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Research article

Willingness to pay for socially responsible products: A meta−analysis of coffee ecolabelling

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ABSTRACT

Primary studies estimate consumers' willingness to pay for a single or a couple of coffee ecolabelling in a single country and occasionally across countries. The estimates are not beyond explaining consumers' willingness to pay for a specific attribute in that particular study area. This creates uncertainty in disentangling heterogeneity in the effect size within the same country and across countries which can be associated with publication bias and/or other factors. We apply a meta−analysis that combines individual willingness to pay (n = 97) from 22 primary studies to estimate average effect size for each attribute and explore factors that explain heterogeneity in the effect size in the last 15 years. Our descriptive analysis results designate that consumers' willingness to pay for a pound of Organic, Country of Origin Labeling, and Fairtrade coffee is positive and significant. The meta−model results show that Organic attribute is the most important factor that affects willingness to pay for eco−coffee. Compared to other stated preference methods, choice experiment has the potential to reduce hypothetical bias and precisely estimate the effect size. The difference in the effect size across regions indicates consumers' preference heterogeneity for coffee ecolabelling. In general, despite the debate that the existence of multiple ecolabelling in the market may cause a decline in consumers' trust and willingness to pay overtime, our study concludes that consumers' purchase behavior in selected countries is pro−eco−coffee.

1. Introduction

The role of ecolabelling of socially responsible and eco−friendly produced goods is increasingly studied in value chains of different commodities (Giovaanucci and Ponte, 2005; Swinnen, 2007; Yokessa and Marette, 2019). The consumers' acceptance of ecolabelling is partly explained by a premium price paid for socially responsible products which rewards the producers (Yokessa et al., 2020). Ecolabelling in agriculture and food production system emerged as a market−based tool for assisting consumers in evaluating food safety, health related benefits, and environmental friendliness (Basu et al., 2003; Bougherara and Combris, 2009; OECD, 2008). Coffee is one of the most extensively consumed beverages and commercially traded commodity (Pierrot et al., 2010; Craparo et al., 2014; ICO, 2018). In the process of agricultural commodity eco−certification, coffee is regarded as a pioneering and model industry (Pierrot et al., 2011; Global Coffee Forum, 2015; ICO, 2017; Reinecke et al., 2012). As a policy instrument, the advantages of ecolabeling to coffee growers are a niche market with higher and more stable prices (Murray et al., 2003; Bacon, 2005; Crespi and Marette, 2005; Bacon et al., 2008).

The most established primary coffee ecolabelling initiatives in the markets are Fairtrade and Organic labelling (Stellmacher and Grote, 2011; Gruère, 2014). Other various third−party sustainable certification schemes such as Rainforest Alliance, Carbon footprint, 4C, and COOL (Pierrot et al., 2011; Dragusanu et al., 2014) are also designed to support producers gain a competitive advantage in the market (Giovaannucci and Ponte, 2005; Van Loo et al., 2010; Hjelmar, 2011; Teisl et al., 2011; Blackman and Rivera, 2011; Reinecke et al., 2012; Kolk, 2013; Dragusanu et al., 2014). However, the positive impacts of ecolabelling on environment can be challenged by perception of the consumers regarding the number of ecolabelling in the market and reliability of the signs on the labels. Consumers' perception has the potential to influence credibility of the labelling system and their willingness to pay (WTP) for such a product (Verbeke, 2008; Grunert, 2011; Ecolabel Index, 2020).

Consumers' WTP for environmental and/or social attributes of goods produced in a sustainable manner is widely examined and helped understand consumers' purchase behaviour (Didier and Lucie 2008; Rousu and Corrigan 2008; Yu et al., 2014; Poelmans and Rousseau 2016). Consumers' behavior towards socially responsible and eco−friendly coffee products is one of the extensively studied areas globally (Van Loo

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et al., 2015). Several primary studies (e.g. De Pelsmacker et al., 2005; Loureiro and Lotade, 2005; Basu and Hicks, 2008; Cicia et al., 2010; Cranfield et al., 2010; Langen, 2011; Rotaris and Romeo, 2011) have been conducted in various countries to evaluate the consumers' WTP for different coffee ecolabelling such as Fairtrade, Organic, Rainforest Alliance and Carbon footprint, among others. These primary studies reported varying WTP premia for ecolabelled coffee. These estimates range from positive, close to zero as well as negative across the different countries. The WTP of these primary studies shows how much consumers in the specific countries are willing to pay for certain coffee attributes. It is also a useful aspect to understand and assess how the WTP for ecolabelled coffee looks like in a wider context by developing a meta−data set that captures the behaviour of coffee consumers in different countries. Such an approach contributes to the ongoing policy dialogues around the roles of ecolabelling in the last couple of decades.

This study applies a meta−analysis to examine overall effect size (ES) and the causes of heterogeneity in the ES for the different coffee ecolabels to understand the consumer purchase behaviour for the last 15 years (2005–2020). We develop a dataset of 97 observations (n = 97) collected from 22 individual primary studies conducted in different countries. This study contributes to the food ecolabelling literature by comprehensively analysing the development of consumers' purchase behaviour for eco−coffee in the last decade. The results also provide coffee industry with an information on the market niche and competitive advantage of the existing coffee ecolabels overtime to make informed production decisions. The findings of this study can also be used as a cost benefit tool by the coffee ecolabelling initiatives to inform their decisions on whether to proceed with the existing ecolabelling approaches or review their policies depending on the consumers' preferences.

The remaining parts of the paper are organized as follows: in the next section, we elaborate on the procedures and methods used to carry out

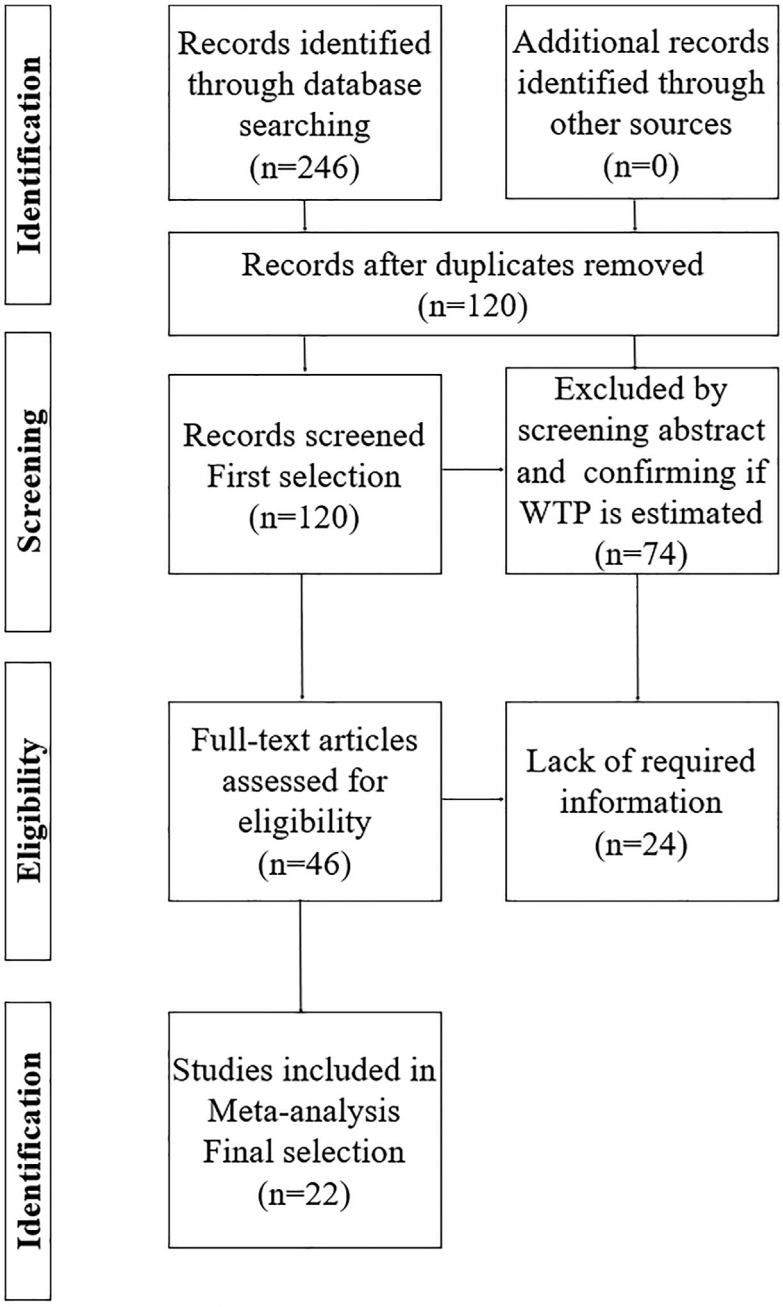

Figure 1. Literature search and documentation procedure using PRISMA. Source: adapted from (Moher et al., 2009).

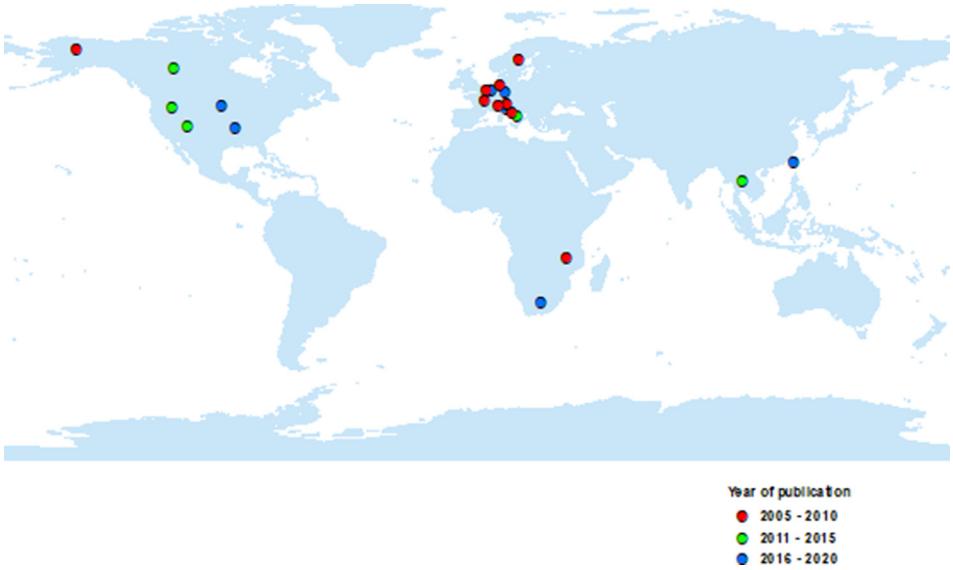

Figure 2. Location and publication years of coffee ecolabelling primary studies included in the meta−analysis. *Note*: among the 22 primary studies, 12 (54.5%), 6 (27.3%), 2 (9.1%) and 2 (9.1%) are from Europe, North America, Africa, and Asia regions, respectively. In terms of the number of observations (n = 97), 42 (43.3%), 40 (41.2%), 8 (8.2%) and 7 (7.2%) are from North America, Europe, Asia, and Africa, respectively.

Table 1. Studies included in the meta−analysis.

Authors	Country	Measures*	Methods
Lappeman et al. (2019)	South Africa	4	Contingent valuation
Catturani et al. (2008)	Italy	5	Choice experiment
Pimsiri and Yingyot (2011)	Thailand	2	Experimental auction
Gianni et al. (2010)	Italy	4	CUB
Lucia and Romeo (2011)	Italy	1	Conjoint analysis
Basu et al. (2016)	Germany	7	Choice experiment
Verteramo et al. (2016)	USA	3	Experimental auction
Verteramo Chiu et al. (2014)	USA	8	Conjoint analysis
Liu et al. (2019)	Taiwan	4	Choice experiment
Grebitus et al. (2009)	Germany	4	Experimental auction
Loureiro and Lotade (2005)	Italy	1	Contingent valuation
Maietta (2005)	Italy	1	Hedonic pricing
Cailleb and Casteran (2008)	France	1	Contingent valuation
Cranfield et al. (2010)	Canada	6	Choice Experiment
Nkana and Gao (2010)	Malawi	3	Choice Experiment
Carlsson et al. (2010)	Sweden	6	Choice Experiment
Cosmina et al. (2016)	Italy	2	Choice Experiment
Loureiro and Lotade (2005)	USA	3	Choice Experiment
De Pelsmacker et al. (2005)	Belgium	2	Choice Experiment
Van Loo et al. (2015)	USA	12	Choice Experiment
Maaya et al. (2018)	Belgium	8	Choice Experiment
Fuller and Grebitus (2019)	USA	10	Choice Experiment

Note: *denotes the number of ESs collected from each study with unweighted mean of 5.4 (see Table 2).

the data search and analysis. In section three, the insights into the results and discussion supported by related literature are presented. Finally, the paper highlights the lessons learned from the research in conclusion.

2. Methods

2.1. Identification of primary studies for meta−analysis

The data was collected with an application of Meta−Analysis of Economics Research Network (MAER−NET) protocol. The papers were collected from different databases such as 'AgEcon', 'ScienceDirect', 'Google Scholar' and 'EVRI' using key search parameters 'Coffee certification scheme + WTP', 'Consumers' behaviour + WTP + Coffee certification', 'Coffee certification + WTP', 'Coffee farmers + WTP + Coffee accreditation', 'Coffee + Organic', 'Coffee + Organic + Rainforest + Fair Trade', 'Coffee + Organic + Carbon Footprint' and 'Coffee + Carbon Footprint'. The data was collected based on the following inclusion criteria: WTP is estimated for one or more coffee ecolabelling, non−market valuations (revealed or stated) techniques applied, the document is written in English the estimates (WTP) are only for coffee beans i.e. the WTP for coffee in café is not considered, the estimates are consumers' WTP for coffee beans to avoid duplication of the effect sizes, and we exclude review papers on coffee ecolabelling.

Table 2. Descriptive statistics of variables included in the meta −regressions.

Variable	Description	Mean
ES*	Average unweighted effect size (ES) or WTP from the 22 studies	5.41
SE	Standard error of the 22 studies	0.08
Number of measures	Average number of WTP estimates collected from individual study	6.03
Grey	Type of document = 1 if the paper is not peer reviewed, 0 otherwise	0.42
COOL	COOL = 1 if the attribute is Country of Origin Labelling (COOL), 0 otherwise	0.04
Fairtrade	Fairtrade = 1 if the attribute is Fairtrade, 0 otherwise	0.45
Fairtrade + Organic	Fairtrade + Organic = 1 if the attributes are Fairtrade and Organic, 0 otherwise	0.05
Organic	Organic = 1 if the attribute is Fairtrade, 0 otherwise	0.18
ST10	ST10 = 1 if the attribute is ST10 and 0 otherwise	0.03
Hedonic pricing	Hedonic pricing = 1 if the method is Hedonic pricing (HP), 0 otherwise	0.01
Choice experiment	Choice experiment = 1 if the method is Choice experiment (CE), 0 otherwise	0.7
Conjoint analysis	Conjoint analysis = 1 if the method is Conjoint analysis (CA), 0 otherwise	0.09
Contingent valuation	Contingent valuation = 1 if the method is Contingent valuation (CV), 0 otherwise	0.08
Experiment auction	Experimental auction = 1 if the method is Experiment auction (EA), 0 otherwise	0.07
Africa	Africa = 1 if the region is Africa, 0 otherwise	0.07
Asia	Asia = 1 if the region is Asia, 0 otherwise	0.06
Europe	Europe = 1 if the region is Europe, 0 otherwise	0.43
North America	North America = 1 if the region is North America, 0 otherwise	0.43
Belgium	Belgium = 1 if the individual country is Belgium, 0 otherwise	0.1
Germany	Germany = 1 if the individual country is Germany, 0 otherwise	0.11
Italy	Italy = 1 if the individual country is Italy, 0 otherwise	0.14
USA	USA = 1 if the individual country is USA, 0 otherwise	0.37

Note: a total of 97 observations (n = 97) were collected from 22 primary studies, and * denotes the dependent variable.

We collected the data from individual papers from the year 2005–2020 during the months of April and May 2020. The time frame starts from the oldest (2005) and ends on the latest (2020) papers that estimated WTP for coffee ecolabelling satisfying our inclusion criteria.

Initially, we collected 246 papers from primary studies using the Preferred Reporting Items for Systematic Reviews and Meta−Analyses (PRISMA) framework as presented in Figure 1 (Moher et al., 2009). We sorted the papers in Mendeley library to remove the duplicates and screen the abstracts. After the duplicates were excluded, we remained with 120 papers. These 120 papers were screened in the first selection which led to exclusion of 74 papers, thus 46 papers remained. The 46 papers were fully assessed to confirm the presence of WTP estimates, which led to exclusion of 24 papers due to lack of required information which brings the final papers included in the meta−analysis to 22. The locations where the primary studies have been conducted are presented in Figure 2. Accordingly, we collected 97 observations (n = 97) from the 22 individual studies (Table 1) out of which 58% were peer−reviewed whereas the remaining 42% were grey literature (Table 2).

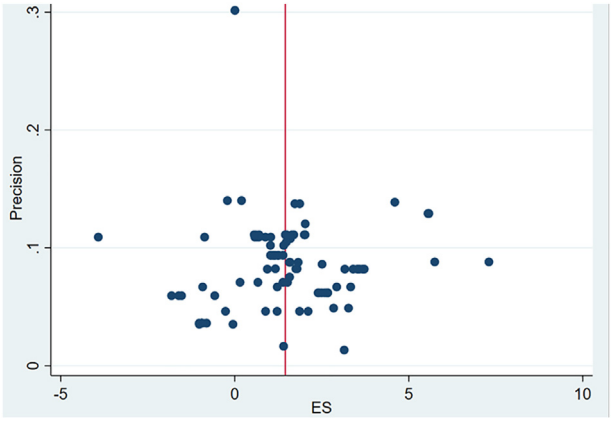

Figure 3. Inverted funnel plot of ES for coffee ecolabelling. *Note*: the solid red line represents the weighted population mean ($1.36/pound of coffee). The horizontal axis represents the ES or the WTP from the primary studies whereas the vertical axis represents the precision measured as inverse of the variance of the ES, approximated using square root of the sample size.

2.2. Data description−diagnostic tests for heterogeneity in the effect size

The heterogeneity in the data set is diagnosed using a funnel plot (Figure 3)and Hedge's Q test. The inverted funnel plot shows the ES associated with the precision measure calculated as the inverse of the square root of the sample size (Stanley, 2005). The funnel plot helps to visually assess the presence or absence of publication selection bias. The vertical axis indicates the measure of precision while the horizontal axis represents the standardized ES values from the primary studies.

The solid red line shows the position of the precise mean value of consumers' WTP for a pound of ecolabelled coffee (1.36$/pound). The deviation of the individual estimates relative to the red line represents the expected pattern of wider dispersion associated with heterogeneous estimates. A further test to diagnose the heterogeneity of the ES using the Hedge's *Q* statistics led to the rejection of the null hypothesis that effect sizes are homogeneous ($\chi^2 = 85.385$, d.f. = 96, heterogeneity index (I^2) = 99.5%, $p < 0.000$) (Hedges and Vevea, 1998). The heterogeneity tests support the existence of factors that explain the variation in the ES which can be publication bias or other factors such as coffee ecolabelling and WTP elicitation methods, among others.

2.3. Identification of explanatory variables

We used various explanatory variables to explain the source of the heterogeneity in the ES which is a common characteristic of meta−data. In our context, the possible causes of the heterogeneity could either be attributed to the region/country of the study, ecolabelling, or elicitation methods used in the primary studies (Oczkowski and Doucouliagos, 2015). The explanatory variables are grouped into four categories. The first variable category includes the standard error (SE) and types of document. The SE is a continuous variable included to capture the variation in the ES associated with publication bias. A highly significant

Table 3. Consumers' WTP for individual coffee ecolabelling.

Attributes	Weighted ES	SE	P−value
Fairtrade	0.710	0.050	0.000***
Organic	0.110	0.320	0.001***
COOL	0.050	0.220	0.028**
Fairtrade + Organic	0.028	0.017	0.101
Rainforest alliance	0.012	0.013	0.217
Local	0.002	0.440	0.660
ST90	0.011	0.010	0.313
ST10	0.101	0.010	0.313
Wild	0.005	0.007	0.489
Carbon footprint	0.008	0.009	0.376
Overall ES	1.360	0.173	0.000***

Note: ***, **, * *indicates significance levels at 1%, 5% and 10%, respectively.*

relationship between the SE and the outcome variable (ES) indicates the existence of publication bias (Stanley, 2005).

The type of document is a dummy variable with a value of 1 denoting grey literature or 0 otherwise (peer−reviewed articles). The grey literature is expected to influence the variation in the ES positively and significantly. The second variable category is coffee ecolabels that include Organic, COOL, ST10, Fairtrade and Rainforest, among others. All the ecolabelling variables are dummy variables with a value of 1 to capture the existence of that particular ecolabel or 0 otherwise.

The third category of the variables is the methodology used in the primary studies to elicit consumers' WTP for a pound or kilogram of eco−coffee. The commonly used elicitation methods are the choice experiment, conjoint analysis, contingent valuation, hedonic pricing, experimental auction and CUB. In econometric estimations, we kept the CUB model a base and compared the other models against the CUB. In addition to explaining heterogeneity in the ES, the inclusion of elicitation methods as moderator variables can also indicate the type of non−market valuation technique more susceptible to hypothetical bias. The last variable category is regional or specific country dummy. We include the regional and individual country dummies to illustrate the consumers' preference for ecolabelled coffee in different regions or countries. Before we estimated our meta−models, we standardized the ES and its respective standard error to make the outcome comparable across the different countries. We used the adjusted Purchasing Power Parity (PPP) at the year of data collection to convert the ES into the same unit ($/pound) and Consumer Price Index (CPI) of the year 2018 to account for inflation.

2.4. Specification of meta−estimators

We used meta−regressions to explain the variation in the ES. Numerous meta−studies have applied different estimators based on the nature of the data and diagnostic tests. In order to identify the estimators

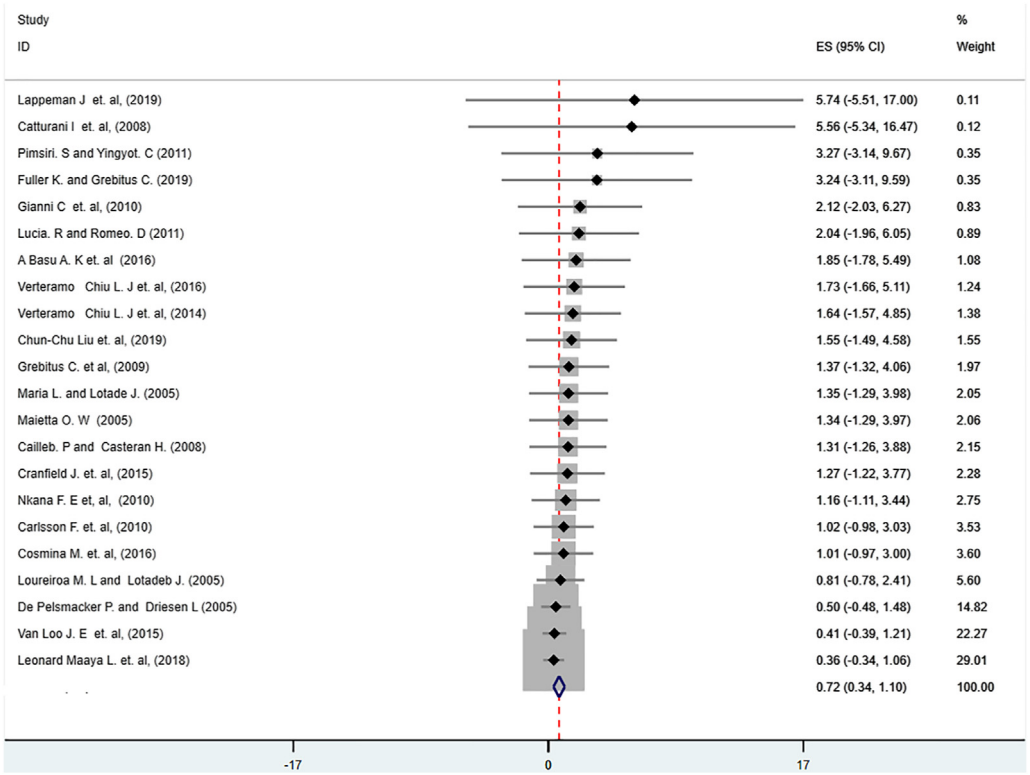

Figure 4. Forest plot of the WTP for coffee eco−labelling. *Note*: the grey horizontal lines represent confidence interval (CI) of the ES. The black diamond shapes denote the individual ES from each primary study. The grey square shape on each diamond shape shows precision level of each ES i.e., the larger the grey square on the ES, the more precise the ES estimates and the narrower CI. Finally, the broken red line represents weighted population mean ($1.36/pound of coffee).

Table 4. Meta−regression analysis of WTP for coffee attributes: regional dummy.

Variables	OLS	WLS, Robust	WLS, Cluster	Panel RE
Standard error (SE)	9.037	31.95*	31.95	−8.248*
	(5.981)	(12.94)	(16.14)	(3.957)
Document (1 = Grey)	0.678	1.112**	1.112*	0.644
	(0.380)	(0.331)	(0.489)	(1.017)
Fairtrade	0.251	−0.0215	−0.0215	1.029***
	(0.498)	(0.408)	(0.398)	(0.298)
Fairtrade + Organic	0.133	−0.653	−0.653	0.235
	(0.859)	(0.869)	(1.018)	(0.459)
Organic	1.113	1.141*	1.141	0.860**
	(0.560)	(0.544)	(0.608)	(0.319)
Rainforest alliance	1.031	0.773	0.773	0.897*
	(0.821)	(0.462)	(0.514)	(0.436)
ST10	0.512	0.739	0.739	0.976
	(1.009)	(0.619)	(0.446)	(0.504)
COOL	−0.158	−0.667	−0.667	−0.209
	(0.872)	(0.620)	(0.525)	(0.594)
Choice experiment (1 = CE)	−0.366	−0.982*	−0.982	0.311
	(0.792)	(0.476)	(0.616)	(1.705)
Conjoint analysis (1 = CA)	−1.248	−2.206*	−2.206	0.611
	(1.046)	(1.033)	(1.126)	(2.249)
Contingent valuation (1 = CV)	−1.386	2.578***	2.578**	−1.330
	(1.167)	(0.606)	(0.682)	(1.827)
Experimental auction (1 = EA)	0.521	−0.852	−0.852	1.451
	(1.046)	(0.838)	(1.076)	(1.812)
Region (1 = Africa)	0.448	−2.429	−2.429	0.883
	(1.303)	(1.847)	(2.209)	(2.360)
Region (1 = Europe)	−1.192	−0.340	−0.340	−2.795
	(0.821)	(0.768)	(1.041)	(1.765)
Region (1 = North America)	−2.330**	−2.309***	−2.309*	−3.691*
	(0.778)	(0.595)	(0.856)	(1.860)
Constant	1.931	0.136	0.136	3.543
	(1.188)	(1.043)	(1.434)	(2.332)
N	97	97	97	97
R^2	0.347	0.535	0.535	$\chi^2 = 36.96$
F	2.87	4.88	13.04	na

Note: ***, **, * indicates significance levels at 1%, 5% and 10%, respectively. CUB model is kept as a base to compare the rest of the models against this. Standard errors in parentheses.

that coincide with the data set, it is important to specify the meta−models stepwise (Poe et al., 2000; Nelson and Kennedy, 2009; Kaul et al., 2013). The model specification begins with Ordinary Least squares (OLS) written as follows:

$$WTP_{ij} = \beta_0 + \sum \beta_{ij} X_{ij} + \beta_1 SE_{ij} + \varepsilon_{ij} \quad (1)$$

In Eq. (1), WTP_{ij} indicates willingness to pay for specific coffee ecolabelling i from study j. The β_0 , β_{ij} and β_1 are the parameters to be estimated. The X_{ij} represents the explanatory variables associated with eco−labeled coffee, elicitation methods, document types and regions whereas the SE_{ij} denotes SE. The ε_{ij} represents stochastic component of the model. Eq. (1) is called Funnel Asymmetry Test−Precision Effect Test (FAT−PET) in meta−regressions (Stanley, 2005). The FAT tests for the existence of publication selection bias i.e., whether $\beta_1 = 0$ or not using SE as an explanatory variable. If the null hypothesis that $\beta_1 = 0$ is rejected, there is significant correlation between the SE and ES which in turn indicates the existence of publication bias. If there is no publication bias, the variation in the ES is explained by other factors beyond the publication bias which is captured by the PET $\beta_0 + \sum \beta_{ij} X_{ij}$. If the hypothesis that the ES is equivalent to zero i.e. all the β_{ij} are not significantly different from zero is rejected, it means that these variables might be ecolabelling or other factors that are significantly explaining the heterogeneity in the ES (Oczkowski and Doucouliagos, 2015).

The OLS estimator is limited in accounting for the precision as it assigns equal statistical significance to the ES of studies. The WTP estimates from the primary studies vary in terms of precision. Some of the effects sizes (ESs) are estimated from large sample sizes whereas others are estimated from small sample sizes which assigns different weights on the precision of the observations. In order to account for the precision of the estimates, it is important to weigh the ES by the inverse of the variance. We applied the Weighted Least Square (WLS) to assign proportional weights to the observations (Lusk et al., 2005). WLS also estimates ES more accurately than other estimators in the presence or absence of publication bias (Oczkowski and Doucouliagos, 2015).

Assuming the variance of a given WTP_i is σ_i^2, the weight assigned to WTP_i from study j can be written as: $w_{ij} = \frac{1}{\sigma_i^2}$

$$WTP'_{ij} = \beta'_0 + \beta'_{ij} X'_{ij} + \varepsilon'_{ij} \quad (2)$$

where the X_{ij} are weighted by w for the purpose of precision of the estimates in Eq. (2).

Table 5. Meta−regression analysis of WTP for coffee Attributes: country dummy.

Variables	OLS	WLS, Robust	WLS, Cluster	Panel RE
Standard error (SE)	12.51*	21.41*	21.41	−6.716
	(5.308)	(8.555)	(12.55)	(4.088)
Document (1 = Grey)	0.865	1.038	1.038	1.213
	(0.454)	(0.546)	(0.551)	(1.065)
Fairtrade	−0.326	−0.593	−0.593	0.965**
	(0.490)	(0.412)	(0.498)	(0.313)
Fairtrade + Organic	−0.219	−0.729	−0.729	0.211
	(0.875)	(0.908)	(1.048)	(0.485)
Organic	0.872	0.494	0.494	0.862*
	(0.566)	(0.568)	(0.582)	(0.337)
Rainforest alliance	0.839	0.666	0.666	0.880
	(0.845)	(0.500)	(0.663)	(0.461)
ST10	0.188	0.287	0.287	0.953
	(1.037)	(0.585)	(0.528)	(0.534)
COOL	−0.578	−1.646	−1.646	−0.236
	(1.048)	(0.948)	(0.984)	(0.630)
Choice experiment (1 = CE)	−0.236	−0.236	−0.236	0.682
	(0.989)	(0.779)	(0.898)	(1.781)
Conjoint analysis (1 = CA)	−1.215	−1.269	−1.269	0.841
	(1.183)	(1.035)	(1.173)	(2.094)
Contingent valuation (1 = CV)	0.0306	3.328**	3.328*	−0.719
	(1.138)	(1.225)	(1.342)	(1.855)
Experimental auction (1 = EA)	0.946	0.357	0.357	1.968
	(1.239)	(1.020)	(1.180)	(1.895)
Belgium	0.778	1.008	1.008	−2.120
	(0.647)	(0.626)	(0.992)	(1.585)
Germany	−0.156	0.0334	0.0334	−2.147
	(0.733)	(0.912)	(1.212)	(1.806)
Italy	0.446	1.001	1.001	−1.411
	(0.725)	(1.232)	(1.371)	(1.302)
USA	−1.320*	−1.349*	−1.349	−3.038*
	(0.529)	(0.626)	(0.841)	(1.284)
Constant	0.546	−0.345	−0.345	1.892
	(1.209)	(1.204)	(1.346)	(1.982)
N	97	97	97	97
R^2	0.318	0.551	0.551	$\chi^2 = 30.34$
F	2.33	5.35	6.16	na

Note: ***, **, * indicates significance levels at 1%, 5% and 10%, respectively. CUB model is kept as a base to compare the rest of the models against this. Standard errors in parentheses.

The WLS estimator has the potential to handle heterogeneous data in the meta−analysis (Oczkowski and Doucouliagos 2015). However, it is also vital to compare WLS estimator results to other estimators such as fixed effect (FE) or random effect (RE) models to understand if the variation among the ESs is due to within or between study variations. The decision whether to use the FE or RE is determined by the objective (Borenstein et al., 2010) of the meta−study and Hausman test (Oczkowski and Doucouliagos, 2015). The FE model assumes that the variation among the ESs of the studies is due to sampling fluctuation only which can be accounted for by moderator analysis. The RE model assumes that the deviation of study mean effect sizes from the population mean is not only due to sample fluctuation, but also the variation in the distribution of the ESs around the population mean. Therefore, the source of variation is as a result of both sample fluctuation and population variability. The Hausman test provided insufficient evidence to reject the null hypothesis ($\chi^2 = 0.75$, Prob = 0.9998) that RE model is an appropriate model (Hunter and Schmidt, 2000). The RE equation can be written as:

$$WTP_{ij} = \beta X_{ij} + \mu_{ij} + \tau_{ij} \quad (3)$$

In Eq. (3), X_{ij} represents the moderator variables, μ_{ij} is deviation of WTP from population mean due to sampling fluctuation (within study error) and τ shows RE variance which is heterogeneity of the ES due to between studies error.

We carry out a variable inflating factor (VIF) test which showed absence of multicollinearity among the explanatory variables (average VIF = 3.24). The White test led to rejection of the null hypothesis that the variance of the error terms is homoscedastic ($p < 0.000$) and concluded that the computation of robust standard errors is important in our meta−models.

3. Results and discussion

3.1. The 15 years WTP for coffee attributes and forest plot

In the descriptive statistics, we illustrate the weighted consumers' WTP for each coffee attribute (Table 3) and the effect of elicitation methods on consumers' WTP (Figure 3).The ES for each attribute is estimated and weighted by the inverse of the variance approximated using square root of the sample size. Accordingly, the weighted average

Table 6. Meta−regression analysis of WTP for coffee attributes: WLS regional dummy.

Variables	Ecolabel	Ecolabel/methods	All
Standard error (SE)	−5.637	8.967*	12.23
	(9.940)	(4.269)	(7.276)
Document (1 = Grey)	0.181	0.440	0.733
	(0.601)	(0.443)	(0.438)
Fairtrade	0.501	0.325	0.429
	(0.659)	(0.611)	(0.554)
Fairtrade + Organic	−0.0320	−0.488	−0.180
	(0.841)	(0.878)	(0.906)
Organic	1.547	1.725*	1.800*
	(0.809)	(0.744)	(0.758)
Rainforest alliance	0.985	0.908	1.496**
	(0.611)	(0.606)	(0.552)
ST10	0.610	0.294	0.740
	(0.752)	(0.600)	(0.572)
COOL	−0.0247	0.510	0.211
	(0.786)	(0.823)	(0.884)
Choice experiment (1 = CE)		−1.216*	−0.963
		(0.490)	(0.509)
Contingent analysis (1 = CA)		−1.719	−1.266
		(0.904)	(0.888)
Contingent valuation (1 = CV)		1.783**	2.076**
		(0.548)	(0.627)
Experimental auction (1 = EA)		−0.228	−0.177
		(0.724)	(0.756)
Region (1 = Africa)			−1.875
			(1.624)
Region (1 = Europe)			−1.461
			(0.864)
Region (1 = North America)			−2.333**
			(0.702)
Constant	0.944	0.611	1.626*
	(1.260)	(0.725)	(0.809)
N	97	97	97
R^2	0.06	0.46	0.50
F	1.15	4.59	4.35

Note: ***, **, * indicates significance levels at 1%, 5% and 10%, respectively. CUB model is kept as a base to compare the rest of the models against this. Standard errors in parentheses.

ES for coffee ecolabel is 1.36$/pound, and significantly different from zero. This indicates that consumers' WTP for a pound of eco−coffee for the last 15 years (2005–2020) is positively significant showing that consumers from our sampled primary studies are pro−eco−coffee. Likewise, the weighted average ES for the Fairtrade, Organic, and COOL are significantly different from zero.

The difference in ES for different attributes indicates consumers' preference for a particular ecolabelled coffee. However, it is not straightforward to compare the ES value of one attribute against the other as the number of studies or observations, elicitation methods and countries where the studies were conducted are different. For example, ES for Organic is 0.11$/pound and that of Fairtrade attribute is 0.71$/pound. However, 11 observations were used to calculate the ES for Organic whereas 44 observations were synthesized to estimate the ES for the Fairtrade attribute; the countries where the studies were conducted, and the elicitation methods applied also vary.

Figure 4 demonstrates the confidence interval of the estimated ES using different non−market valuation techniques. The horizontal grey lines represent the confidence intervals of the individual ES for the 22 studies. The small−black diamonds show the ES for the individual studies within each confidence interval (grey horizonal line). The broken red line is the average population mean of the 22 studies which is $1.36 for a pound of coffee. The grey squares on each diamond shape show the relative size of the ES i.e., precision level of each ES. The narrower the confidence interval, the bigger the precision level of the ESs. Similarly, Figure 4 also shows that most of the discrete choice experiments provide smaller confidence intervals on the ES compared to other elicitation methods. This indicates that elicitation techniques have significant effects on the estimation of WTP in primary studies.

3.2. Meta−regression results and implications

In this section, we present the estimation results of the OLS, WLS Robust, WLS Cluster and RE models. The econometric estimations are presented in Tables 4, 5, 6, and 7. First, we estimated the models using regional and country dummies with other explanatory variables under different model specifications (Tables 4 and 5). The robust WLS model estimates the value by assigning proportional weight to the ES and generates lower standard error compared to other estimators. The cluster WLS model is estimated by clustering the ES at a study level. The existence of multiple ESs from one study supports the use of cluster error estimates. The estimates from WLS Robust and Cluster estimators are similar but differ only in the magnitude of SE (Lusk et al., 2005). Second, we estimated the models in a parsimonious fashion to understand the

Table 7. Meta−regression analysis of WTP for coffee Attributes: WLS country dummy.

Variables	Ecolabel	Ecolabel/methods	All
Standard error (SE)	−5.637	8.967*	12.68*
	(9.940)	(4.269)	(5.313)
Document (1 = Grey)	0.181	0.440	0.856
	(0.601)	(0.443)	(0.561)
Fairtrade	0.501	0.325	−0.160
	(0.659)	(0.611)	(0.498)
Fair + Organic	−0.0320	−0.488	−0.586
	(0.841)	(0.878)	(0.914)
Organic	1.547	1.725*	1.248
	(0.809)	(0.744)	(0.684)
Rainforest alliance	0.985	0.908	1.315*
	(0.611)	(0.606)	(0.536)
ST10	0.610	0.294	0.0558
	(0.752)	(0.600)	(0.612)
COOL	−0.0247	0.510	−1.130
	(0.786)	(0.823)	(1.006)
Choice experiment (1 = CE)		−1.216*	−0.162
		(0.490)	(0.769)
Contingent analysis (1 = CA)		−1.719	−0.525
		(0.904)	(0.934)
Contingent valuation (1 = CV)		1.783**	3.174**
		(0.548)	(1.169)
Experimental auction (1 = EA)		−0.228	1.635
		(0.724)	(1.018)
Belgium			0.940
			(0.662)
Germany			−1.668
			(1.004)
Italy			1.061
			(1.186)
USA			−0.996
			(0.676)
Constant	0.944	0.611	−0.436
	(1.260)	(0.725)	(1.103)
N	97	97	97
R^2	0.06	0.46	0.56
F	1.15	4.59	5.57

Note: ***, **, * indicates significance levels at 1%, 5% and 10%, respectively. CUB model is kept as a base to compare the rest of the models against this. Standard errors in parentheses.

effects of each variable category. We first consider the type of ecolabelling, standard error and document type, then gradually the elicitation methods and finally with all the controls (Tables 6 and 7). In the second estimation, we reported the estimates from WLS Robust model only based on the justification given the previous section.

In this paper, we interpreted the results of robust WLS Robust only as it generates more precise estimates compared to the OLS/RE and lower SE compared to the clustered WLS model for both regional and individual country dummy. The results from model 2, WLS Robust, as illustrated in Table 4, indicate that SE, grey literature, Organic, choice experiment (CE), conjoint analysis (CA), contingent valuation (CV) and Northern American region have significant and different effects on the ES. The SE is a continuous variable that tests either presence or absence of publication bias. The SE is significant at 10% which is acceptable level to indicate the absence of publication bias (Oczkowski and Doucouliagos, 2015). The grey literature has positive and significant effect on the ES which implies that grey literature increases the variation of ES by $1.11 compared to the peer reviewed papers which is consistent with the literature (Stanley, 2005; Stanley et al., 2013). The higher effect of the grey literature compared to peer−reviewed articles indicates that the grey literature may overestimate the WTP (Stanley et al., 2013). Therefore, when the grey literature has positive and significant effects on the ES, it does not necessarily mean that there is publication bias. Rather, it may imply overestimation of the ES in grey literature compared to peer−reviewed papers.

Among the coffee ecolabelling our results indicate that Organic is positively significant which denotes that the presence of Organic coffee ecolabelling increases the ES for a pound of coffee by $1.14, keeping other factors constant. Therefore, Organic coffee production has significantly influenced the consumers' WTP in the last 15 years. We also incorporated WTP elicitation methods as explanatory variables in the meta−regressions. The results show that the choice experiment (CE) and conjoint analysis (CA) significantly influence the variation in the ES negatively, whereas contingent valuation (CV) has a positive and significant effect on the ES. Even though it is not possible to conclude that one model is superior to the other, these results imply that elicitation methods are important factors in explaining the variation in the ES.

Moreover, the mean ratio between CE and CV, using WLS robust, is −0.38 indicating that when the CV tends to increase the WTP by $1

dollar, the CE tends to decrease the WTP by $0.38, *ceteris paribus*. This suggests the presence of hypothetical bias in the CV where consumers overstate their WTP for a pound of coffee compared to CE, this might be associated with the problem of 'yea' saying in the CV. This finding is in line with some meta−analyses literature and contradicts some others. For example, Murphy et al. (2005) found a median ratio of hypothetical to actual WTP of 1.35 factor while List and Gallet (2001) found that participants overstate their preference by 3 factors. However, Carson et al. (1996) concluded that the estimates from stated preference (SP) tend to be lower than the estimates from a revealed preference (RP) with a mean ratio of SP to RP equals 0.89.

Northern American regional dummy negatively and significantly influences the ES of coffee ecolabelling. Despite coffee ecolabelling influencing consumers' familiarity with the product, the increasing number of ecolabels, the imbalance between consumers' intention and actual purchase behavior, the costly accreditation process and complexity of the information and signals being conveyed to the consumers may contribute to the lower consumers' WTP in different regions (Yokessa and Marette, 2019); which might be the case for the Northern America coffee consumers. The individual country dummy results in Table 5, WLS robust, show that consumers' WTP for a pound of coffee in the USA is negatively significant which might be associated with lack of trust in the ecolabels, complexity of the information and signals being conveyed to the consumers, among others. Likewise, CV has positive and significant effect on the ES, *ceteris paribus*.

We also estimated the models in a parsimonious fashion in order to examine how inclusion of each variable category changes the sign and directions of the estimates for both regional and country dummy, considering the WLS model (Robust). In both regional and country dummy models of this estimation, the Organic feature of coffee is observed to be the most important factor explaining the variation in the ES (Tables 6 and 7). This consistent finding across the different models estimated indicates the robustness of the results.

4. Concluding remarks

Primary studies of coffee ecolabelling provide information on consumers' WTP for eco−coffee in a particular country for a specific attribute. However, it is problematic to explain heterogeneity in the ES and the effects of ecolabelling on consumers' purchase behavior in a broader context from the estimates of individual primary studies. To provide comprehensive evidence on the effects of ecolabelling on consumers' purchase behavior in the last 15 years, we applied a meta−analysis that combines ES from individual primary studies and explains the heterogeneity in the ES using several explanatory variables. We conclude that the consumers' WTP for a pound of coffee is positively and significantly influenced by the presence of Organic, COOL, and Fairtrade ecolabels. From the WLS models, we conclude that Organic is the most influential coffee ecolabel affecting consumers' WTP in the last decade. This contributes to food ecolabelling literature indicating that the heterogeneity in consumers' WTP for coffee is explained, mostly, by the presence of Organic attributes in coffee market. This could be explained by the perceived health and environmental benefits attributed to Organic coffee farming. The CE estimates the effect size more precisely compared to other SP methods whereas hypothetical bias is larger in CV compared to the CE. Therefore, we conclude that elicitation methods are important factors in explaining the variation of ES estimates rather than presuming that only product−related attributes cause variation in the ES. The regional difference in the WTP for coffee ecolabelling indicates heterogeneity in consumers' preference for eco−coffee in a broader context−different part of the world. In general, despite the debate in the literature that the existence of multiple ecolabelling in the market may cause a decline in consumers' trust and WTP over time, our study concludes that consumers' purchase behavior in selected countries is pro−eco−coffee.

Declarations

Author contribution statement

Nizam Abdu: Conceived and designed the analysis; Analyzed and interpreted the data; Contributed analysis tools or data; Wrote the paper.

Judith Mutuku: Contributed analysis tools or data; Wrote the paper.

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