1 Introduction

The literature on country- and region-of-origin effects for agri-food products is extensive and growing rapidly. Consumer studies typically employ discrete-choice-modelling approaches to investigate whether consumers value the product cue origin per se and, if so, how much they are willing to pay for a product coming from a certain origin. Another branch of the literature relies on hedonic pricing models to estimate implicit prices for the origin cue. Market data are used to investigate the major price determinants for the product under consideration. This methodology has been used extensively for analysing price variation on the wine market as a function of wine characteristics (Angulo et al., 2000; Haeger and Storchmann, 2006; Landon and Smith, 1997; Schamel and Anderson, 2003).

Another interesting example of a heterogeneous agri-food product is coffee. The increasing role of product differentiation and quality production on the world coffee market is well-documented (Daviron and Ponte, 2005). The so-called specialty coffee, in particular, is supposed to offer a large product variety similar to wine.[1] There is a growing literature which examines the relationship between coffee quality and regional environmental characteristics as a base to establish regional denominations of origin for coffee (Avelino et al., 2005; Oberthür et al., 2011). While this type of studies is highly important for creating the appropriate code of production based on scientifically proven relationships, hedonic price analyses can provide useful information about perceived quality differences. This is possible if the database is rich enough to cover objective as well as subjective quality attributes. A few hedonic analyses have been carried out for the emerging niche market of specialty coffees (Donnet et al., 2007, 2008; Teuber, 2009, 2010a). Donnet et al. (2008) analyzed the single-origin market with respect to the importance of sensory and reputation attributes. They found significant country-of-origin effects even after controlling for objective quality differences by incorporating a sensory quality score (*SQS*). Similar results are reported by Teuber (2010a) for country- and region-of-origin effects. Although no significant region-of-origin effects could be detected by Teuber (2009) for Honduras, the other three cited studies indicate that collective reputation seems to be an important price determinant in the specialty coffee market. This result is similar to findings for the premium wine market.

[1] There are several definitions of specialty coffee. According to the Specialty Coffee Association of America (SCAA), the term was first coined by Erna Knutsen in 1978 stating in essence that 'specialty coffees' are coffees made from coffee beans grown in special geographic microclimates with unique flavour profiles (Rhinehart, 2009).

Hedonic price functions for specialty coffee are estimated in the cited studies based on pooled data. Dummy variables for the regional origin are introduced as intercept dummies. No interaction effects between the sensory quality score and regional dummies are incorporated and, thus, independent marginal prices for the sensory quality score and the country of origin (CO) are computed. Furthermore, it is assumed that parameters are stable and invariant across market segments, particularly across different export markets. Both assumptions, i.e. uniform origin effects based on intercept dummies as well as parameter invariance, may be too restrictive. Firstly, there are hedonic studies which illustrate the need to consider interactions between a product's regional origin and other product characteristics. Loureiro and McCluskey (2000) elaborate in their analysis of the role of a protected geographical indication (PGI) for consumers' appreciation of Galician veal that a price premium exists at medium quality levels but not at the lowest and highest quality levels of meat cuts. Secondly, recent hedonic studies suggest for various markets such as housing (Zietz et al., 2008) or wine (Costanigro et al., 2007, 2009) that product characteristics are not priced uniformly across all market segments. Particularly interesting for the specialty coffee market are the findings by Costanigro et al. (2007) who estimate hedonic price functions for four distinct price classes: a commercial, a semi-premium, a premium and an ultra-premium segment. Both the expert score and the region of origin are valued differently across these four price segments. The score becomes more important the more expensive the wines are. With respect to region-of-origin effects, Washington wines are discounted in the two most expensive market segments, but not in the commercial one. Based on these results it can be concluded that relevant quality signals in one market segment do not necessarily have to be relevant in another one and that a uniform hedonic price function may lead to biased results.

Against this background, it is the objective of the present paper to provide a more differentiated approach to the modelling of regional-origin effects in hedonic analyses. We focus on the premium coffee market and our analysis goes beyond the earlier hedonic literature on auction prices for specialty coffee in three important respects:

(i) A reduced-form hedonic pricing model is suggested that includes intercept- as well as slope-dummy effects of regional origin. In particular, interactions between the origin and the score variable are introduced. This allows analysing whether and how expert assessments of the sensory quality of premium coffees interact with prior beliefs on collective reputation, as measured by dummy variables for the regional origin.

(ii) It will be analysed whether single-origin coffees sold in internet auctions exhibit

identical implicit prices for characteristics or whether implicit prices vary across market segments. We particularly focus on implicit prices of the sensory quality score and the country of origin. Markets for differentiated products are usually segmented based on space, time or product characteristics. In our case we test for market segmentation according to the geographical origin of the buying company, i.e. we test whether an Asian importer or roaster values characteristics in the same way as a European or North American company. By this, we implicitly test for differing consumer preferences across markets.[2]

(iii) Since the reduced-form hedonic pricing model is derived from a supply-and-demand framework, it is possible to explain coffee prices and to assign the price determinants to the underlying demand or supply functions.

The following analysis refers to data from the so-called Cup of Excellence (COE) during the period 2003-2009. The COE can be briefly sketched as follows (for more details, cf. http://www.cupofexcellence.org): Cup-of-Excellence competitions and auctions were introduced in Brazil in 1999 to reward high-quality coffee producers and to promote high-quality coffee to consumers.[3] The coffees traded in these auctions are all single-origin coffees of a particularly high quality. By now, eight Latin American countries, namely Bolivia, Brazil, Colombia, Costa Rica, El Salvador, Guatemala, Honduras and Nicaragua, take part in the COE program. One auction per year takes place in most participating countries. Each coffee farmer located in a country where the COE takes place can submit a sample of green coffee beans which is cupped and evaluated by a jury. This is similar to wine competitions and each coffee receives a score between 0 and 100 for its sensory quality. All coffees achieving a score of 84 and above are subsequently sold in an internet auction, i.e. the number of coffees sold in each auction is endogenously determined by the quality of the submitted coffee samples. International roasters and importers can bid on these coffees. After each auction is finished, the auction manager takes care of the payment and shipping process and information on the winning bidder and the winning bid is made available online.

The remainder of the paper is structured as follows. The next section will provide the theoretical background. In Section 3, the data set and the empirical model are introduced and the empirical results are presented and discussed. The last section concludes.

[2] In the case of the normal coffee market this could be a problematic assumption, since blending is a common feature of this market. However, the coffees we include in our analysis are single-origin coffees which are not blended with each other.

[3] The period covered does not start in 1999 because in the first auction years only very few data were made available online.

2 Theoretical Framework

The following theoretical model concentrates on the impacts of regional origin on market prices. An explicit supply-and-demand framework is formulated in which the regional origin of a high-quality product is incorporated. Thus, implications of the regional origin on the reduced form of the market equilibrium, i.e. the hedonic pricing functions, can be derived. As the market of specialty coffee shall be analysed, it is essential that the model captures some basic features of the auction market for specialty coffee. These market characteristics include the following:

(i) At any Cup-of-Excellence auction, the quantity traded of each high-quality variety is exogenously given. It is not possible for suppliers to react during the auction to favourable or unfavourable price conditions by changes in the quantity supplied.

(ii) The demand side is represented by – typically foreign – processors who buy high-quality raw coffee in order to roast, package and sell it on foreign markets. In a competitive supply chain, demand for the high-quality raw coffee can be regarded as a derived demand from the consumers' demand for processed premium coffee. Thus, determinants of the demand curve at the consumer market should enter the derived demand, i.e. the processors' demand for high-quality raw coffee at the auction market. Additionally, it is very likely that processors will take an active part, too, and go for highly evaluated coffees independent of their customers' established preferences. In particular in the premium segment, they may look for new coffees with a high objective quality and offer those to their discerning customers at the home market.

(iii) These interesting, new coffees which processors plan to offer their customers may well be those which receive particularly high assessments for their sensory quality by coffee experts. When buying at any Cup-of-Excellence auction, scores of the high-quality coffees on the basis of a careful sensory judgement by cuppers are disclosed and known to potential buyers.

(iv) Scores of the high-quality coffees sold at each auction are the result of sensory evaluations by coffee experts. A careful selection process exists, which involves a national and an international jury. The judgments of cuppings are based on multiple sensory criteria: "absence of defects, cleanness of cup, sweetness, quality of acidity and of mouthfeel, flavor, aftertaste and balance" (Cup of Excellence, 2011). This makes the Cup-of-Excellence assessments of specialty coffees very similar to the rating of premium wines. The scores of the traded coffees are thus

predetermined by the decisions of the coffee experts and, at each auction, an important piece of information for the bidders.

Given these essential features of the auction market and our primary interest in the importance of regional origin for auction prices, the following theoretical model can be formulated for the market of a coffee variety *i*:

(1) $q_i^S = \bar{q}_i$ (supply function)

(2) $q_i^D = a + b \cdot p_i + c \cdot SCORE_i + d \cdot ORIGIN_i + e \cdot SCORE_i \cdot ORIGIN_i + f \cdot Z_i$ (demand function)

(3) $q_i^S = q_i^D$ (equilibrium condition)

$q_i^S (q_i^D)$ is the quantity supplied (demanded) of a coffee variety *i*, p_i is the price of this coffee, $SCORE_i$ refers to its sensory quality, $ORIGIN_i$ to its regional origin and Z_i is a vector of other product characteristics such as certification schemes. $\bar{}$ indicates that a variable is exogenously given. According to feature (i) explained above, supply on the coffee auction of each variety is totally price inelastic as shown by (1). According to features (ii) and (iii), we posit that coffee demand is a function of a coffee *i*'s reputation, as indicated by its regional origin (*ORIGIN*), its sensory quality (*SCORE*) and other product characteristics (Z_i). This implies that demand for any coffee variety *i* at the auction contains two different effects of the regional origin:

1. The term $d \times Origin_i$ is the direct effect of reputation on demand. Each regional origin is associated with a reputation of the coffee quality originating in that region, compared to that of a benchmark region. $ORIGIN_i$ will be measured by a dummy variable in the empirical model, and *d* may be positive or negative depending on whether the reputation of the regional origin of coffee *i* is superior or inferior to the one of the benchmark region.

2. Apart from the direct effect of a region's reputation, the interaction term $e \times Score_i \times Origin_i$ covers a second effect of the regional origin. The impact of a better sensory quality on demand for a coffee type may be a function of the coffee's regional origin. Suppose that a region's reputation on the coffee market is still low although objective quality reaches already a high level. If processors realise such a difference between the objective quality and the perceived quality, as indicated by the reputation of the regional origin, increasing scores for the sensory quality may yield a stronger effect on demand than for benchmark regions. Depending on the benchmark region, the interaction term may turn negative, too.

The following signs of the coefficients of equation (2) can be expected: $b < 0$, $c > 0$, $d \gtrless 0, e \gtrless 0$. From equations (1) to (3), the following reduced form of a hedonic pricing model can be derived:

$$(4) \quad p_i = -\frac{a}{b} + \frac{1}{b} \cdot \bar{q}_i - \frac{c}{b} \cdot SCORE_i - \frac{d}{b} \cdot ORIGIN_i - \frac{e}{b} \cdot SCORE_i \cdot ORIGIN_i - \frac{f}{b} Z_i.$$

The implicit price of the regional origin (β) in this reduced-form hedonic pricing model is:

$$(5) \quad \beta = -\frac{d}{b} - \frac{e}{b} \cdot SCORE_i.$$

The first term on the right-hand side of (5) measures the effect of the reputation attached to the regional origin on the auction price, and the second term covers the possibility that the impact of a better sensory quality on the auction price is region-specific.

Although the model is stylised, two other important conclusions can be drawn from it. First, all implicit prices of product characteristics depend on the slope of the demand function (b). The implicit price of the regional origin rises with a better reputation of the coffee (d), a higher value of the interaction term ($e \times Score_i$) and a lower absolute value of the slope of the demand function. Second, auction prices are also driven by exogenous shifts of supply as those result in a move on the demand curve to a new equilibrium price:

$$(6) \quad \partial p / \partial \bar{q} = 1/b < 0.$$

Thus, the marginal willingness to pay for a specialty coffee alters with each shift of the price-inelastic supply curve.

3 Pooled and Segment-Specific Hedonic Models for Single-Origin Coffee

3.1 Data and Empirical Model

The following empirical analysis is based on all available data for Cup-of-Excellence auctions in the period 2003 to 2009, which took place in eight coffee-producing countries. Appendix 1 provides an overview of the available auction data across countries and years. Appendix 2 contains descriptive statistics and definitions of the dependent and independent variables included in different models during the specification search.

In total, 1,280 observations from 46 auctions are available. The number of coffee bags sold in an auction varies from 9 to 122 with an average of 22 bags. On average each farmer

sold 2,904 pounds of green coffee beans.[4] The price paid for a pound of green coffee beans varies from US-$ 1.3 to US-$ 80.2 with an average of US-$ 5.40. The data set includes 1691 tonnes of green coffee beans with a total market value of US-$18.8 million.

In the empirical hedonic function, some variables can be measured as intended in the theoretical model: The dependent variable (*p*) is the auction price for coffee in US-$ per ton. $\bar{q}$ is the quantity of coffee *i* sold on market n in pounds, and the Sensory Quality Score (*SQS*) is the achieved score in the cupping competition. Country-of-origin (*CO*) dummies proxy the *ORIGIN* variable of the theoretical model. Brazil serves as a benchmark country.

In order to capture the origin effects under *ceteris-paribus* conditions, the vector Z_i in equation (2) for other determinants of demand has to be specified. We posit that plant variety (*variety*) determines coffee quality as argued in agronomic studies (Wintgens, 2009). Since anecdotal evidence suggests that many coffee professionals favour traditional varieties such as *Bourbon* or *Typica*, it is hypothesised that these varieties earn a price premium in comparison to modern varieties such as *Caturra*, *Catuai* and *Pacamara*. A further conjecture is that consumers prefer certified to non-certified products and that certified coffees earn a price premium. Therefore, we included dummy variables for certification schemes (*certification*) in several models estimated. Moreover, the analyses by Donnet et al. (2008) and Teuber (2010a) suggested that consumers value the top ranks in coffee auctions apart from the coffee's pure quality score and we introduced variables for the first, second and third rank. In order to control for period-specific effects, year dummies are also included (*auctionyear*).

The specification search was based on Box-Cox regressions, a well-established procedure in finding the appropriate functional form in applied data analysis. Specifically, we fit the model with the transformed dependent variable to test three different functional forms: linear, log-linear and inverse. The log-linear functional form outperformed the linear and the inverse root function in all model specifications, and the following empirical model was estimated:

$$\begin{aligned}\log(p) = {} & ß_0 + ß_1 \cdot \log(\bar{q}) + ß_2 \cdot SQS + ß_3 \cdot organic + ß_4 \cdot ranking + \\ & ß_5 \cdot variety + ß_6 \cdot CO + ß_7 \cdot CO \cdot SQS + ß_8 \cdot auctionyear + u.\end{aligned} \tag{7}$$

In this specification the slope of *SQS* is permitted to differ across countries. In order to derive useful meanings of the initial coefficients and ready-to-interpret standard errors for the partial effect, the variable *SQS* has been centred with respect to its sample mean before creating the interaction terms (Wooldridge 2006, p. 204).

[4] Normally, the sold quantity is given by the number of coffee bags sold. However, since the size of coffee bags differs across countries from 60 to 70 kg the quantity sold is expressed in pounds.

3.2 Results – Pooled Regressions

Several model specifications with different sets of explanatory variables were tested and Table 1 presents different goodness-of-fit criteria which can be used for model selection. This is based on the critique by Thane (2009) who argues that in order to reach reliable and trustworthy conclusions on the relative importance of different sets of explanatory variables it is not sufficient to present results for a combined model including all sets of explanatory variables. It is rather necessary to provide estimates for models containing specific sets of explanatory variable only. His critique is related to the lively discussion in the hedonic wine literature whether objective or sensory attributes are relatively more important in determining wine prices.

Apparently, the basic model without *variety* and *CO* effects explains already about 70% of the variation of the dependent variable. Whereas the additional inclusion of coffee varieties has a limited additional explanatory power, *CO* effects influence the adjusted R^2 substantially.

Table 1: Measures of Goodness-of-Fit for Different Sets of Explanatory Variables[a)]

	Basic Model[b)]	Basic Model with Variety Effects Only	Basic Model with CO Effects Only	Basic Model with Variety and CO Effects (Model I)	Basic Model with Variety, CO and Interaction Effects (Model II)
Adjusted R^2	0.68	0.68	0.75	0.75	0.75
AIC[c)]	668.5	662.9	368.9	372.4	356.2
BIC [c)]	735,2	760.4	471.6	505.8	525.5

[a)] All models are estimated in a log-lin specification. - [b)] The basic model includes the following variables: Log ($\bar{q}$), *SQS*, *ranking*, *organic*, and *auctionyears*. - [c)] AIC = Akaike's information criterion; BIC = Schwarz's Bayesian information criterion.

Source: Own calculations.

The estimation results for the last two models, labelled Model I and Model II, are presented in Table 2. Model I includes intercept dummies only, and is therefore comparable to former results by Donnet et al. (2008) and Teuber (2010a). The second model allows a more differentiated modelling of origin effects by incorporating interaction terms between the *SQS* and *CO* variables. Although additional model comparisons suggest that regular *CO* effects are most important in the case of specialty coffee, interactions between the *SQS* and *CO* variables are significant for various countries.

Table 2: Estimates of Regression Models with Undifferentiated and Differentiated Origin Effects on Coffee Auction Prices, Pooled Data

	Price Regression			
Dependent variable	Log(*p*)			
Explanatory Variables	**Model I**		**Model II**	
Constant	-3.272***	(0.000)	-1.953*	(0.011)
Log($\bar{q}$)	-0.364***	(0.000)	-0.354***	(0.000)
SQS	0.085***	(0.000)	0.069***	(0.000)
Organic	0.122*	(0.034)	0.118*	(0.042)
Ranking (*Reference: Rank 4th and below*)				
1st Rank	0.803***	(0.000)	0.802***	(0.000)
2nd Rank	0.292***	(0.000)	0.275***	(0.000)
3rd Rank	0.238***	(0.000)	0.231***	(0.000)
Variety (*Reference: Mix*)				
Bourbon	0.083*	(0.014)	0.083*	(0.008)
Catuai	0.049	(0.159)	0.050	(0.153)
Caturra	0.050*	(0.048)	0.055*	(0.015)
Pacamara	0.063	(0.204)	0.050	(0.348)
Typica	0.082	(0.276)	0.079	(0.200)
Others	0.093*	(0.011	0.085*	(0.021)
Country-of Origin (*Reference: Brazil*)				
Bolivia	-0.027	(0.517)	-0.029	(0.477)
Colombia	-0.026	(0.517)	-0.027	(0.483)
Costa Rica	-0.177***	(0.000)	-0.184***	(0.000)
El Salvador	-0.229***	(0.000)	-0.235***	(0.000)
Guatemala	0.262***	(0.000)	0.259***	(0.000)
Honduras	-0.342***	(0.000)	-0.347***	(0.000)
Nicaragua	-0.161***	(0.000)	-0.170***	(0.000)
Country-Specific SQS Effect (*Reference: Brazil*)				
Bolivia			0.015	(0.238)
Colombia			0.005	(0.724)
Costa Rica			0.024	(0.149)
El Salvador			0.034*	(0.041)
Guatemala			0.007	(0.728)
Honduras			0.048***	(0.001)
Nicaragua			0.012	(0.315)
Auction year (*Reference: 2003*)				
2004	0.119**	(0.007)	0.145***	(0.189)
2005	0.055	(0.191)	0.075[*]	(0.442)
2006	0.203***	(0.000)	0.229***	(0.000)
2007	0.481***	(0.000)	0.507***	(0.000)
2008	0.578***	(0.000)	0.600***	(0.000)
2009	0.559***	(0.000)	0.580***	(0.000)
N	1250			
Adjusted R^2	0.749		0.752	
AIC	372.4		356.2	
BIC	505.8		525.5	

Notes: [*],*, **, *** denote statistically different from zero at the 10%, 5%-, 1%- and 0.1%- level, respectively. p-values are presented in parentheses. All models are estimated using the White heteroscedasticity-consistent standard errors and covariance. The variable *Rainforest Alliance* had to be removed from the model due to high multicollinearity with the country dummy for El Salvador.

Source: Own calculations.

The results in Table 2 suggest that origin effects should be modelled in hedonic analyses in a differentiated form: The coefficient of the intercept dummy *CO* captures the reputation effect of the country of origin. The coefficient of the slope dummy indicates

whether the effect of the score on the auction price is country-specific. Both effects matter.

In Model II, the intercept and the regression coefficient for the *SQS* variable reflect the impact for coffees originating in Brazil, which was chosen as the reference category. The main country effects have a convenient interpretation due to the re-parameterisation of the regression model. They reflect the partial *CO* effect at the mean score of the sample. The results suggest that the price level as well as the impact of the *SQS* differ significantly across countries. All coffee origins with the exception of Guatemala are discounted compared to Brazilian coffees. The lowest price level is realized in auctions for Honduran coffee, with an average price discount of 29 % *ceteris paribus*. The highest prices are paid for coffees from Guatemala with a price premium of on average 30 %.[5]

A comparison of Models I and II with regard to the regression coefficient of the *SQS* variable illustrate that we can gain additional insights from the differentiated modelling of origin effects. In both models, there is a highly significant and positive impact of the *SQS*. This implies that the marginal willingness to pay on the specialty coffee market is increasing if a coffee's sensory quality improves. But the magnitude of this impact is affected by the country of origin. According to Model I, a higher expert assessment in terms of *SQS* by one score point raises the auction price by 8.6%. In Model II, the coefficient decreases to 4.7% and it refers to the country group without a significant slope-dummy coefficient, i.e. Bolivia, Colombia, Costa Rica, Guatemala and Nicaragua besides Brazil. For coffees from El Salvador and Honduras the impact of an increase in *SQS* by one score point on the auction price is significantly higher. The highest impact of the *SQS* can be observed for Honduran coffee with a 1-point increase in *SQS* resulting in a price increase by 12 %. Apparently, the *SQS* seems to be a more important price determinant for coffee-growing countries which are characterized by a low reputation in the marketplace such as Honduras and El Salvador. On the other hand, for countries with an established reputation for producing high-quality coffee, namely Colombia and Guatemala, the *SQS* seems to be less important in determining auction prices.

Apart from the country-of-origin effects, Table 2 shows the importance of other determinants of prices for specialty coffee. The coffee varieties *Bourbon*, *Caturra* and the group *Others* can achieve significantly higher auction prices than the reference variety. The

[5] The price premium/discount is calculated according to the approach proposed by KENNEDY (1981). KENNEDY proposed to estimate the percentage impact of a dummy variable on the dependent variable in loglinear equations according to $\hat{p} = 100 \cdot \{exp\{\hat{c} - \frac{1}{2}\hat{V}(\hat{c})\} - 1\}$ with $\hat{c}$ being the OLS estimate of the coefficient of a dummy variable and $\hat{V}(\hat{c})$ being the OLS estimate of its variance.

result for *Bourbon* is in line with our hypothesis that traders tend to be willing to pay higher prices for traditional varieties. However, the result for *Caturra* is quite surprising. It seems that this variety has already an established name in the marketplace so that consumers are willing to pay higher prices for this coffee variety. There is a significant price premium for organic compared to conventional coffees, too.

The results with respect to the year dummies indicate that auction prices increased through the analysed time period. This development can certainly be due, at least to some extent, to the booming commodity prices in the years 2007 and 2008.

Besides these demand-driven effects, there is a highly significant negative impact of the quantity supplied on coffee auction prices and, thus, on the marginal willingness to pay. If the supplied quantity increases by 1 %, the auction price decreases by 0.385 %. Such a price flexibility below unity implies that the price elasticity of demand for the traded coffees is above unity in absolute terms. This is exactly what can be expected, i.e. a highly elastic demand for top-quality coffees.

3.3 Results – Segment-Specific Regressions

In the beginning the question was posed whether implicit prices for characteristics are stable over certain market segments. A plausible segmentation strategy in our case is to distinguish between destination markets. Hence, we tested for parameter stability across three different buyer subsamples, i.e. those of Asian, European and North American buyers. This implies that we test for different consumer preferences across these three markets. At first sight, European buyers seem to be a very broad category given the rather large differences in consumer preferences between Northern and Southern European countries. However, a more detailed classification was not feasible or meaningful, since the share of buyers originating in Southern Europe is less than 1 %. The majority of European buyers originate in Northern and Central Europe, with nearly half of all coffees bought by companies located in Norway. Following the approach by Costanigro et al. (2007), we tested for coefficient stability across the three subsamples via a Wald statistic. The test statistic is framed analogously to a Chow breakpoint test. The results are presented in Table 3.

Table 3: Wald Statistics (p-Values) Testing the Hypothesis of Parameter Equality Across Subsamples

	Asia	North America
Europe	86.01 (0.000)	66.20 (0.001)
Asia		107.69 (0.000)

[a)] The test statistic is based on White's heteroscedasticity-robust estimators.

Source: Own calculations.

The results reject the null hypothesis of parameter equality across all three subsamples at the 99%-level of significance. As a consequence, buyer-specific regressions were estimated and the results are presented in Table 4. Again, different functional specifications were tested and the log-linear and the inverse square root functional forms performed best. For ease of comparison and interpretation, the log-linear one was chosen as the final specification.

Besides the estimated regression coefficients and *p*-values, Table 4 does also provide implicit prices for each product attribute. The dummy variables for the coffee-tree variety were dropped either because they had no significant impact (European and Asian subsamples) or led to multicollinearity problems with the country dummy variables (North American subsample). In general, the hedonic models explain more than 70% of the variation of coffee auction prices on all three markets. Moreover, there are important segment-specific differences in regression coefficients.

The intercept dummies for the countries of origin reveal again that the reputation of the origin of the specialty coffees differs widely across countries. It is visible, too, that *CO* effects vary across the three market segments. Colombian coffees are clearly discounted compared to Brazilian coffees by North American buyers. This is not the case for Asian and European buyers. This result is quite surprising given the fact that the brand Juan Valdez and the term Café de Colombia are particularly prominent in the US market (Kotler and Gertner 2004). The results indicate further that coffees from Guatemala possess a good reputation in all three markets, reflected in the statistically significant positive price premia. But the extent of the price premium varies. The largest price premium is paid by Asian buyers, followed by North American buyers and the least one is paid by European buyers. Negative price premia occur for El Salvador and Honduras in the North American sample. These price discounts are less pronounced in the European sample.

Table 4: OLS Estimates for Segment-Specific Hedonic Functions[a)]

	Asian Market			European Market			North American Market		
Dependent variable				Log(*p*)					
	Coefficient	*p*-Value	**Imp.**	Coefficient	*p*-Value	**Imp.**	Coefficient	*p*-Value	**Imp.**
Constant	-1.150	(0.193)		-1.239	(0.484)		-3.655*	(0.015)	
SQS	0.059***	(0.000)	**$0.30**	0.061**	(0.002)	**$0.34**	0.093***	(0.000)	**$0.54**
Log($\bar{q}$)	-0.339***	(0.000)	**-$0.02**	-0.365***	(0.000)	**-$0.02**	-0.381***	(0.000)	**-$0.02**
Organic	0.114*	(0.043)	**$0.60**	-0.127	(0.208)	**-$0.65**	0.113	(0.190)	**$0.66**
Ranking (*Reference: 4th rank and below*)									
1st Rank	0.716***	(0.000)	**$5.22**	0.931***	(0.000)	**$8.40**	0.751***	(0.000)	**$6.19**
2nd Rank	0.307***	(0.000)	**$1.79**	0.361***	(0.000)	**$2.37**	0.307*	(0.046)	**$1.99**
3rd Rank	0.199***	(0.000)	**$1.10**	0.351***	(0.000)	**$2.30**	0.091	(0.444)	**$0.53**
Country of Origin (*Reference: Brazil*)									
Bolivia	-0.070[*]	(0.032)	**-$0.36**	-0.079	(0.092)	**-$0.42**	-0.110[*]	(0.097)	**-$0.58**
Colombia	-0.011	(0.779)	**-$0.05**	-0.039	(0.536)	**-$0.21**	-0.186**	(0.002)	**-$0.94**
Costa Rica	-0.193***	(0.000)	**-$0.88**	-0.334***	(0.000)	**-$1.55**	-0.252*	(0.015)	**-$1.23**
El Salvador	-0.233***	(0.000)	**-$1.05**	-0.162*	(0.029)	**-$0.82**	-0.346***	(0.000)	**-$1.62**
Guatemala	0.247***	(0.000)	**$1.40**	0.116*	(0.049)	**$0.52**	0.239**	(0.001)	**$1.49**
Honduras	-0.376***	(0.000)	**-$1.56**	-0.217**	(0.002)	**-$1.67**	-0.488***	(0.000)	**-$2.14**
Nicaragua	-0.205***	(0.000)	**-$0.92**	-0.178**	(0.002)	**-$0.89**	-0.223***	(0.000)	**-$1.11**
Country-Specific Score Effect (*Reference: Brazil*)									
Bolivia	0.029[*]	(0.080)	**$0.15**	-0.002	(0.951)	**-$0.01**	-0.021	(0.234)	**-$0.12**
Colombia	0.018	(0.335)	**$0.09**	-0.066**	(0.009)	**-$0.35**	-0.000	(0.998)	**-$0.00**
Costa Rica	0.022	(0.321)	**$0.11**	0.014	(0.629)	**$0.08**	-0.006	(0.909)	**-$0.03**
El Salvador	0.032[*]	(0.097)	**$0.16**	-0.012	(0.698)	**-$0.06**	0.008	(0.850)	**$0.04**
Guatemala	-0.003	(0.856)	**-$0.04**	-0.072**	(0.003)	**-$0.38**	0.002	(0.936)	**$0.01**
Honduras	0.048**	(0.006)	**$0.25**	0.006	(0.802)	**$0.07**	0.035	(0.249)	**$0.19**
Nicaragua	0.018	(0.152)	**$0.09**	-0.026	(0.298)	**-$0.14**	0.009	(0.679)	**$0.05**
Auction year (*Reference: 2003*)									
2004	0.103[*]	(0.224)	**$0.54**	0.203*	(0.031)	**$1.23**	0.105	(0.106)	**$0.61**
2005	0.008	(0.876)	**$0.04**	0.197*	(0.034)	**$1.19**	0.047	(0.598)	**$0.27**
2006	0.105*	(0.043)	**$0.55**	0.360***	(0.000)	**$2.37**	0.280***	(0.001)	**$1.79**
2007	0.432***	(0.000)	**$2.69**	0.603***	(0.000)	**$4.52**	0.465***	(0.000)	**$3.28**
2008	0.488***	(0.000)	**$3.14**	0.821***	(0.000)	**$6.96**	0.677***	(0.000)	**$5.36**
2009	0.536***	(0.000)	**$3.53**	0.720***	(0.000)	**$5.76**	0.526***	(0.000)	**$3.83**
Adjusted R^2	0.77			0.72			0.77		
N	652			271			267		

[a)] ***, **, *, [*] denotes statistically different from zero at the 0.1 %-, 1 %-, 5 %- and 10 %- level respectively. p-Values are presented in parentheses. Implicit prices (Imp.) are calculated using segment-specific mean prices.

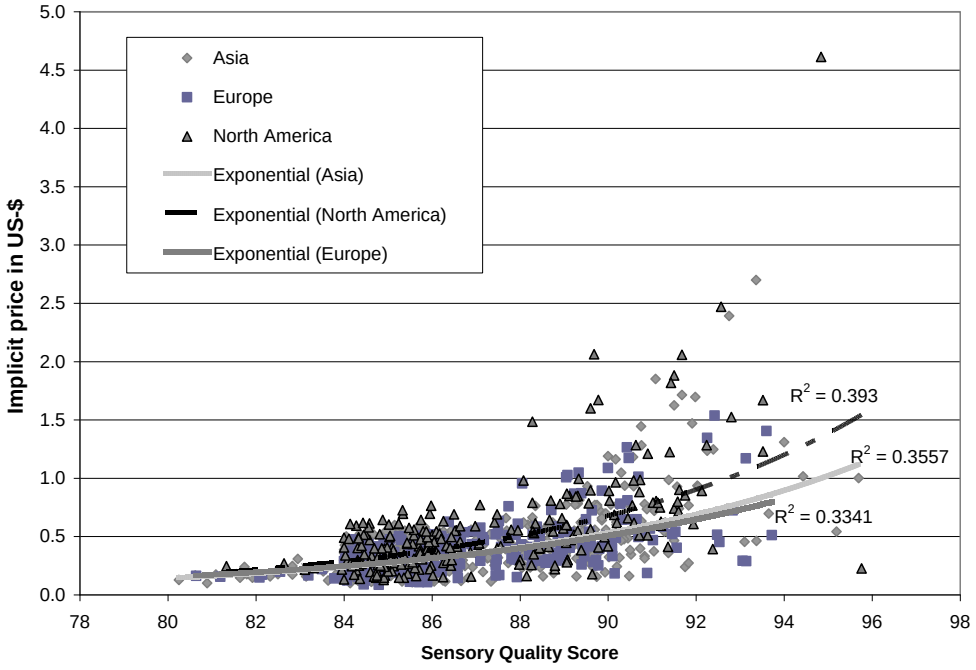
Source: Own calculations.

In general, *CO* effects seem to be more pronounced for the North American and Asian than for the European market. If we consider the results with respect to the *CO* and ranking effects jointly, it seems to be that in the European market the ranking is a more valuable marketing tool and that origin is not such a strong price determinant as in the other two markets. European buyers seem to value the first rank as a quality and/or marketing attribute higher than Asian and North American buyers.

The impact of the sensory quality score on auction prices is again highly significant and positive in all three coffee market segments. However, the magnitude of the impact is very different and highest for the North American market: Whereas an increase of the *SQS* by one score point raises the marginal willingness to pay by nearly 10.0 % on the North American market, the impact is clearly lower on the European and the Asian market with an increase by around 6.0 %. This price-raising impact of the *SQS* on the North American market holds for all producer countries uniformly, whereas differential origin effects are prevailing on the Asian and European markets. To some extent, the effects found in the pooled regression (Table 2) are mirrored in the latter two market segments. In the Asian subsample, the *SQS* effect for Honduran coffee is significantly larger than for the other origins. Apparently, Honduras can again compensate for its lower reputation by higher rewards for its effects to raise coffee quality. In the European sample, the *SQS* effect is significantly lower for Colombian and Guatemalan coffees. We explain this finding as follows: In Europe, Colombian and Guatemalean coffees have a generally high reputation. Therefore, their specialty coffees can gain less from a rise of *SQS* than those from other origins that have not yet reached the same degree of general reputation.

Additionally, differences across the three market segments regarding the implicit price of *SQS* on average are illustrated in Figure 1. In all three markets, we can observe increasing marginal returns to the sensory quality score. However, the increase is more pronounced in the case of North American buyers than for Asian and European buyers.

Figure 1: Implicit Price of the Average Sensory Quality Score for Asian, European and North American Buyers, Calculated with Estimates from the Segment-Specific Models



Source: Own presentation.

3.4 Discussion

We can summarise from the findings of Tables 2 and 4 that origin matters on the specialty coffee market. Even after controlling for expert assessments of the sensory quality of the coffees, very strong reputation effects are induced by the country of origin. Apparently, perceived quality and objective quality of specialty coffees determine the formation of auction prices. The special importance of quality perceptions is underlined by two findings:

(i) The intercept dummies for the countries of origin are statistically significant in almost all cases but are valued differently in North America, Europe and Asia.

(ii) A higher sensory quality as evaluated by coffee experts is well-received on the specialty coffee market but its impact on marginal willingness to pay differs across market segments.

According to the first point, Tables 2 and 4 show first that the reputation effects can be similar in various demand segments like for Guatemala with a higher reputation than for Brazil as benchmark country or Honduras, El Salvador, Costa Rica and Nicaragua with a lower reputation. But they can also differ like in the case of Colombia with a comparatively lower reputation in the North American compared to the European and Asian markets.

The second point illustrates that the sensory assessment by experts affects the consumers' quality perceptions in a non-uniform way. The marginal impact of *SQS* on auction prices

is highest in North America, lowest in Asia and in between in Europe where it is very similar to the pooled regressions. The additional impact of one of the first three ranks is lowest in Asia again and higher in all cases for Europe where the implicit price of the first rank is clearly highest. On the other hand, the pure reputation effects seem to be more significant on the North American and Asian markets than in Europe.

What do the empirical findings of Tables 2 and 4 imply for coffee-producing nations? The significant coefficients of the country-of-origin variables imply that a higher reputation yields a price bonus on the specialty coffee market. But this is only a "gross price premium" and, thus, a necessary pre-condition for a successful marketing of the regional origin of the product. In order to establish and maintain a protected geographical indication along the lines of Café de Colombia successfully, the "gross price premium" has to overcompensate the additional per-unit costs of promotion and quality control.

The significant impact of the *SQS* implies that efforts of coffee producers to improve quality are rewarded on the specialty coffee market as is the country's reputation. Each producer has the chance to work towards a better sensory quality and thus, raise the price via a higher *SQS*. At the same time this might improve in the middle-run its country's reputation for quality and increase the price premia paid for coffees originating in this country.

Apart from these implications, producer countries may derive conclusions for their marketing strategies from the differentiated modelling of the segments of the specialty coffee market.

4 Concluding Remarks

The present paper adds empirical evidence to the growing literature on origin effects by estimating a hedonic price model incorporating intercept- and slope-dummy effects of regional origin. The results indicate that both effects are present and significant, but that the pure reputation effects as indicated by intercept dummies are dominating on the specialty coffee market. These effects were also investigated for three different subsamples indicating that implicit prices for certain characteristics, particularly the origin, vary significantly across different export markets. This is of great importance for coffee producers who want to enter new consumer markets with their coffees. Consequently, the findings suggest that a more differentiated modelling of origin effects in hedonic analyses is needed. Both the pure reputation effect of an origin as well as its interaction with quality scores should be considered. Market segmentation is important, too, that allows for a non-uniform assessment of high-quality foods and beverages across market destinations.

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Appendix

Appendix A: Overview of Available Auction Data

Year / Country	2003	2004	2005	2006	2007	2008	2009
Bolivia		X *(13)*	X *(19)*		X *(26)*	X *(29)*	X *(30)*
Brazil	X *(43)*	X *(36)*	X *(36)*	X *(29)*		X *(23)*	X *(26)*
Colombia			X *(25+33)*	X *(23+30)*	X *(30)*	X *(18)*	X *(27)*
Costa Rica					X *(25)*	X *(30)*	X *(24)*
El Salvador	X *(31)*	X *(35)*	X *(17)*	X *(23)*	X *(23)*	X *(36)*	X *(33)*
Guatemala				X *(25)*	X *(19)*	X *(25)*	X *(23)*
Honduras		X *(21)*	X *(41)*	X *(33)*	X *(24)*	X *(26)*	X *(39)*
Nicaragua	X *(37)*	X *(29)*	X *(35)*	X *(25)*	X *(34)*	X *(25)*	X *(26)*

Notes: The number of coffees sold in each auction is presented in parentheses.

Source: Own presentation.

Appendix B: Description and Summary Statistics of the Available Variables

Variable	Definition	Mean	Std. Dev.
Price (*p*)	Auction price for coffee i in US-$/pound	5.36	4.35
Sensory Quality Score (*SQS*)	The achieved score in the cupping competition that takes place in advance of the auction ranging from 84 -100 points	86.80	2.54
Quantity ($\bar{q}$)	Quantity of coffee i sold in market n in pounds	2923	1269
		Relative Share	
Ranking *(ranking)*	Dummy variable for the achieved rank in the cupping competition		
Rank 1st	Takes the value 1 if the coffee was ranked 1st	0.036	
Rank 2nd	Takes the value 1 if the coffee was ranked 2nd	0.036	
Rank 3rd	Takes the value 1 if the coffee was ranked 3rd	0.036	
Rank 4th and above	Takes the value 1 if the coffee was ranked 4th and above	0.892	
Certification (*certification*)	Dummy variable for different certification schemes		
Organic	Takes the value 1 if the coffee is certified organic	0.026	
Rainforest Alliance	Takes the value 1 if the coffee is Rainforest Alliance certified	0.021	
No certification	Takes the value 1 if it the coffee is not certified	0.953	
Coffee Variety *(variety)*	Dummy variable for different coffee tree varieties		
Bourbon	Takes the value 1 of the coffee variety is Bourbon	0.196	
Catuai	Takes the value 1 if the coffee variety is Catuai	0.144	
Caturra	Takes the value 1 if the coffee variety is Caturra	0.245	
Pacamara	Takes the value 1 if the coffee variety is Pacamara	0.042	
Typica	Takes the value 1 if the coffee variety is Typica	0.011	
Others	Takes the value 1 if the coffee variety is one not mentioned above	0.082	
Mix	Takes the value 1 if the coffee is a mix of different varieties	0.276	
Buyer (*buyer*)	Dummy variable for the type of buyer		
Asia	1 if the coffee was bought by an Asian company	0.523	
Europe	1 if the coffee was bought by an European company	0.217	
North America	1 if the coffee was bought by a North American company	0.215	
Others	1 if the coffee was bought by another company	0.046	
Country of Origin (*CO*)	Dummy variable for the country of origin		
Bolivia	Takes the value 1 if it is a Bolivian coffee	0.093	
Brazil	Takes the value 1 if it is a Brazilian coffee	0.153	
Colombia	Takes the value 1 if it is a Colombian coffee	0.148	
Costa Rica	Takes the value 1 if it is a Costa Rican coffee	0.063	
El Salvador	Takes the value 1 if it is a El Salvadoran coffee	0.158	
Guatemala	Takes the value 1 if it is a Guatemalan coffee	0.073	
Honduras	Takes the value 1 if it is a Honduran coffee	0.144	
Nicaragua	Takes the value 1 if it is a Nicaraguan coffee	0.168	

Source: Own computations.