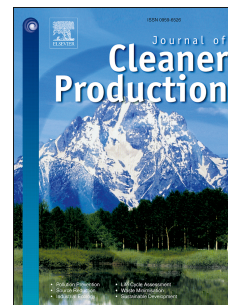


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Emerging versus developed economy consumer willingness to pay for environmentally sustainable food production: A choice experiment approach comparing Indian, Chinese and United Kingdom lamb consumers

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**Abstract**

In China and India, income growth is driving a structural change in dietary patterns away from staples towards more livestock foodstuffs such as meat products, exacerbating already significant environmental pressures from food production. This study uses the choice experiment (CE) method in surveys of Chinese, Indian and United Kingdom lamb consumers to explore potential for environmental labeling of lamb meat in emerging economies to form part of agri-environmental response to these pressures. Choice experiments are a stated-preference nonmarket approach to valuing consumer willingness to pay. Lamb consumers are presented with differing hypothetical products described by attributes describing environmental certification standards, with observed choices and product attributes analysed in a probabilistic Random Utility Model econometric framework. While preference disparities are found between emerging and developed economy consumers, results demonstrate that emerging economy consumers' choice of lamb products can be influenced by production processes that incorporate environmental sustainability. Indian consumers are found to be willing to pay relatively more for environmentally certified production practices than Chinese or UK counterparts. Of the environmental practices considered in this study, Greenhouse Gas minimisation is valued the most, in all three countries.

Key words: Choice experiment; willingness to pay; environmentally sustainable food production; emerging economy; cross-country comparison

## 1. Introduction

Rising income in emerging economies is a significant evolving dynamic in global food demand growth (Schmidler and Shetty, 2005). In China and India, income growth is also driving a structural change in dietary patterns away from staples towards more livestock foodstuffs such as meat products (Goel, 2010; Food and Agriculture Organisation of the United Nations, 2006; 2012). Since 1960, China has experienced a 40-fold increase in meat consumption, contrasting to only a 3-fold increase in cereals (FAOSTAT, 2012). A similar pattern, while not as dramatic as in China, has emerged in India with a 3-fold increase in meat consumption contrasting with a 2-fold increase in cereals consumption over the same period (FAOSTAT, 2012). Furthermore, observed increasing rates of meat consumption are anticipated to continue (OECD FAO, 2012).

This change in dietary patterns exacerbates already significant environmental pressures from food production, such as loss of animal habitat and water quality degradation (Hallström et al. 2015). Reduction of the pollution intensity of high volume grocery products is therefore an objective that could potentially be a major contributor in ameliorating increased environmental pressure (Upham et al. 2011). As incomes grow, consumers' product choice behaviour can change with product attributes other than price playing a greater role in consumption decisions, including for consumers in emerging economy markets (Dong and Fuller, 2007). The potential for environmental sustainability labelling of food products to change emerging economy consumer behaviour has been recognised (Shingrup, 2013; Saxena and Khandelwal, 2010; Vernekar and Wadhwa, 2011). Although estimation of consumer willingness to pay (WTP) for food attributes has received significant research attention in developed economy markets, much less is known about emerging economy consumers. This issue is intensified by a recognition that consumers in different countries may not respond in the same way to the same product attribute, with WTP, especially for socially responsible and origin-based food products, dependent in part on the culture and traditions of countries' consumers (McCluskey and Loureiro, 2003). To date, the focus of direct cross-country comparison studies has been on differences across developed countries (Wezemal et al. 2014) with scant attention to providing direct cross-country comparisons in an emerging economy context (Basu and Hicks, 2008; Tonsor et al. 2009).

Wider consumer literature suggests Chinese consumers tend to prefer goods produced in an environmentally sustainable manner (Zhao et al. 2014; Wang et al. 2013) and that green food certification is rapidly developing (Bai et al. 2007; Liu et al. 2010). However, estimation of WTP for these types of attributes is in its infancy (Shuai et al. 2014) with the literature dominated by studies valuing food safety aspects of production (Ortega et al. 2011; 2012; Zheng et al. 2013; Xu and Wu,

2010; Bai et al. 2013). A similar situation appears in the Indian context. While there are few studies estimating consumer WTP for environmentally sustainable food production (Mahapatra, 2013; Moser et al. 2012), a considerable literature supports the view that Indian consumers are among the highest ranked according to environmental sustainability of their behaviour, preferring greener alternatives over non-green options (Ishaswini and Datta, 2011; Khan, 2012). This is consistent with expectations of green marketing growing in both practice and demand in India (Mishra and Sharma, 2010; Saxena and Khandelwal, 2010; Vernekar and Wadhwa, 2011; Shingrup, 2013; Mandal, 2013).

A review of the literature applying CE method valuing consumer WTP for attributes of food products reveals a relatively small but growing body of work applied to Chinese consumers. Estimates of WTP by Chinese consumers have been found to be relatively high. In a study of Chinese preferences' for pork attributes, Ortega et al. (2011) estimate that consumers are WTP a 100% price increase for pork with safety certification, and 60% more for pork that is labelled with the country of origin. Chinese preferences for safety certification of milk has also been studied with consumers estimated to be WTP 203% price increase for government certification and 98% for private certification (Ortega et al., 2012). Traceability systems have been proposed as an approach to ameliorating safety concerns and consumers are estimated to be WTP a 244% premium for traceability certified milk (Bai et al., 2013). While food safety concerns have dominated CE applications, WTP for attributes embodying environmental outcomes have also been assessed. Consumers have been found to be WTP a 121% increase in the price of onions if they are pesticide-free, and 40% more if they are free from Genetic Modification (GM) (Ehmke et al., 2008). In an application to soybean milk, organic production was estimated to attract a 113% premium, and consumers would be WTP 78% more for GM-free soy milk (Zheng et al., 2013).

Applications of CE method to food product consumers in India is very limited, but there have also been applications of the closely related Contingent Valuation Method (CVM). With a long track record of diverse application, the CVM is also a stated preference survey based nonmarket valuation method, and is the precursor to developments in CE method. In contrast with the majority of consumer applications in China focusing on safety concerns, the limited number of studies in India have explored consumer preferences for environmentally related product attributes. In a study of preferences for banana attributes Moser et al., (2012) found that consumers were WTP 27% more for bananas that had a low environmental impact, and 36% more for bananas that were pesticide free or 23% more if they were sprayed with bio-degradable pesticides. Mahapatra (2013) applied a non-specific generalised product framing when surveying consumers and found them WTP 5 to 10% more for goods that was produced using environmentally friendly production systems. Another

CVM study examining consumer preferences for vegetables found consumers were WTP 56% more for pesticide free production (Krishna and Qaim, 2008).

The aim of this study is to explore potential for environmental labeling of lamb meat in emerging economies to reduce ecological pressures from production. Specifically, by investigating emerging economy consumer preferences over sustainability attributes of lamb production, and how they could affect product choice. To do this we use the CE method in surveys of Chinese, Indian and the United Kingdom (UK) lamb consumers to accomplish two objectives. First, we estimate emerging economy consumers' WTP for different environmental sustainability attributes of lamb production. Second, we investigate if there are any differences in WTP between emerging (i.e. China and India) and developed (i.e. the UK) economy consumers. We select India and China as they are the two largest emerging economies globally, and lamb as a meat product is mutual to all three countries. The inclusion of a developed economy consumer group provides a comparison to consumers relatively advanced in established preferences for environmental attributes of food products (Jaffry et al. 2004; Bitzios et al. 2011). The key question being addressed in conducting this comparison is whether environmental claims are desirable to emerging economy consumers, and if so, whether these preferences are similar or different to those of developed economy consumers. This paper extends current knowledge about emerging economy market consumers where valuation studies are scant, and provides a direct cross-country comparison of emerging and developed economy consumer WTP values, not known to be published previously.

The paper proceeds by presenting next the choice experiment method employed to estimate and compare WTP. Model estimation results are presented and WTP is calculated and discussed in Section 3. Section 4 concludes the paper with main findings.

## **2. Method**

### *2.1 Choice experiment*

This study employs the stated preference method of choice experiments to estimate consumer WTP for attributes of lamb production. Choice experiments have been extensively used to value consumer preferences for food product attributes (Bitzios et al, 2011). As opposed to revealed preference methods such as using direct or indirect market prices, this survey based approach facilitates valuation of attributes that may not be directly observable in markets such as the attributes explored in the current paper. The ability of this method to identify which individual attributes are more important in consumer choices, and to estimate marginal WTP for these

attributes, has seen this approach to valuation become increasingly favoured by researchers. The method involves simulating the context in which consumers would normally make choices among a set of competing food alternatives. This is achieved by designing an experiment in which attributes are systematically and independently varied to produce multiple choice scenarios. Consumers are then asked to indicate their preferred food alternative in each scenario, with the observed levels of attributes in the chosen and non-chosen alternatives modelled in a probabilistic econometric framework.

In this study, alternative lamb products presented to consumers are described by the environmental impacts of production, animal welfare, food safety, country of origin and price. Consumers are asked to indicate their preferred alternative in each scenario. The observed choice and associated attribute levels of each alternative are modelled in a probabilistic econometric framework using Random Utility Models (RUM) underpinned by the theory of choice behaviour known as Random Utility Theory (McFadden, 1974; Ben-Akiva and Lerman, 1985). In this way, choice experiments provide a utility theoretic measure of preferences over various product characteristics. Random Utility Theory postulates that consumers associate some utility (a latent measure of preference) with each product that they consider. Consumers try to maximise their utility by choosing the product option that they think is best for them, subject to what they know about competing options and whatever constraints, such as income, are operating on their choices. The concept of randomness in the RUM context does not imply that people make their choices randomly, but that there is a random component associated with an individual's choices that is a consequence of factors unobserved by the researcher, that are influencing choice. The RUM can be made operational by formulating the relationship of an individual's utility function as:

$$U_{ni} = \beta_{0,n} + \sum \beta_k x_{ni} + \varepsilon_{ni} \quad (1)$$

Where,  $U_{ni}$  is the measure of utility from alternative  $i$  for individual  $n$  and is a function of constant variable  $\beta_0$ , the sum of the utilities for each  $k$  attribute where  $\beta_k$  is the utility weight to be estimated and  $x$  is a vector of observed parameters,  $\varepsilon_{ni}$  is an unobserved error term which is randomly distributed. The random component allows analysts to express consumer choice in probabilistic terms that enables the underlying preferences for attributes to be extracted:

$$P_{(ni|A)} = \text{Prob}(U_{ni} > U_{nj}) \quad i, j \in A \text{ and } i \neq j \quad (2)$$

Where the probability of choosing alternative  $i$  in choice set  $A$  ( $P_{(ni|A)}$ ) is commensurate with the probability that the utility  $U_{ni}$  is greater than the utility of the other alternatives  $U_{nj}$  in  $A$ . Assuming that the error term is distributed independently and identically (IID) with extreme value type I, results in the multinomial logit (MNL) model (McFadden, 1974), the most commonly used form of discrete choice model. Under these circumstances the probability of selecting alternative  $i$  has a simple closed form solution which assumes homogenous preferences of attributes for all consumers in the sample (i.e. the  $\beta_k$  is the same for all individuals). However the restrictive assumptions of this model inherent in the error term formulation are often not satisfied in the empirical data (Train, 2009). In this paper we employ an alternative more flexible model, the Random Parameter Logit (RPL) model which represents a full relaxation of the IID assumption, accommodates correlations among panel observations and accounts for uncontrolled heterogeneity in tastes across respondents (Train, 2009). Preference heterogeneity is introduced in the individual specific random parameters for attributes (Greene and Hensher, 2007). The parameter vector is expressed as the population mean  $\beta$  and the individual specific deviation  $\eta_n$  from a specified continuous distribution (Train, 2009). Hence the utility function can be rewritten as:

$$U_n = \beta X_n + \eta_n X_n + \varepsilon_n \quad (3)$$

The stochastic part of utility may now be correlated among alternatives and across the sequence of choices via the common influence of  $\eta_n$  (Greene and Hensher, 2007). We include an error components specification that allows for correlation patterns between the unobserved portions of the utility of alternatives. In order to take into account the degree of heterogeneity whilst obtaining meaningful WTP estimates, we specify triangular distributed random parameters for all attributes including price, with the spread of the price coefficient constrained to be equal to its mean. The choice probability resulting from this specification does not have a closed form solution and requires estimation by simulated Maximum Likelihood (ML). The ML algorithm searches for a solution by simulating draws from distributions with given means and standard deviations. Probabilities can then be calculated by integrating the joint simulated distribution (the mixture distribution of the IID distribution of  $\varepsilon_n$  and the specified distribution for  $\eta_n$ ). Five hundred shuffled Halton draws were used in maximising the log-likelihood function. Simulated unconditional estimates of WTP for attribute  $j$  by consumer  $i$  are calculated as the ratio of the estimated model parameters accommodating the influence of the random component (Cicia et al. 2013) as:



$$WTP_i^j = - \left( \frac{\beta_j + \varepsilon_{ij}}{\beta_{price} + \varepsilon_{ip}} \right) \quad (4)$$

To evaluate if observed differences in WTP between countries are statistically significant we employ the Complete Combinatorial testing method (Poe et al., 2005). This is a non-parametric test that compares differences in WTP estimates for all possible WTP combinations to estimate a p-value for the null hypothesis of no difference in WTP estimates. The complete combination of two sets of 1,000 element vectors (as is the case when comparing two countries WTP estimates here) results in a vector of one million differences.

## 2.2 Survey development and administration

Selection of the set of lamb production attributes for the choice experiment was motivated by a consideration of consumer choice when faced with a broad set of credence attributes. Typically, similar studies are narrowly focused on a single attribute type, or a relatively small subset of attributes. Our aim is to present respondents with lamb product choices that embody a broader set of credence attributes to facilitate identification of relative preferences over a larger set than that usually considered in similar studies. Two main phases were used to this end. The first comprised of conventional in-depth literature review concentrated on meat product studies in the CE literature, including meta-analyses of consumers preferences for attributes of meat products (Yu and Gao, 2010) and specifically farm animal welfare (Lagervist and Hess, 2010), country of origin (Ehmke, 2006), and food safety (Morkbak et al., 2008). This formed the basis for a broad categorisation of food production attributes relevant to meat products including lamb (Miller et al., 2014). To test this set of possible attributes against industry perceptions we engaged with industry stakeholders including key members of the Agricultural Research Group on Sustainability ([argos.org.nz](http://argos.org.nz)), a long running public-private venture mandated to examine environmental, social and economic sustainability of farming systems. This dialogue was important for two main reasons; it allowed us to narrow the relevant set of attributes on the basis of minimising likely production system adjustment costs, and it also allowed us to identify possible attributes that were not present in the review of current CE literature.

The second phase was the development and administration of an online self-administered scoping survey, conducted in the UK, China and India in August 2012. The sampling strategy involved recruiting 100 consumers in each country who had purchased a lamb product at least once in the last month. The scoping surveys contained questions constructed to assess consumer attitudes and

preferences towards the food attributes identified in the first phase. The central objective of these surveys was to inform attribute selection for the CE survey application reported in the current paper, based primarily on respondent rankings of the importance of agricultural production standards. Each survey also contained three open-ended Contingent Valuation Methodology (CVM) exercises eliciting separate WTP for foods certified for food safety, farm animal welfare, and environmental sustainability. Respondents were therefore able to state any level of WTP they preferred. Further details and results of the scoping surveys can be found in Saunders et al. (2013). Vectors of WTP values in response to these questions were employed in forming the vector of price changes used as the CE payment vehicle. Drawing these threads together yielded the final attributes employed in the CE survey, shown in Table 1 which also presents the attribute definitions shown to respondents.

**Table 1.** Lamb attribute descriptions and levels

<b>Attribute</b>	<b>Description</b>	<b>Levels</b>
<b>Price change</b>	This attribute compares the price for lamb in the survey to the price you currently pay for lamb you normally buy. The lamb in the survey may cost the same or may cost more than you currently pay	1%, 5%, 10%, 20%
<b>Safety certified</b>	The lamb product has been officially certified by a Food Safety Agency who guarantees that the food product is safe to eat	Certified/Not certified
<b>Farm animal welfare certified</b>	The lamb product has been officially certified by a Farm Animal Welfare Agency who guarantees that the production of this product has met at least minimum welfare standards	Certified/Not certified
<b>Water management certified</b>	The lamb product has been officially certified by an Environmental Agency who guarantees that the production of this product employs a management system that minimises water pollution	Certified/Not certified
<b>Greenhouse Gas (GHG) minimisation certified</b>	The lamb product has been officially certified by an Environmental Agency who guarantees that the production of this product employs a management system that minimises Greenhouse gas emissions	Certified/Not certified
<b>Biodiversity enhancement certified</b>	The lamb product has been officially certified by an Environmental Agency who guarantees that the production of this product employs a management system that enhances biodiversity	Certified/Not certified
<b>Country of origin</b>	The consumer is able to identify the country where the lamb product is manufactured or produced	Domestic / Foreign/No label

The importance of certification schemes in providing credible assurance was found in scoping surveys to be a significant determinant of consumers' response to production claims. Reflecting this finding, we frame changes in a products attributes as attainment (or not) of a particular hypothetical certification standard from a public authorising agency. The price attribute was framed as a percentage increase in the price currently paid for a respondents usual lamb product. This facilitated

readily interpretable cross-country comparisons without the added complication of adjusting for differing domestic price levels. Non-price attributes were framed within a context of certification standards applied to non-specific lamb products. Rather than a framing constructed using a specific lamb product, we select a non-specific framing to overcome problems in selecting commensurate products consumed in all countries while facilitating a direct cross-country comparison. Moreover, an objective of the study design was to facilitate industry-wide relevance of results that would be hampered by a specific product framing. This product framing approach has been successfully applied in similar contexts (Hersleth et al. 2012).

The experimental design consisted of eight choice sets each made up of three alternatives employing a D-efficient fractional factorial experimental approach generated using NGene™ (ChoiceMetrics, 2014) and included the ability of respondents to opt-out of making a choice. To improve reliability, surveys were targeted at household members who were regular grocery shoppers, and who had purchased lamb products at least once in the last month. Samples of consumers were obtained from Research Now™ (researchnow.com) an international consumer research consultancy that provides analytical services and maintains one of the largest global databases of consumers. This sampling approach was chosen as the most practicable given limitations in obtaining sampling frames in developing countries comparable to typically utilised registries of voters available in developed countries. Surveys were implemented online in December 2012 achieving sample sizes of 686 in China, 695 in India and 686 in the UK.

### **3. Results and discussion**

#### *3.1 Sample characteristics*

The characteristics of the respondents in the three national surveys are shown in Table 2. The distributions over age, education, occupation, gender, location and household composition demonstrate that the samples covered a broad range of individuals. Importantly, these samples are not intended to be representative of a countries overall population, but rather the relevant population that we attempt to draw inference on are lamb consumers who purchase lamb often. The population characteristics of this group of consumers are not known with a degree of accuracy equivalent to census level that facilitates meaningful statistical comparison.

**Table 2.** Sample characteristics (%)

		UK	China	India
<b>Male</b>		50	56	71
<b>Age</b>	19 – 29	29	13	22
	30 – 44	39	59	54
	45 – 64	30	27	21
	65 ≤	1	2	4
<b>Education</b>	Less than High School	3	0	1
	High School	26	4	3
	Tertiary other than university	32	69	6
	University degree	29	19	49
	Post-graduate degree	9	8	40
<b>Location</b>	Urban	38	94	76
	Suburban	40	5	13
	Rural	22	1	10
<b>Household composition</b>	Single no children	24	30	37
	Single with children	7	2	2
	Couple no children	23	10	12
	Couple with children	40	54	44
	Live with unrelated people	3	2	3
<b>Main occupation of chief income earner in household<sup>1</sup></b>	Higher managerial, administrative or professional	12	16	31
	Intermediate managerial, administrative or professional	28	46	35
	Supervisory or clerical and junior managerial, administrative or professional	23	20	18
	Skilled worker	23	12	8
	Other	12	7	9

### 3.2 Statistical modelling

Statistical analysis was conducted using econometric software Limdep v.9™ and Nlogit v.4.3™. Alternative model specifications including an attribute non-attendance model yielded no qualitative improvement over parameter estimates presented in Table 3. All parameters except for domestic origin in India and foreign origin in China are highly statistically significant and of the expected signs. Attainment of certification standards increases the probability of a lamb product being chosen, while products with higher prices are less likely to be chosen. The standard deviations of the majority of parameter distributions are statistically significant, exceptions are for water in the UK and India, GHG in India and animal welfare in China, suggesting significant taste heterogeneity exists within the

<sup>1</sup> We use the National Readership Survey social grades to describe employment types. NRS grades are a system of demographic classification widely used in Europe. The grades are based on the occupation of the chief income earner of the household. Income is not part of the grade classification. However there is a strong correlation between income and social grade (NRS, 2010).

data for these attributes. In particular, consumer preferences for animal welfare in the UK, and safety in China, appear to be the most varied within each country. These factors alongside the Akaike Information Criterion (AIC), Log-likelihood function value (LL) and McFadden Pseudo-R<sup>2</sup> form the basis for a test of relative model fit. The Pseudo-R<sup>2</sup> values indicate that these models have an acceptable level of explanatory power (McFadden, 1974).

Looking at the effect of country-of-origin on choice of lamb product, UK consumers are more likely to choose domestically produced lamb. Whereas Indian and Chinese consumers exhibit similar preferences with Chinese consumers less likely to choose domestically produced product and Indian consumers more likely to choose foreign produced product.

**Table 3.** Parameter estimates for lamb product choice models

	UK	India	China
Safety	1.08***	1.03***	2.39***
Animal Welfare	1.29***	0.52***	0.72***
Water	0.41***	0.35***	0.66***
GHG	0.39***	0.46***	0.76***
Biodiversity	0.34***	0.54***	0.74***
Domestic origin	0.35***	0.3	-1.52***
Foreign origin	-0.31***	0.34***	0.77
Price	-6.52***	-1.47***	-6.19***
<i>Standard deviations of parameter distributions (Triangular)</i>			
Safety	2.59***	2.80***	4.66***
Animal Welfare	3.45***	0.74***	0.79
Water	0.29	0.46	1.04***
GHG	0.91**	0.52	1.67***
Biodiversity	1.91***	1.56***	2.91***
Domestic origin	1.24***	2.12***	2.98***
Foreign origin	1.25***	1.47***	0.21*
Price	6.52***	1.47***	6.19***
<i>Error component</i>			
Alt1 & Alt2	0.43***	0.34***	0.53***
Alt2 & Alt3		0.32**	
Alt1 & Alt3		0.55***	
Number of obs.	2672	2696	2456
LL <sup>a</sup>	-2934	-2558	-1878
AIC	4888	5151	3792
Pseudo-R <sup>2</sup>	0.22	0.20	0.31

\*\*\*, \*\*, \* denotes statistical significance at 1%, 5%, and 10% level respectively

<sup>a</sup> LL: Value of Log Likelihood function

<sup>b</sup> AIC: Akaike Information Criterion

### 3.3 Willingness-to-pay for attributes of lamb production

We simulate the unconditional distributions of WTP for lamb attributes and report the medians, lower and upper quartiles (Table 4.). The interpretation of WTP is the percentage change in the price of lamb that achieves a particular certification. Ranking the WTP estimates reveals some similarities are observed across all three countries. Food safety and farm animal welfare are valued the most or second highest of all certification standards, across all countries. When considering separately the environmental sustainability certifications, GHG minimisation is valued highest of the environmental attributes for all countries.

Chinese consumers have considerably higher WTP for ensuring food safety compared with any of the other attributes, which were valued at least a quarter as much. Chinese consumers strong preferences for improvements in safety assurance may be a product of Chinas relatively poor food safety record, including the 2008 melamine in infant formula instance, coupled with a low level of trust in government safety certification schemes (Sun and Collins, 2012; Liu et al., 2012). The next major influence on choice for Chinese consumers was a strong preference to avoid domestic production. This result too may stem from low levels of trust in domestic production systems. Interestingly, preferences over the remaining four attributes WTP estimates are significantly lower and do not vary greatly. The significant but relatively low WTP estimate for animal welfare certification is consistent with the CVM study by Zhao and Wu (2011) who found 90% of their sample favoured paying more to improve animal welfare. Compared with UK consumers, food safety and GHG minimisation are valued higher, and farm animal welfare lower, no statistical differences in WTP for water minimisation or biodiversity enhancement certifications are found.

**Table 4.** Estimated marginal WTP values

	China	India	UK
<b>Safety</b>	34 (24:42) <sup>H</sup>	49 (3:121) <sup>H</sup>	15 (4:37)
<b>Welfare</b>	9 (7:10) <sup>L</sup>	29 (14:53) <sup>H</sup>	18 (3:46)
<b>Water</b>	7 (6:9) <sup>N</sup>	21 (17:28) <sup>H</sup>	6 (5:8)
<b>GHG</b>	8 (6:10) <sup>H</sup>	28 (22:38) <sup>H</sup>	6 (1:13)
<b>Biodiversity</b>	5 (2:8) <sup>N</sup>	26 (0:63) <sup>H</sup>	4 (-3:17)
<b>Foreign Origin</b>	-	13 (-8:48) <sup>H</sup>	-5 (-8:0)
<b>Domestic Origin</b>	-27 (-30:-25) <sup>H</sup>	-	5 (0:14)

WTP calculated as % change in lamb product price.  
Median WTP [lower and upper quartiles in brackets].

<sup>L</sup> Significantly lower than UK; <sup>H</sup> Significantly higher than UK, <sup>N</sup> No significant difference.

Indian consumers have relatively higher WTP, over all product attributes, compared to their UK and Chinese counterparts. Consistent with Chinese consumers, Indian consumers' strongest influence on product choice is the presence of food safety certification. Also broadly consistent with Chinese consumers, they prefer foreign produced lamb, and WTP across the remaining four attribute WTP estimates does not vary greatly. Interestingly, GHG and water minimisation are valued nearly as much as animal welfare.

UK consumers WTP for food safety is a close second to farm animal welfare. They prefer domestic production and are less likely to select a lamb product that is foreign produced, preferences that are starkly divergent to Indian or Chinese consumers. This finding is consistent with Hersleth et al. (2012) who in a conjoint method study found that Norwegian and Italian consumers prefer domestically produced lamb meat over internationally produced lamb meat. Also in contrast to Indian and Chinese consumers, farm animal welfare certification is valued significantly more than any of the environmental attributes. While UK consumers value safety and farm animal welfare similarly, in both emerging economies food safety certification is valued higher by a substantial margin.

The finding of food safety being valued highest in emerging economies and animal welfare highest in a developed economy is consistent with Krystallis et al 2012. In a conjoint approach to identifying preferences for attributes of pig production systems, these authors found that the most preferred sustainability aspect of production for European consumers was farm animal welfare, while for Chinese consumers food safety was the most preferred aspect. High values for farm animal welfare in the UK have also previously been found (Bennett et al. 2012). Our estimate of Chinese consumers WTP for food safety is low relative to the Ortega et al (2011) estimate of a 100% increase in pork product price, but significantly higher than estimates of very low WTP for certified traceability (Xu and Wu, 2010; Bai et al, 2013). This distribution of preferences suggests significant consumer heterogeneity for food safety may be related to product type.

Our estimates for environmentally sustainable production attributes by Indian consumers are relatively higher than that estimated by Mahapatra (2013). However that study grouped agri-food products with non-food goods and so is unlikely to identify preferences for food attributes robustly. However, Moser et al. (2012) WTP estimates for low environmental impact production systems of 29% are remarkably similar to those found in our study.

Our finding of significant, although relatively low, WTP for GHG minimisation by Chinese consumers is consistent with estimates of WTP for low carbon agri-foods (Shuai et al. 2014; Yingheng and Wu, 2012). Furthermore, our WTP estimates for biodiversity enhancement are of a similar magnitude to estimates of WTP for urban biodiversity conservation by Chinese residents (Chen and Jim, 2010). Collectively, these results are in line with positive Chinese WTP estimates found for organic production systems (Zheng et al. 2013; Yin et al. 2010). No known published CE studies have estimated WTP for water use efficiency or biodiversity enhancement as attributes of agri-foods, either in China nor India, and so no direct comparison with existing estimates is offered.

Looking at the country-of-origin influence on product choice, emerging economy consumer preference for foreign rather than domestic production is supported by Sharma (2011) who found that Chinese and Indian consumers preferred cars imported from developed countries rather than cars from emerging country markets. However, Zheng et al (2013) find Chinese consumers are WTP more for domestic ingredients of soymilk compared to ingredients sourced from the United States, and Ehmke et al (2008) estimate Chinese consumers are WTP 50% more for domestically produced onions. The finding that UK consumers prefer domestic lamb is consistent with other similar studies (Jaffry et al. 2004). Overall, there is a consistent message that information regarding the origin of a product is important, including to Chinese consumers (Ortega et al, 2011).

Our WTP estimates suggest that Indian consumers offer greater opportunities for environmentally differentiated food products compared with China as they are WTP relatively more. This finding must be considered against the higher costs of supply chain management in an economy where food system management issues such as unreliable cold store distribution are significant. The WTP estimates calculated in this paper are formed relative to a domestic base price. While employing percentage changes comparative to domestic process is useful in comparing relative consumer preferences, it must be considered that the absolute price change may be lower in India or China, than in the UK, as domestic price levels are lower for some lamb products. This means that although percentage WTP is lower in the UK for environmental attributes, the absolute values of price premiums may be higher than in China or India. Again, this must be weighed against the cost of doing business in a relatively highly regulated market environment such as the UK.

The finding that GHG minimisation is valued highest of the environmental attributes, across all three countries provides useful insight to multi-national companies considering certification standards applied across national borders. The implication for primary sectors is that consumers foremost prefer environmental strategy focused at climate targets, and are WTP for products that deliver this benefit. The finding of consistent preferences across cultural and country borders suggests that development of carbon labelling schemes within a domestic context may be more readily



transferable to international supply chains than typically assumed. The ability to maintain uniformity in labelling scheme designs for products consumed domestically, as well as being exported, could be achieved without significant loss of generality of the effect on consumer behaviour. This is also a useful finding within the broader public policy context considering that international coordination is required for effective climate mitigation policy, our results act to encourage government agencies to actively participate in labelling as a policy mechanism contributing to mitigation targets without the risk of voter disapproval.

Changes in lamb product attributes presented to respondents in this study were described by whether the product was certified by a relevant agency as being produced by a firm that has implemented the relevant production system. Firms considering obtaining particular certification standards must form a Benefit-Cost analysis to determine whether such strategies are optimal. Factors in the decision facing an individual firm within the lamb meat industry as to whether or not to obtain a particular certification includes a systematic consideration of the costs incurred to obtain that certification, the cost structure of the individual firm, and the likely benefits of obtaining certification. These factors are likely to vary significantly for several reasons. Regulatory settings vary from country to country, and across jurisdictional boundaries within each country, creating disparate initial conditions facing firms initiating changes in production processes. This could translate into different costs of obtaining certification across regulatory jurisdictions. The cost structure of individual firms varies enormously, fundamentally by the specific lamb product type that a firm is selling, but also by factors including firm size, ownership structure, and market structure elements such as the level of competition faced. With this in mind, accurate estimates of the costs of obtaining certification, and practical details of a firm's cost structure, are only realistically acquired by firms themselves. This study provides firms with information concerning estimates of the in-market benefits to a firm, for three markets at the country level for a generalised lamb product, in the form of price premiums. Firms are able to incorporate this information into their own strategic planning utilising cost estimates specific to them. Given the significant degree of firm heterogeneity within the lamb meat industry broadly, strategic advice based on premiums estimated here must be tempered by the risk of oversimplifying industry level complexities and therefore overstating implication for firms.

Overall however, the results generated in this study point to opportunities for environmentally sustainable production systems being preferred to those that do not provide such attributes in consumers' food choices. While food safety may be anticipated to continue to be an expected credential for any reliable food producer, production systems that operate in an environmentally conscious manner can be seen as enhancing safety credentials. In this way, environmental

performance of firms acts as a proxy for safety under the belief that food produced within a clean natural environment is safer for human consumption (Guenther et al., 2015).

#### 4. Conclusions

This study demonstrates that emerging economy consumers' choice of lamb product can be influenced by production processes that incorporate environmental sustainability. This finding generates implications for both private agri-food sector stakeholders, and agri-environmental public policy development. Stakeholders throughout agri-food supply chains should be encouraged to develop differentiation strategies that capture the additional value environmental attributes generate to consumers. Given Indian and Chinese consumers preferences for non-domestic lamb meat, exporters to these markets should consider marketing strategies that further differentiate products reflecting these consumer preferences. Indian and Chinese public officials considering the development of appropriate policy to ameliorate domestic agri-environmental pressures should be encouraged to establish certification schemes that provide legitimacy to product claims.

Overall, our findings are in line with the view that disparities in consumer preferences for the same product attributes across countries is a characteristic finding in a relatively scant literature providing such comparisons (Wezemaal et al. 2014). However, our results suggest that emerging consumer preferences may be relatively more similar in terms of which attributes influence product choice the most. This discovery emphasises the relevance of our study to refining and extending cross-country comparison literature into emerging economy contexts.

As differences in consumer preferences over product attributes have been found, the ability to generalise results to other countries is restricted. In addition, only lamb meat is considered, further research is required to establish the degree of preference homogeneity with other emerging economy consumers and agri-food products. The central limitation of this study stems from the hypothetical context of WTP elicitation inherent in stated preference valuation methodology. The choice of this approach is necessitated by a lack of observed market transaction data for products communicating the environmental attributes of interest. As growth of the green market in India and China develops further, this could provide an opportunity to design valuation studies comprising models that combine revealed preference and stated preference data. This approach would offer potential to ameliorate hypothetical weaknesses while overcoming common statistical deficiencies in market transaction data.

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## Research Highlights

- Emerging economy consumers lamb choice can be influenced by environmental attributes
- Emerging economy consumers have higher WTP for environmentally certified lamb production
- Indian consumers have higher WTP for environmental certification than Chinese and UK
- Indian, Chinese and UK consumers WTP is highest for GHG minimisation