect and other factors tend to influence the prices. For example, two coffees that obtain the same score but were produced in different countries usually obtain different prices. This paper examines specialty coffee pricing at the top quality e-auctions and distinguishing the effect of the sensory evaluation from other factors that influence the price.

The CofE auctions involve two parts: the cupping competition and the Internet coffee auction. The cupping competition consists of the tasting of the coffees and evaluation of the coffee's attributes, such as fragrance, aroma, body, acidity and flavor profile, through the private cupping form of the CofE. The result of the cupping evaluation is a score with a maximum of 100 points. The jury that evaluates the coffee is formed by the most renowned coffee experts and managers of coffee firms who usually have an interest in procuring the participating specialty coffees. The cupping rules are very rigorous and guarantee transparency, impartiality, and credibility of the evaluation process (United Nations 2003). In addition, samples are shipped to

potential buyers so that they can conduct their own cupping, hence further increasing information and transparency.

The coffees with the highest scores are then auctioned online with ascending bidding. The coffees ranked at the top of the competition have obtained remarkably high prices which continue to increase auction after auction. For example, the 2005 first place winning coffee from Brazil attained a record price of \$49.75 per pound. This is more than 40 times the International Coffee Organization (ICO) composite price index (\$1.15 per pound) for the Brazilian Natural Arabicas which is a common benchmark price. Although the specialty market is separate from the commodity market (“C” market), the quality premiums seem to be related to the price levels of the “C” price as shown from the recovery of world coffee prices since 2005 (Ganes-Chase 2006).

As can be observed at a first look at the auction results, there is a relation between specialty coffee prices and the jury score. However, this relationship is not perfect and for the same cupping score, prices paid at the coffee auction vary, particularly, across countries. This suggests that the price of specialty coffee is influenced by other factors not captured by the score. Coffee is a complex product with attributes that emerge from a combination of characteristics displaying a rich variability of individual types that cannot be totally decomposed. These ‘natural variations’ of coffee that complexly produce the final quality relate to different coffee varieties, soil, altitude and rainfall conditions, and cultivation and processing methods used by producers in different producing regions (Roseberry, Dec. 1996). All of these factors may constitute reputation attributes that signal the sensory quality and/or enhance it in the case of attributes that may not be captured by the sensory evaluation of the product. For example, coffee producing regions that have a reputation for producing high quality specialty coffee in Central and South

America include Costa Rica, Guatemala, and Colombia with respect to Nicaragua, Mexico and Peru (Kilian et al. 2006).

Pricing of specialty coffees can be compared to pricing of wines and other differentiated food products. In general, the price of differentiated food products depends on quality attributes as well as on reputation attributes (de Figueiredo 2000). Reputations allow the relationship of the sensory and credence attributes that influence the preferences of consumers to specific conditions and methods of production. Reputations are usually not perfectly correlated with the sensory product attributes as evaluated and measured by expert tasters (Landon and Smith 1997; Boccaletti 1999)¹. A debate exists on how much weight should be placed on the importance of quality vs. reputation, thus resulting in a ‘puzzle’ for pricing specialty food products (Lecocq and Visser 2003). This paper seeks to shed some light on the pricing puzzle for specialty coffee sold through online auctions.

The purpose of this paper is to analyze the price determinants of specialty coffee; both sensory and reputation, using the hedonic price approach with observations from the Cup of Excellence auctions. The objective is to determine which variables significantly affect specialty coffee prices. We discuss the economic impact of the individual sensory and reputation attributes.

Literature Review

For this study, we surveyed previous works on hedonic pricing of heterogeneous and differentiated food products. Hedonic pricing is a statistical technique suitable for dealing with issues of product quality that developed from seminal works such as Lancaster (1966) and Rosen (Jan.-Feb. 1974). Lancaster (1966) proposed that consumers have preferences over the characteristics of a product and therefore products can be viewed as a bundle of characteristics

desired by consumers. Rosen defines hedonic prices as the ‘specific sets’ of the observed product prices and the specific amounts of characteristics associated with the product. The prices of the attributes are latent variables as we only observe the price of the coffee and not the price of its attributes. We propose that specialty coffee is a heterogeneous product that can be viewed as a bundle of characteristics including sensory attributes, such as flavor, aroma and body, and reputation attributes, such as the origin, variety and production methods².

Hedonic price analysis has been applied to the study of the marginal effect of sensory and reputation quality on prices of wines of various types and origins. Our study is the first to apply the hedonic technique to specialty coffee. Combris et al. (1997) found that consumers’ prices of Bordeaux wine are determined by label characteristics shown on the bottle label, including color, vintage and appellation of origin, while an estimation of the jury grade equation shows that quality is determined by the wine sensory characteristics (e.g. aroma and flavor). For the same type of wines, (Landon and Smith 1997; Landon and Smith 1998) found that the reputation attributes have a greater effect than the sensory factors in determining wine prices.

Schamel March (2000) used a hedonic wine price model to compare two situations: an ‘information’ situation in which buyers fully rely on sensory quality ratings, and a ‘reputation’ situation in which collective indicators for wine growing areas and individual indicators for specific wine attributes provide additional information about quality to the consumers. The author found highly significant estimators for sensory wine quality as well as for reputation attributes, both individual and collective. Individual reputations are based on the past performance of an individual producer (Landon and Smith 1998). Collective reputation is the average quality of a group of producers with which an individual producer can be identified (Landon and Smith 1998). Collective reputation can be approximated by the origin of a product

which usually affects the overall evaluation of the product, the perception of single attributes and several subjective factors (Boccaletti 1999). In our paper, we deal with the effect of collective reputations, such as the ranking of a coffee relative to its group, the producing country, variety and processing method, on specialty coffee prices.

Ashenfelter et al. (1995), in Bordeaux wines, consider the relationship between the vintage and the weather conditions that prevailed during the growing season. Their study found that 83 percent of the variation in vintage wine prices is explained with four variables: the age of the wine, the average temperature during the growing season, the rainfall in August and September and the rain in the winter preceding the vintage. They conclude that “great vintages for Bordeaux wines are the years in which August and September are dry, the growing season is warm, and the previous winter has been wet” (Ashenfelter et al. 1995). We also analyze the effect of the coffee variety, processing method and altitude on specialty coffee prices.

Lecocq and Visser (2003) also analyze the partial effects of objective characteristics that appear on the label, as well as sensory characteristics and a grade assigned by expert tasters. Authors have three almost identically structured data sets (two on Bordeaux wines, and one on Burgundy wines). The results are used to make comparisons between two of the most important wine regions in France, and comparisons over time (the two Bordeaux data sets are sampled at different points in time). This paper addresses the remarkable price variation at the very top end of wines fueled by reputation as much as by sensory quality. We are also interested in explaining the remarkably high prices obtain by certain specialty coffees.

Data

The Cup of Excellence e-auction (<http://www.cupofexcellence.org>) provides a good data source for analyzing the question of hedonic price determinants in specialty coffee. For a detail

of the data see Appendix A (Table A1). To date, the CofE program has auctioned more than 14,000 bags of coffee. For this study we use the 2003-2006 auction data which is comprised of 461 observations. Descriptive statistics for the data set are shown in Table A2 (Appendix A).

We include the prices in the “C” market as a benchmark from the monthly averages of the International Coffee Organization (ICO) for the corresponding groups: Brazilian Natural Arabicas for Brazil, Colombian Mild Arabicas for Colombia, and Other Mild Arabicas for Bolivia, El Salvador, Honduras and Nicaragua³ (see Table A3 in Appendix A). This approach was used for the months in which the auctions took place.

Our data set presents a couple of shortcomings that require special assumptions to be made. First, the hedonic wine studies use data at the retail level. This makes sense since it is consumers who present the demand for the bundle of hedonic characteristics. We assume that the derived demand at the coffee buyers’ level is proportional to the primary demand at the consumers’ level. This approach represents the case of the ‘origin’ coffees, varietals, estates and region coffees which represent 5 to 10% of the specialty trade (Hillside 2001 - 2002). The relation between primary and derived demand for specialty coffee attributes may be more difficult to establish. Second, cupping is a subjective matter and different juries in different places may not give comparable scores. Ideally, one would only work with relatively large data sets cupped by the same cupper (Oberthur 2006). Claiming that the CofE cupping evaluations intend to be consistent, we are assuming that 85 or any other score means the same intrinsic quality. Third, due to the earlier stage of the specialty coffee life cycle –e.g. relative to the wine industry–, the cupping juries have a key role in defining the industry’s quality standards. However, because many specialty firms have been operating longer than the implementation of cupping competitions and auctions, quality preferences due to marketing strategies that are not

captured by the intrinsic evaluation are likely to show in the bidding behavior of specialty buyers. As a consequence, a problem arises regarding to what extent there could be unobserved variables affecting the prices and this is what we are addressing through the reputation variables in our hedonic analysis. Fourth, a missing variable problem may arise from the fact that potential bidders obtain samples of the available coffees and do their own cupping. This cupping may not necessarily rank the coffees in the same way the CofE cuppers do. It is likely that their bidding and pricing behavior is therefore reflecting this unobservable variable (Oberthur 2006).

Model and Results

Utilizing ordinary least squares (OLS), we estimate the hedonic price equation for specialty coffee: $\ln p_i = \beta_0 + \beta_{v_i} \mathbf{X}_i + \varepsilon_i$, where the dependent variable is the logarithm of the price and the explanatory variables are: 1) one sensory variable: the jury score; 2) eight reputation variables: the ranking in the cupping competition, the competition year, the country of origin, the coffee variety, the initial processing method, the production altitude, the coffee growing area and the lot size; and 3) the “C” price used as a price index benchmark.

In Table 1, we report the estimated coefficients of three hedonic equations. The first equation (Column 1 in Table 1) contains a reduced number of variables: score, ranking, year and country. The second equation (Column 2) contains the variables in the first column plus the variety, processing system, altitude, coffee growing area, lot size and the “C” price. The third equation (Column 3), we remove ‘altitude’ from the previous list to compare the value of the coefficients with the increased number of observations that we get from dropping altitude. This is because there are many missing observations on this variable (the Brazil data do not contain this variable).

Table 1: Results of the Specialty Coffee Hedonic Price Equation

Dependent Variable: log (price)	Column 1 Reduced Number of Variables	Column 2 Extended Number of Variables	Column 3 Extended without 'Altitude'
Score	0.073 (0.010)***	0.069 (0.010)***	0.072 (0.009)***
Ranking¹			
1	0.956 (0.129)***	0.919 (0.131)***	0.936 (0.122)***
2	0.331 (0.114)***	0.342 (0.120)***	0.333 (0.103)***
3	0.324 (0.083)***	0.320 (0.098)***	0.314 (0.080)***
4	0.192 (0.093)**	0.210 (0.092)**	0.167 (0.092)*
Year²			
2004	-0.076 (0.062)	-0.424 (0.078)***	-0.260 (0.063)***
2005	-0.583 (0.094)***	-0.669 (0.105)***	-0.646 (0.094)***
2006	-0.516 (0.101)***	-0.552 (0.108)***	-0.557 (0.099)***
Country³			
Bolivia	0.173 (0.047)***	-	-1.017 (0.140)***
Colombia	0.150 (0.050)***	0.800 (0.088)***	-0.213 (0.122)*
El Salvador	-0.204 (0.059)***	0.802 (0.146)***	-0.359 (0.109)***
Honduras	-0.349 (0.065)***	0.172 (0.083)**	-0.851 (0.107)***
Nicaragua	-0.179 (0.041)***	0.738 (0.114)***	-0.421 (0.108)***
Variety⁴			
Catuai		0.011 (0.112)	-0.080 (0.062)
Caturra		0.073 (0.098)	0.033 (0.074)
Typica		-0.085 (0.084)	-0.103 (0.084)
Paca		0.042 (0.119)	0.090 (0.095)
Other		-0.128 (0.141)	-0.025 (0.083)
Process⁵			
Depulped		-	-
Ecological		-1.197 (0.106)***	-1.022 (0.098)***
Pulped		-0.820 (0.089)***	-0.951 (0.125)***
Wet		-0.977 (0.096)***	-0.826 (0.086)***
Altitude (masl)		0.0001 (0.000)**	
Coffee growing area (Ha)		0.000 (0.001)	0.000 (0.000)
Lot size (Bags)		-0.008 (0.001)***	-0.008 (0.001)***
Commodity Price (US \$/lb)	1.076 (0.153)***	1.391 (0.166)***	1.363 (0.150)***
Constant	-5.831 (0.847)***	-5.699 (1.007)***	-4.648 (0.821)***
R-squared		0.63	0.77
Observations		461	341
			435

Robust standard errors in parentheses

* significant at 10%; ** significant at 5%; *** significant at 1%.

¹ Dummy variables indicating coffee ranking 1, 2, 3 or 4, respectively. Base group is rank between 5 and 43.

² Dummy variable indicating auction year. Base group is 2003.

³ Dummy variable indicating country of coffee origin. Base group is Brazil.

⁴ Dummy variable indicating variety of coffee. Base group is Bourbon.

⁵ Dummy variable indicating processing system. Base group is Not Available/Unknown.

The first equation (Column 1) present a relatively good overall fit with R^2 s of 0.63. Most of the variables included in this model are significant at 1%: the score, rankings 1 to 3, all countries, years 2005 and 2006, and “C” price.

The incorporation of the coffee variety, processing method, altitude, coffee growing area, and lot size in the extended variables model (Column 2) increases the explanatory power to 0.77. The score, ranking, years, countries and “C” price continue to be significant. In addition, the altitude, processing method and lot size are significant at 5%. Note that although the altitude is statistically significant at 5% its economic impact is practically zero. Since altitude is not economically significant and we are losing the Brazil observations with it we will refer our analysis to the first and third column from now on.

Dropping altitude we obtain a goodness of fit for the hedonic equation in Column 3 of 0.74. Comparing Column 3 to Column 1, we see that the estimates keep their significance and sign for the score, ranking, the year dummies 2004 and 2005, the country dummies for El Salvador, Honduras and Nicaragua, the ecological, pulped and wet processing methods, the coffee growing area, lot size and the “C” price.

In the following we use Column 3 in Table 1 to explain the single effects of the sensory and reputation variables on specialty coffee prices since this equation has the larger number of significant explanatory variables with lower standard errors of the coefficients. The jury score has a positive and significant impact on prices. One point change in the jury score causes the price to increase by 7.2 percent, a five point increase in the score would represent a 35 percent increase in the price.

The first three rankings are significant at 1% while the fourth ranking is significant only at 10%. The partial effect of obtaining the first place in the CofE competition increases the price

at the auction by 94 percent on average with respect to no rank (all coffees from the fifth place on). The partial effect of obtaining the second and third place increases the price by 33 and 31 percent respectively. Placing in the top three for the auction is highly significant and important to increasing overall total revenue for the producer.

The partial effect of the year is significant (at 1%) and negative for each of the years 2004, 2005 and 2006 with respect to 2003. This is indicating that, *ceteris paribus*, prices have been 26, 65 and 58 percent lower on average in 2004, 2005 and 2006 (so far as the year goes) respectively than in 2003.

The partial effect of the country is significant at 1% and negative (with respect to Brazil) for Bolivia, El Salvador, Honduras and Nicaragua. The dummy for Colombia is not significant at 5% but positive. These results indicate that, on average, El Salvador, Honduras and Nicaragua coffees receive a lower price than Brazilian coffees. For example, a Nicaraguan coffee of a certain score, ranking, variety, processing system and lot size would obtain a price that is 144 percent lower than a Brazilian coffee with the same other characteristics.

Comparing Column 3 (extended number of explanatory variables) to Column 1 (less number of explanatory variables) we see a change in the signs for the Bolivia and Colombia dummies. Possible problems that might be causing this change when adding further independent variables are the overlapping of the countries with varieties and processing methods. The partial effect of these countries needs to be further clarified through the analysis of the interaction between variables. Another possible reason is the small number of observations for Bolivia in particular; the incorporation of the upcoming 2006 auction results will improve the analysis.

The processing method is significant at 1% and negative for ecological, pulped and wet with respect to unknown. This indicates that knowing the processing system is taken into account

by bidders. The interpretation of the negative sign is confusing and needs further investigation. The lot size is significant at 1% and its economic effect is negative and very small: as the coffee lot size increases by one bag, the price decreases by 0.8 percent, ceteris paribus. Finally the “C” price has a significant at 1% and positive effect, as expected. A unitary price increase in the commodity coffee price per pound causes a 136 percent increase in the specialty price paid at the CofE auction. For example, the average price paid for the Nicaraguan coffees in 2005 was \$3.37 per pound while the “C” price was \$1.21 per pound. The settle price for July 2006 “C” coffee price was \$0.98 on May 26. Assuming that this will be the “C” price in July (around the auction time) we would expect an average price for the CofE auction Nicaragua 2006 this year to be \$3.05 per pound.

Two variables that were not significant were variety and the coffee growing area. This was surprising but in the case of the variety it denotes that good coffees are produced from different varieties that in combination with the local conditions of soil, altitude, weather and cultivation practices result in the different flavor profiles that are appreciated by specialty coffee buyers. This shows preference of buyers for variety (diversity) of coffees. The non significance of the coffee growing area indicates that there are no scale effects for the CofE winners.

Summary, Conclusions, Limitations and Further Research

In this paper, we applied the hedonic technique to specialty coffees traded at the CofE electronic auction. The hedonic model includes the jury score as the only sensory characteristics variable and a number of reputation characteristics including the ranking, year, country, coffee varieties, coffee processing methods, growing area, lot size and “C” price as a benchmark price. The data set for these variables contain 431 observations.

Our results indicate that the jury score has an important effect in determining specialty coffee prices as expected due to the earlier stage of the specialty coffee life cycle, e.g. relative to the wine industry, and therefore the importance of the consensual jury of the cupping competitions in defining the industry's quality standards. Also, the partial effects for the first places in cupping competition have a huge effect on the prices paid at the auction asserting the tremendous importance placed on this type of quality competitions for the specialty coffee industry marketing and promotion. On average, specialty coffees from El Salvador, Honduras and Nicaragua receive lower prices than coffees from Brazil. The initial processing system used for coffee impacts the price while the variety types do not. Moreover, results indicate that the prices at the auctions are pegged to the "C" market.

The implicit prices are informing producers about the product characteristics that are most attractive to consumers, thus providing the producers with a signal of the demand. The most important message for coffee producers from the buyers bidding behavior at the CofE auction is that quality and promotion of quality pays in all producing countries where e-auctions have been conducted. In this regard, the digitalized data generated from CofE and other auctions is very valuable for producers to learn about demand and match their production characteristics to the most appropriate market.

The factors limiting the analysis and contribution of this study relate to the extent to which this information impacts the specialty industry. The evidence presented in this paper is restricted to the top quality segment of the whole specialty coffee industry since the data is from the winners only. As more evidence is incorporated from the CofE auctions coming up this year as well as from other specialty auctions, particularly several Q auction programs of the Specialty Coffee Association of America, the specialty coffee hedonic equation can be validated for coffees

from Central and South America as well as from other origins. In addition, the comparison of the competition winning coffees with the non-winning ones can provide insights on entry barriers in the specialty coffee industry.

A final statement on the importance and application of hedonic analysis of specialty coffee prices: much like the wine industry has accomplished over the years, the specialty coffee industry can benefit from a buying behavior that consistently remunerates production characteristics resulting in high quality of the coffee product. The communication of these characteristics to the final consumer through marketing strategies will help consumers gain a more direct appreciation of the role of coffee growers on the final product quality. This would enhance the integration of production into the specialty coffee supply chain and sustainability of the industry.

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¹ Boccaletti uses the terms 'objective' and 'sensory' which corresponds with 'reputation' attributes and 'sensory' attributes in this paper.

² Following de Figueiredo (2000) this condition can also be referred to as a 'look and feel product with variable quality'.

³ The ICO calculates the price indicators for the different coffee groups by weighting the average of the ex-dock prompt shipment prices in the markets of New York and Bremen/Hamburg.

Appendix A

Table A1: Sensory and reputation attributes available from CofE data set

Variable name	Definition	Modalities
<i>Sensory attributes</i>		
Score	The jury scored	Continuous
Description of the jury (coffee profile)	Special taste and aroma characteristics outlined by jury	E.g. red wine, chocolate, cedar
<i>Reputation attributes</i>		
Ranking	Rank in the cupping competition	Categorical dummy
Year	Year of the competition	Categorical dummy
Country	Country of the competition	Categorical dummy
Region	Municipality/Department	Defined for each country
Certifications¹	If the coffee is certified organic or other	Yes/No
Altitude	Altitude	Continuous
Coffee variety	Coffee variety	Categorical dummy, e.g. Caturra, Bourbon
Precipitation	Precipitation	Continuous/categorical
Processing system	Coffee milling system	Categorical e.g. Wet/Ecological
Lot size	Lot size in number of bags	Continuous
Auction total	Total quantity at the auction	Continuous

¹ There is not enough variability

Table A2: Specialty Coffee Descriptive Statistics: Price, Score, Farm Size, Coffee Growing Area and Lot Size by Country

	Country					
	Bolivia	Brazil	Colombia	El Salvador	Honduras	Nicaragua
Price (US \$/lb)						
Mean*	5.51 (2.4)	4.21 (4.9)	4.80 (2.8)	3.40 (2.5)	3.40 (2.8)	3.21 (1.8)
Minimum	3.0	1.3	1.9	1.2	1.5	1.3
Maximum	12.6	49.8	19.1	16.3	17.6	12.5
Score						
Mean*	87.7 (2.7)	86.8 (3.0)	86.8 (2.4)	85.8 (3.0)	87.4 (2.6)	86.2 (2.9)
Minimum	84.0	80.5	84.1	80.6	84.1	80.3
Maximum	93.5	95.9	93.1	95.8	95.7	95.2
Coffee growing area (Ha)						
Mean*	23.7 (74.7)	55.5 (58.9)	6.7 (12.3)	36.3 (30.2)	16.1 (13.8)	35.8 (47.9)
Minimum	2.5	2.8	0.7	1.4	2.1	2.0
Maximum	420	239	106	182	72	280
Lot size (Bags)						
Mean*	16 (4.7)	25 (13.1)	16 (5.2)	23 (8.9)	19 (7.9)	23 (11.6)
Minimum	9	12	14	10	9	10
Maximum	27	100	48	56	46	93
Altitude (masl)						
Mean*	1575 (126.6)	N/A	1647 (188.5)	1407 (155.5)	1499 (158.4)	1199 (115.0)
Minimum	1200	N/A	1100	900	600	875
Maximum	1800	N/A	2050	1800	1800	1450

* Standard deviation in parentheses.

N/A: there is no altitude data available for Brazil

Table A3: “C” price monthly averages used as benchmarks of e-auction prices

	“C” Price (US \$/lb)					
	Bolivia	Brazil	Colombia*	El Salvador	Honduras	Nicaragua
2003	-	0.5479	-	0.6104	0.6104	0.6104
2004	1.0412	0.7039	-	0.8221	0.7494	0.7494
2005	1.0505	1.1498	1.3554/1.0621	1.2116	1.2116	1.2116
2006	-	-	1.1787	-	-	-

* Two auctions yearly